Openness and Academic Success in Postsecondary Education

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Dedicated to Ioana, Jana, and Nina.

Abstract

Within the five-factor model of personality, openness describes an individual's general appreciation for new intellectual and cultural experiences. Encompassing traits such as curiosity, open-mindedness, ingenuity, self-reflection, and thoughtfulness, it has often been theorized to be a major success factor in learning and education. However, empirical research conducted over the past several decades has yielded rather inconsistent results, and recent meta-analyses have found surprisingly small correlations between openness and postsecondary academic achievement.

This intriguing discrepancy was the starting point for this dissertation. Its core consists of three original articles that examine the relationship between openness and several indicators of postsecondary academic success. A fourth supplemental article describes the development of an alternative measure of a specific, academically relevant facet of openness, namely, *openness to ideas*.

The first article is a meta-analysis that examined the relationship between openness and postsecondary academic achievement. It found that across 149 studies with a total sample of 50,449 undergraduate students, overall openness was indeed only weakly related to academic achievement. However, through meta-analytic structural equation modeling using 19 primary studies with a total of 5,861 subjects, it also demonstrated that openness comprises two distinct aspects, namely *intellectual* and *senso-aesthetic openness*, and that these two aspects have opposing effects on academic performance.

The second article is a study that used a self-report measure specifically designed to assess the two openness aspects in order to examine their relationships with objective and subjective academic achievement. Regression analyses using cross-sectional data from 424 undergraduate students showed that intellectual openness was a strong positive predictor of both forms of academic achievement, while senso-aesthetic openness

was a moderate negative predictor. Furthermore, the two aspects of openness showed considerably more incremental validity over two aspects of conscientiousness (i.e., industriousness and orderliness) than vice versa.

The third article is a study that used a more comprehensive operationalization of academic success and a time-lagged research design. It analyzed self-report data from two measurement times to examine the predictive validity of the two openness aspects for future academic achievement, academic satisfaction, student persistence, and post-college career success. In a sample of 196 undergraduate students from 30 majors, intellectual openness predicted grade point average and satisfaction after an average of 27 months, while senso-aesthetic openness was a strong negative predictor of graduation likelihood. Furthermore, in a sample of 132 professionals from 25 occupational fields, intellectual openness did not predict objective career success after an average of 33 months, but it did predict several dimensions of subjective career success. Senso-aesthetic openness, on the other hand, was a negative predictor of future salary, a positive predictor of hierarchical job status, and largely unrelated to subjective career success.

The fourth article describes the development and validation of a situational judgment test that measures, in addition to four other personality traits, openness to ideas. In a sample of 255 subjects the openness to ideas scale exhibited good internal consistency, the expected relationships with the five scales of the NEO PI-R, and a strong positive correlation with secondary school grade point average. This showed that the intellectual components of openness can be measured using an approach that is less prone to response bias and faking than the commonly used self-report measures.

Overall, this dissertation demonstrates that openness is indeed a highly relevant personality trait in postsecondary academic success—when properly operationalized as a truly dichotomous construct. It also provides initial insight into the nature of the relationships between the two openness aspects and academic achievement, and highlights some promising avenues for further research on the role of openness in postsecondary academic success.

Zusammenfassung

Im Rahmen des Fünf-Faktoren-Modells der Persönlichkeit beschreibt Offenheit die allgemeine Wertschätzung einer Person für neue intellektuelle und kulturelle Erfahrungen. Sie umfasst Eigenschaften wie Neugier, Aufgeschlossenheit, Einfallsreichtum, Selbstreflexion und Nachdenklichkeit und wird oft als wichtiger Erfolgsfaktor für Lernen und Bildung angesehen. Die empirische Forschung der letzten Jahrzehnte hat jedoch eher widersprüchliche Ergebnisse erbracht und neuere Metaanalysen haben überraschend geringe Korrelationen zwischen Offenheit und akademischen Leistungen nach der Hochschulreife festgestellt.

Diese verblüffende Diskrepanz war der Ausgangspunkt für diese Dissertation. Sie besteht im Kern aus drei Originalartikeln, die den Zusammenhang zwischen Offenheit und verschiedenen Indikatoren für den akademischen Erfolg nach der Hochschulreife untersuchen. Ein vierter ergänzender Artikel beschreibt die Entwicklung eines alternativen Maßes für eine spezifische, akademisch relevante Facette der Offenheit, nämlich die *Offenheit für Ideen*.

Bei dem ersten Artikel handelt es sich um eine Metaanalyse, in der die Beziehung zwischen Offenheit und akademischem Erfolg nach der Hochschulreife untersucht wurde. Dabei wurde festgestellt, dass in 149 Studien mit einer Gesamtstichprobe von 50,449 Studenten Offenheit insgesamt nur schwach mit der akademischen Leistung zusammenhängt. Durch metaanalytische Strukturgleichungsmodellierung unter Verwendung von 19 Primärstudien mit insgesamt 5,861 Probanden wurde jedoch auch gezeigt, dass Offenheit zwei unterschiedliche Aspekte umfasst, nämlich intellektuelle und senso-ästhetische Offenheit, und dass diese beiden Aspekte gegensätzliche Auswirkungen auf akademische Leistung haben.

Bei dem zweiten Artikel handelt es sich um eine Studie, in der ein Selbstauskunftsverfahren verwendet wurde, das speziell für die Erfassung der beiden Offenheitsaspekte entwickelt wurde, um deren Beziehungen zu objektiven und subjektiven akademischen Leistungen zu untersuchen. Regressionsanalysen anhand von Querschnittsdaten von 424 Studenten zeigten, dass intellektuelle Offenheit ein starker positiver Prädiktor für beide Formen der akademischen Leistung war, während senso-ästhetische Offenheit ein moderat negativer Prädiktor war. Darüber hinaus zeigten die beiden Aspekte von Offenheit eine deutlich höhere inkrementelle Validität über zwei Aspekte der Gewissenhaftigkeit (nämlich Fleiß und Ordnungsliebe) hinaus als umgekehrt.

Der dritte Artikel ist eine Studie, die eine umfassendere Operationalisierung von akademischem Erfolg und ein zeitversetztes Forschungsdesign verwendete. Sie analysierte Selbstauskunftsdaten von zwei Messzeitpunkten, um die Vorhersagekraft der beiden Offenheitsaspekte für künftige akademische Leistungen, akademische Zufriedenheit, studentisches Durchhaltevermögen und beruflichen Erfolg nach dem Studium zu untersuchen. In einer Stichprobe von 196 Studenten aus 30 Studiengängen sagte intellektuelle Offenheit den Notendurchschnitt und die Zufriedenheit nach durchschnittlich 27 Monaten vorher, während senso-ästhetische Offenheit ein starker negativer Prädiktor von Abschlusswahrscheinlichkeit war. In einer Stichprobe von 132 Berufstätigen aus 25 Berufsfeldern sagte intellektuelle Offenheit nach durchschnittlich 33 Monaten zwar nicht den objektiven Berufserfolg, wohl aber mehrere Dimensionen des subjektiven Berufserfolgs vorher. Senso-ästhetische Offenheit hingegen war ein negativer Prädiktor für das zukünftige Gehalt, ein positiver Prädiktor für den hierarchischen Berufsstatus und weitgehend unzusammenhängend mit subjektivem Karriereerfolg.

Der vierte Artikel beschreibt die Entwicklung und Validierung eines situativen Urteilstests, der neben vier anderen Persönlichkeitsmerkmalen auch die Offenheit für Ideen misst. In einer Stichprobe von 255 Probanden zeigte die Skala „Offenheit für Ideen“ eine gute interne Konsistenz, die erwarteten Beziehungen zu den fünf Skalen des NEO PI-R und eine starke positive Korrelation mit dem Notendurchschnitt in der Sekundarstufe. Dies zeigt, dass die intellektuellen Komponenten von Offenheit mit einem Verfahren gemessen werden können, das weniger anfällig für Antwortverzerrungen und Verfälschungen ist als die üblicherweise verwendeten Selbsteinschätzungen.

Insgesamt zeigt diese Dissertation, dass Offenheit in der Tat ein höchst relevantes Persönlichkeitsmerkmal für den akademischen Erfolg nach der Hochschulreife ist—

sofern sie richtig als wirklich dichotomes Konstrukt operationalisiert wird. Sie gibt auch einen ersten Einblick in die Art der Beziehungen zwischen den beiden Offenheitsaspekten und akademischer Leistung und zeigt einige vielversprechende Wege für die weitere Erforschung der Rolle von Offenheit für den akademischen Erfolg nach der Hochschulreife auf.

Preface

The general direction for this dissertation was set in March 2013. In his earlier work on personality predictors of postsecondary academic performance (Trapmann et al., 2007; von Stumm, Hell, et al., 2011), my thesis advisor Benedikt Hell (BH) had observed a somewhat ambiguous relationship between the openness trait from the five-factor model of personality and academic achievement. Thus, he encouraged me to conduct a meta-analysis examining the predictive validity of the six openness facets proposed by Costa and McCrae (1992) for academic performance.

Between March 2013 and May 2017, I extended BH's original idea of focusing primarily on facets by including two additional construct levels, namely overall openness and the two intermediate *aspects* suggested by DeYoung et al. (2007), in order to provide a truly comprehensive meta-analysis on the topic. First, I conducted the literature search, obtained additional data from various authors of eligible primary studies, and coded all relevant information, which BH cross-checked. I then planned and performed all meta-analytic calculations, wrote the manuscript, and revised it twice during the peer review at the *Journal of Educational Psychology* until it was accepted for publication in May 2017 (Gatzka & Hell, 2018). BH supported the writing and editing process with constructive comments and helpful advice. The final manuscript is implemented as *Article 1* (Chapter 6) in this dissertation.

In October 2014, an interesting opportunity arose to incorporate a manuscript focused on test development—one of my main areas of interest during my academic career—in this dissertation when Patrick Mussel (PM) invited me to co-author an article describing the development and validation of a new situational judgment test. I saw a good thematic fit with the dissertation since this new test included a scale for openness to ideas (which had shown promising associations with academic performance in my

preliminary analyses for the ongoing meta-analysis) and grades point average as one of the criterion measures. Thus, I gladly accepted the invitation to collaborate. PM and his colleague Johannes Hewig (JH) had already completed the test construction and data analysis, when they asked me to write the introduction and contribute to the discussion. I wrote my parts in March 2015 and the paper was submitted to the *European Journal of Psychological Assessment*. After a revision done by PM with advice from JH and me, the article was accepted for publication in October 2015 (Mussel et al., 2018). The final manuscript is implemented as *Article 4* (Chapter 9) in this dissertation.

In early 2018, I followed up on the research avenues identified in the meta-analysis to formulate several research questions and to compile a selection of relevant predictors, mediators, and academic success criteria (see Table 1 for more details). I then translated English scales that were not available in German with a back-translation by a bilingual native speaker following the recommendations of Hambleton (2001) and conducted an online questionnaire with BH providing funding for participant incentives.

By the end of March 2018, I was able to collect data from 1,136 undergraduate students and 171 graduate students across 15 Swiss higher education institutions. Within the undergraduate sample, there were three rather homogeneous subsamples, that is, 424 students enrolled in 11 majors at the *Berner Fachhochschule*, 167 psychology students and 231 economics students at the *Fachhochschule Nordwestschweiz*, and another, more heterogeneous subsample of 329 students from 13 other universities enrolled in 13 different majors.

After several unsuccessful attempts to fit all the research questions and samples into a single manuscript, I decided to split them into two more concise manuscripts. Using the Berner Fachhochschule subsample, I wrote a manuscript that focused on the interaction between aspects of openness and conscientiousness in predicting of academic achievement and the possible mediating effect through grit (Duckworth et al., 2007). The resulting article was submitted to *Learning and Individual Differences* in February 2019, but was rejected after peer review in April 2019, primarily due to concerns about testing the mediation hypothesis with a cross-sectional study design, theoretical and methodological issues with the grit construct, and the length of the manuscript. As a result, I removed grit from my research plan and reduced the manuscript to half its original length by focusing on the interplay between the aspects of openness and conscientiousness as predictors of objective and subjective academic performance. This

Table 1

Constructs and Measures Used in the Online Questionnaire in March 2018

Construct	Measure	Purpose	Article 2	Article 3
		Personality Traits		
Openness	BFAS	predictor	yes	yes
	IPIP-NEO	validation	no[a]	no[a]
	BFI2-S	incentive	no[b]	no[b]
Conscientiousness	BFAS	predictor	yes	no
	IPIP-NEO	validation	no[a]	no[a]
	BFI2-S	incentive	no[b]	no[b]
Extraversion	BFI2-S	incentive	no[b]	no[b]
Agreeableness	BFI2-S	incentive	no[b]	no[b]
Neuroticism	BFI2-S	incentive	no[b]	no[b]
Grit	GS	mediator	no[c]	no[c]
Mind-Wandering	MWQ	mediator	no	yes
		Academic Success		
Objective Achievement	GPA	criterion	yes	yes
Subjective Achievement	SAAS	criterion	yes	no
Satisfaction	DSAS	criterion	no	yes
Intended Persistence	APS	criterion	no	yes

Notes. BFAS = Big Five Aspect Scales (DeYoung et al., 2007), IPIP-NEO = International Personality Item Pool Representation of the NEO PI-R (Goldberg et al., 2006), BFI2-S = Short form of the Big Five Inventory–2 (Soto & John, 2017a), GS = Grit-Scale (Duckworth et al., 2007), MWQ = Mind Wandering Questionnaire (Mrazek et al., 2013), GPA = grades point average, SAAS = Subjective Academic Achievement Scale (Stadler, Kemper, et al., 2015), DSAS = Domain-Specific Academic Satisfaction Scale (Lent et al., 2005), APS = Academic Persistence Scale (Lent et al., 2005)

[a] Not used (no construct validation needed).

[b] Used for the norm-based, individual feedback for the participants.

[c] Removed due to methodological concerns raised by peer reviewers.

new manuscript was submitted to the *European Journal of Psychology of Education* in March 2020, but was rejected without peer review due to its focus on individual differences rather than educational contexts. In April 2020, I submitted the manuscript to *Personality and Individual Differences*, where the reviewers encouraged a revision and resubmission in June 2020. After my revision in September 2020, the article was accepted for publication in the same month (Gatzka, 2021). The final manuscript is implemented as *Article 2* (Chapter 7) in this dissertation.

Using the remaining two student subsamples, I wrote another manuscript between April and July 2020 that addressed the remaining research questions (i.e., mediation

by mind-wandering, as well as academic satisfaction and intended persistence as additional criteria of academic success). This manuscript was submitted to the *Journal of Individual Differences* in July 2020, but was rejected without peer review due to its focus on higher education and learning rather than personality traits. After some minor revisions, I submitted the manuscript to *Research in Higher Education* in December 2020. In August 2021, it was rejected after peer review due to concerns about cross-sectional testing of the mediation hypotheses and insufficient journal fit. A subsequent submission to *Current Psychology* in September 2021 was rejected after peer review, again with criticism of the cross-sectional research design.

I then decided to address this recurring problem by collecting additional data that would allow me to switch to a time-lagged research design. From May to June 2022—more than four years after the initial data collection—I was able to obtain additional data from 278 of the original participants through a follow-up questionnaire. Although the focus remained on mediation by mind-wandering, I also took the opportunity to expand the scope of the study by including additional cognitive constructs and success criteria (see Table 2 for more details). The resulting manuscript was submitted to the *Journal of Career Assessment* in October 2022, but rejected in November 2022 after peer review due to some methodological concerns (e.g., the low reliability estimates of the mind-wandering measure) and criticism of the broad scope of the analyses. After some revisions to address those concerns and to improve the rationale and readability of the manuscript, I submitted it to the *International Journal of Personality Psychology* in February 2023, where it is currently under review. This manuscript is implemented as *Article 3* (Chapter 8) in this dissertation.

This dissertation project would not have been possible without the support of several people, whom I would like to thank at this point:

- Prof. Dr. Benedikt Hell, for the opportunity to take on this challenge, the excellent collaboration on Article 1, his constructive comments on the introduction, discussion, and Article 3 of this dissertation, his support in obtaining funding for the sample acquisition, and his patience—which I have tried beyond all decency;
- PD Dr. Esther Kaufmann, for her time and effort as second referee of this dissertation;

Table 2

Constructs and Measures Used in the Online Questionnaire in June 2022

Construct	Measure	Purpose
	Personality Traits	
Openness	BFAS	predictor
Self-Assessed Intelligence	single item[a]	predictor
Cognitive Self-Consciousness	MCQ	predictor
Declarative Knowledge (Metacognition)	MAI	predictor
Mind-Wandering	MWQ	mediator
	Academic Success	
Objective Achievement	GPA	criterion
Satisfaction	DSAS	criterion
Graduation	single item	criterion
	Career Success	
Salary	single item	criterion
Hierarchical Status	single item[b]	criterion
Subjective Success	SCSI	criterion

Notes. BFAS = Big Five Aspect Scales (DeYoung et al., 2007), MCQ = Metacognitions Questionnaire (Arndt et al., 2011), MAI = Metacognitive Awareness Inventory (Schraw & Dennison, 1994), MWQ = Mind Wandering Questionnaire (Mrazek et al., 2013), GPA = grades point average, DSAS = Domain-Specific Academic Satisfaction Scale (Lent et al., 2005), SCSI = Subjective Career Success Inventory (Haenggli & Hirschi, 2020)

[a] Adopted from Chamorro-Premuzic and Furnham (2006b).

[b] Adopted from Abele and Spurk (2009).

- Prof. Dr. Ulf-Dietrich Reips, for his time and effort as chairman of the examination committee;
- Prof. Dr. Patrick Mussel, for the opportunity to contribute to Article 4 and the great collaboration;
- Dr. Michael Ott, for his helpful inputs on each manuscript, his tireless efforts to keep me motivated, and his friendship over many years;
- All authors who provided supplemental data for the meta-analytic analyses in Article 1, especially Vic Catano, Stephen Dollinger, and Marc Lochbaum, who went above and beyond to retrieve nearly ancient data files;

- All anonymous reviewers who provided valuable input that greatly improved the quality of the articles contained in this dissertation.

Finally, my infinite and eternal gratitude goes to my wife, Ioana Gatzka, for her enduring patience over the past 10 years, her loving care and support, and her unrivaled ability to *bring out the best in me*.

Contents

Abstract v

Zusammenfassung vii

Preface xi

I Introduction 1

1 The Importance of Academic Success 3

2 Individual Differences and Academic Achievement 7

2.1 Cognitive Abilities and Academic Achievement 8

2.2 Noncognitive Traits and Academic Achievement 8

2.3 An Integrative Perspective: Intellectual Investment 12

3 Openness: The Ominous "Factor V" 17

3.1 Openness to Experience *versus* Intellect 18

3.2 Openness to Experience *and* Intellect 19

3.3 Openness Aspects and Academic Achievement 22

4 The Measurement of Openness 25

4.1 Self-Report Measures 28

4.2 Other-Report Measures 31

4.3 The Forced-Choice Format 34

4.4 Situational Judgment Tests 36

5 Aims and Scope of This Dissertation **41**

II Original Articles **45**

6 Article 1: Openness and Postsecondary Academic Performance: A Meta-Analysis of Facet-, Aspect-, and Dimension-Level Correlations (Gatzka & Hell, 2018) **47**

6.1 Introduction 48
6.1.1 Openness—A Controversial Construct 49
6.1.2 The Lower-Level Structure of Openness 50
6.1.3 Why Openness Should Be Related to Academic Performance . 51
6.1.4 Possible Reasons for the Weak Relationship Between Openness and Academic Performance 58
6.1.5 The Present Research 63
6.2 Method 63
6.2.1 Literature Search 63
6.2.2 Study Inclusion and Exclusion Criteria 64
6.2.3 Coding 66
6.2.4 Statistical Procedures 68
6.3 Results 70
6.4 Discussion 78
6.4.1 Openness Facets and Aspects and Academic Performance . . . 79
6.4.2 Openness and Academic Performance 82
6.4.3 Limitations and Future Research 83
6.4.4 Conclusion 86

7 Article 2: Aspects of Openness as Predictors of Academic Achievement (Gatzka, 2021) **87**

7.1 Introduction 88
7.1.1 Intellectual Openness Versus Senso-aesthetic Openness 88
7.1.2 Incremental Validity Over Conscientiousness Aspects 89
7.1.3 Interactions Between Openness and Conscientiousness Aspects 90
7.2 Method 91

7.2.1 Participants . . . 91
7.2.2 Procedure . . . 91
7.2.3 Measures . . . 91
7.3 Results . . . 93
7.3.1 Bivariate Correlations . . . 93
7.3.2 Regression Analyses . . . 95
7.3.3 Interactions . . . 97
7.4 Discussion . . . 97
7.4.1 Openness Aspects and Academic Achievement . . . 97
7.4.2 Incremental Validity . . . 99
7.4.3 Interactions . . . 100
7.4.4 Limitations and Further Research . . . 101
7.4.5 Implications and Conclusion . . . 102
7.5 Addendum: Replications of the Results . . . 103

8 Article 3: Openness Aspects as Predictors of Future Academic and Career Success: A Two-Wave Study 107
8.1 Introduction . . . 108
8.1.1 Openness Aspects and Academic Success . . . 109
8.1.2 Openness Aspects and Career Success . . . 111
8.1.3 How Are the Openness Aspects Related to Academic Success? 113
8.2 Method . . . 116
8.2.1 Procedure and Participants . . . 116
8.2.2 Measures . . . 117
8.3 Results . . . 120
8.3.1 Bivariate Correlations . . . 120
8.3.2 Path and Regression Analyses . . . 121
8.4 Discussion . . . 130
8.4.1 Intellectual Openness as a Predictor of Academic Success . . . 130
8.4.2 Intellectual Openness as a Predictor of Career Success . . . 133
8.4.3 Senso-Aesthetic Openness as a Predictor of Academic Success 134
8.4.4 Senso-Aesthetic Openness as a Predictor of Career Success . . 135
8.4.5 Limitations and Further Research . . . 136

8.4.6 Implications and Conclusion 137

9 Article 4: Situational Judgment Tests as an Alternative Measure for Personality Assessment (Mussel et al., 2018) 139
9.1 Introduction 140
9.2 Method 142
9.2.1 Sample 142
9.2.2 Measures 142
9.2.3 Statistical Analyses 146
9.3 Results 146
9.4 Discussion 151

III Discussion 155

10 Synthesis of the Findings 157
10.1 Is Openness Related to Academic Success? 158
10.1.1 Objective Academic Achievement 158
10.1.2 Subjective Academic Achievement 160
10.1.3 Academic Satisfaction 161
10.1.4 Student Persistence 162
10.1.5 Career Success 164
10.2 How is Openness Related to Academic Success? 166
10.2.1 The Interplay Between Openness and Conscientiousness . . . 166
10.2.2 Mind-Wandering as a Potential Mediator 169
10.2.3 Incremental Validity Over Related Cognitive Constructs 170

11 Limitations and Further Research 173
11.1 Psychometric and Methodological Issues 173
11.2 Further Research on Cognitive Mediators 175
11.3 Toward a Comprehensive Causal Framework 177
11.3.1 Predictors 178
11.3.2 Mechanisms and Processes 179
11.3.3 Outcomes 182

12 Conclusion **185**

References **189**

Appendices **265**

A Appendix for Article 1 **267**

B Appendix for Article 2 **293**

B.1 Exploratory Factor Analyses 293

B.2 Re-Calculations With the Re-Scored Openness and Conscientiousness Scales 294

B.3 Replications of the Results in the Other Undergraduate Samples . . . 298

C Appendix for Article 4 **305**

List of Tables

1 Constructs and Measures Used in the Online Questionnaire in March 2018 xiii
2 Constructs and Measures Used in the Online Questionnaire in June 2022 xv
3 Meta-Analytic Results on the Relationship Between the Personality Traits From the Five-Factor Model and Postsecondary Academic Performance 11
4 Results of the Bare-Bones Meta-Analysis on the Relationship Between the Two Openness Aspects and Intelligence, Creativity, and Need for Cognition 24
5 Major Five-Factor Model Inventories With Proxies for Intellectual and Senso-Aesthetic Openness 28
6 Suggested Aspects of Openness and the Corresponding NEO-PI-R Facet Scales 52
7 Overview of the Construct Levels and Components of the Openness Domain 53
8 Parameters for the Electronic Database Search 64
9 Correlations Between the NEO-PI-R Openness Facets and Academic Performance 71
10 Correlations Between the NEO-PI-R Ideas and Values Facets and Academic Performance by Academic Major 72
11 Results of the Two-Stage Structural Equation Modeling 75
12 Correlations Between Openness and Academic Performance 77

13 Means, Standard Deviations, Reliabilities, and Intercorrelations of the Personality and Criterion Variables 94
14 Summary of the Regression Analyses of Academic Achievement on Openness and Conscientiousness Aspects 96
15 Replication of the Key Results of the Present Study in the Other Undergraduate Samples 105

16 Descriptive Statistics and Intercorrelations of the Personality and Criterion Variables at t1 and t2 122
17 Summary of the Regression Analyses of the Three Career Success Criteria at t2 on the two Openness Aspects at t1 126
18 Summary of the Regression Analyses of the Eight Subjective Career Success Criteria at t2 on the two Openness Aspects at t1 128
19 Summary of the Stepwise Regression Analyses of GPA on Self-Assessed Intelligence, Metacognition, and Intellectual Openness at t2 129
20 Standardized Path Coefficients from the Time-Lagged Mediation Analyses 130

21 Bivariate Correlations Between the Five Facets Assessed by Either the SJT or the NEO-PI R 143
22 Results for Latent Multitrait-Multimethod Analysis 148
23 Correlations Between the Five Facets Assessed by Either the SJT or the NEO-PI R with External Variables 150
24 Stepwise Multiple Regression, Separately for Criterion Indicators of Each of the Five Facets and GPA, Predicted by Corresponding Facets of the SJT and the NEO-PI R 152

25 References Used in the Meta-Analysis (Article 1) 267
26 Samples and Statistics Used in the Meta-Analysis (Article 1) 272

27 Exploratory Factor Analysis Results for the German Translation of the BFAS Openness Scale 295
28 Exploratory Factor Analysis Results for the German Translation of the BFAS Conscientiousness Scale 296

29 Means, Standard Deviations, Reliabilities, and Intercorrelations of the Personality and Criterion Variables for the Re-Scored Openness and Conscientiousness Scales (cf. Table 13) 297
30 Summary of the Regression Analyses of Academic Achievement on Openness and Conscientiousness Aspects for the Re-Scored Openness and Conscientiousness Scales (cf. Table 14) 298
31 Means, Standard Deviations, Reliabilities, and Intercorrelations of the Personality and Criterion Variables in the Psychology Sample from the Fachhochschule Nordwestschweiz 299
32 Summary of the Regression Analyses of Academic Achievement on Openness and Conscientiousness Aspects in the Psychology Sample from the Fachhochschule Nordwestschweiz 300
33 Means, Standard Deviations, Reliabilities, and Intercorrelations of the Personality and Criterion Variables in the Economics Sample from the Fachhochschule Nordwestschweiz 301
34 Summary of the Regression Analyses of Academic Achievement on Openness and Conscientiousness Aspects in the Economics Sample from the Fachhochschule Nordwestschweiz 302
35 Means, Standard Deviations, Reliabilities, and Intercorrelations of the Personality and Criterion Variables in the Miscellaneous Undergraduate Sample 303
36 Summary of the Regression Analyses of Academic Achievement on Openness and Conscientiousness Aspects in the Miscellaneous Undergraduate Sample 304

37 Openness to Ideas Items form the SJT (Article 4) 306

List of Figures

1 Forest Plot of the Available Population Coefficients and Their Respective 80% Credibility Intervals From the Meta-Analysis Presented in Table 3 15

2 Model of Openness as a Predictor of Academic Performance with Standardized Path Coefficients 76

3 Interaction Between Intellectual Openness and Orderliness in the Prediction of GPA 98

4 Standardized Path Coefficients for the Prediction of Future Academic Success 125

5 Standardized Path Coefficients for the Prediction of Future Graduation 129

Part I

Introduction

1 The Importance of Academic Success

In an era of a *global knowledge economy*, where wealth creation is "based no longer on muscle but on mind" (Toffler, 1990, p. 9), intellectual capital is increasingly valued as a strategic resource. Recognizing the role of higher education in fostering the necessary knowledge and innovation as well as a skilled and competitive workforce (Marginson, 2010), policymakers around the world are continuously striving to improve their country's level of educational attainment (World Bank, 2002).

As a result, higher education has increasingly become a key determinant of employability and career success (Schomburg, 2007; Schomburg & Teichler, 2006). In addition to its impact on economic growth and development, higher education is also a major driver of social progress, fostering a pluralistic and prosperous civil society characterized by social mobility, political participation, and a higher quality of life (Baum & Payea, 2007; Jalaliyoon & Taherdoost, 2012). Due to this wide range of economic and societal benefits, postsecondary educational attainment has become both, an important desideratum and a critical asset for individuals, organizations, and societies.

The elevated role of higher education has steadily increased research interest in its contributions to the needs of the knowledge society, its impact on equity and social justice, and its governance (Brennan & Teichler, 2008). In addition, scholars have rigorously analyzed its threefold mission of accumulating academic knowledge, distributing this knowledge among students, and facilitating its transfer and application outside the academic environment (Pinheiro et al., 2015).

Complementing this top-down perspective, researchers have examined the individual and educational determinants of academic success (Brock, 2010; Wood & Breyer, 2016), a rather broad construct that encompasses various elements such as "academic achievement, attainment of learning objectives, acquisition of desired skills and competencies, satisfaction, persistence, and post-college performance" (York et al., 2015, p. 5). Others have investigated the correlates and consequences of academic achievement, that is, "performance outcomes in intellectual domains taught at school, college, and university" (Spinath, 2012, p. 1) as the most obvious and widely used indicator of academic success (York et al., 2015).[1] As a result, postsecondary academic achievement has been linked to various positive outcomes for individuals, organizations, and even entire economies, underscoring its overarching importance.

For the individual, academic achievement is a "gatekeeper to higher education and a master key to the labor market" (von Stumm, Hell, et al., 2011, p. 575). This is particularly true for undergraduate academic performance. Based on the notion that undergraduate grades predict further academic performance (Kuncel et al., 2007), they are widely used as admission criteria for graduate programs—especially in European higher education (Chadi & de Pinto, 2018). Similarly, recruiters often use them to select job applicants (Imose & Barber, 2015). Thus, undergraduate academic achievement not only reflects the successful acquisition of knowledge and skills, but also increases the number of choices individuals have regarding their educational and professional development, ultimately facilitating their socioeconomic prosperity (Spinath, 2012). Accordingly, undergraduate academic achievement is a consistent predictor of academic satisfaction (Bücker et al., 2018), as well as of student persistence and degree completion in higher education (Allen et al., 2008; Pascarella & Terenzini, 2005). It is also associated with broader indicators of subjective well-being such as life satisfaction (C. L. Powers, 2008), self-esteem (Crocker et al., 2003), and a lower overall stress levels (Richardson et al., 2012).

[1] Given that the overwhelming majority of research on the role of openness for academic success focuses on performance-related outcomes (i.e., grades), the following introduction and literature review will largely follow suit. Furthermore, like many other authors, I will use the terms "academic performance" and "academic achievement" interchangeably for the sake of variety. However, additional criteria of academic success, namely, subjective evaluations of academic achievement, academic satisfaction, student persistence, and post-academic success shall be explicitly examined in Articles 2 and 3.

For organizations, an applicant's postsecondary academic achievement is a valid and readily available predictor of job performance (P. L. Roth et al., 1996) and training performance (Dye & Reck, 1989). It reflects the applicant's or employee's contribution to the human capital of the organization (Jones & Jackson, 1990), that is, a "resource that is created from the emergence of individuals' knowledge, skills, abilities, and other characteristics" (Ployhart & Moliterno, 2011, p. 128), and is positively related to organizational performance (Crook et al., 2011). As a more indirect benefit, academic achievement facilitates the person-organization fit by giving employees more opportunities to choose those work environments that meet their needs and preferences (Spinath, 2012). This, in turn, promotes employee performance, satisfaction, and commitment and thus the success and effectiveness of the organization (Su et al., 2015).

From a more general perspective, research has identified positive effects of educational attainment (i.e., the highest level of formal education completed by an individual) on economic outcomes. At the national level, it fosters economic growth (Organisation for Economic Cooperation and Development, 2010) because it increases the human capital of a country, the innovativeness of its economy, and the availability of the knowledge needed to implement and fully exploit new technologies (Hanushek & Wößmann, 2010)[2]. In addition, educational attainment leads to higher individual incomes (Ng et al., 2005) and thus could stimulate the economy through increased aggregate demand and labor productivity (Lavoie & Stockhammer, 2013).

Overall, postsecondary academic success is an important determinant of success and prosperity at individual, organizational, and societal levels. Consequently, a large body of research has examined its antecedents and predictors in order to understand how it can be facilitated and enhanced. Educational researchers, on the one hand, have focused on external influences such as socioeconomic status (Rodríguez-Hernández et al., 2020), learning technologies (Schmid et al., 2014), or instructional approaches (Dudley-Marling, 2013; Pascarella et al., 2008). Psychologists, on the other hand, have studied internal factors such as emotions (Tze et al., 2016), creativity (Gajda et al., 2017), metacognition (Ohtani & Hisasaka, 2018), academic self-efficacy (Robbins et al., 2004), or emotional intelligence (MacCann et al., 2020). Taken together, psychological

[2] A more in-depth—-yet somewhat controversial—discussion of the relationship between intellectual capital and economic prosperity is provided by Lynn and Vanhanen (2002, 2006) and Rindermann et al. (2015).

research on predictors of academic success tends to focus on the students' "skills, aptitudes, and abilities to learn and perform . . . [as well as] their preferences for learning and their willingness to learn" (Sullivan, 2009, p. 252)—or in short: academically relevant *individual differences*.

2 Individual Differences and Academic Achievement

The role of individual differences in educational contexts is both a widespread topic in current psychological research and a field with a long and rich tradition. In fact, the notion that students' psychological characteristics are relevant to their success in learning and education can be considered the starting point of modern educational psychology (Ackerman & Heggestad, 1997; De Raad & Schouwenburg, 1996). For more than a century, two—largely parallel—streams of research have analyzed the role of these characteristics in educational settings, focusing on either *cognitive abilities* or *noncognitive traits* as predictors of academic achievement (Borghans et al., 2008; Vedel & Poropat, 2017).

Cognitive abilities are usually considered to reflect *intelligence*, that is, the "ability to understand complex ideas, to adapt effectively to the environment, to learn from experience, to engage in various forms of reasoning, [and] to overcome obstacles by taking thought" (Neisser et al., 1996, p. 77). Accordingly, skills such as reading comprehension, problem solving, and abstract reasoning but also academic subject knowledge or working memory capacity can be considered exemplary components of the cognitive domain (Farkas, 2003). Noncognitive traits, on the other hand, are often subsumed under the concept of *personality*, that is, a complex system of "psychological qualities that contribute to an individual's enduring and distinctive patterns of thinking, feeling and behaving" (Cervone & Pervin, 2016, p. 7). Some illustrative examples of the noncognitive domain include academic motivation, persistence, self-esteem, effortful control, and socio-emotional skills (L. G. Smithers et al., 2018).

2.1 Cognitive Abilities and Academic Achievement

The stream of research focusing on cognitive predictors of academic achievement could be described as a lengthy, but fairly straightforward success story. Building on Spearman's (1904) seminal concept of a general factor of intelligence (commonly referred to as *g*) and Thurstone's (1938) theory of primary mental abilities, the work of researchers such as Cattell (1943), Horn (1965), and Carroll (1993) culminated in a widely accepted—although not unchallenged (Gardner, 1983)—structural model of intelligence (W. J. Schneider & McGrew, 2018) that provided a useful frame of reference for scholars in their search for cognitive predictors of academic achievement (Valentini & Laros, 2014).

From the beginning, this endeavor has been accompanied by efforts to use psychometric measures of cognitive abilities as predictors of academic success. Starting with Binet and Simon (1904) and their "échelle métrique de l'intelligence" (p. 194), cognitive tests were increasingly used in educational settings (e.g., student admissions) up to the point where academic performance eventually became "the criterion par excellence" (Chamorro-Premuzic & Furnham, 2006a, p. 253) for their validation. Ultimately, this led to a large body of research on the relationship between cognitive abilities and academic achievement. Given that intelligence encompasses the "ability or capacity to learn and acquire new knowledge and skill" (Kuncel et al., 2004, p. 149), it is not surprising that various meta-analyses have found cognitive abilities to be strong predictors of academic achievement in school (B. Roth et al., 2015; Zaboski et al., 2018) and higher education settings (Kuncel et al., 2007; Kuncel & Hezlett, 2007; Poropat, 2009; Postlethwaite, 2011).

2.2 Noncognitive Traits and Academic Achievement

The research path focusing on noncognitive predictors of academic achievement, on the other hand, has arguably been much more arduous and intricate. In one of the first scientific studies to examine the impact of character on academic performance, (Webb, 1915) identified student qualities with "a general and fundamental bearing upon the total personality" (p. 11) that were both, independent of g and associated

with academic success. He subsumed these traits, such as perseverance in the face of challenges or willingness to pursue long-term goals, under a general factor reflecting persistence of motives or will, thus labeled *w*.

Despite some methodological flaws (Deary, 1996), Webb's (1915) work had considerable merit in that it not only advocated the importance of personality in learning and education, but also foreshadowed later findings that effort regulation and achievement motivation are among the most important determinants of academic achievement (Richardson et al., 2012; Robbins et al., 2004). However, although it inspired some further research on academically relevant constructs such as self-control (Spearman, 1927) and persistence (Ryans, 1939), Webb's (1915) w was far from being the catalyst for research on noncognitive predictors of academic achievement that Spearman's (1904) g was for the cognitive research stream.

In the decades that followed, research on personality in general and its impact on academic outcomes in particular suffered greatly from methodological problems (Harris, 1940), a lack of coherent theories (Stein, 1963), inadequate measures (Goldberg, 1971), and inconsistent results (Margrain, 1978). In addition, fundamental skepticism about the existence and meaningfulness of personality traits ushered in a "decade of doubt" (McAdams, 1997, p. 21) in the late 1970s, further impeding meaningful research progress. Consequently, despite some attempts to provide a systematic overview of the noncognitive determinants of academic success (Messick, 1979), research remained scattered because there was "no accepted referential framework, no metaphor or paradigm to guide studies at the crossing of personality and education" (De Raad & Schouwenburg, 1996, p. 304).

Fortunately, this issue was largely resolved with the emergence and establishment of the five-factor model of personality (Costa & McCrae, 1992; Goldberg, 1990). Providing a coherent theoretical framework for personality research, "a new sheriff came to town, instilling a measure of order in a notoriously lawless group discussion" (Hogan, 2007, p. 27). The guidance and structure provided by the five factors (i.e., *neuroticism*, *extraversion*, *openness*[3], *agreeableness*, and *conscientiousness*) have enabled researchers

[3]As will be discussed in Section 3.1, there is considerable controversy about the appropriate label for this factor. Depending on the underlying research tradition, it is usually labeled either "openness to experience" or "intellect". However, these two labels are more than an onomastic quibble, as they reflect two fundamentally different conceptualizations of the factor and should therefore not be considered interchangeable. For the sake of brevity, the term "openness" shall serve as a noncommitted, inclusive

in their efforts to find consistent relationships between academic achievement and personality traits. This was further facilitated by the development (Hunter et al., 1982; Schmidt & Hunter, 1977) and establishment of the *psychometric meta-analytic method* (Hunter & Schmidt, 2004; Schmidt, 2015), which allowed scholars to systematically synthesize and generalize the findings of the new plethora of primary studies.

With regard to undergraduate academic achievement, at least six major meta-analyses have reviewed and summarized these findings in the past two decades (McAbee & Oswald, 2013; O'Connor & Paunonen, 2007; Poropat, 2009; Richardson et al., 2012; Trapmann et al., 2007; Vedel, 2014). As shown in Table 3, the most consistent predictor of postsecondary academic performance within the five-factor model of personality is conscientiousness. Openness and agreeableness tend to have small positive relationships with academic achievement, while extraversion and neuroticism can be considered unrelated. A visualization of the available population coefficients and their 80% credibility intervals is presented in Figure 1.

In addition to a widely shared—although not undisputed (Boyle, 2008)—understanding of the fundamental structure of personality, the five-factor model also provided researchers with the cornerstones of an extensive nomological network (Cronbach & Meehl, 1955) that guided their efforts to identify more specific personality trait with implications for learning and education, both within and beyond the scope of the five factors. For example, within the conscientiousness domain, relationships with academic performance have been found for grit (Lam & Zhou, 2019), self-control (Duckworth et al., 2019), and perfectionism (Madigan, 2019). Outside of the five-factor taxonomy, traits such as self-efficacy (Honicke & Broadbent, 2016), trait emotional intelligence (Perera & DiGiacomo, 2013), learning goal orientation (Payne et al., 2007), self-concept (Marsh & Martin, 2011), and vocational interests (Nye et al., 2012) have been found to be valid predictors of postsecondary academic achievement.

In conclusion, psychological research on the noncognitive determinants of academic achievement has a long and turbulent history. From the early attempts to prove empirically that there is more to educational success than mere ability, through a dark

label for the factor in this dissertation, while "openness to experience" and "intellect" will be used whenever a clear distinction between the two different conceptualizations becomes necessary. Also, the term "five-factor model" will be used exclusively to refer to the overall taxonomy, although strictly speaking it refers only to the factor model stemming from the questionnaire tradition, whereas in the lexical tradition the factor model is usually referred to as "Big Five".

age of scientific doubt, hardship and setbacks, the search for noncognitive predictors of academic achievement has steadily gained momentum, especially in the past 40 years. As a result, a large body of research has provided convincing evidence that personality traits are indeed important drivers of success in learning and educational settings. Thus, it seems reasonable to conclude that noncognitive traits need to be taken into account

Table 3

Meta-Analytic Results on the Relationship Between the Personality Traits From the Five-Factor Model and Postsecondary Academic Performance

Meta-analysis[a]	*k*	*N*	*r*	CI95	ρ	CR80[b]
			Neuroticism			
McAbee-13	51	24,968	.00	[−.02; .02]	.00	[−.07; .07]
O'Connor-07	21	5,091	−.03	–	−.03	[−.07; .01]
Poropat-09	80	28,967	–	–	.01	–
Richardson-12	58	23,659	−.01	[−.04; .01]	.01	[−.09; .11]
Trapmann-07	59	14,653	−.01	[−.03; .02]	.00	[−.11; .11]
Vedel-14	21	17,717	−.01	[−.05; .03]	–	–
			Extraversion			
McAbee-13	50	24,740	−.02*	[−.04; .00]	−.03	[−.09; .03]
O'Connor-07	22	5,161	−.05	–	−.05	[−.11; .01]
Poropat-09	78	28,242	–	–	−.01	–
Richardson-12	58	23,730	−.04*	[−.07; −.02]	−.03	[−.11; .05]
Trapmann-07	54	12,424	−.05*	[−.09; −.01]	−.06	[−.24; .12]
Vedel-14	21	17,717	.00	[−.03; .02]	–	–
			Openness			
McAbee-13	51	24,996	.07*	[.05; .09]	.08	[.01; .15]
O'Connor-07	23	5,878	.05	–	.06	[−.05; .15]
Poropat-09	77	28,471	–	–	.07	–
Richardson-12	52	23,096	.09*	[.06; .12]	.09	[.01; .17]
Trapmann-07	41	14,942	.10*	[.07; .13]	.13	[.01; .26]
Vedel-14	21	17,717	.07*	[.03; .11]	–	–
			Agreeableness			
McAbee-13	49	24,615	.06*	[.04; .07]	.07	[.03; .11]
O'Connor-07	19	4,490	.06	–	.06	[.03; .09]
Poropat-09	75	27,944	–	–	.06	–
Richardson-12	47	21,734	.07*	[.04; .09]	.06	[−.01; .13]
Trapmann-07	34	12,452	.04*	[.02; .07]	.06	[−.03; .15]
Vedel-14	21	17,717	.08*	[.05; .11]	–	–

continued on the next page

Table 3 (continued)

Meta-Analytic Results on the Relationship between the Personality Traits from the Five-Factor Model and Postsecondary Academic Performance

Meta-analysis[a]	*k*	*N*	*r*	CI95	ρ	CR80[b]
			Conscientiousness			
McAbee-13	57	26,382	.23*	[.20; .24]	.26	[.19; .33]
O'Connor-07	23	5,878	.22	–	.24	[.17; .31]
Poropat-09	92	32,887	–	–	.23	–
Richardson-12	69	27,875	.19*	[.17; .22]	.23	[.16; .30]
Trapmann-07	41	10,855	.21*	[.18; .24]	.27	[.15; .39]
Vedel-14	21	17,717	.26*	[.23; .30]	–	–

Notes. k = number of effect sizes; N = total sample size; r = mean correlation corrected for sampling error; CI95 = lower and upper bounds of the 95% confidence interval; ρ = mean correlation corrected for sampling error and measurement error; CR80 = lower and upper bounds of the 80% credibility interval; dashes indicate that the value was not reported in the publication; asterisks indicate that the 95% confidence interval did not include zero.

[a] McAbee-13 = McAbee and Oswald (2013), O'Connor-07 = O'Connor and Paunonen (2007), Poropat-09 = Poropat (2009), Richardson-12 = Richardson et al. (2012), Trapmann-07 = Trapmann et al. (2007), Vedel-14 = Vedel (2014).

[b] The original publications reported credibility intervals at different levels of credibility (i.e., 80%, 90%, or 95%). To facilitate the comparability of the results, all credibility intervals were recalculated at the 80% level suggested by Hunter and Schmidt (2004).

when predicting academic achievement (Bowles & Gintis, 2002), with some authors even arguing that "personality is at least as, if not more, important than intelligence in educational settings" (Vedel & Poropat, 2017, p. 9). This may be particularly true in higher education, where rigorous admission processes often pre-select students based on their cognitive abilities (Furnham et al., 2003) and where the autonomy and responsibility for translating these abilities into learning and performance outcomes increasingly rests with the student (Carpenter & Pease, 2013; Devlin, 2002).

2.3 An Integrative Perspective: Intellectual Investment

The assumption that there are associations between cognitive abilities and noncognitive traits (Alexander, 1935; Lorge, 1940; Wechsler, 1940) and that the right combination of ability and effort should be most beneficial for academic success was voiced quite early

in individual differences research (Harris, 1940). In the following decades, various personality traits have been proposed as influences on cognitive performance outcomes such as intellectual efficiency (Gough, 1953), intellectual disposition (Heist & Yonge, 1968), academic curiosity (Vidler & Rawan, 1974), or intellectence (Welsh, 1975), paving the way for a better understanding of the interplay between cognitive abilities and noncognitive traits as predictors of academic achievement.

Building on these early efforts, Cattell's (1943) distinction between *fluid* and *crystallized intelligence* (i.e., general reasoning processes and experience-based problem-solving skills, respectively), and K. J. Hayes (1962) notion that "innate intellectual potential consists of tendencies to engage in activities conducive to learning, rather than inherited intellectual capacities, as such" (p. 337), Ackerman (1996) postulated the model of *intelligence-as-process, personality, interests, and intelligence-as-knowledge*. In short, this model suggests that certain personality traits and interests are instrumental in the translation of cognitive processes (i.e., fluid intelligence) into knowledge (i.e., crystallized intelligence) because they facilitate a person's desire and commitment to exert their cognitive abilities, thereby promoting learning and intellectual growth. A prototypical example is *typical intellectual engagement*, a trait that differentiates individuals in terms of their "desire to engage and understand their world, their interest in a wide variety of things, and their preference for a complete understanding of a complex topic or problem, a need to know" (Goff & Ackerman, 1992, p. 539).

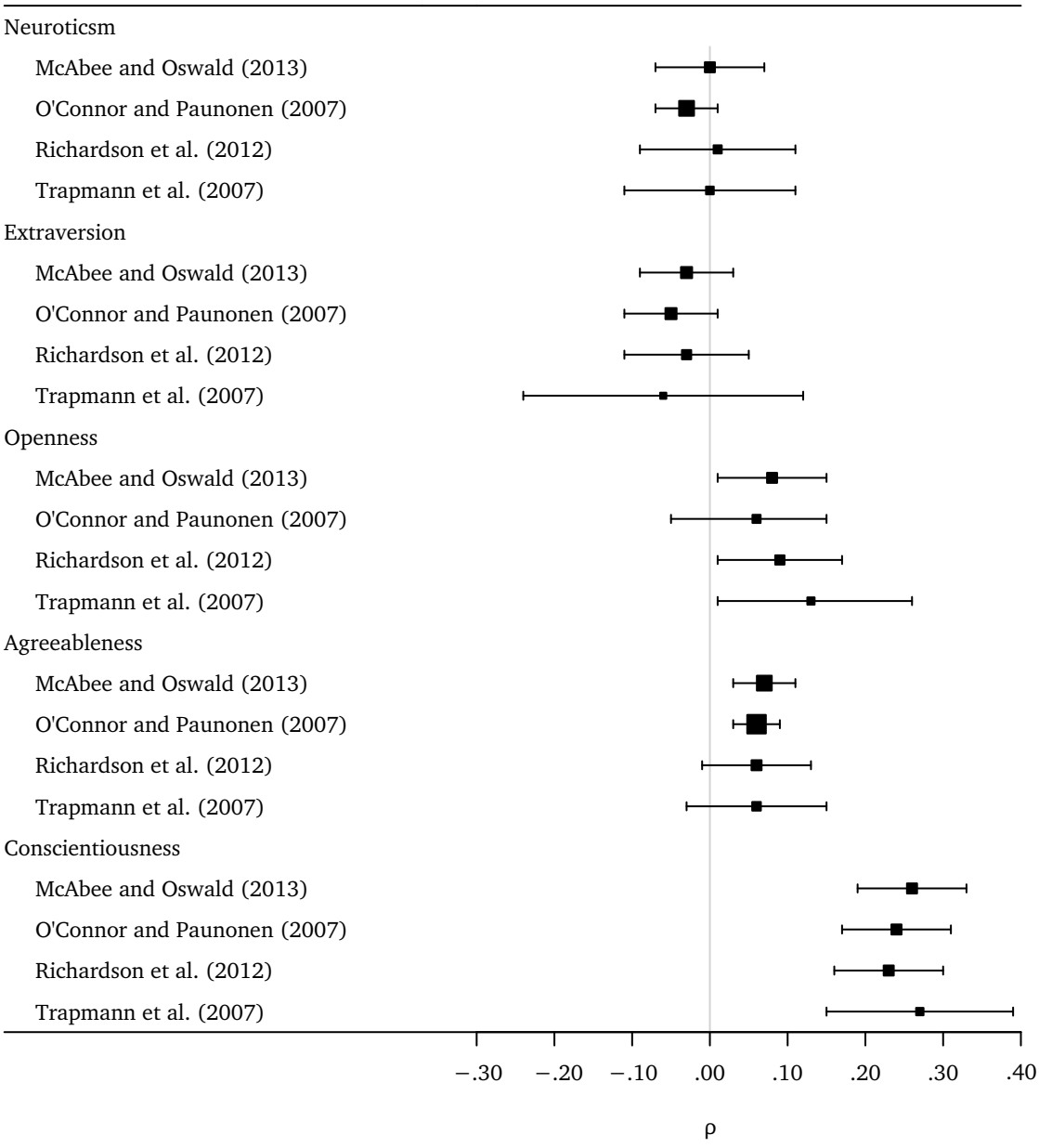
In their comprehensive review and meta-analysis, von Stumm and Ackerman (2013) compiled over 30 other intellectual investment traits, that is "stable individual differences in the tendency to seek out, engage in, enjoy, and continuously pursue opportunities for effortful cognitive activity" (von Stumm, Chamorro-Premuzic, & Ackerman, 2011, p. 225) such as need for cognition (Cacioppo & Petty, 1982), epistemic curiosity (Litman & Spielberger, 2003), or mindfulness (Langer, 1989). Reflecting a "a general learning orientation, or, more colloquially, the hunger for knowledge" (von Stumm & Ackerman, 2013, p. 842), intellectual investment traits play a crucial role in educational settings because they facilitate not only the eager exploration of new learning opportunities, but also their efficient exploitation, that is, their translation into knowledge (Ackerman, 1996; Vedel & Poropat, 2017; Ziegler, Danay, Heene, et al., 2012). Thus, it is not surprising that many intellectual investment traits have been found to be valid

predictors of postsecondary academic achievement (von Stumm & Ackerman, 2013; von Stumm, Hell, et al., 2011).

As mentioned above, the intellectual investment construct space encompasses a wide variety of different traits that can be grouped into seven categories, such as novelty seeking, absorption, and intellectual curiosity (von Stumm & Ackerman, 2013). Interestingly, there is one broader personality trait that seems to play a pivotal role within the framework, as it not only defines an entire subset of intellectual investment traits (von Stumm, 2018), but also, through its various facets, is represented in four of the seven categories. This trait, which is also highly correlated with the two core intellectual investment traits, namely typical intellectual engagement and need for cognition (Ackerman & Goff, 1994; Woo et al., 2007), is *openness* from the five-factor model of personality.

Figure 1

Forest Plot of the Available Population Coefficients and Their Respective 80% Credibility Intervals From the Meta-Analysis Presented in Table 3



Note. Bigger boxes in the diagram correspond to a higher precision estimates (i.e., more narrow credibility intervals).

3 Openness: The Ominous “Factor V”

Arguably the first conceptualization of a higher-level openness factor was presented by Fiske (1949) and subsumed traits such as breadth of interests, independence of mind, and imaginativeness. Although Fiske (1949) noted that these traits seemed to describe a *cultured* personality, he decided to emphasize the aspect of intellectual curiosity within the factor by labeling it *inquiring intellect*. Subsequent researchers, on the other hand, actually chose the term culture to summarize such traits as intellectuality, artistic sensitivity, refinement, and imagination (Norman, 1963; Tupes & Christal, 1961). Others interpreted the factor point-blank as *intelligence* (Borgatta, 1964; Cattell, 1957) or *intellectance* (Hogan, 1983), focusing on aspects such as quick-wittedness, imagination, creativity, intellectual interests, and educational aptitude.

When Tupes and Christal (1961)—the “true fathers” (Goldberg, 1993, p. 27) of the five-factor model—remarked that openness “is the least clear of the five factors” (p. 10), they foreshadowed a lengthy and intense controversy over the correct interpretation and appropriate labeling of the openness factor that is still not fully resolved (Connelly, Ones, & Chernyshenko, 2014). Illustrative for the extent of the disagreement, an entire special issue of the *European Journal of Personality* was devoted to the fierce discourse about the nature and scope of what was often neutrally labeled *Factor V* (De Raad & van Heck, 1994). Particular disagreement arose between proponents of the two research traditions that—largely independently from each other and through different methodological approaches—derived those fundamental personality factors that eventually converged, more or less, into the contemporary five-factor framework (Digman, 1990; J. A. Johnson, 2017).

3.1 Openness to Experience *versus* Intellect

Personality researchers from the *questionnaire* approach, on the one hand, discovered the five factors[4] by identifying statistical similarities between seemingly unrelated personality questionnaires through factor analysis. Extending the earlier work of Eysenck and Eysenck (1964), who had already established neuroticism and extraversion as broad personality factors, Costa and McCrae (1976, 1978) identified a third basic factor for which they borrowed the label *openness for experience* (Coan, 1972; Fitzgerald, 1966; C. R. Rogers, 1954). Reflecting the “breadth, depth, and permeability of consciousness and . . . the recurrent need to enlarge and examine experience” (McCrae & Costa, 1997, p. 826), openness to experience is arguably the broadest and most heterogeneous of the five factors (Digman, 1990). Based on the six facets that it subsumes (McCrae, 1993), individuals with higher levels of the factor can be described as “imaginative, sensitive to art and beauty, emotionally differentiated, behaviorally flexible, intellectually curious, and liberal in values” (McCrae & Sutin, 2009, p. 258), although it should be noted that due to the loose relationships between these facets, not all of these attributes are necessarily equally pronounced in an individual.

Personality researchers from the *lexical* approach, on the other hand, based their search for universal personality factors on the hypothesis that personality is encoded in—and therefore can be extracted from—natural language, especially person-describing adjectives (Allport & Odbert, 1936). Building on the earlier classifications of Norman (1963, 1967), Goldberg (1980) empirically reduced 1,710 trait adjectives into five broad and robust personality factors, for which he coined the term *Big Five* (Goldberg, 1981). The factor with the closest conceptual resemblance and the strongest empirical links to openness to experience, as described above, was characterized by adjectives such as intellectual, imaginative, reflective, philosophical, creative, and curious, and was therefore labeled *intellect* (Digman & Takemoto-Chock, 1981; Peabody & Goldberg, 1989).

As noted above, the equivalence of openness to experience and intellect—or even their exact relationship with each other—have been the subject of controversial debate

[4] More specifically, only three factors (i.e., neuroticism, extraversion, and openness) were found this way, while the two others (i.e. agreeableness and conscientiousness) were adopted from the lexical approach (McCrae, 1990).

(De Raad & van Heck, 1994). For example, McCrae (1994) argued that intellect should be considered subordinate to openness to experience, since the latter has a much broader scope than mere intellectuality. Goldberg (1994) countered that intellect is a more appropriate contender for a broad personality dimension due to its stronger lexical underpinning and positioned openness as "a narrow and specific attribute at a considerably lower level in the hierarchy of lexicalized personality" (p. 355). While Trapnell (1994) concluded that openness to experience and intellect were at least partially incommensurable, Saucier (1992) suggested that there was enough conceptual overlap between the two to consider the controversy "much ado about nothing" (p. 385), especially if one considers imagination, creativity, or originality to be the common core of openness to experience and intellect.

3.2 Openness to Experience *and* Intellect

Somewhat neglected by the disputants, some authors have suggested that openness to experience and intellect may actually be two distinct, equally important aspects of the same personality domain. Digman and Takemoto-Chock (1981), for example, reanalyzed existing personality data sets and found support for two separate subcomponents of openness, "one of which appeared to be concerned more with intelligence, the other with matters of culture" (p. 155). Similarly, J. A. Johnson (1994) suggested interests in *truth* and *beauty* as two of the purest components of openness. However, despite providing an opportunity for a conciliatory compromise between the two research traditions, it took nearly two decades for the idea of a truly dichotomous openness factor to gain traction in personality research.

As implied earlier, each of the five factors subsumes various facets, that is, narrow lower-level traits with a more or less substantial share of common variance. As might be expected, there is some disagreement about the number and nature of these facets for the openness factor. For example, Saucier and Ostendorf (1999) found three subcomponents (intellect, imagination-creativity, and perceptiveness), while Kaufman (2013) proposed four (intellectual engagement, explicit cognitive ability, affective engagement, aesthetic engagement). According to Hofstee et al. (1992) there could be up to nine facets (intellect, ingenuity, reflection, competence, quickness, introspection,

creativity, imagination, and depth)[5]. More recently, Connelly, Ones, Davies, et al. (2014) categorized and meta-analyzed 85 existing openness scales in order to empirically determine the facet structure. They report four distinct facets within the openness domain (openness to sensation, aestheticism, non-traditionalism, and introspection). In a similar approach, Woo, Chernyshenko, Stark, et al. (2014) present an empirically driven bottom-up approach to integrate the various facet taxonomies of openness. According to their comprehensive factor analyses of existing personality scales, openness consists of the six facets (intellectual efficiency, ingenuity, curiosity, aesthetics, tolerance, and depth).

However, arguably the most established openness facets were presented by Costa and McCrae (1992). They suggested that the openness factor subsumes six facets, namely openness to *fantasy* (vivid imagination and active fantasy), *aesthetics* (appreciation of art and beauty), *feelings* (receptivity to one's feelings and emotions), *actions* (willingness to try new activities), *ideas* (intellectual curiosity and interest), and *values* (willingness to reexamine social, political, and religious values).

When Jang et al. (2002) analyzed the genetic influences on these six facets, they found that not one, but two genetic factors were necessary to explain their shared variance. The first factor, *reflection*, influenced three facets (i.e., fantasy, aesthetics, and feelings), while the second factor, *curiosity*, influenced the other three (i.e., actions, ideas, and values). Although it should be noted that these results were somewhat inconsistent across two different samples, they indicated the existence of an intermediate level of trait organization between the high-level factor and the low-level facets. Similar results were reported by Wainwright et al. (2008), who found an additive genetic factor that was predominantly associated with two facets (ideas and values)—as well as measures of cognitive ability—and another additive genetic factor that was associated with the four other openness facets (fantasy, aesthetic, feelings, and actions).

In parallel with this behavioral genetics research, other researchers have explored the lower-level structure of openness using the same empirical approach that led to the five-factor model itself, namely factor analysis. Rather than focusing on the extraction of broad personality factors, they conducted factor analyses on openness facet scores to determine how they grouped at an intermediate level. As a result, competing models

[5]These labels are taken from Goldberg (1999), as Hofstee et al. (1992)only provided numerical labels.

have emerged with more or less divergent structural assumptions. Griffin and Hesketh (2004) found two components and labeled them *openness to internal experience* (fantasy, aesthetics, feelings) and *openness to external experience* (actions, ideas, values). Gignac et al. (2004) replicated the second component and labeled it *objective openness*. However, the first component did not emerge in their study. Instead all six facets also loaded on another factor which they labeled *general openness*. Mussel et al. (2011) compared different facet models using confirmatory factor analysis. They concluded that the two-factor solution proposed by Griffin and Hesketh (2004) was the most appropriate and suggested *perceptual openness* and *epistemic openness* as the two aspect labels.

Finally, DeYoung et al. (2007) examined 15 openness facet scales from the *Revised NEO Personality Inventory* (NEO-PI-R; Costa & McCrae, 1992) and the *International Item Pool* (Goldberg et al., 2006) version of the *Abridged Big-Five Dimensional Circumplex* (Hofstee et al., 1992) through exploratory factor analysis, further supporting the assumption of two subcomponents. The first one, *intellect*, measured by the ideas facet of the NEO-PI-R, focused on abstract information processing, cognitive efficiency, and intellectual engagement. The second one, *openness*, measured by the aesthetics, fantasy, feelings, and actions facets of the NEO-PI-R, focused on sensory and perceptual information processing, imagination, reflection, and artistic inclination. In recent years, this model has been increasingly adopted in various areas of individual differences research, most notably in studies of work performance (Judge et al., 2013), personality structure (Barford et al., 2015; K. Lee & Ashton, 2019; Ludeke et al., 2019), subjective well-being (Sun et al., 2018; Zajenkowski & Matthews, 2019), and the susceptibility to pseudo-profound bullshit (Bainbridge et al., 2019) or paranormal beliefs (Chauvin & Mullet, 2018). Furthermore, it has been translated into a truly dichotomous measure of openness, namely the *Openness/Intellect* scale from the *Big Five Aspect Scales* (BFAS; DeYoung et al., 2007).

Despite their occasional divergences in structure and nomenclature, the findings on the lower-level structure of openness strongly support the notion of openness as a dichotomous personality domain consisting of two separable but related subcomponents, for which DeYoung et al. (2007) coined the term *aspect*. This notion not only provided a conciliatory resolution of the controversy over whether openness to experience or intellect were more appropriate conceptualizations of Factor V. It also allowed personality researchers to disentangle some of the relationships between openness and other

constructs that had previously been obfuscated by the monolithic operationalization of what is actually a dichotomous factor. This, in turn, may be crucial to understanding the true relationship between openness and postsecondary academic achievement.

3.3 Openness Aspects and Academic Achievement

Unfortunately, there are virtually no studies that have directly examined the relationship between the two aspects of openness and academic achievement. A notable exception is the study by Moorman and Samuel (2018) who found that the intellect aspect was related to standardized scholastic aptitude tests (but not high school GPA), while the openness aspect was not related to these academic outcomes at all. It should be noted though that their sample included approximately 25% students with elevated schizotypal symptoms, which limits the generalizability of the findings. However, there are some other empirical findings that suggest the potential of the two openness aspects as predictors of academic achievement.

First, there is empirical evidence that the two openness aspects show specific associations with constructs that have been found to be relevant to postsecondary academic performance, namely intelligence (Kuncel et al., 2004; Poropat, 2009; Postlethwaite, 2011), creativity (Gajda et al., 2017), and need for cognition (von Stumm & Ackerman, 2013). The summary of a bare-bones meta-analysis[6] (Hunter & Schmidt, 2004) of the currently published results, computed for this dissertation using the *psychometric* package for R (Fletcher, 2010), can be found in Table 4.

Although these results should be interpreted with caution due to the small number of studies, they suggest that the intellect aspect is more strongly related to general intelligence and need for cognition, while the openness aspect tends to show stronger associations with creative achievement. This is consistent with the assumption that the intellect aspect reflects a preference for abstract reasoning and intellectual engagement, whereas the openness aspect describes a desire for aesthetic stimulation and affective

[6]Due to the small number of studies and the considerable amount of missing reliability information within these studies, a meaningful calculation of population estimates (i.e., ρ and its credibility intervals) did not seem feasible. The only exception was the relationship between general intelligence and the two aspects of openness, which yielded $\rho = .46$, 80% CR $[.41, .52]$ for intellectual openness and $\rho = .21$, 80% CR $[.15, .28]$ for senso-aesthetic openness. The amount of variance explained by artifacts was 69% and 70%, respectively.

engagement (Kaufman, 2013). As a result, the intellect aspect may be a more consistent predictor of academic achievement across a wide range of subjects, whereas a possible effect of the openness aspect on academic performance may depend on educational environments that reward innovation and unconventionality. Contrary to what might be expected, there were no significant differences between the aspects in their correlations with verbal and nonverbal cognitive abilities. Also, both aspects appear to be unrelated to divergent thinking, that is, the ability to quickly generate numerous original solutions for open-ended problems (Guilford, 1967, 1984).

Second, other studies have found additional relevant differences between the two aspects. For example, Kaufman et al. (2010) determined that the intellect aspect was related to working memory capacity and explicit learning (i.e., the instructed memorization of stimulus-response pairs) but not implicit learning (i.e., the automatic detection of complex regularities), whereas the opposite was true for the openness aspect. Douglas et al. (2016a) found that the openness aspect predicted vigor and dedication in a sample of university students, whereas the intellect aspect predicted absorption (i.e., "being concentrated and engrossed in work", p. 268) when the respective other aspect was controlled for.

Third, a few studies have reported correlations between openness facets that are considered good markers of either the intellect aspect (i.e., ideas) or the openness aspect (i.e., aesthetics) and academic achievement. Unfortunately, their findings are somewhat contradictory. While two studies found ideas, but not aesthetics, to be moderately related to academic achievement (Dollinger & Orf, 1991; Ziegler, Danay, Schölmerich, et al., 2010), two others found no statistically significant associations (Chamorro-Premuzic & Furnham, 2003b; De Fruyt & Mervielde, 1996). Furthermore, in a longitudinal study, Lievens et al. (2009) found moderate correlations between ideas and first-year GPA of medical students. Interestingly, both facets (i.e., ideas and aesthetics) showed moderate predictive validity from the fourth to the final, seventh year.

Fourth and finally, a more recent meta-analysis focused on typical intellectual engagement as a predictor of postsecondary academic performance (von Stumm, Hell, et al., 2011). As mentioned above, this trait is a core component of the intellectual investment construct space and has been found to be highly correlated with openness (Woo et al., 2007) as well as academic achievement (von Stumm & Ackerman, 2013).

Table 4

Results of the Bare-Bones Meta-Analysis on the Relationship Between the Two Openness Aspects and Intelligence, Creativity, and Need for Cognition

			Intellect		Openness	
Construct	k	N	$\bar{r}$	CI95	$\bar{r}$	CI95
g[a]	7	2,167	.36*	[.32; .40]	.16*	[.12; .20]
g_{verbal}[b]	3	527	.33*	[.26; .41]	.33*	[.25; .40]
$g_{non\text{-}verbal}$[c]	4	743	.21*	[.14; .28]	.09*	[.02; .16]
Creative Achievement[d]	4	1,475	.19*	[.14; .24]	.34*	[.30; .39]
Divergent Thinking[e]	3	1,224	.23*	[.18; .29]	.12*	[.06; .17]
Need for Cognition[f]	3	827	.68*	[.65; .72]	.33*	[.26; .39]

Notes. k = number of effect sizes; N = total sample size; $\bar{r}$ = mean correlation corrected for sampling error; CI95 = lower and upper bound of the 95% confidence interval; asterisks (*) indicate that the 95% confidence interval did not include zero.
The following studies were included in the meta-analysis according to the index letters in the table: Bainbridge et al. (2019): a, f; Bédard and Le Corff (2020): a, b, c; Benedek et al. (2017): d, e; DeYoung et al. (2012): a, f; DeYoung (2014): a, b, c; Diedrich et al. (2018): d; Grazioplene et al. (2016): a; Kaufman et al. (2016): a, d, e; Kuijpers et al. (2019): f; Silvia et al. (2017): d, e; Zajenkowski and Matthews (2019): c.

It can also be considered as a good proxy measure of intellect (DeYoung, 2014). From this point of view, von Stumm, Hell, et al.’s (2011) meta-analysis provides further insights into the unique effects of the two openness aspects on academic achievement.

Using meta-analytic path analysis, they found that academic performance was positively predicted by general mental ability, typical intellectual engagement, and conscientiousness, while openness to experience was a negative predictor. These results are particularly interesting because the beta weights in a multiple regression analysis reflect the predictive validity of each construct when all other constructs are being held constant. This has two important implications. First, the intellect aspect (as represented by typical intellectual engagement without the variance it shares with openness to experience) does indeed appear to be a strong predictor of academic performance—even when intelligence is controlled for. Second, the openness aspect (as represented by openness to experience without the variance it shares with typical intellectual engagement) appears to be negatively related to academic achievement. This also supports the notion that the non-academic qualities associated with openness may be unfavorable in leaning and educational settings (DeYoung, 2014).

4 The Measurement of Openness

Following the establishment of the five-factor model as the dominant structural framework in personality research, about 30 major scientific personality inventories measuring the five factors have been published in the past decades (de Raad & Perugini, 2002; Simms et al., 2017). In addition, there are many other, lesser-known measures (e.g., Konstabel et al., 2012; Minkov et al., 2019; Woo, Chernyshenko, Longley, et al., 2014), various revised or abbreviated forms of existing instruments (e.g., Rammstedt & John, 2007; Soto & John, 2017b), and several commercially distributed inventories (e.g., Hogan & Hogan, 1992; Jackson, Paunonen, et al., 2000). Combined with the notion that ultimately "one could understand any assessment of personality traits as an assessment of at least a portion of the [five-factor model]" (Boudreaux & Ozer, 2015, p. 230), it seems fair to conclude that there are several dozen of scales that measure openness in one form or another.

As discussed in Chapter 3, there are two distinct research traditions that have more or less converged in the contemporary five-factor model (i.e., the questionnaire and lexical approaches) but differ substantially in their understanding of the openness factor. Accordingly, openness scales in personality inventories tend to have an either a more senso-aesthetic or a more intellectual orientation. For example, in the openness scale of the NEO-PI-R (Costa & McCrae, 1992), which can be considered both, the "gold standard for measuring the dimensions of the [five-factor model]" (Muck et al., 2007, p. 166) and the flagship of the questionnaire research measures, only 17% of the 48 openness items (i.e., the 8 items representing the ideas scale) measure the intellectual components of openness. In contrast, the openness scales of the three most widely used lexical measures (Simms et al., 2017), namely the *Big Five Inventory* (John et al., 1991), *Goldberg's Synonym Clusters* (Goldberg, 1990), and *Goldberg's Big Five*

Markers (Goldberg, 1992), have a considerably stronger intellectual focus (50% of 10 items, 66% of 35 items, and 65% of 20 items, respectively).

As a result, the convergent validity between different measures of overall openness is lower than one might expect, ranging from .40 to .51, according to recent meta-analytic findings (Pace & Brannick, 2010). This should be kept in mind, when using measures of openness as predictors of academic achievement, especially since lexical measures such as the Mini-Markers (Saucier, 1994) appear to have a higher criterion-related validity for academic performance than measures based on the questionnaire tradition (Gatzka & Hell, 2018).

As will be shown in Chapters 6, 7, and 8, intellectual and senso-aesthetic openness show different correlations with various academic success criteria. Thus, it seems prudent to use measures of openness that clearly distinguish between these two aspects when attempting to predict academic success. Unfortunately, while some of the lower-level facet scales in available five-factor model inventories can be considered appropriate proxies for the two openness aspects (see Table 5), measures that have been explicitly designed to reflect a truly dichotomous openness factor are few and far between. One exception is the Openness/Intellect scale from the BFAS (DeYoung et al., 2007), which will play a central role throughout this dissertation.

More recently, Woo, Chernyshenko, Longley, et al. (2014) examined 36 openness-related scales from 7 major personality inventories through factor-analyses and derived six facets of openness, namely *intellectual efficiency* (i.e., intellectuality and quick information processing), *ingenuity* (i.e., creative and innovative thinking), *curiosity* (i.e., desire for knowledge and scientific interest), *aesthetics* (i.e., interest in art and beauty), *tolerance* (i.e., acceptance of different opinions and cultures), and *depth* (i.e., introspection and interest in personal growth). These six facets were then subsumed under two intermediate aspects, namely *intellect* (intellectual efficiency, ingenuity, and curiosity) and *culture* (aesthetics, tolerance, and depth), which resemble the two aspects proposed by DeYoung et al. (2007). Based on this structure, Woo, Chernyshenko, Longley, et al. (2014) developed a novel openness scale measuring the six facets with 15 items each. In parallel, they conducted a meta-analysis on the relationship between all openness components (i.e., the overall dimension, the two aspects, and the six facets) and various work-related outcomes such as job performance, leadership and training performance, and cognitive abilities (Woo, Chernyshenko, Stark, et al., 2014).

However, despite the apparent similarities between the models of DeYoung et al. (2007) and Woo, Chernyshenko, Longley, et al. (2014), there are also some differences. For example, while Woo, Chernyshenko, Longley, et al. (2014) consider creativity/innovation to be part of the intellectual aspect and depth to reflect the senso-aesthetic aspect, DeYoung (2014) argues that they are a blend of both aspects. In terms of creativity, DeYoung, 's (2014) point of view would be more consistent with the meta-analytic findings presented in Section 3.3 that creative achievement is related to both aspects. Furthermore, unlike Woo, Chernyshenko, Longley, et al. (2014), DeYoung (2014) suggests that tolerance/values is a composite of multiple traits within the five-factor model and therefore should not be considered a component of openness.

Overall, these differences illustrate that the two models—and their respective measures—are not as congruent as their structural assumptions and nomenclature might suggest. In addition, while DeYoung et al. (2007) explicitly aimed to construct a dichotomous measure of openness based on prior empirical findings and theoretical considerations (e.g., DeYoung et al., 2005; J. A. Johnson, 1994), the two aspects in the scale developed by Woo, Chernyshenko, Longley, et al. (2014) are more of a byproduct of their empiristic effort to consolidate a wide range of scales "conceptually relevant to openness" (p. 31).

Finally, it should be noted that there are several scales outside the domain of the five-factor model that measure components of intellectual or senso-aesthetic openness, although they usually do not cover the respective aspect in its entirety. Examples of scales that partially reflect intellectual openness include *Understanding* from the *Six Factor Personality Questionnaire* (Jackson, Paunonen, et al., 2000), *Intellectual Efficiency* from the *California Personality Inventory* (Gough, 1987), the *Typical Intellectual Engagement* scale (Goff & Ackerman, 1992), the *Need for Cognition* scale (Cacioppo & Petty, 1982), and the *Epistemic Curiosity* scale (Litman & Spielberger, 2003). Scales that include elements of senso-aesthetic openness are, for example, *Absorption* from the *Multidimensional Personality Questionnaire* (Tellegen & Waller, 2008), *Sentience* from the *Personality Research Form* (Jackson, 1984), and the *Perceptual Curiosity* scale (Collins et al., 2004)

Table 5

Major Five-Factor Model Inventories With Proxies for Intellectual and Senso-Aesthetic Openness

Measure	Scale	Example Item
	Intellectual Openness	
AB5C	Quickness	"Am quick to understand things."
	Creativity	"Like to solve complex problems."
	Intellect	"Enjoy thinking about things."
	Ingenuity	"Quickly think up new ideas."
	Competence	"Use my brain."
BFI	Ideas	"Likes to reflect, play with ideas."
BFI–2	Intellectual curiosity	"Is complex, a deep thinker."
IPIP-HEXACO	Inquisitiveness	"Enjoy intellectual games."
IPIP NEO-PI-R	Intellect	"Like to solve complex problems."
NEO-PI-R	Openness to ideas	"He often enjoys playing with theories or abstract ideas."
	Senso-aesthetic openness	
AB5C	Imagination	"Believe in the importance of art."
	Reflection	"Enjoy the beauty of nature."
BFI	Aesthetics	"Values artistic, aesthetic experiences."
BFI–2	Aesthetic sensitivity	"Is fascinated by art, music, or literature."
IPIP-HEXACO	Aesthetic appreciation	"See beauty in things that others might not notice."
IPIP NEO-PI-R	Artistic interests	"Do not like art."
	Emotionality	"Experience my emotions intensely."
	Imagination	"Enjoy wild flights of fantasy."
NEO-PI-R	Openness to aesthetics	"Aesthetic and artistic concerns aren't very important to him."
	Openness to feelings	"He seldom notices the moods or feelings that different environments produce."
	Openness to fantasy	"He has an active fantasy life."

Notes. AB5C = Abridged Big Five Circumplex (Goldberg, 1999); BFI = Big Five Inventory (Soto & John, 2009); BFI–2 = Big Five Inventory-2 (Soto & John, 2017b); IPIP-HEXACO = International Personality Item Pool HEXACO scales (Ashton et al., 2007); International Personality Item Pool Revised NEO Personality Inventory scales (Goldberg et al., 2006); NEO-PI-R = Revised NEO Personality Inventory (Costa & McCrae, 1992).

4.1 Self-Report Measures

Personality traits such as openness are usually assessed with measures of *typical performance* that focus on the subject's regular behavior under life-like conditions (Cronbach,

1949; Fiske & Butler, 1963).[7] If one wants to know how a person behaves in everyday life, it seems obvious to simply ask them about this information. Thus, it is not surprising that self-reports are by far the most common method in individual differences research (Robins et al., 2007) and that most of the openness-related scales mentioned above are primarily designed as such. Indeed, self-report measures have several advantages, such as ease of interpretation, richness of first-hand information (in terms of quality, quantity, and breadth), acceptance by participants (e.g., due to the possibility of responding anonymously), efficiency, and practicality (Paulhus & Vazire, 2007).

Unfortunately, self-report measures of personality have their own unique set of challenges and limitations stemming from their reliance on authentic, correct, and honest responses from the subjects (Zeidner & Matthews, 2000) as well as from the absence of universally correct or incorrect answers (Paunonen & LeBel, 2012). For example, the self-knowledge necessary for accurate and valid responses may be flawed (e.g., incomplete or misconstrued) or simply unavailable to the subject (Dunning et al., 2004). Furthermore, the human ability to introspect and self-reflect—and thus to generate meaningful and accurate insights—is far from perfect (Silvia & Gendolla, 2001; Vazire, 2010).

However, arguably the most prominent problem with self-reports are response biases, that is, "habitual tendencies to respond to questions based on item properties such as keying direction and the desirability of the response options" (Paulhus, 2017, p. 1). According to Jackson and Messick (1958), they include *response sets* (i.e., purposeful response distortions specific to a particular assessment situation), and *response styles* (i.e., more general tendencies to answer questionnaire items in a particular, distorted way regardless of the item content).

With regard to the scope of this dissertation (i.e., the use of openness measures as predictors of academic success), one response set[8] appears to be particularly relevant, namely *socially desirable responding* (SDR) or "the tendency of individuals to present themselves favorably with respect to current social norms and standards" (Zerbe & Paulhus, 1987, p. 250). Although the precise nature of SDR is the subject of an ongoing

[7] In contrast, cognitive ability tests typically measure *maximum* performance (i.e., what a person can do under optimal conditions).

[8] While SDR is often considered to be a situation-specific response set (Ziegler, 2015), it should be noted that it also "may occur as a response style, that is, a general tendency to give desirable answers on all self-reports" (Paulhus, 2017, p. 1).

debate (Uziel, 2010), there is evidence that it encompasses two largely orthogonal subcomponents, namely *impression management* and *self-deception* (Paulhus, 2002). Whereas the former subsumes misrepresentations that are deliberate, dishonest, and directed towards others (e.g., exaggerations, fabrications, and lies), the latter reflects unconscious self-serving response distortions that promote and preserve an overly positive self-perception (e.g., self-enhancement, defensiveness, and denial; Paulhus & Vazire, 2007).

Surprisingly, meta-analytic evidence suggests that SDR—or more precisely: faking, that is, the "volitional attempt at increasing one's score on a personality assessment in order to obtain the desired outcome" (Griffith & Robie, 2013, p. 253)—has little effect on the criterion-related validity of personality scales as predictors of performance outcomes (Hough, 1998; Ones & Viswesvaran, 1998; Ones et al., 1996). However, the conclusion that faking is not an issue in self-report measures may be unwise for at least two reasons. First, many studies that have examined the effect of faking on criterion-related validity have either artificially induced faking through specific instructions to "fake good" or used special SDR scales to control for faking effects (Paunonen & LeBel, 2012). This raises questions about the generalizability of these findings to real-life, high-stakes settings. Second, there is empirical evidence that faking alters measured trait levels (Birkeland et al., 2006; Viswesvaran & Ones, 1999) and affects the construct validity of personality measures (P. Lee et al., 2019; Ziegler, MacCann, et al., 2012). This, in turn, could have serious negative consequences for the outcome of real-life decision-making processes, such as personnel selection or student admissions (Marcus, 2006; Mueller-Hanson et al., 2003).

For openness in particular, there are several relevant findings regarding SDR. First, openness is moderately related to both impression management and self-deception (A. Li & Bagger, 2006). This complicates the interpretation of openness scores due to a confounding between the true trait level and systematic distortion tendencies (Paulhus, 2017). Second, measures of openness are as susceptible to SDR as measures of the other personality dimensions in the five-factor model (Viswesvaran & Ones, 1999); in other words, openness *can* be faked. Third, openness—especially the intellect aspect—has been found to be one of the most evaluative (i.e., socially desirable) personality traits within the five-factor model (John & Robins, 1993; Smeding et al., 2017). This generally increases the likelihood of SDR occurring, especially in high-

stakes settings (e.g. selection procedures) that provide incentives for an overly positive self-presentation (Kenny & West, 2010; Morgeson et al., 2007); in other words, it likely *will* be faked under certain circumstances.

Taken together, these findings suggest that response sets such as SDR have palpable effects on self-report measures of openness, reducing their usefulness as predictors of academic achievement—especially in high-stakes settings such as student admissions or assessment processes. Furthermore, like other self-report measures, they are subject to the aforementioned response styles (Cronbach, 1946, 1950) for example, *acquiescent responding* (i.e., the tendency to simply agree with items regardless of their content), *extreme responding* (i.e., the tendency to choose either the lowest or the highest category of a rating scale), and *evasive* or *midpoint responding* (i.e., the tendency to choose the neutral, middle category of a rating scale)s as well as various other response styles such as random, inconsistent, or patterned responding (Paulhus & Vazire, 2007; Ziegler, 2015). Similar to situation-specific response sets, these more temporally persistent response styles have been found to have a considerable impact on the construct validity of personality measures (Rammstedt & Farmer, 2013; Wetzel et al., 2016). Given all of these challenges associated with the use of self-report measures, it seems prudent to consider alternative methods for assessing openness as a predictor of academic achievement.

4.2 Other-Report Measures

One way to mitigate some of the shortcomings of self-report measures is to use knowledgeable informants (e.g., supervisors, teachers, or peers) to assess a subject's personality (McCrae & Weiss, 2007). Although less commonly used, such other-report measures have a long tradition (Shen, 1925) and are well-established as alternatives or complements to self-report measures in personality research (Robins et al., 2007). This is not surprising, given the various advantages and possibilities that other-report measures offer.

For example, they my provide more objective and accurate information about the target's personality because they are less affected by biased self-perceptions and self-serving response distortions (Kenny & West, 2010; Vazire, 2010). This appears to be

particularly true for personality traits that are highly evaluative (i.e., are considered particularly desirable or undesirable in a society), such as agreeableness or openness (John & Robins, 1993; Kenny, 1994). In addition, other-reports may provide unique insights because of their stronger focus on behavioral expressions rather than cognitive or affective components of personality (Pytlik Zillig et al., 2002), their attention to the pragmatic value of personality traits (Gill & Swann, 2004), their ability to integrate multiple impressions across different situations (Moskowitz, 1986), and their grounding in the "currently observable reality" (Kenny, 1994, p. 191). From a methodological point of view, other-reports are less likely to produce spurious correlations due to common method variance (Podsakoff et al., 2003) and can be aggregated across multiple raters to increase the reliability of personality assessments (Hofstee, 1994).

Over the past few decades, a large number of studies have compared other-reports with self-reports of personality traits, facilitating several meta-analyses that have drawn comprehensive conclusions about their psychometric properties. For openness in particular, other-ratings have demonstrated a sufficient reliability and a substantial convergence with self-reports, supporting the notion that openness can indeed be adequately assessed by knowledgeable informants (Connolly et al., 2007; H. Kim et al., 2019). In terms of their criterion-related validity, other-ratings of openness have shown correlations with job performance on par with (He et al., 2019) or even above those found for self-reports (Oh et al., 2011). For academic achievement, two recent meta-analyses found correlations with other-reported openness that were substantially higher than those with self-reports (Connelly & Ones, 2010; Poropat, 2014). Overall, these findings support the notion that other-ratings are a useful alternative for assessing openness—especially in predicting of performance outcomes.

A variety of measures is available to those who wish to assess openness through knowledgeable informants. Many of the self-report openness scales presented in the previous section (see Table 5) either have other-rating forms (such as the NEO-PI-R; Costa & McCrae, 1992) or could be converted to such forms with reasonable effort (McCrae & Weiss, 2007). In addition, there are several other approaches to obtaining observer-ratings of a subject's openness, such as behavioral observation (Borkenau et al., 2004), behavioral outcome analysis (Azucar et al., 2018; Gosling et al., 2002), and interviews (Barrick et al., 2000; Huffcutt et al., 2001; D. M. Powell & Bourdage, 2016; Raymark & Van Iddekinge, 2013). For example, Trull et al. (1998) developed

and validated the *Structured Interview for the Five-Factor-Model of Personality*, which also measures the six openness facets from the NEO-PI-R with four interview questions each and showed a good convergent validity with self-report data.

However, other-reports of openness have also have some potential limitations that should be considered. According to Funder (1995), two major prerequisites for accurate personality judgments by others are the relevance of the target trait (i.e., its effective expression in a given environment) and the availability of related information to observers. In addition, the accuracy is moderated by features such as the visibility of trait-based behavior and the goodness (i.e., quality and quantity) of trait-related information. This has important implications for the assessment of openness by knowledgeable informants. In contrast to expressive personality traits such as extraversion, openness relates more to thoughts and feelings than to observable behavior (John & Robins, 1993; Pytlik Zillig et al., 2002). This could negatively affect the accuracy of observer judgments due to a reduced availability and quality of trait-related information (Funder, 2012). In addition, the more private nature of openness may require a higher degree of acquaintance between rater and ratee. Indeed, meta-analytic evidence suggests that the convergence between self-reports and other-reports of openness is considerably lower when strangers (rather than close friends or relatives) are used as observers (Connelly & Ones, 2010; Connolly et al., 2007).

Furthermore, while observer ratings are usually not affected by self-enhancement bias, there may be situations (e.g., student admission processes) in which informants (e.g. friends and family) are motivated to present the subject in a more favorable manner—especially if there is a close personal relationship (McCrae & Weiss, 2007). In addition, observer ratings may be subject to the same response styles as self-reports such as acquiescent, extreme, and midpoint responding (Oh et al., 2011), as well as judgment errors and biases such as severity and leniency tendencies or the halo effect (Hoyt, 2000). Finally, from a practical standpoint, one observer ratings may be less feasible and efficient than self-reports due to the need to involve one or more additional persons (i.e., knowledgeable informants), although modern technology (e.g., online questionnaires) has provided substantial relief in this regard (Vazire, 2006).

4.3 The Forced-Choice Format

Personality scales typically consist of separate statements about trait-relevant thoughts and behaviors that a subject (or an observer) is asked to rate on a Likert-type scale in terms of their respective frequency (i.e., how often they occur in everyday situations) or descriptiveness (i.e., how well they represent the target under regular circumstances). This *single-stimulus* response format is popular with test-takers and test-makers alike because of its broad applicability, ease of use, and straightforward statistical evaluation (A. Brown & Maydeu-Olivares, 2013; Wetzel et al., 2020). However, it is also particularly susceptible to many of the aforementioned biases and distortions, such as response styles and socially desirable responding.

One of the earliest approaches in personality research to address this issue is the forced-choice (FC) format (Travers, 1951; Wetzel et al., 2020; Zavala, 1965), which has recently received increased research attention, especially in high-stakes settings such as applicant selection (Rothstein & Goffin, 2006; Ryan & Ployhart, 2014). Each item in an FC personality measure typically consists of "two or more statements, each reflecting a different, independent dimension or trait. The respondent must choose, rank order, or otherwise indicate preference among the statements presented in the item" (Heggestad et al., 2006, p. 9).

According to Hicks (1970) there are three different types of FC measures. In purely *ipsative* FC measures, the sum of the scores across all measured traits is constant for each subject, resulting in a dependence between the different scales. In other words, if a person scores higher on one personality trait (e.g., conscientiousness) this will necessarily result in a lower score on another trait (e.g., openness). *Quasi-ipsative* FC measures, on the other hand, allow for some variation in the scoring of each item and therefore the total score. For example, Heggestad et al. (2006) used a scoring method where "most like me" responses to a statement indicating a high trait level would yield 2 points, while "least like me" responses would yield 0 points for that statement (and vice versa for statements indicating a low trait level). Statements that were not selected were scored with 1 point. Thus, a subject could receive between 2 and 6 points for each tetradic item. Finally, *normative* FC measures deviate from the above definition by grouping only statements within an item that measure the same personality trait (e.g., openness).

A defining feature of the statements within an FC item is that they are comparable in terms of social desirability and/or extremity (Salgado & Táuriz, 2014). The perceived equivalence of the statements and the requirement to make a limited choice are the foundation for the two main advantages of the FC format. On the one hand, they make it more difficult for a subject to respond in a socially desirable way (Heggestad et al., 2006; Jackson, Wroblewski, et al., 2000). Accordingly, a recent meta-analysis has found empirical support for the notion that FC personality measures are more resistant to faking than single-stimulus measures (Cao & Drasgow, 2019). On the other hand, the FC format is naturally unaffected by response styles (e.g., midpoint responding) and has been shown to reduce rating biases such as leniency/severity or the halo effect (Bartram, 2007; Cheung & Chan, 2002).

With regard to openness and academic performance, a recent meta-analysis (Salgado & Táuriz, 2014) found that quasi-ipsative (but not ipsative or normative) FC measures of openness had a higher criterion-related validity for GPA than single-stimulus measures (e.g., Poropat, 2009). In addition, several primary studies have shown that FC measures of openness have good convergent and divergent construct validity, as well as adequate reliability (Heggestad et al., 2006; P. Lee et al., 2018; Wetzel & Frick, 2020; B. Zhang et al., 2020).

Although less common than their single-stimulus counterparts Goffin and Christiansen, 2003; Tett et al., 2011, there are several five-factor model FC measures that include openness scales such as the *International Personality Item Pool Multidimensional Forced-Choice Measure* (Heggestad et al., 2006), the *Big Five Triplets* (Wetzel & Frick, 2020), the *Tailored Adaptive Personality Assessment System* (B. Zhang et al., 2020), and the *Système de description en cinq dimensions* (Rolland & Mogenet, 2001). Furthermore, other FC instruments include scales that measure openness-related traits such as the *Original Thinking* scale from the *Gordon Personal Profile–Inventory* (Gordon, 1993) or the *Conceptual*, *Innovative*, and *Adaptable* scales from the *Occupational Personality Questionnaire* (SHL, 2009). More recently, Watrin et al. (2019), published an FC version of the BFAS, which has shown acceptable psychometric qualities and provides one of the few currently available ways to assess intellectual and senso-aesthetic openness in an FC format.

Unfortunately, the FC format itself has several shortcomings (A. Brown & Maydeu-Olivares, 2013). First and foremost, ipsative scores provide information only about

the intraindividual rank order of the personality traits assessed, but not about the absolute level of the trait. This makes them inappropriate for meaningful interindividual comparisons (Cattell & Brennan, 1994; Closs, 1996; Hicks, 1970), severely limiting the utility of ipsative FC measures in selection procedures (C. E. Johnson et al., 1988). Although this problem can be circumvented by using normative and—to some extent—quasi-ipsative FC measures, these formats have their very own limitations. While normative FC measures of openness appear to have no predictive validity for academic performance (Salgado & Táuriz, 2014), "we do not know precisely how to interpret partially ipsative scores" (Heggestad et al., 2006, p. 10) because they incorporate characteristics from both, ipsative and normative measures.

Second, FC measures are subject to a variety of psychometric issues. Because they rely on comparative rather than absolute judgments, they are in part incompatible with central assumptions of the classical test theory (Meade, 2004). As a result, ipsative data are not suited for correlational procedures and may therefore produce distorted or spurious estimates of validity and reliability (A. Brown & Maydeu-Olivares, 2013; Meade, 2004; Salgado & Táuriz, 2014).

Third and finally, the proper construction and scoring of FC measures is arguably more challenging than the development and implementation of single-stimulus instruments. For example, most approaches to constructing ipsative and quasi-ipsative FC measures that yield normative scores (McCloy et al., 2005; Stark et al., 2006) rely heavily on complex models deeply rooted in item response theory, such as the generalized graded unfolding model (J. S. Roberts et al., 2000) or Bayesian statistics (H. Lee & Smith, 2020). It seems fair to assume that not many researchers and test developers—let alone practitioners—are familiar with these models and proficient in their application.

4.4 Situational Judgment Tests

Over the past three decades, another method of measurement that combines several advantages of other formats, such as the efficiency of self-reports and the faking-resistance of forced-choice measures, has steadily gained popularity among researchers and practitioners, namely *situational judgment tests* (SJTs; Campion et al., 2014; Weekley et al.,

2015; Weekley & Ployhart, 2006). SJTs typically present a series of hypothetical real-life "situations or scenarios that describe a dilemma or problem . . . and usually contain options representing alternative courses of action from which the test taker chooses the most appropriate response" (Christian et al., 2010, p. 84). Alternatively, the subject is asked to "evaluate each course of action for either the likelihood that they would perform the action or the effectiveness of the action" (Whetzel & McDaniel, 2009, p. 188). These responses or choices are then compared to a scoring key that has been determined empirically, derived from theory, or based on consensus among subject matter experts (Weekley et al., 2006).

In the decades following their first appearance (Moss, 1926), SJTs were occasionally used to assess managerial potential and supervisory qualities (Bruce & Learner, 1958; Campbell et al., 1970; Corts, 1980; File & Remmers, 1948; Greenberg, 1963). However, it was not until their reintroduction by Motowidlo et al. (1990) as "low-fidelity simulations" (p. 640) that SJTs became widely popular and well-established in applicant assessment and selection (Campion et al., 2014).

Since then, several reviews and meta-analyses have shown that SJTs generally have a good criterion-related validity for performance-related outcomes in work settings (Christian et al., 2010; Lievens et al., 2008) and incremental validity above and beyond cognitive abilities and the personality dimensions in the five-factor model (McDaniel et al., 2007). Due to their origin in personnel selection, SJTs often focus on the assessment of job-related skills, such as leadership (Faraci et al., 2013; A. Howard & Choi, 2000; Peus et al., 2013) or teamwork (Gatzka & Volmer, 2017; Mumford et al., 2008; Stevens & Campion, 1999). However, there is an emerging trend to use them in student admissions, especially in medical education (Lievens, 2013; Patterson et al., 2016; Webster et al., 2020) and in the selection of prospective teachers (Aldrup et al., 2020; Klassen et al., 2014; Koschmieder & Neubauer, 2021). This trend is supported by empirical findings that SJTs are indeed valid predictors of postsecondary academic performance (Lievens & Coetsier, 2002; Lievens & Sackett, 2012; Oswald et al., 2004; Peeters & Lievens, 2005; Schmitt et al., 2009).

The construct validity of SJTs, on the other hand, is a more complex matter—and somewhat of a "hot mess" (McDaniel et al., 2016, p. 47). Much research has focused on the relationship between SJTs and intelligence as well as personality. A meta-analysis by McDaniel et al. (2007) found that SJT scores generally show small but

statistically significant correlations with extraversion and openness, as well as moderate correlations with conscientiousness, agreeableness, and cognitive ability. Interestingly, these correlations appear to be moderated by the type of instructions given to the subjects. Whereas SJTs that asked respondents to indicate what they should do in the given situations (i.e., knowledge-based instructions) were more saturated with cognitive ability and less with personality traits, the opposite was true for SJTs that asked the subjects to indicate what they actually would do (i.e., behavioral tendency instructions). This suggests that SJTs can be constructed as measures of either maximum or typical performance (McDaniel et al., 2007; Whetzel & McDaniel, 2009).

A particular challenge in determining the construct validity of SJTs is their heterogeneous nature. Many SJTs are designed to measure broad constructs (e.g., applied social skills) or construct composites (Campion et al., 2014; Christian et al., 2010), which often results in a high degree of multidimensionality—even within individual items (Chan & Schmitt, 2005). On the one hand, this complicates the factor-analytic examination of SJTs—at least with conventional approaches (Revuelta et al., 2021)—which often results in a plethora of hardly interpretable factors (McDaniel & Whetzel, 2005; Schmitt & Chan, 2006). On the other hand, it makes it difficult to systematically determine the convergent and discriminant validity of an SJT (McDaniel et al., 2016). However, some recent studies suggest that SJTs developed for specific constructs show the expected relationships with self-report measures of constructs within their respective nomological network (e.g., de Meijer et al., 2010; Olaru et al., 2019; Teng et al., 2020).

In terms of reliability, SJTs tend to have low internal consistencies (Catano et al., 2012; Kasten & Freund, 2016), often well below the recommended thresholds for both research and applied contexts (Nunnally & Bernstein, 1994). However, Cronbach's alpha is reduced by heterogeneous test content, which may lead to an underestimation of the true reliability (Cronbach, 1970; Osburn, 2000). Therefore, some researchers have questioned its appropriateness and usefulness for SJTs and called for a stronger emphasis on other types of reliability estimates (Lievens et al., 2008; McDaniel et al., 2007; Whetzel & McDaniel, 2009). Unfortunately, this call has gone largely unanswered, as Cronbach's alpha continues to be the most commonly reported reliability measure for SJTs (Corstjens et al., 2017). However, the few studies that have examined the test-retest, parallel-form, or split-half reliability of SJTs paint a somewhat more optimistic

picture (Campion et al., 2014), although these results should be interpreted with caution due to the relatively small amount of data available.

The development of SJTs usually follows a simulation-oriented, contextualized approach, in which the scenarios and response alternatives are derived from real-life situations (e.g., critical incidents; Flanagan, 1954), with little effort to identify or specify the underlying constructs (Bergman et al., 2006; Christian et al., 2010; Gessner & Klimoski, 2006; Weekley et al., 2006). While this arguably benefits the content, face, and criterion-related validity of SJTs, it also makes it difficult to pin down what they actually measure (Schmitt & Chan, 2006), thus casting a rather unflattering aura of "psychometric alchemy" (Landy, 2007, p. 418) upon them. More tangibly, such a lack of clarity regarding the underlying constructs of SJTs severely hinders their proper development and application. For example, it fosters an entanglement between method and construct (Arthur & Villado, 2008; Schmitt & Chan, 2006), obfuscates *how* and *why* SJTs predict specific outcomes (Christian et al., 2010), limits the interpretability of SJT scores (Guenole et al., 2017), and complicates the design of SJTs for specific purposes (Whetzel & McDaniel, 2009). To address these issues and to alleviate the aforementioned psychometric problems stemming from the atheoretical and multidimensional nature of traditional SJTs, researchers have therefore called for a more construct-driven approach to SJT development (Chen et al., 2016; Christian et al., 2010; Lievens, 2017; Lievens & Motowidlo, 2016).

More recently, there seems to be a growing consensus that such an approach would improve the psychometric properties of SJTs and concrete recommendations for construct-driven SJTs have been published (Guenole et al., 2017; Tiffin et al., 2020). In parallel with these advances, SJTs have been developed to measure constructs from the domain of individual differences, such as emotional intelligence (Sharma et al., 2013), personal initiative (Bledow & Frese, 2009), goal orientation (Westring et al., 2009), resilience (Teng et al., 2020), and integrity (Becker, 2005; de Meijer et al., 2010). However, despite theoretical considerations (Campion & Ployhart, 2013; Whetzel & McDaniel, 2016) and promising empirical groundwork (McDaniel et al., 2007) suggesting that SJTs can be constructed to measure the personality dimensions of the five-factor model, corresponding SJTs are few and far between (Motowidlo et al., 2006; Oostrom et al., 2019). SJTs targeting narrow facets within these dimensions

appear to be even rarer, with the notable exception of an SJT measuring dependability (Olaru et al., 2019), a core facet of conscientiousness.

With regard to the emphasis of this dissertation (i.e., the use of openness measures in postsecondary educational settings), SJTs have several other advantageous characteristics in addition to their aforementioned good predictive validity for academic performance. For example, empirical evidence from both laboratory and field studies suggests that they are more resistant to faking than self-report measures of personality (Hooper et al., 2006; Kasten et al., 2020), which would increase their utility in high-stakes situations such as student admission procedures. Furthermore, SJTs—especially when constructed as measures of typical performance—tend to show a reduced adverse impact on minority groups or gender (Juster et al., 2019; Lievens et al., 2008; Whetzel et al., 2008), potentially contributing to the ever-increasing efforts to promote diversity and inclusion in higher education enrollments (Hakkola & Ropers-Huilman, 2018; Stewart & Valian, 2018). Finally, it has been theorized that "SJTs of all sorts should be perceived positively by applicants" (T. N. Bauer & Truxillo, 2006, pp. 244–245) due to their high face validity and realistic test content. Although research on the this topic is still rather limited, initial findings seem to support this notion (Klassen et al., 2014). This would further increase the appeal of SJTs for personality assessment in high-stakes selection procedures (e.g., student admissions), as traditional personality measures have a somewhat problematic image among test-takers in such settings (Hausknecht et al., 2004).

Taken together, SJTs appear to have several advantageous qualities as both, predictors of academic achievement and measures of specific personality traits such as openness. However, their potential currently remains largely untapped due to a lack of construct-oriented measures. Thus, it seems promising to investigate whether a valid and reliable SJT can be constructed that measures those components of openness that have been shown to be relevant for academic success.

5 Aims and Scope of This Dissertation

The overarching objective of this dissertation is to examine the role of openness as a fundamental personality factor in postsecondary educational settings. It seeks to synthesize and consolidate previous research on this topic and to extend it with original research on *whether* and *how* openness and its subcomponents are related to postsecondary academic success.

Much of this effort focuses on the two aspects of openness proposed by DeYoung et al. (2007). Although the original aspect labels (i.e., *openness* and *intellect*) elegantly represent and integrate the two research traditions that led to the openness factor (see Chapter 3), these terms are used somewhat inconsistently in individual differences research. For example, openness is routinely used as a label for the overall factor. The term intellect, on the other hand, has previously been used either to summarize an individual's cognitive skills and abilities as well as their academic knowledge (Ackerman, 1996; von Stumm & Ackerman, 2013), to define a construct space of "behavior, intentions, affect, attitudes, and mental processes related to intellectual performance, such as problem-solving, thinking, information search, learning, or creativity" (Mussel, 2013a, p. 886), or simply as an alternative label for the overall factor (e.g., Goldberg, 1990). Therefore, in order to avoid misunderstandings and to facilitate a concise wording, two new labels have been derived from the comprehensive description of the two aspects by DeYoung (2014) and will be used in the remainder of this dissertation, namely *intellectual openness* (for the intellect aspect) and *senso-aesthetic openness* (for the openness aspect).

As shown earlier, openness tends to show statistically significant correlations with academic achievement in postsecondary education (see Section 2.2). However, these effects were often surprisingly small given the pivotal role that openness plays within the

intellectual investment trait nexus (see Section 2.3) and its rather obvious intellectual conceptualization—especially in the lexical research tradition (see Section 3.1).

The first original contribution of this dissertation (Chapter 6) addresses this peculiarity in a systematic review and meta-analysis of the relationship between openness and postsecondary academic performance. Based on a comprehensive literature review, it first develops the theoretical rationale for an association between openness and academic performance, taking into account that the lower-level components of the openness factor (i.e., facets and aspects) may have specific—potentially divergent—associations with academic achievement (see Sections 3.2 and 3.3). The following meta-analytic calculations have three goals. First, they examine the relationships between the six openness facets from the NEO-PI-R (Costa & McCrae, 1992) and postsecondary achievement with special attention to previously unpublished data. Second, a meta-analytic structural equation approach (Cheung, 2014a; Cheung & Chan, 2005) is used to determine the most appropriate way to subsume the six facets into the two aspects and to analyze the effect of these on postsecondary academic achievement. Third, a comprehensive meta-analysis of the relationship between overall openness and academic performance summarizes the results of 149 independent effect sizes with a total sample size of 50,449 and examines the moderating effects of different openness measures and academic majors.

The second original contribution (Chapter 7) follows up on these findings and addresses the lack of studies using truly dichotomous measures of openness to examine the predictive validity of intellectual and senso-aesthetic openness for postsecondary academic achievement (see Section 3.3). It is presumably the first study that uses the openness/intellect scale from the BFAS (DeYoung et al., 2007) in a nonclinical undergraduate sample to predict the academic achievement of 424 students enrolled in 11 different majors at a single higher education institution. The study further extends previous research by comparing the two openness aspects with the two aspects of conscientiousness, which is widely considered to be the best predictor of academic performance within the five-factor model of personality (see Section 2.2). It also examines, for the first time, possible interactions between the four aspects in predicting not only objective academic performance (i.e., self-reported GPA), but also subjective academic achievement (i.e., a student's perceived success in relation to their personal efforts and expectations; Stadler, Becker, et al., 2015).

The third original contribution (Chapter 8) extends the previous two articles in two general ways, using overlapping subsamples of 132 to 250 undergraduate students. First, it investigates the relationship between the two aspects of openness and a broader set of academic success criteria, namely, academic achievement, academic satisfaction, student persistence, and career success in a time-lagged research design. Second, it provides additional insight into the underlying mechanisms linking the two aspects of openness and academic success by examining a possible mediation by dispositional mind-wandering (i.e., the tendency to engage in task-unrelated cognitions; Schooler et al., 2011) and the incremental validity of intellectual openness as a predictor of academic performance above and beyond related cognitive constructs, namely self-assessed intelligence and metacognition (i.e., the awareness and knowledge of one's own thought processes; Flavell, 1979).

The fourth and final original contribution (Chapter 9) describes the development and validation of a situational judgment test (see Section 4.4) in a sample of 255 subjects from the general population. Although not specifically targeted at the two aspects, the measure also assesses openness to ideas, which is considered a good marker of intellectual openness (DeYoung et al., 2007). Therefore, this study can be seen as a proof of concept, demonstrating the viability of an alternative approach to measuring openness that goes beyond the predominant method of self-report questionnaires with their limitations, such as proneness to faking, biases, and response sets (see Section 4.1).

This dissertation concludes with a synthesis and critical review of the empirical findings from the aforementioned studies (Chapter 10). Finally, perspectives and avenues for further research are presented to guide future endeavors striving for a better understanding of the somewhat complicated relationship between openness and academic success in higher education (Chapter 11) and an overall conclusion is offered (Chapter 12).

Part II

Original Articles

6 Article 1: Openness and Postsecondary Academic Performance: A Meta-Analysis of Facet-, Aspect-, and Dimension-Level Correlations (Gatzka & Hell, 2018)

Abstract

Openness to experience has often been linked to academic achievement because it subsumes traits such as curiosity, open-mindedness, thoughtfulness, and intellectuality. However, recent meta-analyses have reported rather small true correlation estimates. In this article, we first provide a comprehensive rationale for a relationship between openness and academic performance with a distinct focus on specific components of openness (i.e., facets and aspects). We then extend prior research by presenting our own meta-analysis ($k = 28$, $N = 5,861$) on the relationship between 6 openness facets and postsecondary academic performance. Furthermore, we report results from meta-analytic structural equation modeling ($k = 19$, $N = 3,627$) that describe the effects of 2 openness aspects, which form an intermediate construct-level between dimension and facets, on academic achievement. Finally, we investigate 2 possible moderators in a dimension-level meta-analysis ($k = 149$, $N = 50,449$). Overall, our

findings suggest that a) only 2 openness facets are positive predictors of academic performance, b) the 2 openness aspects have contrary effects on academic achievement, and c) the correlation between openness and academic performance is moderated by openness scales and academic majors. We conclude that the true potential of openness for predicting academic performance is concealed within the heterogeneity of the construct and discuss according perspectives for future research.

Keywords: Academic Performance, Aspects, Facets, Meta-Analysis, Openness to Experience

CRediT Statement

Thomas Gatzka: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing; **Benedikt Hell:** Conceptualization, Supervision, Writing – review & editing

6.1 Introduction

Since the very dawn of modern educational psychology there has been a strong interest in personality traits as predictors of academic achievement. From the first systematic attempts to identify character traits related to learning and education (Webb, 1915) through a challenging era of scattered personality theories and measures (Margrain, 1978; Messick, 1979; Stein, 1963) to the emergence of the five-factor model of personality (Digman, 1990) and beyond (Richardson et al., 2012), researchers strived to identify nonability personality traits that are related to academic performance (for an excellent review see De Raad & Schouwenburg, 1996).

Being both comprehensive and parsimonious, the five-factor model (i.e., neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness; Costa & McCrae, 1992) eventually became the dominant personality paradigm and the "common currency for personality psychology" (Funder, 2001, p. 200). Within this model, conscientiousness tends to be the best predictor of performance-related outcomes in educational settings (O'Connor & Paunonen, 2007; Poropat, 2009; Richardson

et al., 2012; Trapmann et al., 2007; Vedel, 2014). However, there is another dimension that is often linked to academic achievement both theoretically and—albeit with mixed success—empirically: *openness to experience* (in short, *openness*). In this article, we first present a comprehensive rationale, why openness should be related to academic performance. We then review the somewhat surprising empirical findings so far and discuss possible explanations for those findings. Finally, we expand previous research by presenting our own meta-analysis on the relationship between openness and postsecondary academic performance with a distinct focus on specific construct components and potential moderator variables.

6.1.1 Openness—A Controversial Construct

Although numerous conceptualizations of openness have been discussed in the past 65 years (e.g., Borgatta, 1964; Cattell, 1957; Fiske, 1949; Norman, 1963; Tupes & Christal, 1961), two more recent approaches are noteworthy, not only because they represent the two historical paths to the five factors but also because of their useful complementarity. Costa and McCrae (1992), representing the *questionnaire* approach (i.e., researchers who derived the fivefactor model through factor analyses of personality questionnaires), labeled the dimension *openness to experience*. It covers a "wide range of loosely related traits" (McCrae, 2004, p. 707) such as active imagination, aesthetic sensitivity, attentiveness to feelings, preference for variety, intellectual curiosity, and independence of judgment. From this perspective, openness can be summarized as a general "preference for and excitement by aesthetic beauty and novelty" (Connelly, Ones, Davies, et al., 2014, p. 17). Those representing the *lexical* approach (i.e., researchers who derived the Big Five through empirical reduction of personality describing vocabulary from dictionaries), on the other hand, usually prefer the dimension label *intellect* (e.g., Digman & Takemoto-Chock, 1981; Goldberg, 1990, 1992) or *imagination* (Saucier, 1992, 1994). According to their interpretation, the dimension represents a set of intellectual and sophisticated traits such as intellectuality, introspection, and curiosity, as well as creativity and originality. Thus, this perspective "focuses on intelligence, cleverness, and interests in deep thoughts, imagination, and self-reflection" (Connelly, Ones, Davies, et al., 2014, p. 17). In conclusion, the questionnaire tradition would describe persons

with high openness scores as open-minded, aesthetic freethinkers, whereas the lexicalist approach would characterize them as erudite, thoughtful intellectuals.

Whereas two decades ago some deemed these two conceptualizations at least partly incommensurable (Trapnell, 1994), more recently there has been the conclusion that there is "sufficient overlap between the lexical and questionnaire models to assume Openness and Intellect refer the same domain of personality" (DeYoung et al., 2005, p. 827). Consequently, instead of arguing over the more appropriate nomenclature, researchers shifted their attention toward the internal structure of the openness dimension and its subcomponents.

6.1.2 The Lower-Level Structure of Openness

Based on their theoretical considerations, Costa and McCrae (1992) suggested that each of the five dimensions subsumes six specific lower-level personality traits, which they called *facets*. For the openness domain, these facets are labeled *fantasy* (vivid imagination and active fantasy), *aesthetics* (appreciation for art and beauty), *feelings* (receptivity to own feelings and emotions), *actions* (willingness to try new activities), *ideas* (intellectual curiosity and interest), and *values* (readiness to reexamine social, political, and religious values). Although the number of these facets could be criticized as somewhat arbitrary (Costa et al., 1991), it has received empirical support (e.g., Aluja et al., 2005). Although much research focused on this two-level hierarchy, considerably less attention has been paid to a possible intermediate level between dimensions and facets (DeYoung et al., 2007). Despite the aforementioned two divergent conceptualizations of openness (Costa & McCrae, 1992; Goldberg, 1992), the possibility of a truly dichotomous openness domain has been mostly neglected for roughly two decades. Interest in this matter was renewed by behavioral genetics when Jang et al. (2002) found that two genetic components are responsible for the shared variance of the openness facets. The first component, *reflection*, was defined by fantasy, aesthetics, and feelings, whereas the second component, *curiosity*, was formed by actions, ideas and values. Similar results were presented by Wainwright et al. (2008). Paralleling this research, others scrutinized the internal structure of openness by conducting factor analyses on openness facet scores. Unlike the mostly unanimous results at the dimension level, different competing models have emerged from this approach (DeYoung et al., 2007;

Gignac et al., 2004; Griffin & Hesketh, 2004; Mussel et al., 2011). For instance, DeYoung et al. (2007) factor-analyzed 15 openness facet scales of the NEO-PI-R (Costa & McCrae, 1992) and the AB5C-IPIP (Goldberg et al., 2006) and clearly identified the two components *intellectual openness* (ideas) and *senso-aesthetic openness* (aesthetics, fantasy, feelings, and actions)[9].

In conclusion, the concept of an intermediate construct level between dimensions and facets has received both attention and empirical support over the last few years. DeYoung et al. (2007) coined the term *aspect* to describe this level of trait organization that we shall adopt for this article. However, there seems to be no consensus about the exact nature of the openness aspects. As shown in Table 6, at least six different aspect models with four unique facet configurations are being discussed in the literature. While all of them have been derived empirically, which one of them is the most adequate representation of the openness domain—especially for the prediction of academic performance—remains to be answered. A summarizing overview of all construct levels and components of openness, along with the component labels and relevant correlates can be found in Table 7.

6.1.3 Why Openness Should Be Related to Academic Performance

Most conceptualizations of openness emphasize traits and behaviors that seem particularly advantageous in learning situations. Encompassing features such as receptiveness for new perspectives, inquiring curiosity, and broad-minded intellectuality, the traits of openness indeed seem to "form an cluster of the ideal student" (De Raad & Schouwenburg, 1996, p. 327). Providing a more explicit rationale for the relationship between openness and academic performance, Ziegler, Danay, Heene, et al. (2012) assumed that higher levels of openness increase both the desire to learn new things and the likelihood to encounter new learning opportunities. Sharing this notion of openness as a motor for intellectual exploration, DeYoung (2014) described it as the "tendency to seek, detect, comprehend, utilize, and appreciate complex patterns of information"

[9]Because values loaded only slightly stronger on senso-aesthetic openness (.44) than on intellectual openness (.32), it is usually not considered a particularly good marker for either component (DeYoung, 2014). Following the lead of Judge et al. (2013) and the definition by DeYoung (2014), we adjusted the original aspect labels ("openness" and "intellect") to avoid confusion with the dimension label "openness" and other conceptualizations of intellect (e.g., von Stumm & Ackerman, 2013).

Table 6

Suggested Aspects of Openness and the Corresponding NEO-PI-R Facet Scales

			NEO-PI-R Openness Facet Scales					
Source	Methodical Approach	Aspect Label	Fantasy	Aesthetics	Feelings	Actions	Ideas	Values
*Jang et al. (2002)	behavior genetics	reflection	X	X	X			
		curiosity				X	X	X
Gignac et al. (2004)	factor analysis	general	X	X	X	X	X	X
		objective				X	X	X
*Griffin and Hesketh (2004)	factor analysis	internal	X	X	X			
		external				X	X	X
DeYoung et al. (2007)	factor analysis	senso-aesthetic[a]	X	X	X	X		(X)[b]
		intellectual[a]					X	
Wainwright et al. (2008)	behavior genetics	openness[c]	X	X	X	X		
		intellect[c]					X	X
*Mussel et al. (2011)	factor analysis	perceptual	X	X	X			
		epistemic				X	X	X

Notes. Models marked with an asterisk share the same facet configuration. NEO-PI-R = NEO Personality Inventory Revised.

[a] The original labels ("openness" vs. "intellect") were adapted for this article to avoid confusion (see also footnote 9).

[b] Based on the findings by DeYoung et al. (2007) this facet could either be considered part of the senso-aesthetic openness aspect or excluded entirely.

[c] Post hoc labels used by von Stumm, Chamorro-Premuzic, and Ackerman (2011).

Table 7

Overview of the Construct Levels and Components of the Openness Domain

Construct Level	Component(s)	Description and Labels	Examples of correlates
Macro	Dimension	Global personality factor that describes "individual differences in the ability and tendency to seek, detect, comprehend, utilize, and appreciate complex patterns of information, both sensory and abstract" (DeYoung, 2014, p. 369) *Labels*: openness (used in the present article); openness/intellect (DeYoung et al., 2007); openness to experience (Costa & McCrae, 1992), intellect (Goldberg, 1990), imagination (Saucier, 1992), culture (Tupes & Christal, 1961)	deep learning (Duff et al., 2004), general intelligence (von Stumm, Chamorro-Premuzic, & Ackerman, 2011), learning goal orientation (Payne et al., 2007)
Meso	Aspects	Distinct but related sub-factors that reflect two complementary trait-clusters within the dimension (e.g., intellectuality vs. preference for novelty). *Labels*: senso-aesthetic vs. intellectual openness (used in the present article); perceptual vs. epistemic openness (Mussel et al., 2011); openness vs. intellect (DeYoung et al., 2007), internal vs. external openness (Griffin & Hesketh, 2004), reflection vs. curiosity (Jang et al., 2002)	*intellectual openness*: cognitive abilities (DeYoung et al., 2014) *senso-aesthetic openness*: creativity (Nusbaum & Silvia, 2011)
Micro	Facets	Narrow, lower-level personality traits within the aspects. *Labels*: fantasy, aesthetics, feelings, actions, ideas, values (Costa & McCrae, 1992, used in the present article); imagination, artistic interest, emotionality, adventurousness, intellect, liberalism (Goldberg et al., 2006)	*ideas*: crystallized intelligence (von Stumm & Ackerman, 2013), fluid intelligence (DeYoung et al., 2005) *values*: college entry test results, crystallized intelligence (von Stumm & Ackerman, 2013)

(p. 369). Taken together, persons high in openness are eager to explore new perspectives, extend their knowledge, and engage in intellectual activities. In addition to having this mindset of a "true scientist" (Fiske, 1949, p. 337), they are imaginative, self-reflected, and autonomous (Peabody & Goldberg, 1989). Thus, it seems reasonable to assume that they should do fairly well in a university classroom. However, aside from this theoretical rationale, openness also has been linked empirically to other constructs that are highly relevant for learning and academic performance.

Relations With Intelligence

First and foremost, openness appears to be associated with intelligence, which is one of the best predictors of academic performance (Kuncel et al., 2004; Postlethwaite, 2011; Strenze, 2007). While there is an ongoing controversy about the relationship between intelligence and personality (for an overview see DeYoung, 2011), at least some common ground between openness and intelligence seems plausible, given that open people are often described as clever, bright, insightful, complex, intellectually efficient, ingenious or point-blank intelligent (Goldberg, 1990; Saucier & Ostendorf, 1999; Woo, Chernyshenko, Stark, et al., 2014). Indeed, in their seminal meta-analysis, Ackerman and Heggestad (1997) found a correlation of .33 between openness and general intelligence. Although these initial findings were based on a rather small number of studies, they have been replicated subsequently (e.g., Busato et al., 2000; DeYoung et al., 2014; D. M. Higgins et al., 2007; Paunonen, 2003) and corroborated in more recent reviews (DeYoung, 2011; von Stumm, Hell, et al., 2011).

To understand these findings and their implications, Ziegler, Danay, Heene, et al. (2012) developed a theoretical model of the interplay between openness, fluid intelligence (i.e., cognitive abilities that reflect a person's capability for inductive and deductive reasoning), and crystallized intelligence (i.e., cognitive abilities that reflect the breadth and depth of a person's acquired knowledge). Integrating prior theories (Ackerman, 1996; Cattell, 1987) and their own empirical results, they concluded that openness fosters the development of fluid intelligence (through the increased likelihood of encountering new cognitive challenges) and, by extension, crystallized intelligence (through a more efficient acquisition of knowledge from learning experiences). The application of these findings to educational settings seems obvious and emphasizes the

importance of openness for academic success: Not only should open students encounter more learning opportunities, they also should be more capable of utilizing them to acquire knowledge due to their better reasoning abilities. This kind of "cognitive flexibility" (DeYoung et al., 2005, p. 850) and the resulting advantage of being both quick-witted and knowledgeable should ultimately facilitate academic performance.

Relations With Intellectual Investment Traits

A second compelling argument for an effect of openness on academic performance is its relation with numerous intellectual investment traits (von Stumm & Ackerman, 2013). Based on the assumption that personality traits influence the acquisition of knowledge (Ackerman, 1996), this label subsumes a variety of "stable individual differences in the tendency to seek out, engage in, enjoy, and continuously pursue opportunities for effortful cognitive activity" (von Stumm, Chamorro-Premuzic, & Ackerman, 2011, p. 225). While more than 40 of these traits can be identified in the psychological literature (von Stumm & Ackerman, 2013), two of them seem both representative for the group of investment traits and particularly relevant for postsecondary academic learning environments, namely *typical intellectual* engagement and *epistemic curiosity*.

Goff and Ackerman (1992) defined typical intellectual engagement as a desire to engage, embrace and understand complex intellectual topics or problems. It reflects a person's everyday preference to seek out and master intellectual challenges instead of ignoring or avoiding them, thereby facilitating the development of intellectual abilities (Ackerman et al., 1995). Being "the broadest of all possible interests" (Schmidt, 2014, p. 213), it plays a crucial role in learning, especially when students can choose their educational activities, as for instance, in a university curriculum (Goff & Ackerman, 1992). Accordingly, a recent meta-analysis by von Stumm and Ackerman (2013) reported a substantial correlation between typical intellectual engagement and academic performance ($\rho = .29$).

Epistemic curiosity refers to "the desire for knowledge that motivates individuals to learn new ideas, eliminate information gaps, and solve intellectual problems" (Litman, 2008, p. 1586). Reflecting a fundamental "drive to know" (Berlyne, 1954, p. 187), a preference for intellectual exploration (Litman et al., 2005), and a strong interest in new information (Litman & Spielberger, 2003), epistemic curiosity appears to be

a highly desirable and advantageous personality trait in learning and educational environments. Accordingly, recent studies have linked epistemic curiosity to both academic achievement itself (Kashdan & Yuen, 2007; C. Powell & Nettelbeck, 2014) and its correlates such as learning strategies (Richards et al., 2013), memory function (Kang et al., 2009), and intellectual-scientific interests (Mussel, 2013a).

In conclusion, the positive relationship between intellectual investment traits and academic performance is both theoretically sound and empirically underpinned (von Stumm & Ackerman, 2013). This supports the hypothesis of a link between openness and academic performance in so far that openness itself is closely related to those traits. From a theoretical point of view, conceptualizations of openness subsume features such as *curiosity* (Costa & McCrae, 1992), *thoughtfulness* (Goldberg, 1990), *broad-mindedness* (Peabody & Goldberg, 1989), or intellectuality (Saucier & Ostendorf, 1999) that are also key components of intellectual investment traits. From an empirical perspective, substantial overlaps have been found between openness and typical intellectual engagement ($\rho = .64$; von Stumm, Chamorro-Premuzic, & Ackerman, 2011) as well as epistemic curiosity ($r = .59$; Mussel, 2013a). Given this close relationship between openness and intellectual investment, we assume that openness should facilitate academic performance in a similar vein and to a comparable extent.

Relations With Learning

Our final argument for a positive effect of openness on academic performance draws on coherent findings that openness is related to a wide variety of other beneficial constructs within the learning domain, both behavioral and motivational. To provide a representative yet concise overview, we shall discuss three of these constructs in more detail, that is, *student approaches to learning*, *learning goal orientation*, and *self-regulated learning*, and give a brief summary for some other constructs.

First, openness shows positive correlations with deep and strategic learning as well as negative correlations with surface learning (Duff et al., 2004; Swanberg & Martinsen, 2010). These three learning approaches reflect "different motives with corresponding strategies that the student utilizes to accomplish diverse intentions related to studying" (Diseth, 2003, p. 145). While deep learners strive to fully comprehend the subject matter through diligent processing, surface learners mostly rely on rehearsal and memorization

to acquire the pivotal facts with minimal effort (Dinsmore & Alexander, 2012). Strategic learners, finally, combine these two approaches to achieve the best results in a specific learning task or environment (Biggs, 1987; Sadler–Smith, 1997). Given the importance of effective learning for academic performance, it is not surprising that Richardson et al. (2012) found small to moderate, yet significant correlations between academic performance and deep learning ($\rho = .03$), surface learning ($\rho = .19$), and strategic learning ($\rho = .31$).

Second, openness is an important antecedent of learning goal orientation ($\rho = .44$; Payne et al., 2007). From a social–cognitive perspective, goal orientation links personality to achievement as it influences individuals' affective, behavioral, and cognitive responses to performance-related situations (Dweck & Leggett, 1988). Most models of goal orientation concur that there is a fundamental difference between *performance goals* and *learning goals* (e.g., Button et al., 1996; Elliot & McGregor, 2001; Vandewalle, 1997). Whereas performance goals are "focused on the demonstration of competence relative to others" (Elliot & McGregor, 2001, p. 501), learning goals focus on *gaining competence, developing new skills, learning from experience, and achieving a sense of mastery* (Klein & Lee, 2006, p. 44). Learning goal orientation is related to determinants of academic performance such as study strategies (Elliot et al., 1999), adaptive learning (Day et al., 2003), and ambitious goal setting (Vandewalle et al., 2001). Accordingly, it also correlates with academic performance ($\rho = .16$; Payne et al., 2007).

Third, there are substantial associations between openness and various self-regulated learning processes, such as meta-cognition, elaboration, critical thinking, time management, effort regulation, and organization (Bidjerano & Dai, 2007; Blickle, 1996; MacCann et al., 2012; McKenzie & Gow, 2004). In general, self-regulated learning describes to what extent students are "metacognitively, motivationally, and behaviorally active participants in their own learning process" (Zimmerman, 2001, p. 5) and is often conceptualized as a framework that encompasses several regulatory components (for an overview see Dent & Koenka, 2016). Self-regulated learning facilitates academic achievement because it promotes confidence and diligence in learning situations, academic self-awareness, persistence in the face of educational challenges and obstacles, and a sense of self-efficacy and self-responsibility (Zimmerman, 1990). Once again, meta-analytical findings show correlations between self-regulated learning processes

and academic performance, ranging from .14 for meta-cognition and elaboration up to .35 for effort regulation (Richardson et al., 2012).

In conclusion, openness is related to crucial determinants of success and effectiveness in educational settings, such as deep and strategic learning, learning goal orientation, and self-regulated learning. Furthermore it correlates with other constructs that have been found to contribute to academic achievement, such as intrinsic academic motivation (Hazrati-Viari et al., 2012), academic self-efficacy and self-concept (J. Zhang & Ziegler, 2016), achievement motivation (Richardson & Abraham, 2009), creative thinking (Hirsh & Peterson, 2008), self-directed learning (Lounsbury et al., 2009), and work drive (Ridgell & Lounsbury, 2004). Overall, given the apparent role of openness in the acquisition and development of skills and knowledge, it seems more than plausible that it also should be related to one of the distal outcomes of learning, that is, academic performance.

6.1.4 Possible Reasons for the Weak Relationship Between Openness and Academic Performance

As described before, a substantial relationship between openness and academic performance may be expected, given its pertinent conceptualization and its ties with various constructs that are highly useful in educational environments. However, several meta-analyses drew a surprisingly pessimistic picture, reporting population coefficients between .06 and .09 (McAbee & Oswald, 2013; O'Connor & Paunonen, 2007; Poropat, 2009; Richardson et al., 2012; Vedel, 2014) with the somewhat noteworthy exception of Trapmann et al. (2007) who found a coefficient of .13. Despite all arguments in favor of a relationship between openness and academic performance, the true correlation appears to be rather small.

Still, none of the reported meta-analytic confidence intervals of the mean effect size included zero, indicating a statistically significant effect. Furthermore, the significant heterogeneity measures and the fairly large credibility intervals of the population parameter estimates (e.g., between .01 and .17 with a probability of 80%; Richardson et al., 2012) suggested the presence of moderator variables. Finally, it should be noted that all these findings pertain to openness at a dimension level.

Consequently, we will first elaborate on the possibility that specific components of openness (i.e., facets and aspects) have different relations with academic performance. Based on prior findings, we then shall discuss conceptual differences between openness scales as a possible moderator. Finally, we will present another potential moderator, namely academic major, which is more theoretical in nature given the limited number of empirical findings.

Differential Correlations for Openness Facets and Aspects

As outlined before, openness subsumes a variety of quite diverse personality traits. Considering this heterogeneity, it seems plausible that not all components of openness are equally beneficial for academic achievement (Paunonen & Ashton, 2001b). Indeed, whereas some facets (e.g., ideas, values) seem clearly more relevant in educational environments than others (e.g., feelings, actions), some might even impede academic achievement by facilitating mind-wandering or inadequate priorities (e.g. fantasy, aesthetics). In other words, components of openness that reflect creativity, imagination and intellectual engagement should be better predictors of academic performance than components that tap into the aesthetic or unconventional nature of the domain (Noftle & Robins, 2007). Thus, differential correlations between specific openness facets and academic performance might explain the unexpectedly low correlation with the dimension itself (Paunonen & Ashton, 2001b).

Although this issue has been raised repeatedly over the last years (McAbee & Oswald, 2013; O'Connor & Paunonen, 2007), it has received comparatively little attention. To our knowledge, only six published studies report according findings for the openness facets (Chamorro-Premuzic & Furnham, 2003b; De Fruyt & Mervielde, 1996; Dollinger & Orf, 1991; Lievens et al., 2009; Noftle & Robins, 2007; Ziegler, Danay, Schölmerich, et al., 2010)[10]. Interestingly, in every one of them at least one openness facet correlated higher with the academic performance criterion than the dimension score itself.

As described earlier, a relationship between openness and academic performance seems plausible due to the substantial overlap between openness and intelligence as well as the crucial role of the latter for academic achievement. In a very similar manner,

[10]Although more studies have applied the NEO-PI-R (i.e., a facet-level measure of the five-factor model) to assess openness in postsecondary education samples, they did not report any facet-level data.

empirical findings on cognitive correlates of openness support the notion of differential correlations for specific facets. Indeed, the ideas facet consistently showed the highest correlation with general intelligence, typically yielding effect sizes between .30 and .40 (DeYoung et al., 2005; Moutafi et al., 2003; Wainwright et al., 2008), while there was a substantial correlation between the values facet and crystallized intelligence ($\rho = .58$, von Stumm & Ackerman, 2013). Overall, openness for ideas and values seem to be stronger related to cognitive abilities than the other facets. We therefore assume that these two facets should surpass the others in their correlation with academic performance.

Although researchers have only recently begun to consider openness aspects in their analyses (e.g., Judge et al., 2013; Weisberg et al., 2011), the available results seem to parallel the findings on the relationship between the openness facets and intelligence, at least for the aspect model suggested by DeYoung et al. (2007). Nusbaum and Silvia (2011) found that intellectual openness, reflecting "the ability and tendency to explore abstract information through reasoning" (DeYoung et al., 2014, pp. 46–47), was associated with fluid intelligence but not creativity. The exact opposite was true for senso-aesthetic openness, that is, "the ability and tendency to explore sensory and aesthetic information through perception, fantasy, and artistic endeavor" (DeYoung et al., 2014, p. 47). Given that similar results have been reported in other studies (DeYoung et al., 2014; Kaufman et al., 2010), differential correlations for openness aspects seem equally plausible as for openness facets. Further support for this assumption can be derived from a theoretical framework proposed by Mussel (2013a). He assumed that typical intellectual engagement and need for cognition can both be integrated into the intellectual aspect of openness as they reflect the combination of "a general openness that accompanies approaching situations that are intellectually challenging" (p. 886) with a habitual appreciation for "thinking about theories, engaging in problem-solving behavior, analyzing complex situations, or puzzling for hours over a problem" (p. 887). According to Mussel (2013a), the very same holds true for the ideas facets of openness. Indeed, this might explain the substantial overlap between openness and various intellectual investment traits. Ultimately, one could consider all those traits as measures of the intellectual openness aspect (DeYoung, 2014) which therefore should be a valid predictor of academic achievement. Unfortunately, to our knowledge, no study that

examined the relationship between openness aspects and academic performance has been published so far.

Openness Scale as a Moderator

Previous meta-analyses have often grouped different openness scales together based on the assumption that they all fundamentally measure the same construct. Recent findings suggest that this approach might not be warranted given the unexpectedly moderate convergent validity among various openness scales ($\bar{r} = .51$; Pace & Brannick, 2010). These apparent dissimilarities between the scales (e.g., in trait definition or item content) might as well affect their specific criterion-related validity. Indeed, McAbee and Oswald (2013) found between-measure differences in the criterion-related validity for academic performance, ranging from .02 (for the *Big Five Inventory*; John & Srivastava, 1999) to .13 (for the *NEO Five-Factor Inventory*; Costa & McCrae, 1992).

From a theoretical point of view, scale-specific criterion-related validities for academic performance seem plausible, given the different conceptualizations of openness. As mentioned earlier, researchers from the questionnaire tradition consider openness to reflect a general preference and excitement for novelty (e.g., McCrae, 2004), whereas lexicalists strongly emphasize its intellectual and scholastic components. Thus, it seems reasonable to assume that scales stemming from the lexical approach such as the *Mini-Markers* (Saucier, 1994) or the *IPIP-50 Big Five Factor Markers* (Goldberg et al., 2006) have higher criterion-related validity for academic performance than scales that are based on the questionnaire approach such as the *Revised NEO Personality Inventory* (Costa & McCrae, 1992).

Academic Major as a Moderator

Another potential moderator for the relationship between openness and academic performance is the academic major of the sample as study subjects may differ in their educational goals and demands. Whereas some fields rely more on the effective acquisition of factual knowledge (i.e., memorization and rehearsal), other academic domains place stronger emphasis on the ability to evaluate, elaborate and integrate pluralistic perspectives in order to address issues that often lack a definite solution (i.e., creativity and reasoning). A possible consequence for the relationship between openness

and academic performance can be derived from *trait activation theory* (Tett et al., 2013). In short, this model states that personality traits such as openness are activated (i.e., expressed behaviorally), if situational features (e.g., task demands) permit and facilitate such behaviors. Furthermore, these situational features also determine whether the behaviors are positively or negatively related to performance. Although this theory was originally developed for work settings (Tett & Burnett, 2003), it seems reasonable to apply it to learning environments. For instance, openness should be positively related to academic performance in subjects such as humanities, which not only provide opportunities to be open-minded, critical, and argumentative but also reward these behaviors in their performance appraisals. On the other hand, openness should be less correlated with achievement in subjects such as medicine, where unorthodox perspectives, deviations from established pathways, and non-compliance with default procedures are less acceptable, ultimately constraining the activation of such openness-related behaviors and their value in performance evaluations. Further support for this moderation hypothesis can be derived from vocational interest research. For instance, Larson et al. (2002) found that openness related negatively to conventional interests. Nye et al. (2012), on the other hand, reported meta-analytic evidence that a high congruence between a person's vocational interests and the characteristics of a learning environment related positively to academic performance and persistence. Therefore, it seems reasonable to assume that a particularly open person would be less satisfied and successful in learning environments that places strong emphasis on rules and regulations (e.g., law, finances, medicine). Taken together, students with higher levels of openness should "thrive in educational settings promoting and rewarding critical and original thought, while students relatively low in Openness to experience (but matched in intelligence and motivation/application) should fare better in educational settings promoting and rewarding acquisition of received wisdom" (Farsides & Woodfield, 2003, pp. 1239–1240).

Although several studies have examined group differences in openness between academic majors (for a systematic review see Vedel, 2016), to our knowledge only two of them have also compared correlations with academic performance. De Fruyt and Mervielde (1996) analyzed data from eight different faculties and found diverging correlations between openness and final grades ranging from −.23 (for civil engineering) and .03 (for political and social sciences). Vedel et al. (2015) examined seven

academic majors and found a similar pattern for average grades, reporting values between .03 (for medicine) and .23 (for political science). Although these coefficients did not reach statistical significance, they might indicate that the correlation of openness and academic performance does indeed vary between different academic majors.

6.1.5 The Present Research

In the previous paragraphs, we have discussed possible explanations for the small meta-analytic correlation estimates for openness and academic performance. The goal of the present study is to follow up on these explanations and to test whether they can close the gap between the promising rationale for openness as a strong predictor of academic performance and the lack of empirical support for this hypothesis. For this, we shall consider all three construct levels of openness, that is, facets, aspects, and the dimension itself. First, we present a meta-analysis of the facet-level correlations between openness and academic performance and examine the influence of academic majors on these effect sizes. Second, we report results from meta-analytic structural equation modeling that offer insights into the internal structure of openness and the relative effect of the two intermediate construct components (i.e., aspects) on academic performance. Third, we describe the findings from a comprehensive meta-analysis at the dimension-level to identify the moderator effects of openness scales and academic majors on the relationship between openness and post-secondary academic performance.

6.2 Method

6.2.1 Literature Search

We followed multiple approaches to identify relevant studies for our meta-analysis. First, we conducted a systematic search in electronic databases for psychology (*PsycINFO*, *PsycARTICLES*, *PSYNDEXplus*), educational science (*ERIC*), medicine (*MEDLINE*), and humanities and social sciences (*FRANCIS*), as well as in *Google Scholar*. The according keywords and Boolean operators are listed in Table 8. All articles, book chapters and theses that were published prior to September 2015 were considered. Based on a review of the abstracts we obtained copies of the studies to evaluate if they met the

inclusion criteria for our meta-analysis. Second, we screened the reference list of nine other meta-analyses and reviews (De Raad & Schouwenburg, 1996; McAbee & Oswald, 2013; Noftle & Robins, 2007; O'Connor & Paunonen, 2007; Poropat, 2009; Richardson et al., 2012; Trapmann et al., 2007; Vedel, 2014) for eligible publications as well as the reference lists of those publications. Third, we issued a call for unpublished data through various mailing lists and on the online network *ResearchGate*. Overall, these three approaches yielded a total of 161 potential publications for consideration in our meta-analysis.

Table 8

Parameters for the Electronic Database Search

Category	Keyword and Boolean operators
Openness	(openness OR openness to experience) AND ((personality OR facet* OR sub-facet* OR aspect*) OR (fantasy OR aesthetics OR feelings OR actions OR ideas OR values) OR (imagination OR artistic OR emotionality OR adventurousness OR intellect OR liberalism))
Related constructs	(Big Five OR typical intellectual engagement OR need for cognition OR curiosity)
Major personality inventories	(BFI OR HEXACO OR IPIP OR NEO) AND (personality OR PI*)
Academic performance	(academic OR student OR university OR education OR scholastic OR graduate OR undergraduate OR postgraduate OR post-secondary OR tertiary) AND (performance OR achievement OR success OR grade* OR GPA OR point average OR score average OR course score OR exam* OR attainment OR outcome*)

Note. Each term from the categories "openness", "related constructs", and "major personality inventories" was combined with the "academic performance" term. An asterisk indicates that a wildcard was used in the electronic database search keyword (e.g., facet* would search for facet, facets, facet-model etc.)

6.2.2 Study Inclusion and Exclusion Criteria

Studies were included in the meta-analysis if they a) were conducted with a sample of tertiary level (i.e., undergraduate or graduate) students; b) included a dimension-

or facet-level, self-rated measure of the personality trait openness from the five-factor model or the corresponding lexical trait intellect; c) reported a zero-order correlation between this measure and at least one grade-based, tertiary level academic performance criterion (or sufficient data to derive the bivariate effect size). Accordingly, we did not include studies that were conducted in primary or secondary school settings, relied solely on other-ratings or used measures of openness that were not based on (or specifically validated for) the five-factor model such as the *California Psychological Inventory* (Gough, 1987), the *Hogan Personality Inventory* (Hogan & Hogan, 1992) or the *Personality Research Form* (Jackson, 1984). Although a correlation coefficient between openness and the academic performance criterion was a mandatory requirement for inclusion, we did not exclude studies without this information right away. Instead, we tried to contact the corresponding author or their co-authors up to three times to obtain the bivariate correlation coefficients, especially when the study used a facet-level measure but only reported dimension-level results.

Despite our best efforts we had to exclude 22 studies due to missing bivariate effect sizes. Next, we carefully compared studies that shared one or more authors to identify possible sample overlaps. We identified and excluded eight more studies (e.g., Lievens & Coetsier, 2002) because they shared at least parts of their sample with more recent or more comprehensive studies that have already been included in our meta-analysis (e.g., Lievens et al., 2009). Three more studies were excluded because they measured academic performance through the amount of obtained credit points within a specific time frame (De Feyter et al., 2012; van der Zee et al., 2002) or via self-assessed performance categories instead of grades (Chamorro-Premuzic et al., 2010). Finally, we excluded the study by Detrick et al. (2005) that examined the influence of personality traits on police academy performance because of its unique setting and sample.

Overall, we included 119 journal articles, 3 doctoral theses and 4 unpublished manuscripts in our meta-analysis. In total, these 126 references yielded 160 correlations between academic performance and the openness dimension, as well as 28 to 29 criterion-related validity coefficients for each the six NEO-PI-R openness facets. It should be noted that 160 of these 331 effect sizes (48%) were provided to us directly by the respective study authors. In addition, we received 19 full inter-correlation matrices for the six openness facets and academic performance.

6.2.3 Coding

Procedure

For each effect size, we coded the full APA reference, publication year, reference type (article, dissertation, unpublished), country of origin, sample size, academic major, openness scale, predictor (e.g. openness to ideas), reliability of the predictor, academic performance criterion (e.g., grade point average; GPA), reliability of the criterion, correlation coefficient, and source of the effect size (text or author), whenever this information was available. If possible, we preferred the students' official grade point average (oGPA) from the university records as the academic performance criterion. If oGPA was not available, we looked for self-reported grade point average (sGPA). Only if neither oGPA nor sGPA were reported in a study, we relied on single performance measures (SPM; e.g., exam, course or thesis grades). In those cases, we also coded the subject of the performance measure (to substitute the academic major of the sample for that specific effect size) and the number of components (e.g. exams) that constituted the measure (for reliability estimations; see below), if this information was given in the study.

All variables were coded by the first author and independently validated by the second author of this article. Overall, there was an excellent inter-rater agreement with a mean Cohen's kappa of .98. For the few existing discrepancies, consensus was reached through discussion.

Dependent effect sizes

A few longitudinal studies reported GPAs for more than one year or semester in one sample (e.g., Lievens et al., 2009). In these cases, we first checked if there was a decrease of sample size over time (i.e., subject dropout). If so, we used the GPA with the largest sample size (usually the earliest measurement point). Otherwise we computed an aggregated correlation coefficient for all criterion measurements with the maximal sample size. If the inter-correlations between the different GPA measures were given, we used the composite validity formula provided by Hunter and Schmidt (2004). Otherwise we computed the average effect size using Fisher's z-transformation. Some studies reported more than one SPM in one sample, such as multiple exams (e.g.,

Furnham & Chamorro-Premuzic, 2004) or multiple performance appraisal methods (e.g., exams, independent projects, and essays; Dollinger & Orf, 1991). If a study reported an average or total score for these components, we used it as the performance measure instead of the individual effect sizes. Otherwise we aggregated the correlation coefficients following the same principles as with multiple GPAs. Finally, some studies administered more than one openness measure in the same sample to predict academic performance (e.g., Thalmayer et al., 2011). We first coded every available predictor separately for the scale-specific subgroup analyses and then computed an aggregated correlation (as described above) for the overall analyses.

Reliability estimates

To correct the observed correlations for measurement error (see below), we used Cronbach's alpha estimates, whenever they were reported in the study. If no alpha values were available for the openness measure, we used the values from the respective test manual or the original validation article as a substitute. Given that only 10% of the studies reported alpha values for the academic performance criteria, we paid careful attention to derive appropriate reliability estimates for the remaining predictor-criterion-combinations. First we used the reliability estimate from Bacon and Bean (2006) for oGPA (.94). Then, we used the meta-analytic correlation between oGPA and sGPA (.90; Kuncel et al., 2005) and the attenuation correction formula to compute a reliability estimate for sGPA (.86). Third, we used the meta-analytic correlation between oGPA and SPM (.59; Richardson et al., 2012) and the attenuation correction formula to compute a reliability estimate for SPM with a single component (.37). If multiple SPM were aggregated (see above), we used the Spearman–Brown formula to adjust the reliability estimate for the number of components.[11]

[11] As noted by an anonymous reviewer, both the attenuation correction formula and the Spearman-Brown formula assume (at least essentially) parallel measurement for all components (i.e., equal true scores and error variances). However, it is unlikely that this strict assumption is met by the diverse academic performance measures in our meta-analysis. Thus, our corrected reliabilities might underestimate the true reliability (Salkind, 2010). This caveat should be kept in mind when interpreting the findings.

6.2.4 Statistical Procedures

Meta-Analyses

Following the approach by Hunter and Schmidt (2004) and in accordance with other recent meta-analyses on personality and academic performance (McAbee & Oswald, 2013; Poropat, 2009), we conducted random-effects meta-analyses of correlations between dimension- and facet-level openness and academic performance. In a first step, we computed a sample-size-weighted average correlations to estimate the effect size corrected for sampling error alone (also known as bare-bones meta-analysis; Hunter & Schmidt, 2004) as well as the according 95% confidence intervals. In a second step, we corrected the observed effect sizes for measurement error in both the predictor (i.e., openness) and the criterion (i.e., academic performance), to obtain the true correlation estimates. Missing reliability information were derived from the artifact distribution across all studies (Hunter & Schmidt, 2004).

We did not correct for range restriction for two reasons. First, a substantial amount of studies (34%) did not report the necessary data (i.e., the standard deviations) for the predictor measure. Second, information on unrestricted ranges for specific populations (e.g., post-secondary students) can be difficult to obtain, especially for non-commercial openness scales without a comprehensive test manual. Fortunately, direct range restriction in the predictor seems unlikely under the assumption that openness scales are not routinely used for student selection and assessment. However, standardized academic ability tests (such as the *Scholastic Aptitude Test* or the *Graduate Record Examination*) are commonly utilized for student admissions all over the world. Thus, range restriction in our academic performance criteria appears possible. Additionally, this might also lead to indirect range restriction in the predictor, given the aforementioned relationship between openness and cognitive abilities (as well as with admission test scores; Noftle & Robins, 2007). Unfortunately, we are not aware of any valid method for estimating these effects, given the plethora of different grading systems and admission procedures, as well as the lack of data about unrestricted ranges.

In a third step, we calculated the amount of variance due to artifacts, the 80% credibility intervals for the true correlation coefficient (Hunter & Schmidt, 2004), and Q statistics as measures of between-study heterogeneity and thereby indicators for

the presence of moderators. To quantify this heterogeneity, supplemental I^2 values were calculated. These values indicate how much of the between-study variation is due to systematic heterogeneity rather than random sampling error (J. P. T. Higgins & Thompson, 2002). We then analyzed the influence of two potential moderators (openness scale and academic major) through subgroup-analyses. All meta-analytic computations were made with the *psychometric* package for R (Fletcher, 2010).

Meta-Analytic Structural Equation Modelling

To identify the most adequate aspect-model of openness (see Table 6) and to determine the influence of the aspects on academic performance, we adopted the *two-stage structural equation modeling* approach (TSSEM; Cheung & Chan, 2005). In short, TSSEM first uses multi-group confirmatory factor analysis to test the homogeneity of the correlation matrices across different studies and estimates a pooled correlation matrix as well as an asymptotic covariance matrix. In a second stage these matrices are used to fit structural equation models (SEM) and to estimate their parameters and goodness-of-fit. TSSEM is the preferable approach to integrate meta-analysis and SEM as long as at least one study provides a full correlation matrix (Landis, 2013)

Overall we compared ten different aspect models of openness. Aside from the four unique facet constellations (both with and without the values facet) in Table 6, we also examined a model without aspects (i.e., with the facets loading directly on the openness dimension).[12] Following the recommendations by Hu and Bentler (1999), in addition to the χ^2 goodness-of-fit statistic we compared the following fit indices: *Tucker-Lewis Index* (TLI; recommended cutoff: $>.95$), *Comparative Fit Index* (CFI; $>.95$), *standardized root mean squared residual* (SRMR; $<.08$), and *root mean squared error of approximation* (RMSEA; $<.06$). All TSSEM computations were made with the *metaSEM* package for R (Cheung, 2014b).

[12] While only DeYoung (2014) provides an explicit rationale for the removal of the values facet (i.e., the possibility that this facet is actually an indicator of sociopolitical orientation instead of openness), we removed it from the other models as well. Otherwise a fair comparison of the model-fit indices would not have been possible. We thank an anonymous reviewer for this suggestion.

6.3 Results

The results of our meta-analysis on the relationship between the six openness facets and academic performance are presented in Table 9. The aggregated sample size ranged from 5,880 (aesthetics) to 5,971 (values). The highest true correlation estimates were found for ideas, values, and actions. While the ideas facet ($\rho = .08$) and the values facet ($\rho = .06$) showed a positive correlation with academic performance, the coefficient for the actions facet was negative ($\rho = -.05$). For these three facets, the confidence intervals around the sample size weighted mean correlation coefficient did not include zero, while the contrary was true for the other three facets (fantasy, aesthetics, and feelings). Except for the aesthetics facet, all *Q* statistics reached statistical significance, indicating a substantial amount of between-study heterogeneity. The according I^2 values for the five heterogeneous facets ranged from 35% (fantasy) to 62% (values). While all of them had rather broad credibility intervals, the interval for the ideas facet did not include zero. As to the percentage of variance explained by artifacts (PVA), no facet except aesthetics reached the recommended cut-off of 75% which would indicate the absence of moderators (Hunter & Schmidt, 2004). Overall, only openness to ideas and openness to values were valid positive predictors of academic performance, albeit their true correlation estimates were quite small. In addition, heterogeneity statistics, credibility intervals, and PVAs indicated the likely influence of moderators on the facet-level correlations, thus limiting the generalizability of the findings.

To examine the moderating effect of academic majors we conducted according subgroup analyses for the two statistically significant positive facet-level predictors of academic performance (i.e., ideas and values).[13] Academic majors were included in the analysis if they comprised at least five independent effect sizes. This approach yielded two subgroups, namely medicine and psychology. The following paragraphs highlight the most noteworthy findings, while Table10 provides the complete results.

For the ideas facet, we found small correlations with academic performance. The true correlation estimates were .08 for medicine and .10 for psychology. Although

[13]The subgroup analysis results for the other four facets are omitted due to space reasons. They are available upon request from the first author. However, we did not find any particularly noteworthy results, except a rather plausible positive correlation between the feelings facet and academic performance in psychology samples ($\rho = .08$).

Table 9

Correlations Between the NEO-PI-R Openness Facets and Academic Performance

Facet	k	N	$\bar{r}$	CI95	ρ	CR80	PVA	Q	I^2
O1 – Fantasy	28	5,861	−.02	[−.05; .00]	−.03	[−.11; .05]	67	41.65*	35
O2 – Aesthetics	28	5,880	.00	[−.02; .03]	.00	–[a]	100	26.42	0
O3 – Feelings	29	5,968	.02	[−.01; .04]	.03	[−.08; .13]	56	51.36**	45
O4 – Actions	28	5,881	−.04	[−.06; −.01]	−.05	[−.14; .04]	65	43.15*	37
O5 – Ideas	29	5,970	.07	[.04; .09]	.08	[.00; .17]	64	45.28*	38
O6 – Values	29	5,971	.04	[.02; .07]	.06	[−.09; .21]	40	72.88***	62

Notes. $\bar{r}$ = correlation coefficient corrected for sampling error only; CI95 = lower and upper bound of the 95% confidence interval; ρ = correlation coefficient corrected for sampling error and measurement error in the predictor and the criterion; CR80 = lower and upper bound of the 80% credibility interval; PVA = percentage of variance accounted for by artifacts; Q = Cochran's measure of heterogeneity; I^2 = heterogeneity index by J. P. T. Higgins and Thompson (2002).

[a] not available due to negative estimates of variances (see Hunter & Schmidt, 2004, pp. 399–401).

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 10

Correlations Between the NEO-PI-R Ideas and Values Facets and Academic Performance by Academic Major

Academic Major	k	N	$\bar{r}$	CI95	ρ	CR80	PVA	Q	I^2
O5 – Ideas									
Medicine	6	1,362	.06	[.01; .12]	.08	[−.01; .16]	60	9.96	50
Psychologiy	11	2,090	.08	[.04; .12]	.10	[.02; .18]	65	16.83	41
O6 – Value									
Medicine	6	1,362	−.06	[−.11; −.01]	−.08	[−.23; .07]	38	15.90***	69
Psychologiy	11	2,090	.09	[.05; .13]	.12	[.02; .22]	60	18.35*	46

Notes. $\bar{r}$ = correlation coefficient corrected for sampling error only; CI95 = lower and upper bound of the 95% confidence interval; ρ = correlation coefficient corrected for sampling error and measurement error in the predictor and the criterion; CR80 = lower and upper bound of the 80% credibility interval; PVA = percentage of variance accounted for by artifacts; Q = Cochran's measure of heterogeneity; I^2 = heterogeneity index by J. P. T. Higgins and Thompson (2002).
* $p < .05$. ** $p < .01$. *** $p < .001$.

neither confidence interval included zero, both intervals overlapped with each other. I^2 values indicated a moderate to substantial amount of systematic between-study variation for both, psychology (41%) and medicine (50%). Despite the quite broad credibility interval for psychology, it did not include zero. As to PVA, neither academic major reached the cut-off value. Taken together, the ideas facet was a positive but weak predictor of academic performance for both majors. While the subgroups showed a lower degree of effect size heterogeneity, there were still some moderators that were unaccounted for.

For the values facet, we also found some small correlations with academic performance. However, the results were less unanimous with true correlation estimates of −.08 for medicine and .12 for psychology. Neither confidence interval included zero. Again, both majors yielded significant Q statistics, substantial I^2 values, PVAs below the cut-off, and rather broad credibility intervals, which only for psychology did not include zero. Overall, the values facet was either facilitating academic performance (for psychology) or impeding it (for medicine). As before, various heterogeneity measures revealed a substantial between-study variation indicating the influence of unknown moderators on the correlation estimates.

To extend our meta-analysis from the facet-level to the aspect-level of openness, we first determined which aspect model from Table 6 was the most appropriate representation of our data. Following the TSSEM approach (Cheung & Chan, 2005), in the first of the two stages we tested the homogeneity of all facet-level studies which provided correlation matrices for the six openness facets and academic performance. Overall, we were able to include 19 matrices with an aggregated sample size of 3,627. Although the general assumptions of a random-effects model seemed more appropriate for our analyses, we first applied a fixed-effect model. In contrast to a random-effect model it provides standard goodness-of-fit indices for stage 1, thus facilitating an objective and appropriate interpretation. Moreover, the result from the fixed-effect approach can serve as an indication whether a fixed-effect or a random-effects would more suitable in stage 2 (Cheung, 2014a). As displayed in Table 11, the goodness-of-fit indices for the homogeneity model (TLI = .93, CFI = .93, SRMR = .09, RSMEA = .06) did not reach the recommended cut-off criteria by Hu and Bentler (1999), indicating a substantial between-study heterogeneity and therefore a preference for the random-effects approach. Thus, we repeated stage 1 and conducted both stages of

the TSSEM as random-effects models. The goodness-of-fit indices for all competing aspect models can also be found in Table 11. We also included a null-model in which the facets loaded directly on the openness dimension (i.e., without aspects as an intermediate construct level). Fit indices indicated that this model did not represent our meta-analytical data adequately (TLI = .82, CFI = .88, SRMR = .05, RSMEA = .07). In contrast, the aspect model suggested by DeYoung et al. (2007)—sans the somewhat ambiguous values facet—yielded the best overall results and met almost all criteria for a very good model fit (TLI = .94, CFI = .97, SRMR = .04, RSMEA = .05).[14] Figure 2 shows the path diagram for this model with standardized path coefficients. To avoid model under-identification, we imposed equality constraints on the paths between the openness dimension and the two openness aspects (i.e., senso-aesthetic openness and intellectual openness) and fixed the path coefficient for the ideas facet (i.e., the only real observed indicator for intellectual openness) to .89.[15] Congruent with the findings of DeYoung et al. (2007), the aesthetics facet was the strongest indicator for senso-aesthetic openness ($\lambda = .73, p < .001$), which in turn had a small negative effect on academic performance ($\lambda = -.12, p < .001$). Intellectual openness, on the other hand, had a moderate positive influence on academic performance ($\lambda = .18, p < .001$). Taken together, these findings did not only provide empirical support for DeYoung et al.'s (2007) concept of openness aspects but also for the hypothesis that some components of openness facilitate academic performance while others are, in fact, detrimental.

Finally, we conducted the most comprehensive meta-analysis on the relationship between openness and post-secondary academic performance so far, to identify the effect of possible moderators (i.e., openness scale and academic major). Overall, we included 149 effect sizes with an aggregated sample size of 50,449. As displayed in Table 12, openness showed a small true correlation with post-secondary academic performance ($\rho = .07$), which is consistent with prior meta-analytic findings (e.g., Poropat, 2009;

[14] It should be noted that, except for the TLI, the Gignac et al. (2004) model (without values) showed a similar goodness of fit (TLI = .91, CFI = .97, SRMR = .04, RSMEA = .06). However, the DeYoung et al. (2007) model also yielded more plausible parameter estimates, avoided "adventurous" (Kenny et al., 1998, p. 254) double loadings and was more profoundly grounded in personality theory, which is why we considered it the most preferable aspect model.

[15] This is the square-root of the mean reliability of the ideas facet in our data set (.79) and prevents the error variance from the manifest indicator (ideas) to be transferred to the latent variable (intellectual openness), which is supposed to be free of measurement error. We thank an anonymous reviewer for this suggestion.

Table 11

Results of the Two-Stage Structural Equation Modeling

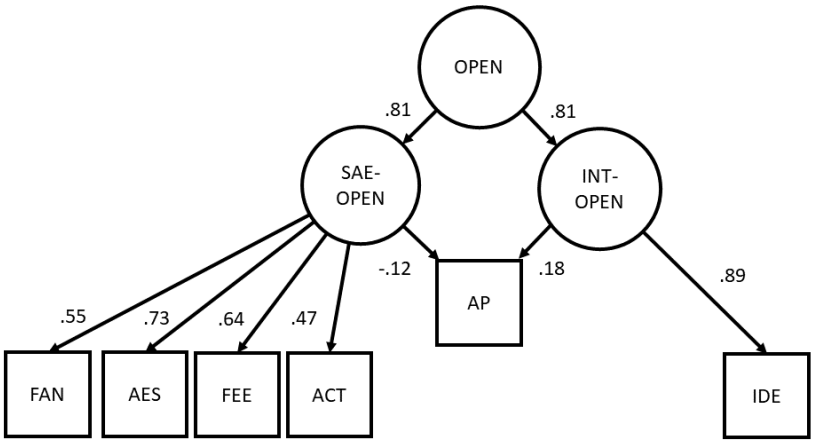
Stage / Model	χ^2	df	TLI	CFI	SRMR	RMSEA [CI95]
Stage 1 (Test for homogeneity of correlation matrices)	649.64	378	.93	.93	.09	.06 [.05; .07]
Stage 2 (Meta-analytic structural equation modeling)						
M0a – No-Aspect-Model	290.58	14	.82	.88	.05	.07 [.07; .08]
M0b – No-Aspect-Model without Values	94.26	9	.93	.96	.05	**.05** [.04; .06]
M1a – Jang et al. (2002)	136.13	12	.91	.95	**.04**	**.05** [.05; .06]
M1b – Jang et al. (2002) without Values	74.20	7	.92	.96	**.04**	**.05** [.04; .06]
M2a – Gignac et al. (2004)	112.90	9	.90	.96	**.04**	.06 [.05; .07]
M2b – Gignac et al. (2004) without Values	63.02	5	.91	**.97**	**.04**	.06 [.05; .07]
M3a – DeYoung et al. (2007)	124.18	13	.82	.89	.05	.07 [.07; .08]
M3b – DeYoung et al. (2007) without Values[a]	70.36	8	**.94**	**.97**	**.04**	**.05** [.04; .06]
M4a – Wainwright et al. (2008)	128.15	12	.91	.95	.05	**.05** [.04; .06]
M4b – Wainwright et al. (2008) without Values[a]	70.36	8	**.94**	**.97**	**.04**	**.05** [.04; .06]

Notes. $N = 3,627$. All "p"-values for χ^2 are smaller than .001. Results for stage 1 are based on a fixed-effects model, results for stage 2 are based on a random-effects model. The most favorable goodness-of-fit indices per column appear in bold. TLI = Tucker-Lewis-Index; CFI = comparative fit index; SRMR = standardized root mean square residual; RMSEA = root mean square error of approximation; CI95 = lower and upper bound of the 95% confidence interval.

[a] The removal of the values facets makes these two models isomorphic.

Figure 2

Model of Openness as a Predictor of Academic Performance with Standardized Path Coefficients



Note. $k = 19$, $N = 3{,}627$. OPEN = openness dimension; SAE-OPEN = senso-aesthetic openness aspect; INT-OPEN = intellectual openness aspect; FAN = fantasy facet; AES = aesthetics facet; FEE = feelings facet; ACT = actions facet; IDE = ideas facet; AP = academic performance. All path coefficients are significant at $p < .01$.

Richardson et al., 2012). Analogous to the facet-level analyses, a significant Q statistic, a substantial I^2 value, a fairly large credibility interval that included zero, and a moderate PVA indeed strongly indicated the presence of moderators. Thus, we proceeded with subgroup analyses for openness scales and academic majors. Again, categories were included in the subgroup analyses if they comprised at least five independent effect sizes. The results of these analyses can be found in Table 12.

The first subgroup analysis revealed some differences in the criterion-related validity of various openness scales. The highest true validity was found for the Mini-Markers $\rho = .17$), followed by the NEO-FFI ($\rho = .11$), whereas the NEO-PI-R yielded the lowest coefficient ($\rho = .04$). With exception of the HEXACO-PI-R, no confidence interval included zero. Furthermore, all confidence intervals overlapped with each

Table 12

Correlations Between Openness and Academic Performance

Facet	k	N	$\bar{r}$	CI95	ρ	CR80	PVA	Q	I^2
Overall	149	50,449	.06	[.05; .07]	.07	[−.02; .17]	45	327.77***	55
Openness Scales									
BFI	14	13,694	.05	[.03; .07]	.06	[−.01; .14]	33	41.92***	69
HEXACO-PI-R	5	1,123	.05	[−.01; .11]	.06	–[a]	100	0.86	0
IPIP-50	14	6,665	.08	[.05; .10]	.09	–[a]	100	10.21	0
NEO-FFI	42	9,738	.09	[.07; .11]	.11	[.01; .22]	53	79.76***	49
NEO-PI-R	45	7,585	.03	[.01; .06]	.04	[−.07; .15]	53	85.49***	49
Mini-Markers	5	1,191	.13	[.07; .19]	.17	[−.02; .35]	27	18.63***	79
Others	35	12,788	.04	[.03; .06]	.05	[−.06; .16]	36	97.10***	65
Academic Majors									
Business	15	2,559	.05	[.02; .09]	.07	[−.08; .22]	42	35.72**	61
Humanities and Social Sciences	10	1,520	.06	[.01; .11]	.08	[−.06; .22]	46	21.63*	58
Medicine	11	2,549	−.02	[−.05; .02]	−.02	[−.14; .10]	43	25.43**	61
Psychology	48	22,450	.05	[.04; .07]	.06	[.01; .12]	63	75.76**	38
STEM	9	1,007	.03	[−.04; .09]	.04	[−.11; .18]	58	15.52*	48
Mixed	26	9,897	.09	[.07; .11]	.11	[.02; .20]	46	57.10***	56

Notes. r = correlation coefficient corrected for sampling error only; CI95 = lower and upper bound of the 95% confidence interval; ρ = correlation coefficient corrected for sampling error and measurement error in the predictor and the criterion; CR80 = lower and upper bound of the 80% credibility interval; PVA = percentage of variance accounted for by artifacts; Q = Cochran's measure of heterogeneity; I^2 = heterogeneity index by J. P. T. Higgins and Thompson (2002); BFI = Big Five Inventory; HEXACO-PI-R = HEXACO Personality Inventory Revised; IPIP-50 = International Personality Item Pool (50-item version); NEO-FFI = NEO Five-Factor Inventory; NEO-PI-R = NEO Personality Inventory Revised; STEM = science, technology, engineering, and mathematics.

[a] not available due to negative estimates of variances (see Hunter & Schmidt, 2004, pp. 399–401).

* $p < .05$. ** $p < .01$. *** $p < .001$.

other, except those for the NEO-PI-R and the NEO-FFI as well as for the NEO-PI-R and the Mini-Markers. While we did not find any substantial effect size heterogeneity for the HEXAO-PI-R and the IPIP-50, the contrary held true for all other openness scales. It is noteworthy that the measure with the highest validity estimate (i.e., the Mini-Markers) also had the largest credibility interval, the highest I^2 value and the lowest PVA, indicating the highest amount of between-study variation for this particular openness scale. Furthermore, the NEO-FFI was the only measure with a credibility interval that did not include zero. Taken together, our results suggest that some openness scales are indeed stronger predictors of academic performance than others. However, the substantial amount of heterogeneity should be taken into consideration when interpreting and generalizing these findings, as it indicates the existence of additional moderator variables.

In the second subgroup analysis, we examined the correlation between openness and academic performance in various academic majors. The highest population coefficient was found for mixed samples ($\rho = .11$), followed by humanities and social sciences ($\rho = .08$), whereas science, technology, engineering and mathematics (STEM) and medical samples showed the weakest link between openness and academic performance ($\rho = .04$ and $-.02$, respectively). In contrast to the other majors, the confidence intervals of the latter two did not exclude zero. Statistically significant differences in effect sizes (i.e., non-overlapping confidence intervals) were only found between medicine and psychology as well medicine and mixed samples. As in the first subgroup analysis, heterogeneity statistics, credibility intervals, and PVAs indicated a substantial amount of systematic between-study variation and the presence of additional moderator variables. Overall, these results suggest a varying effect of openness on academic performance in different academic majors, although once again one should interpret them with caution due to the heterogeneity of the effect sizes within each category.

6.4 Discussion

Since the earliest appearance of the five-factor model of personality scholars have theorized about the role of openness in learning and academic environments. Given its strong emphasis on features like intellectuality, open-mindedness, and ingenuity as

well as its empirical associations with cognitive abilities, intellectual investment and learning behavior, openness has often been presumed to have a significant impact on academic success. However, several recent meta-analyses dampened this enthusiasm by reporting rather small correlations between openness and post-secondary academic performance (McAbee & Oswald, 2013; O'Connor & Paunonen, 2007; Poropat, 2009; Richardson et al., 2012; Trapmann et al., 2007; Vedel, 2014).

In the present study, we followed up on these somewhat surprising findings. Extending prior research, we first examined the differential correlations of openness components at a narrower construct level, that is, facets and aspects. Our own meta-analytic results indicate that only two of the six openness facets, namely ideas and values, are positively related to academic performance whereas the other four are not. Furthermore, on the intermediate level between dimension and facets, intellectual openness (reflected by the ideas facet) promoted academic performance, while senso-aesthetic openness (reflected by the fantasy, aesthetics, feelings, and actions facets) showed, in fact, a detrimental effect in our meta-analytic structural equation model. We then conducted the most comprehensive meta-analysis on the relationship between openness and academic performance so far to identify potential moderating effects. Indeed, we found elevated correlation coefficients for the Mini-Markers openness scale (Saucier, 1994) and reduced coefficients for medical and STEM students.

Although the correlation coefficients in our analyses were rather small, we believe that our findings bear relevance and potential for the understanding of the relationship between openness and academic performance. In the following paragraphs, we elaborate on this perspective and provide recommendations for further research.

6.4.1 Openness Facets and Aspects and Academic Performance

Our finding that openness to ideas is the strongest predictor of academic performance within the openness domain does not strike as a surprise given the facet's obvious intellectual orientation (Costa & McCrae, 1992) and its empirical association with cognitive abilities (von Stumm & Ackerman, 2013). Furthermore, our results suggest that the link between the ideas facet and academic performance is quite persistent across different learning environments. Indeed, one could argue that an open mind and a certain willingness to deal with novel perspectives are essential prerequisites for the

acquisition of academic skills and knowledge. However, in light of the small effect size, other more specific individual differences such as intrinsic motivation (Komarraju et al., 2009), academic aspirations (Dollinger et al., 2008) or intellectual ability (Busato et al., 2000) might be of greater importance for the learning process than a general openness for new ideas.

From another perspective, our findings are relevant to one of the liveliest controversies in applied personality research, that is, whether broad dimensions or narrow facets are better predictors of performance (Judge et al., 2013; Salgado et al., 2014). As to openness and academic performance, the narrow ideas facet ($\rho = .08$) explained virtually the same amount of variance in the criterion as the broad openness dimension ($\rho = .07$), despite being part of said dimension. This result contradicts the notion that broad personality variables are per se superior predictors of broad performance criteria (Ones & Viswesvaran, 1996). Instead it supports the general assumption that broad measures might obfuscate "meaningful and exploitable relations at more specific levels" (Tett et al., 2003, 354–355) and the particular hypothesis that the heterogeneous components of openness might have equally diverse effects on academic performance (Noftle & Robins, 2007). Yet, a definite conclusion in this matter remains difficult given the special nature of the openness domain as a compound of "loosely related traits" (McCrae, 2004, p. 707).

Although the values facet has also been linked to intelligence (Wainwright et al., 2008), at first it seem less evident why the "readiness to reexamine social, political, and religious values" (Costa & McCrae, 1992, p. 17) should be related to academic performance. Our subgroup analyses provide a possible explanation. Whereas the values facet was a positive predictor of academic performance in psychology samples, a higher level of openness for values resulted in lower academic performance for medical students. Thus, it appears that the values facet promotes academic performance in subjects that endorse critical evaluation, pluralistic perspectives and original argumentation. In contrast, academic performance in subjects that rely more on rote learning of facts (e.g., the human anatomy) or the strict compliance with definite rules (e.g., medical procedures), might profit from a lower tendency to question or challenge predominant values.

While most research so far has focused either on dimension-level or facet-level relationships between personality and academic performance, the intermediate construct

level (i.e., aspects) has rarely been considered. Whereas a recent meta-analysis has investigated the relationship between personality aspects and job performance (Judge et al., 2013), to our knowledge this perspective has yet to be adopted in educational psychology (for a noteworthy exception see Kaufman et al., 2010). We believe that our article contributes to this promising endeavor in two ways. First, we addressed the issue that no less than four competing aspect models of openness have been discussed in the literature so far, which might impede a unified attempt to establish aspects as a common level of analysis. Based on our meta-analytic structural equation modeling, we conclude that the most appropriate representation of the openness domain includes senso-aesthetic openness (fantasy, aesthetics, feelings, and actions) and intellectual openness (ideas), as described by DeYoung et al. (2007). Therefore, we suggest that further research should place stronger emphasis on this particular model. Second, in our meta-analytic SEM, intellectual openness had a moderately positive effect on academic performance, whereas senso-aesthetic openness had a small, but statistically significant, negative influence. This is in accordance with the assumption that the non-academic interests associated with senso-aesthetic openness might interfere with academic achievement (DeYoung, 2014). Overall, the surprisingly low correlation between the personality dimension with the ostensibly strongest intellectual orientation and academic performance might in fact be due to its heterogeneous composition that encompasses both academically advantageous and impedimentary personality features. Acknowledging this inherent dichotomy might not only foster a deeper understanding of the true relationship between openness and academic success but also facilitate the development of innovative openness measures with an increased relevance for post-secondary education.

Taken together, our facet-level meta-analysis clarified the somewhat vague relationship between openness and academic performance by identifying the specific, narrow construct components that are related to academic achievement (i.e., ideas and values). Our meta-analytic SEM expanded these findings by providing stringent information about the optimal configuration of these components within the openness domain and by determining the effect of intellectual and senso-aesthetic openness under optimal circumstances (i.e., without sampling and measurement error and while controlling for the other construct components).

6.4.2 Openness and Academic Performance

Given these findings, one could argue that research should focus exclusively on the narrow components of openness instead of the dimension itself. However, this might be ill-advised given that facet- or aspect-level assessments of openness are far from being prevalent in educational psychology research and practice. Whereas short dimension-level openness scales are often preferred over comprehensive facet-level inventories due to time constraints, availability or convenience, dedicated aspect-level measures like the Big Five Aspect Scales (DeYoung et al., 2007) are yet to be widely established. Consequently, dimension-level results might be more tangible for educational researchers. Furthermore, the greater amount of empirical studies permits more detailed moderator analyses at the dimension level. These provide a more in-depth insight into the parameters of the relationship between openness and academic performance and, by extension, further research directions for all three construct levels.

Regarding the dimension level, our own results were in line with those of other recent meta-analyses (McAbee & Oswald, 2013; O'Connor & Paunonen, 2007; Poropat, 2009; Richardson et al., 2012; Trapmann et al., 2007; Vedel, 2014), as we found a small, albeit statistically significant effect. Given the large number of studies and the overall sample size in our analysis, we feel confident that our estimate of the true correlation ($\rho = .07$) is both accurate and robust. We therefore indeed suggest a moratorium on further examinations of the bivariate association between dimension-level openness and post-secondary academic performance—especially in undergraduate psychology samples. However, additional research seems warranted to identify study settings and educational environments that increase or decrease the correlation of openness and academic performance.

A possible direction for this undertaking can be derived from the differences that we found between openness scales in terms of their criterion-related validity. While the Mini-Markers (Saucier, 1994) showed the highest correlation with academic performance, the openness scale of the NEO-PI-R (Costa & McCrae, 1992) yielded the lowest validity coefficient. It is remarkable that the former measure is a rather pristine representation of the lexical tradition (which emphasizes the intellectual components of openness) whereas the latter can be seen as the flagship of the questionnaire approach (with its focus on aesthetics and novelty). Given that the true validity estimate for the

Mini-Markers ($\rho = .17$) can be considered a medium effect size in applied settings (Bosco et al., 2015), one might argue that the lexical conceptualization of openness is of greater relevance for educational environments than the questionnaire approach. Given the limited number of studies, the low percentage of accounted variance due to artifacts, and the fairly large credibility intervals, however, further research should examine the robustness and generalizability of these findings. If they should be corroborated, a revision of the two-decade truce between the two research traditions' perspective on openness might be in order—at least in applied educational contexts.

6.4.3 Limitations and Future Research

As most other studies, the present meta-analysis has some limitations that should be addressed. Most of these might also provide promising opportunities for further research on the relationship between openness and academic performance.

First, an important limitation applies to the generalizability of our effect size estimates. In most analyses, statistically significant Q statistics and high I^2 values indicated a substantial level of between-study heterogeneity at both the overall and subgroup level. Furthermore, the amount of variance explained by artifacts rarely reached the cut-off of 75% recommended by Hunter and Schmidt (2004) and the rather broad credibility intervals often included zero. Overall, these results indicate the presence of additional, unknown moderator variables or unknown sources of error (e.g. quality of the criterion grades). Thus, we advise a cautious interpretation of our findings as well as more focused research on moderators of the openness-performance relationship.

Second, we focused on a single educational level, that is, post-secondary academic environments. As shown by Poropat (2009), the relationship between openness and academic performance is indeed moderated by the educational level, declining from a population coefficient of .24 in primary education to .07 in tertiary education. Thus, further research should expand our approach and examine the facet- and aspect-level correlations for other educational levels.

Third, our facet- and aspect-level analyses were limited to studies that relied on the NEO-PI-R as a measure of openness. Although there are other questionnaires that assess openness components below the dimension-level—such as the IPIP-NEO (Goldberg et al., 2006) or the Big Five Aspect Scales (DeYoung et al., 2007)-—we were

not able to locate a single study that reported a relationship between these measures and post-secondary academic performance. This is especially unfortunate given that the NEO-PI-R showed the lowest dimension-level validity of all openness scales in the according subgroup analysis. However, this might simply be due to the fact that all six openness facets are equally represented in the overall openness scale of the NEO-PI-R. In contrast, items from the ideas facet constitute one third of the NEO-FFI openness scale, which yielded the second highest true validity estimate. Consequently, the lower weight of the academically relevant ideas facet in the overall openness score might explain the substantially lower criterion-related validity of the NEO-PI-R.

Fourth, although we were able to identify a total of 45 studies that used the NEO-PI-R (i.e. a facet-level inventory), we managed to obtain the facet-level correlations for only two thirds of these studies. Thus, in contrast to the overall dimension-level correlation estimate which is based on a comprehensive sample of studies, the effect sizes at the facet- and aspect-level might be less robust and definite.

Fifth, we treated academic performance as a homogeneous construct in our analyses, using different performance measures (i.e., GPA and single grades) as indicators that merely differed in their amount of error variance. However, as noted by an anonymous reviewer, it seems possible that certain openness components (e.g., senso-aesthetic openness) are more relevant for certain performance appraisal methods (e.g., essay-type exams). Unfortunately, we were not able to test this moderator hypothesis due to insufficient information in the primary studies. Therefore, we suggest further research to scrutinize the validity of our findings for particular measures of academic performance.

Finally, some empirical results suggest a nonlinear relationship between openness and academic performance (Cucina & Vasilopoulos, 2005) that is beyond the scope of conventional meta-analytic procedures. Indeed, it seems plausible that extreme levels of openness might be detrimental for academic performance. While students with low levels of openness might not recognize learning opportunities or utilize them in full, too high levels might result in volatile interests or a lack of discipline and determination that is necessary for academic success. Thus, we echo the call for more research on the curvilinear relationships between openness and academic performance (Poropat, 2009) and encourage its expansion onto the aspects and facets of openness.

Some research perspectives can be derived directly from our findings and the aforementioned limitations. In addition to those, we would like to draw attention to three other paths that appear both promising and relevant.

First and foremost, there is some empirical evidence for indirect effects of openness on academic performance. For instance, Diseth (2003) found the correlation to be fully mediated by a deep learning approach, while Steinmayr et al. (2011) established a partial mediation through learning goal orientation. More recently, these findings have been replicated and extended by J. Zhang and Ziegler (2016), who concluded that openness predicts academic performance indirectly via motivational aspects (i.e., self-efficacy and self-concept) and learning approaches. These results support the interpretation that at least some of the learning-related correlates of openness might actually be mediators in the relationship with academic performance. As discussed earlier, Ziegler, Danay, Heene, et al. (2012) showed that openness facilitates the acquisition of knowledge (i.e., crystalized intelligence) by increasing the amount of learning opportunities and thereby the development of problem-solving abilities (i.e., fluid intelligence). Unsurprisingly, crystallized intelligence is highly correlated with academic performance (Postlethwaite, 2011), which opens up the possibility of an indirect effect of openness on academic achievement. A thorough investigation of these indirect effects (e.g., through meta-analytic SEM) with an emphasis on intellectual openness seems crucial for a deeper understanding of the relationship between openness and academic performance.

Second, two recent meta-analyses have shown the superiority of other-ratings of openness over self-reports in predicting academic performance (Connelly & Ones, 2010; Poropat, 2014). Given the substantial true correlation estimates ($\rho = .29$ and .28, respectively) which even surpass the effect size for general intelligence ($\rho = .25$; Poropat, 2009) we call for an integration of other-ratings and the facet/aspect-level approach from the present article. Although there are some challenges in the observation-based assessment of personality traits, especially those that are less behaviorally explicit (Connolly et al., 2007), other-rating measures for openness to ideas or intellectual openness might yield substantial criterion-related validities for academic performance.

Finally, we encourage researchers to follow-up on the recent meta-analysis by Judge et al. (2013) by extending our findings into the domain of training performance. In their seminal review, Barrick and Mount (1991) hypothesized that openness should

predict training proficiency because participants with high levels of openness "are more likely to be motivated to learn upon entry into the training program and, consequently, are more like to benefit from the training" (p. 6). Accordingly, openness has been found to be the strongest predictor of training performance within the five-factor model ($\rho = .33$; Barrick et al., 2001). Given this result and the similar learning requirements and processes in post-secondary education and job-related trainings, we are confident that the differential correlation patterns that we found will largely translate into training settings. We therefore encourage further research to examine the correlations between specific openness components and job-related training performance.

6.4.4 Conclusion

In their review of personality in learning and education, De Raad and Schouwenburg (1996) noted that openness "contains traits that seem to form an cluster of the ideal student" (p. 327). In the two decades since this enthusiastic conclusion, more than 100 empirical studies have scrutinized the relationship between openness and post-secondary academic performance—quite often with sobering results. Unfortunately, many of them merely invoked the obvious academic relevance of openness instead of elaborating a sound rationale why and how openness should be related to academic achievement. A more profound understanding of this relationship might enable researchers to delve into the reasons for the surprisingly low correlations.

To facilitate this endeavor, we compiled a comprehensive and in-depth rationale for the association between openness and academic performance from the literature, including both the apparent theoretical qualities of openness as well as its empirical links with cognitive abilities, typical investment traits, and learning. We also emphasized the potential of openness for predicting academic achievement that is somewhat concealed within the heterogeneous nature of the construct. For this purpose, we provided empirical evidence for the differential correlations for specific components of openness as well as for the presence the moderating influence of openness scales and academic majors on the openness-performance relationship. We hope that this article will further rekindle the scientific interest in openness as a predictor of academic performance, stimulate focused research and ultimately contribute to the success of the long-lasting quest for the personality traits of an *ideal student*.

7 Article 2: Aspects of Openness as Predictors of Academic Achievement (Gatzka, 2021)

Abstract

Recent meta-analytical findings have corroborated the notion of openness as a dichotomous personality dimension that encompasses two distinct aspects, namely intellectual and senso-aesthetic openness. This article investigates the associations of these two aspects with objective and subjective academic achievement as well as their incremental validity over and interaction with the two conscientiousness aspects industriousness and orderliness. Cross-sectional data from 424 undergraduate students suggested that a) intellectual openness was a strong positive predictor of academic achievement, whereas senso-aesthetic openness was a moderate negative predictor, b) openness aspects showed substantially more incremental validity over conscientiousness aspects than vice versa, and c) intellectual openness and orderliness interacted in the prediction of objective academic achievement. These results emphasize the relative importance of openness in postsecondary education and provide promising perspectives for further research.

Keywords: Openness, Conscientiousness, Aspects, Academic Achievement

CRediT Statement

Thomas Gatzka: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Visualization, Writing – original draft, Writing – review & editing; **Benedikt Hell:** Funding acquisition

7.1 Introduction

The two factors within the five-factor model of personality most frequently associated with academic achievement are *conscientiousness* and *openness* (Vedel & Poropat, 2017). Whereas conscientiousness encompasses numerous traits with evident relevance for learning success, such as achievement striving, diligence, and self-discipline, openness has been linked to academically advantageous qualities such as curiosity, independent-mindedness, and educational aptitude. However, while several meta-analyses have confirmed conscientiousness as a strong predictor of postsecondary academic performance, the corresponding effect sizes for openness were minute at best (e.g., Poropat, 2009).

7.1.1 Intellectual Openness Versus Senso-aesthetic Openness

A possible explanation lies within the notion that each of the five broad dimensions comprises two lower-order *aspects*, that is, distinct but related trait-clusters (DeYoung et al., 2007). Indeed, a recent meta-analysis found that *intellectual openness* (i.e., the preference for intellectual stimulation, scholastic endeavors, and cognitive engagement) facilitated academic performance, whereas *senso-aesthetic openness* (i.e., the preference for sensory and perceptual exploration and immersion in art, fantasy, and imagination) showed an impeding effect (Gatzka & Hell, 2018). Consequently, openness measures that neglect the two opposing aspects might obfuscate meaningful relations with academic achievement.

Because truly dichotomous openness measures are not yet widely used, Gatzka and Hell (2018) resorted to deriving the two openness aspects from the lower-level openness *facets* of the *Revised NEO Personality Inventory* (Costa & McCrae, 1992) through structural equation modeling. While four facets (i.e., fantasy, aesthetics, feelings, ac-

tions) were used as indicators for the senso-aesthetic aspect, only a single facet (i.e., ideas) served as an approximation for intellectual openness. However, intellectual openness encompasses much more, as it reflects "the ability and tendency to explore abstract information through reasoning" (DeYoung et al., 2014, pp. 46–47). Thus, the first goal of the present study is to re-examine the predictive validity of openness for academic achievement with a with a truly dichotomous aspect-level measure of openness:

H1 Academic achievement is (a) positively related to intellectual openness but (b) negatively related to senso-aesthetic openness.

7.1.2 Incremental Validity Over Conscientiousness Aspects

Analogous to openness, conscientiousness consists of two aspects, namely *industriousness* (i.e., the tendency to stay focused and to pursue goals in an effortful, determined manner) and *orderliness* (i.e., the preference for schedules, deliberation and detail-orientation; DeYoung et al., 2007). While there are virtually no findings at the aspect-level yet, facet-level studies suggest that industriousness and—to a lower extent—orderliness predict academic achievement (e.g., Noftle & Robins, 2007).

With regards to academic achievement, openness seems to facilitate cognitive exploration (DeYoung et al., 2011), thus increasing both the likelihood and efficiency of learning (Ziegler, Danay, Heene, et al., 2012). Conscientiousness, on the other hand, appears to foster self-regulatory behaviors, such as planning, time management, and persistence (L. E. Kim et al., 2016). Drawing on motivation theory (Heckhausen, 2007), openness can be linked to motivation (i.e., the decision for a particular goal and against others), while conscientiousness seems to be more pertinent to volition (i.e., the maintained commitment to the chosen goal and sustained effort for its realization). Accordingly, openness—especially its intellectual component—has been linked to *intellectual investment* (i.e., the desire to engage in intellectual activities and to pursue cognitive challenges; von Stumm & Ackerman, 2013), whereas conscientiousness has been associated with *effortful control* (i.e., the willful direction of attention, maintenance of task focus, and avoidance of distractions; Rothbart, 2007).

Overall, each personality dimension apparently encompasses distinct traits that seem highly relevant for educational settings. Consequently, their aspects should explain unique variance in measures of academic achievement. Thus, the second goal of the present study is to determine the incremental validity of the two openness aspects over the two conscientiousness aspects (and vice versa):

H2 As predictors of academic achievement, (a) the two openness aspects will show incremental validity over the two conscientiousness aspects and (b) vice versa.

7.1.3 Interactions Between Openness and Conscientiousness Aspects

Motivation and volition are sequential phases within the action regulation process and therefore *both* crucial for performance-related behavior (Keller, 2008). From this perspective, a combination of high conscientiousness and high openness should be most beneficial. Indeed, it has been theorized that a low level in one of the two traits might suffice to impede academic achievement (Lord, 2007).

Applying this perspective to the aspect-level, students with high intellectual openness but low industriousness might be interested in new learning opportunities but struggle to "stay on track". In contrast, a very industrious student might be able and willing to ensure successful memorization of the subject matter, yet simply lack a genuine desire to truly understand and utilize it due to low intellectual openness. Furthermore, the negative effect of senso-aesthetic openness on academic achievement might be at least partially due to a lack of focus on relevant matters and thus be mitigated by high levels of industriousness (i.e., increased determination) or orderliness (i.e., helpful routines). Thus, the third goal of the present study is to examine possible interactions between the four aspects:

H3 As a predictor of academic achievement, intellectual openness interacts with (a) industriousness and (b) orderliness. Analogously, senso-aesthetic openness interacts with (c) industriousness and (d) orderliness.

7.2 Method

7.2.1 Participants

The sample consisted of 424 undergraduate students (79% female) from a university of applied sciences in the German-speaking part of Switzerland. It consisted of 34% freshmen, 27% sophomores, 26% juniors, and 12% seniors. Participants had a mean age of 24.6 years ($SD = 5.1$) and were enrolled in a total of 11 different majors, with nursing science (22%), nutritional science (17%), and midwifery (15%) being the three most frequent. The sample was recruited through mailing lists and student organizations. A post-hoc analysis yielded a statistical power of .80 to detect an effect of .14 at a significance level of .05.

7.2.2 Procedure

Participation was anonymous and voluntary. Participants were fully informed about the purpose of the study as they completed an online questionnaire consisting of various demographic items and the personality scales and criterion measures described below. As an incentive, they received individual feedback on their Big Five trait levels. For this sole purpose, participants also completed the short form of the *Big Five Inventory–2* (BFI–2S; Soto & John, 2017a), which was not included in any other analyses. Furthermore, participants were offered to enter a raffle for 10 gift certificates for an online retail shop ranging from 25 to 100 Swiss Francs (approximately 25 to 100 US Dollars).

7.2.3 Measures

Personality

The following self-report measures were presented in Standard High German with a 5-point Likert scale. Participants were instructed to indicate to what extent each item applied to them personally, ranging from 0 (“not at all”) to 4 (“fully”). Whenever Standard High German translations of the items were available from the *International Personality Item Pool* (IPIP) website (Goldberg et al., 2006), they were used. Otherwise,

the original items were translated into Standard High German by the author of the present article and back-translated by a bilingual native English speaker.

The openness scale of the *Big Five Aspect Scales* (BFAS; DeYoung et al., 2007) consists of 20 items that assess overall openness as well as its two aspects, namely intellectual openness (e.g., "I have difficulty understanding abstract ideas.") and senso-aesthetic openness (e.g., "I see beauty in things that others might not notice.") with 10 items each. Cronbach's alpha was .78 for intellectual openness, .73 for senso-aesthetic openness, and .79 for overall openness.

The conscientiousness scale of the BFAS consists of 20 items that assess overall conscientiousness as well as its two aspects, namely industriousness (e.g., "I get things done quickly.") and orderliness (e.g., "I like order."), with 10 items each. Cronbach's alpha was .82 for industriousness, .79 for orderliness, and .85 for overall conscientiousness.[16]

Academic Achievement

To obtain a measure of objective academic achievement, participants were asked to provide their current GPA using the Swiss grading system where 6.0 is the highest and 1.0 the lowest possible grade. However, self-reported GPA may not be sufficiently comparable between different majors (e.g., due to grade inflation or grading differences; Lei et al., 2001) and reported less accurately by low-performing students (Kuncel et al., 2005). Furthermore, it does not factor in the possibility that "students who are high on openness learn more, but do not care to exchange performance for grades" (Poropat, 2016, p. 177). Thus, subjective academic achievement was obtained as a complementary criterion measure. The *Subjective Academic Achievement Scale* (SAAS; Stadler, Kemper, et al., 2015) consists of 5 items (e.g., "My grades are appropriate for my effort.", "I progress adequately fast in my studies.") that assess internalized

[16] As suggested by an anonymous reviewer, the internal structure of the translated openness and conscientiousness scales was examined through factor analyses (see Appendix B.1). This revealed two problematic items, namely "Avoid philosophical discussions." (which loaded on senso-aesthetic openness instead of intellectual openness) and "Follow a schedule." (which loaded on industriousness instead of orderliness). Consequently, the four aspect scales were re-scored and all analyses were repeated. However, this had barely any impact on the results and did not change the findings of the present study. Thus, in order to ensure the comparability with other studies that used the BFAS and to maintain the content validity of the measures, the results for the original scale compositions are reported in this article. However, the results for the re-scored aspect scales are available in Appendix B.2.

achievement evaluations weighted against one's personal expectations. Cronbach's alpha was .80.

7.3 Results

All analyses were conducted in *R 3.6.2* (R Core Team, 2019) with the *rockchalk* package (P. E. Johnson, 2019) being used to produce the interaction plots. The interpretation of the effect sizes drew upon the benchmarks provided by Bosco et al. (2015), who suggested .09 and .26 as lower and upper boundaries of a medium correlation. In contrast to the widely established thresholds of .30 and .50 suggested by Cohen (1988), those values have been derived empirically through a meta-analysis of 147,328 published effect sizes. Thus, they arguably provide a more objective, realistic, and practical benchmark for interpreting correlational effect sizes in applied research settings.

7.3.1 Bivariate Correlations

Descriptive statistics and intercorrelations for all personality and criterion measures are displayed in Table 13. Overall openness was positively related to GPA ($r = .16, p = .001$) and subjective achievement ($r = .19$, $p < .001$). However, there were noticeable differences between the two openness aspects. While intellectual openness correlated with GPA ($r = .31$, $p < .001$) and subjective achievement ($r = .38$, $p < .001$) senso-aesthetic openness did not ($r = -.05$, $p = .289$ and $r = -.07$, $p = .162$, respectively).

Very similar patterns were found for conscientiousness, which was also was positively related to GPA ($r = .19$, $p = .001$) and subjective achievement ($r = .19$, $p < .001$). Again, the two aspects differed substantially. Whereas industriousness correlated with GPA ($r = .28$, $p < .001$) and subjective achievement ($r = .33$, $p < .001$) orderliness did not ($r = .05$, $p = .300$ and $r = .01$, $p = .884$, respectively).

For both academic achievement criteria, the correlation coefficients of intellectual openness and industriousness were compared using the formula by Steiger (1980). However, there was no significant difference between the two coefficients for either GPA ($z = 0.58$, $p = .560$) or subjective achievement ($z = 1.00$, $p = .317$).

Table 13

Means, Standard Deviations, Reliabilities, and Intercorrelations of the Personality and Criterion Variables

Variable	*M*	*SD*	1	2	3	4	5	6	7	8
Personality traits										
1. Openness (overall)	50.87	8.50	(.79)							
2. Intellectual openness	25.53	5.19	.79***	(.78)						
3. Senso-aesthetic openness	25.34	5.40	.81***	.29***	(.73)					
4. Conscientiousness (overall)	48.93	9.16	−.05	.18***	−.26***	(.85)				
5. Industriousness	24.12	5.20	.10*	.37***	−.20***	.84***	(.82)			
6. Orderliness	24.81	5.58	−.18***	−.04	−.24***	.86***	.44***	(.79)		
Academic achievement										
7. Grade point average	4.82	0.32	.16**	.31***	−.05	.19***	.28***	.05	–	
8. Subjective academic achievement	13.62	3.10	.19***	.38***	−.07	.19***	.33***	.01	.60***	(.80)

Notes. $N = 424$. Values in parentheses are Cronbach's Alphas.
* $p < .05$. ** $p < .01$. *** $p < .001$.

7.3.2 Regression Analyses

The incremental validity of the two openness aspects over the two conscientiousness aspects (and vice versa) and possible interactions between them were examined through stepwise multiple regression analyses. The results can be found in Table 14.

Industriousness was a positive predictor of both GPA ($\beta = .32$, $p < .001$) and subjective achievement ($\beta = .40$, $p < .001$) when orderliness was controlled for (model 1a). Orderliness, on the other hand, negatively predicted subjective achievement ($\beta = -.17$, $p < .001$) but not GPA ($\beta = -.09$, $p = .076$).

Similarly, while intellectual openness was positively related to both GPA ($\beta = .36$, $p < .001$) and subjective achievement ($\beta = .43$, $p < .001$) when senso-aesthetic openness was controlled for (model 1b), the latter was a negative predictor for both criteria ($\beta = -.15$, $p = .001$ and $\beta = -.19$, $p < .001$, respectively).

When all four aspects were included in the regression (model 2), the beta coefficients of industriousness decreased for both GPA ($\beta = .18$, $p = .002$) and subjective achievement ($\beta = .22$, $p < .001$). Analogously, the beta weights of intellectual openness were reduced for GPA ($\beta = .27$, $p < .001$) and subjective achievement ($\beta = .33$, $p < .001$), although to a smaller extent. The approach suggested by Cumming (2009) was used to test whether the standardized beta weights of intellectual openness and industriousness were different from each other. In short, one can assume that two point-estimates (e.g., beta weights) differ significantly ($p < .05$) if the lower half of the 95% confidence interval of the higher point-estimate and the upper half of the 95% confidence interval of the lower point-estimate overlap less than 50%. The corresponding confidence intervals were estimated via bias-corrected bootstrapping with 5,000 samples. For GPA and subjective achievement, the overlap between the two according confidence intervals was 121% and 105%, respectively. Therefore, intellectual openness and industriousness were equally valid predictors of the two academic achievement criteria.

Overall, the two openness aspects displayed incremental validity over the two conscientiousness aspects, increasing the explained variance for GPA, $\Delta R^2 = .05$, $F(2, 419) = 12.60$, $p < .001$, and subjective achievement, $\Delta R^2 = .08$, $F(2, 419) = 20.14$, $p < .001$. In comparison, the incremental validity of the conscientiousness

aspects was noticeably smaller for both, GPA, $\Delta R^2 = .02$, $F(2, 419) = 4.85$, $p = .001$, and subjective achievement, $\Delta R^2 = .03$, $F(2, 419) = 8.03$, $p < .001$.

Table 14

Summary of the Regression Analyses of Academic Achievement on Openness and Conscientiousness Aspects

		GPA			SUB		
Model	Predictor	β	R^2		β	R^2	
M1a	C-IND	.32***			.40***		
	C-ORD	−.09			−.17**		
			.09			.13	
M1b	O-INT	.36***			.43***		
	O-SAE	−.15**			−.19***		
			.12			.18	
M2	C-IND	.18**			.22***		
	C-ORD	−.04			−.11*		
	O-INT	.27***			.33***		
	O-SAE	−.11*			−.15**		
			.14	ΔR^2_{M1a}: .05***		.21	ΔR^2_{M1a}: .08***
				ΔR^2_{M1b}: .02**			ΔR^2_{M1b}: .03***
M3	C-IND	.19**			.23***		
	C-ORD	−.06			−.11*		
	O-INT	.27***			.34***		
	O-SAE	−.10*			−.15**		
	C-IND × O-INT	−.02			.06		
	C-IND × O-SAE	−.04			−.02		
	C-ORD × O-INT	.10*			.03		
	C-ORD × O-SAE	.05			−.03		
			.16	ΔR^2_{M2}: .02		.21	ΔR^2_{M2}: .01
M4	C-IND	.19**					
	C-ORD	−.05					
	O-INT	.27***					
	O-SAE	−.10*					
	C-ORD × O-INT	.11*					
			.15	ΔR^2_{M2}: .01*			

Notes. $N = 424$. GPA = grade point average; SUB = subjective academic achievement; C-IND = industriousness; C-ORD = orderliness; O-INT = intellectual openness; O-SAE = senso-aesthetic openness. * $p < .05$. ** $p < .01$. *** $p < .001$.

7.3.3 Interactions

Finally, product terms of the two openness aspects and the two conscientiousness aspects were added to the regression model (model 3). As shown in Table 14, this did not result in a significant increase of explained variance for either GPA, $\Delta R^2 = .01$, $F(4, 415) = 2.12$, $p = .078$, or subjective achievement, $\Delta R^2 = .00$, $F(4, 415) = 0.78$, $p = .538$. However, the product term for intellectual openness and orderliness was a significant predictor of GPA ($\beta = .10$, $p = .037$). Adding this product term (model 4) led to a small, yet statistically significant increase of explained variance in GPA, $\Delta R^2 = .01$, $F(1, 418) = 6.67$, $p = .010$, over the model containing only the four aspects (model 2). The according interaction is plotted in Figure 3.

7.4 Discussion

7.4.1 Openness Aspects and Academic Achievement

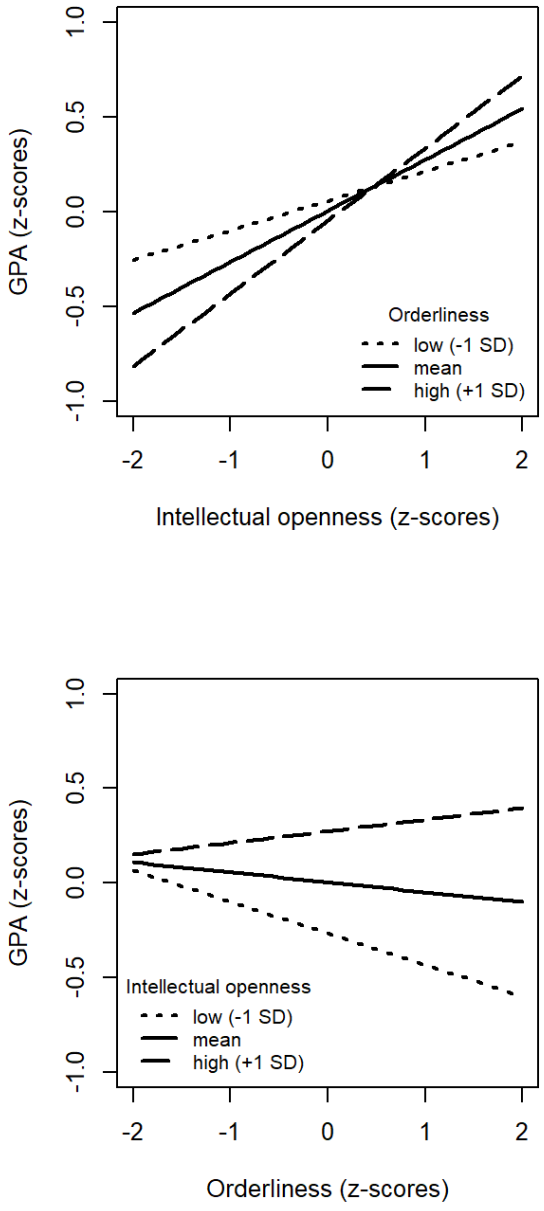
As stated in Hypothesis 1a, intellectual openness was positively related to academic achievement. The according coefficients exceeded .30 in nearly all analyses and can be classified as large effect sizes in applied psychology research (Bosco et al., 2015). Thus, those components of openness reflecting intellectual and scholastic engagement indeed seem to translate positively into postsecondary learning environments.

The relationship between intellectual openness and GPA was noticeably stronger than in the meta-analysis by Gatzka and Hell (2018). A possible explanation is their use of the narrow "openness to ideas" facet—emphasizing on intellectual open-mindedness—as a proxy for intellectual openness. In contrast, the more comprehensive measure of intellectual openness in the present study also encompassed intellectual engagement and cognitive efficiency. Therefore, the larger effect might be due to an increased overlap with other intellectual investment traits and cognitive abilities, which are strong predictors of academic performance themselves (Kuncel et al., 2004; von Stumm & Ackerman, 2013).

Furthermore, intellectual openness showed even stronger associations with subjective academic achievement. Thus, intellectually open students are more likely to be content with their grades, their study progress, and their "return on investment",

Figure 3

Interaction Between Intellectual Openness and Orderliness in the Prediction of GPA



that is, the balance between their efforts and rewards. Applying expectancy and goal setting theory (Friedman & Mandel, 2009), this seems plausible if intellectual openness increases the reward (i.e., grades) while simultaneously reducing the perceived effort through intellectual efficiency and a positive attitude towards intellectual stimulation and cognitive endeavors.

For senso-aesthetic openness, a moderate negative effect on both objective and subjective achievement was found, when intellectual openness was controlled for, largely supporting Hypothesis 1b. Thus, those components of openness that are truly unique to the senso-aesthetic aspect (e.g., aesthetic sensitivity and artistic inclination) seem indeed to impede academic achievement. This is in line with the assumption that the non-academic components of openness might be detrimental to academic success (DeYoung, 2014).

7.4.2 Incremental Validity

The present study revealed a noteworthy parallel between openness and conscientiousness. Each dimension encompassed one aspect that showed substantial, positive relationships with academic achievement (i.e., intellectual openness and industriousness) and one aspect that showed moderate negative associations (i.e., senso-aesthetic openness and orderliness). Overall, intellectual openness yielded similar effect sizes as industriousness. This challenges the long-standing notion of conscientiousness as the "most important personality predictor of academic performance" (Poropat, 2016, p. 174).

As stated in Hypotheses 2a and 2b, the two openness aspects showed incremental validity over the two conscientiousness aspects and vice versa. Interestingly, intellectual openness and industriousness lost some of their predictive validity when the other aspect was controlled for. This is in line with empirical findings suggesting that openness and conscientiousness both facilitate academic achievement through academic effort regulation (Corker et al., 2012; Komarraju et al., 2011). However, the observed beta-weight reduction was more substantial for industriousness (about 50%) than for intellectual openness (about 25%). Furthermore, openness showed a higher incremental validity over conscientiousness than vice versa. Thus, those facilitating processes that

are unique to openness seem to have more impact on academic achievement than those stemming solely from conscientiousness.

7.4.3 Interactions

Contrary to Hypotheses 3a, 3c, and 3d, there were no interactions between intellectual openness and industriousness or senso-aesthetic openness and either conscientiousness aspect. This questions the notion of academic achievement as a product of the motivational factor intellectual openness and the volitional factor industriousness. Instead, it appears that the direct contributions of these two aspects to academic success are additive rather than multiplicative. However, it is also possible that the interplay between intellectual openness and industriousness is more intricate. For instance, the interaction might take place at an earlier phase of a more complex process model, where a joint effect of intellectual openness and industriousness on academic achievement is mediated through constructs such academic effort regulation or learning approaches.

There was a significant interaction between intellectual openness and orderliness when predicting objective academic success (i.e., GPA), at least partially supporting Hypothesis 3b. This can be interpreted from two complementary perspectives. On one hand, it seems that orderliness enhances the positive effect of intellectual openness on academic achievement. Encompassing the "overarching tendency to be prepared" (B. W. Roberts et al., 2014, p. 1317), orderliness might facilitate a better organized approach to cognitive exploration. In other words, more orderly students might act out their intellectual engagement in a more structured manner, therefore faring better than peers who pursue their "desire to know" in a more disordered way. On the other hand, higher levels of intellectual openness appear to mitigate the somewhat negative effect of orderliness on academic achievement, which might stem from the association between orderliness and compulsory tendencies (Krueger et al., 2007). Consequently, overly orderly students might be impeded in their academic endeavors by excessive rigidity and maladaptive perfectionism. Higher levels of intellectual openness might counteract this by fostering a "desire to move forward"—away from the details, towards the bigger picture.

7.4.4 Limitations and Further Research

One limitation of the present study is its reliance on self-reports for both the predictor and the criterion measures, which introduces the possibility of spurious relationships due to common method variance (Podsakoff et al., 2003). This should be taken into consideration when interpreting the present results and emphasizes the need for a replication with other-report personality measures and more objective achievement criteria (e.g., official GPA records). This seems particularly promising given that other-ratings of overall openness show higher correlations with postsecondary academic performance than self-reports (Poropat, 2014).

Another methodological limitation pertains to the content validity of the intellectual openness measure that was used in the present study. Indeed, about half of its items focus on self-assessed cognitive ability and efficiency (e.g. "Am quick to understand things.", "Can handle a lot of information."). Given the substantial relationship between intelligence and postsecondary academic performance (Kuncel et al., 2004), the present findings might be at least partially due to the saturation of the intellectual openness measure with cognitive abilities. Thus, it seems worthwhile to examine whether the relationship between intellectual openness and academic achievement remains as substantial as in the present study when general mental ability is controlled for. Prior research suggests that this holds true for overall openness (Farsides & Woodfield, 2003).

A third limitation lies within the scope of the present study, as it focused mainly on the question, to what extent openness aspects predict academic achievement. Given the substantial predictive validity of intellectual openness and the negative effect of senso-aesthetic openness, further research should investigate in more detail, *how* and *when* these aspects affect performance in academic environments.

As to the first point, various mediators of the relationship between overall openness and academic performance have been identified so far, such as learning approaches (Komarraju et al., 2011) or self-efficacy (J. Zhang & Ziegler, 2016). Those might provide promising starting points for aspect-level analyses—especially for intellectual openness—while disruptive cognitive processes, such as mind-wandering (Randall et al., 2014), might help to understand the negative impact of senso-aesthetic openness. As to the second point, the effect of openness on academic performance differs between academic majors (Vedel, 2016). Thus, it seems advisable to explore whether

the correlation between intellectual openness and academic achievement remains consistent in different academic environments. Unfortunately, such sub-group analyses were not possible in the present study due to insufficient sample sizes. Furthermore, it has been theorized that openness "may have a positive effect in academic performance when artistic, imaginative, and creative intervention of students is highly regarded, but not in other degrees in which systematic, organized, and dutiful performance is required" (Chamorro-Premuzic & Furnham, 2003b, p. 247). From this perspective, senso-aesthetic openness could be less disadvantageous—or even beneficial—in certain academic settings. Consequently, further research should investigate which characteristics of learning environments moderate the relationship between the two openness aspects and academic achievement.

7.4.5 Implications and Conclusion

Although openness has been associated with academic achievement since the very emergence of the five-factor model of personality, most studies have yielded rather disappointing results so far. This steered the research focus towards other, seemingly more valid personality predictors of academic achievement such as conscientiousness. The present study corroborated the notion that the low association between overall openness and academic achievement stems from the opposing effects of the two aspects, namely intellectual and senso-aesthetic openness. It also demonstrated that the criterion-related validity of intellectual openness is at least on par with the industriousness aspect of conscientiousness, contributing to the vindication of openness as a personality dimension with substantial relevance for postsecondary education.

These findings have several implications for both personality research and educational practice. In general, they encourage a stronger research focus on openness aspects, especially intellectual openness, as antecedents of postsecondary academic achievement. They also imply that openness and conscientiousness have both unique and shared effects on academic success and that traits unique to intellectual openness (e.g., quick-wittedness or scientific curiosity) might have more impact than those unique to industriousness (e.g. determination or achievement striving) or those within the overlap of the two domains (e.g., scholastic meticulousness or cognitive perseverance). This might provide further guidance for defining the exact mechanisms that connect

openness and conscientiousness to academic achievement. From a more practical perspective, the results of the present study emphasize the usefulness of aspect-level openness for selection and assessment procedures in postsecondary education (e.g., admission examinations or guidance counselling), either as a parsimonious predictor of academic achievement on its own or as a supplement to aspect-level measures of conscientiousness. Another practical implication can be derived from the finding that orderliness appears to enhance the positive effect of intellectual openness on academic achievement. For instance, it might facilitate the academic success of intellectually open students when educators encourage and reward orderly (i.e., structured and self-organized) learning approaches in order to guide the students' intellectual engagement. However, given the focus of the present study on personality traits instead of external moderators, such as learning environments, this hypothesis remains to be tested.

Overall, the present study illustrated the relative importance of the two openness aspects for academic achievement. Yet, there is much more to learn about the underlying mechanisms and processes. Hopefully, the promising results from this article will encourage personality researchers to explore this somewhat winding and overgrown path.

7.5 Addendum: Replications of the Results

To examine the stability and generalizability of the findings of the present study, all analyses were repeated in three other undergraduate samples mentioned in the Preface. Key results are presented in Table 15, while more detailed results are shown in Tables 31 through 36 in Appendix B.3.

Overall, the bivariate correlations between both, the two openness aspects (i.e., intellectual and senso-aesthetic openness) and the two conscientiousness aspects (i.e., industriousness and orderliness) and the GPA criterion showed converging patterns in two of the three other samples. However, neither intellectual openness ($r = .14$, $p = .082$), nor industriousness ($r = .10$, $p = .210$) showed a statistically significant correlation with GPA in a sample of 167 psychology students.

Similarly, the two openness aspects did not show incremental validity over the two conscientiousness aspects for GPA in said sample, $\Delta R^2 = .02$, $F(2, 162) = 1.43$,

$p = .244$. Furthermore, the two conscientiousness aspects did not show incremental validity over the two openness aspects in any of the three other samples.

In contrast, the psychology sample was the only one, in which the interaction effect between orderliness and intellectual openness in the prediction of GPA could be replicated, $\Delta R^2 = .02$, $F(1, 161) = 7.02$, $p = .009$. However, contrary to the results in the present study, the standardized beta weight of the interaction term was negative ($\beta = -.20$, $p = .009$), suggesting that the criterion-related validity of intellectual openness decreased with higher levels of orderliness or—from the complementary point of view—that orderliness became a positive predictor of GPA with decreasing levels of intellectual openness.

With regards to the subjective academic achievement criterion, the bivariate correlations with the two openness aspects were, in general, quite comparable across all four samples. However, the correlation coefficient for industriousness failed to reach statistical significance in the psychology sample ($r = .13$, $p = .095$). Accordingly, the two conscientiousness aspects did not display incremental validity over the two openness aspects, $\Delta R^2 = .01$, $F(2, 162) = 0.50$, $p = .608$, for subjective academic achievement.

Table 15

Replication of the Key Results of the Present Study in the Other Undergraduate Samples

		Other Undergraduate Samples		
	Present Sample ($N = 424$)	Economics ($N = 231$)	Psychology ($N = 167$)	Miscellaneous ($N = 314$)
Grade Point Average				
Bivariate Correlations				
Openness	.16**	.17*	.07	.07
O-INT	.31***	.27***	.14	.18**
O-SAE	−.05	.02	−.01	−.06
Conscientiousness	.19***	.21**	.09	.15**
C-IND	.28***	.25***	.10	.16**
C-ORD	.05	.11	.05	.10
Regression Coefficients				
O-INT	.36***	.28***	.16	.20***
O-SAE	−.15**	−.04	−.07	−.09
Incremental Validity				
O-Aspects over C-Aspects (ΔR^2)	.05***	.04*	.02	.02*
C-Aspects over O-Aspects (ΔR^2)	.02**	.02	.01	.01
Interaction (C-ORD × O-INT)				
ΔR^2 over the four aspects	.01*	.00	.04**	.00
$\beta_{\text{interaction term}}$	.11*	−.04	−.20**	.01
Subjective Academic Achievement				
Bivariate Correlations				
Openness	.19***	.20**	.21**	.17**
O-INT	.38***	.37***	.29***	.31***
O-SAE	−.07	−.01	.08	−.03
Conscientiousness	.19***	.26***	.09	.26***
C-IND	.33***	.30***	.13	.30***
C-ORD	.01	.16*	.03	.15**
Regression Coefficients				
O-INT	.43***	.39***	.30***	.32***
O-SAE	−.19***	−.10	−.04	−.07
Incremental Validity				
O-Aspects over C-Aspects (ΔR^2)	.08***	.08***	.07**	.05***
C-Aspects over O-Aspects (ΔR^2)	.03***	.03*	.01	.04**

Notes. O-INT = intellectual openness; O-SAE = senso-aesthetic openness; C-IND = industriousness; C-ORD = orderliness.
* $p < .05$. ** $p < .01$. *** $p < .001$.

8 Article 3: Openness Aspects as Predictors of Future Academic and Career Success: A Two-Wave Study

Abstract

Building on the notion that openness consists of two aspects, namely intellectual and senso-aesthetic openness, this study used self-report data from two measurement times to scrutinize these two aspects as predictors of academic and career success. In a sample of 196 undergraduate students from 30 majors, intellectual openness predicted GPA and satisfaction after an average of 27 months. Unexpectedly, the association with academic achievement was not mediated by mind-wandering. An additional cross-sectional regression analysis with data from 250 undergraduate students suggested that intellectual openness explains variance in academic achievement above and beyond self-assessed intelligence and metacognition. Senso-aesthetic openness, on the other hand, was a negative predictor of graduation. Furthermore, in a sample of 132 professionals from 25 occupational fields, intellectual openness did not predict objective career success after an average of 33 months, but various dimensions of subjective career success.

Keywords: Intellectual Openness, Senso-Aesthetic Openness, Mind-Wandering, Academic Success, Career Success

CRediT Statement

Thomas Gatzka: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing; **Benedikt Hell:** Writing – review & editing

8.1 Introduction

Within the five-factor model of personality, *openness* reflects "curiosity about and tolerance for diverse cultural and intellectual experiences" (Vedel & Poropat, 2017, p. 5). Encompassing traits such as open-mindedness, imagination, and reflection, it has often been theorized to be an important determinant of academic achievement (Gatzka & Hell, 2018). However, most studies have found surprisingly low correlations between overall openness and academic success in postsecondary educational settings, which ultimately fostered a research focus on seemingly more relevant personality traits such as conscientiousness (Poropat, 2009; Trapmann et al., 2007). In other words, although many of the traits included in openness "seem to form an cluster of ideal student" (De Raad & Schouwenburg, 1996, p. 327), empirical evidence from several decades has not supported this assumption.

A few years ago, the long-lasting debate about the dichotomous nature of openness (Saucier, 1992) culminated in the notion that openness encompasses two distinct but related trait clusters or *aspects* (DeYoung et al., 2007). While *intellectual openness* reflects a preference for engaging in intellectual activities to explore, learn, and comprehend new information, *senso-aesthetic openness* describes the tendency to immerse oneself into sensory, perceptual, and artistic experiences (DeYoung, 2014).

Subsequent research showed that the two aspects were differentially related to other academically relevant constructs such as cognitive ability (DeYoung et al., 2014), creativity (Kaufman et al., 2016), and need for cognition (Kuijpers et al., 2019). Furthermore, intellectual openness was found to be positively correlated with academic achievement in postsecondary education, whereas senso-aesthetic openness showed a negative association in a recent meta-analysis (Gatzka & Hell, 2018). In addition, the two aspects of openness showed incremental validity above and beyond conscientious-

ness (Gatzka, 2021). These findings suggest that openness may play a more important role in academic settings than previous findings have suggested, and that acknowledging its dichotomous nature may be key to adequately testing this assumption.

The present study seeks to further scrutinize the predictive validity of the two aspects of openness for success criteria in the academic domain and beyond, and to shed light on the nature of these relationships. It extends previous research in four ways. First, it investigates a broader set of success criteria, namely academic achievement (i.e., GPA), academic satisfaction, intended persistence, graduation, and career success. Second, it contributes to efforts to clarify the relationship between openness and career success by using multidimensional measures of both objective and subjective career success. Third, it provides additional insight into the nature of the relationship between the two aspects of openness and academic achievement and satisfaction, respectively, by examining the incremental validity of intellectual openness above and beyond related constructs (i.e., self-assessed intelligence and metacognition) as well as the effect of a possible mediator (i.e., mind-wandering). Fourth and finally, it appears to be the first study to scrutinize the predictive validity of the two openness aspects for *future* success using a two-wave (i.e., time-lagged) research design.

8.1.1 Openness Aspects and Academic Success

Academic Achievement

Previous research suggests that the two openness aspects show different relationships with postsecondary academic achievement (Gatzka, 2021; Gatzka & Hell, 2018), which is the most common indicator of success in higher education (York et al., 2015). Intellectual openness, on one hand, has shown a substantial positive association, which is plausible given that it encompasses academically relevant traits such as cleverness, curiosity, and cognitive engagement (DeYoung et al., 2014). Furthermore, it has shown positive associations with important determinants of learning success, such as fluid intelligence (Nusbaum & Silvia, 2011) and working memory (DeYoung et al., 2009). Senso-aesthetic openness, on the other hand, has shown a modest negative correlation with academic achievement. This is consistent with the assumption that the unconventional and non-intellectual components of openness may interfere with

academic achievement (DeYoung, 2014) and congruent with recent empirical findings that senso-aesthetic openness is negatively related to achievement values (Douglas et al., 2016b).

H1 While (a) intellectual openness is a positive predictor of future academic achievement, (b) senso-aesthetic openness is a negative predictor.

Academic Satisfaction

Another important component of academic success is academic satisfaction (York et al., 2015). Reflecting the "favorability of a student's subjective evaluation of the various outcomes and experiences associated with education" (Elliott & Shin, 2002, p. 198), academic satisfaction has been identified as a determinant of academic achievement (Bean & Bradley, 1986), student persistence (Schreiner & Nelson, 2013), and institutional commitment (Strauss & Volkwein, 2004). While there seems to be no prior research on the relationship between the two aspects of openness and academic satisfaction, a few studies have examined its relationship with overall openness. However, those findings are rather inconsistent as some authors found moderate positive correlations (Pawlowska et al., 2014), while others did not (Wach et al., 2016).

Again, acknowledging the dichotomous nature of openness may provide an explanation. While senso-aesthetic openness appears to have no direct relevance to academic satisfaction, a case can be made for intellectual openness by applying *person-environment fit theory*, which postulates that individuals are more satisfied when their individual traits and needs match with the demands and resources of the environment (Su et al., 2015). Given that intellectual openness encompasses the preference for intellectual stimulation and scholastic activities as well as a willingness to engage in cognitive endeavors (DeYoung, 2014), it seems reasonable to assume that students with higher trait levels will generally look back more favorably on their educational experiences.

H2 While (a) intellectual openness is a positive predictor of future academic satisfaction, (b) senso-aesthetic openness is not.

Intended Persistence and Graduation

Another indicator of academic success is student persistence (York et al., 2015). Given that successful graduation is the ultimate goal for most students in higher education (Pascarella & Terenzini, 2005), it is not surprising that there is plenty of research on the determinants of student retention (Aljohani, 2016). However, that research has often focused on institutional and psychosocial factors, and empirical findings on the role of openness are few and far between. Moreover, certain studies have found no relationship between openness and retention (e.g., Trapmann et al., 2007), whereas more recent, longitudinal research has indeed reported a positive association (e.g., Hoff et al., 2021).

Unfortunately, there appears to be no research on the relationship between student persistence and the two aspects of openness. Yet, some inferences can be made from empirical findings for overall openness. For example, overall openness has been associated with antecedents of student persistence such as academic self-efficacy (J. Zhang & Ziegler, 2016), intrinsic academic motivation (Schwaba et al., 2019), achievement motivation (Richardson & Abraham, 2009), and learning goal orientation (Payne et al., 2007). It seems reasonable to assume that these associations are mainly due to the intellectual rather than the senso-aesthetic aspect of openness. Consequently, the preference of students high in intellectual openness to engage in cognitive endeavors and their commitment to academic goals should result in a higher level of persistence (S. D. Brown et al., 2008). Senso-aesthetic openness, on the other hand, seems to have no apparent relevance for student persistence. Thus, the lack of relationship between overall openness and this indicator of academic success may—analogous to academic achievement—be obfuscated by incongruent effects of the two openness aspects.

H3 Intellectual openness (a) correlates positively with intended persistence and (b) predicts future graduation, whereas (c) senso-aesthetic openness does neither.

8.1.2 Openness Aspects and Career Success

Finally, there is another more distal—but nonetheless crucial—indicator of academic success, namely career success (York et al., 2015). Defined as “the positive psychological and work-related outcomes accumulated as a result of one’s work experiences” (Seibert

& Kraimer, 2001, p. 2), career success can be seen as a manifestation of the long-term goal of higher education to "enable [the students] to be economically self-sufficient and civically responsible post college" (Kinzie & Kuh, 2017, p. 19). While early research on career success focused primarily on objective or extrinsic indicators such as salary, promotions, and hierarchical position, more recently a consensus has emerged that career success also includes a subjective or intrinsic component, that is, positive evaluations made by individuals about their career accomplishments (Gunz & Heslin, 2005; Judge & Kammeyer-Mueller, 2007).

Although a large body of research has examined the relationship between personality traits and career success, the lack of an apparent link between openness and career success, as well as the inconsistent empirical findings, have fostered a reluctance among researchers to even formulate concrete hypotheses (Gelissen & de Graaf, 2006). For example, in meta-analyses it has been found that openness was generally unrelated to promotions, but had a small positive correlation with income and moderate associations with subjective career success (Ng et al., 2005; Ng & Feldman, 2014). More recent longitudinal studies, on the other hand, found that overall openness predicted job satisfaction—one indicator of subjective career success—as well as occupational status and prestige, but not income (Schwaba et al., 2019), both income and status (Ganzach & Pazy, 2015), or status, but not income or career satisfaction (Hoff et al., 2021). Finally, the sparse facet-level results indicated that intellectual openness (as reflected by the *openness to ideas* facet) was associated with less work-family conflict (Wille et al., 2013)—another indicator of subjective career success—as well as with higher hierarchical status and salary, but not with job satisfaction (Sutin et al., 2009).

Again, acknowledging the dichotomy of the openness dimension may help to disentangle these inconsistencies. For example, the propensity to "job hopping" (Judge et al., 1999, p. 625), which some authors have attributed to higher levels of openness (Wille et al., 2010), might be mainly due to the preference for change, novelty, and variety, as well as to the reduced striving for security and conformity associated with senso-aesthetic openness (Douglas et al., 2016b). This, in turn, could have a negative impact on indicators of objective career success such as salary and hierarchical status. Individuals high in intellectual openness, on the other hand, may have both the motivation (i.e., the desire for intellectual stimulation and the willingness to engage in cognitive efforts) and the means (i.e., cognitive flexibility and resourcefulness) to

either consciously choose or be promoted into jobs of greater complexity and thus higher pay and status. This may also explain the finding that overall openness is a strong predictor of upward job mobility into managerial and professional positions (Nieß & Zacher, 2015).

More recently, scholars have advocated a more comprehensive, multidimensional construct definition of subjective career success that includes various facets such as personal growth, work-life balance, meaningful work, personal fulfillment, and self-determination (Briscoe et al., 2021; Shockley et al., 2016; Zhou et al., 2013). This notion may prove useful in disentangling the relationship between subjective career success and aspect-level openness. For example, intellectual openness should be related to personal growth and development because of its obvious association with learning. Furthermore, it might predict subjective career facets such as recognition, influence, and meaningfulness, as individuals with higher trait levels can be described as resourceful, cognitively engaged individuals who enjoy solving complex problems (DeYoung, 2014). Senso-aesthetic openness, on the other hand, appears to have no apparent links to these or other facets of subjective career success. This would be consistent with the rather modest correlations that previous studies have found for overall openness, given that the vast majority of openness scales measure a composite of the two aspects.

H4 Intellectual openness is a positive predictor of future (a) salary, (b) occupational status, and (c) subjective career success, whereas senso-aesthetic openness is a negative predictor of future (d) salary and (e) status, but (f) not subjective career success.

8.1.3 How Are the Openness Aspects Related to Academic Success?

Incremental Validity over Self-Assessed Intelligence and Metacognition

Since its earliest conceptualizations, openness has been associated with cognitive abilities (Borgatta, 1964; Cattell, 1957), and some scholars have even suggested that intelligence should be considered a facet of intellectual openness (DeYoung, 2014; DeYoung et al., 2012). Accordingly, measures of intellectual openness such as the *Intellect* scale in the *Big Five Aspect Scales* (DeYoung et al., 2007), are substantially saturated with items that can be seen as measures of self-assessed intelligence (e.g., “Can handle

a lot of information."). Indeed, recent research has found a substantial correlation between intellectual openness and self-assessed intelligence (Zajenkowski & Matthews, 2019). In addition, self-assessed intelligence has been found to correlate with objectively tested intelligence (Ackerman & Wolman, 2007) and to have incremental validity over tested intelligence in predicting academic performance (Chamorro-Premuzic & Furnham, 2006b).

From a complementary perspective, measures of intellectual openness arguably reflect knowledge or awareness of one's own cognitive processes (e.g., "Formulate ideas clearly"). Similar to subjective intelligence, this type of cognition about cognitive phenomena—or simply "metacognition" (Flavell, 1979, p. 906)—has been found to correlate with both objective intelligence and academic performance (Ohtani & Hisasaka, 2018).

Taken together, one might argue that the relationship between intellectual openness and academic achievement is largely due to the overlap with self-assessed intelligence and metacognition. However, empirical results suggest that measures of intellectual openness also tap into the domain of *intellectual investment* (Christensen et al., 2019; Woo, Chernyshenko, Longley, et al., 2014). In short, intellectual investment subsumes various traits that reflect a general tendency "to seek out, engage in, enjoy, and continuously pursue opportunities for effortful cognitive activity". (von Stumm, Chamorro-Premuzic, & Ackerman, 2011, p. 225). Such traits have been found to be valid predictors of academic achievement (von Stumm & Ackerman, 2013), even above and beyond objectively measured intelligence (von Stumm, Hell, et al., 2011). Therefore, intellectual openness should show incremental validity over self-assessed intelligence and metacognition in predicting academic achievement.

H5 Intellectual openness explains variance in academic achievement above and beyond self-assessed intelligence and metacognition.

Mind-Wandering as a Mediator

Given the cognitive orientation of openness (Pytlik Zillig et al., 2002), cognitive processes may be part of the mechanism that differentially links the two aspects of openness to academic achievement. One such process, *mind-wandering*, describes the tendency of

"engaging in cognitions unrelated to the current demands of the external environment" (Schooler et al., 2011, p. 319) and can be conceptualized as both a transient state and a stable personality trait (Mrazek et al., 2013). Previous research has found that it interfered with learning-related processes such as memory (Thomson et al., 2014) and sustained attention (Stawarczyk et al., 2011). Consequently, mind-wandering has also been associated with performance deficits in educational settings such as reduced retention of lecture material (Risko et al., 2012), scores on in-class quizzes (Kane, Smeekens, et al., 2017) and GPA (N. A. Moon et al., 2020).

Openness has been theorized to increase the likelihood of mind-wandering "due to a richer inner life, expressed in extensive processes of thinking together with plentiful availability of ideas and thoughts" (Ibaceta & Madrid, 2021, p. 2). Accordingly, overall openness has been empirically associated with the occurrence of everyday mind-wandering (Kane, Gross, et al., 2017) as well as habitual mind-wandering (Marcusson-Clavertz & Kjell, 2019).

Again, it is crucial to consider the dichotomous nature of openness. The definition of mind-wandering as "drifting away from a task toward unrelated inner thoughts, fantasies, feelings, and other musings" (Smallwood & Schooler, 2006, p. 946) bears a remarkable resemblance to two of the six facets of openness (Costa & McCrae, 2010), namely *openness to fantasies* and *openness to feelings*. These two facets are markers of senso-aesthetic openness, which indeed showed a negative effect on academic performance (Gatzka & Hell, 2018). Furthermore, senso-aesthetic openness includes traits such as apophenia and absorption, which may facilitate the engagement in "cognitive processes akin to dreaming while awake" (DeYoung et al., 2012, p. 76). Thus, senso-aesthetic openness might facilitate mind-wandering, which in turn should interfere with academic performance. In contrast, intellectual openness might prevent mind-wandering given its focus on intellectual efficiency (Woo, Chernyshenko, Longley, et al., 2014) and cognitive quickness (DeYoung et al., 2007). Furthermore, it has been empirically linked to brain activity associated with information integration, goal-directed performance monitoring, and working memory capacity (DeYoung et al., 2009), which in turn has been found to reduce mind-wandering during cognitively challenging daily activities (Kane, Gross, et al., 2017).

H6 The relationship between (a) intellectual openness and (b) senso-aesthetic openness and academic achievement is at least partially mediated by mind-wandering.

8.2 Method

8.2.1 Procedure and Participants

Data were collected at two measurement times. The first (t1) was in March 2018. Student organizations at all postsecondary educational institutions in German-speaking Switzerland were contacted and asked to extend an e-mail invitation to their students to participate in a study on openness and academic success. Those willing to participate completed an online questionnaire that included the measures described below. In return, students received individual feedback on their Big Five personality traits[17] and were offered the opportunity to win one of ten gift certificates ranging in value from approximately 25 to 100 US dollars. A total of 1,136 undergraduate students (69% female) with a mean age of 24.4 years ($SD = 4.9$) from 14 different institutions completed the questionnaire. They were enrolled in 47 different majors, with economics (21%), psychology (18%), and nursing (8%) being the three most frequent majors. The sample consisted of 37% freshmen, 28% sophomores, 25% juniors, and 10% seniors. A post hoc analysis showed statistical power of .80 to detect a correlation of .08 at a significance level of .05.

The second time of measurement (t2) was in June 2022. Of the 1,136 undergraduate students who participated at t1, 571 (50%) had provided a personal e-mail address that was used to invite them directly to the follow-up measurement, which contained the measures described further below. In return, they were offered the opportunity to win one of five gift certificates worth approximately 50 US dollars each. After an initial invitation and two reminders over the course of two weeks, 278 subjects (49%) completed the second online questionnaire (74% female). The mean age of the participants was 28.5 years ($SD = 5.1$). A post-hoc analysis showed a statistical power of .80 to detect a correlation of .17 at a significance level of .05.

[17] For this purpose only, participants also completed the short form of the *Big Five Inventory-2* (Soto & John, 2017a), which was not included in other analyses.

One hundred and ninety-six subjects (73% female) had either not graduated at t2 ($n = 28$, 14%) or had graduated at least 12 months after t1 ($n = 168$, 76%). This *academic subsample* was used in the time-lagged analyses to determine the validity of the two openness aspects as predictors of *future* academic success. The mean age of the subjects was 28.1 years ($SD = 5.0$) and they had been enrolled in 30 different majors, with psychology (17%), economics (14%), and nursing sciences (12%) being the three most frequent. The average time lag between t1 and graduation was 26.5 months ($SD = 8.6$).

One hundred and thirty-two subjects (78% female) were currently employed at t2, had started their careers *after* t1 and had at least 12 months of work experience at t2[18]. This *career subsample* was used in the time-lagged analyses to determine the validity of the two openness aspects as predictors of *future* career success. The mean age was 28.4 years ($SD = 4.7$) and they worked in 25 different occupational fields, with nursing (15%), physiotherapy (12%), and education (12%) being the three most frequent. The average career duration was 32.7 months ($SD = 10.8$), the average job tenure was 22.5 months ($SD = 13.1$), and the subjects worked an average of 34.9 hours per week ($SD = 9.2$).

8.2.2 Measures

The following self-report measures were presented with a 5-point Likert scale. Participants were instructed to indicate the extent to which each item applied to them personally, ranging from 0 (“not at all”) to 4 (“fully”), unless noted otherwise.

Individual Differences

The two openness aspects were measured at both t1 and t2 using the openness scale of the *Big Five Aspect Scales* (BFAS; DeYoung et al., 2007). Each aspect was assessed with 10 items. Example items are “I like to solve complex problems.” (intellectual openness) and “I see beauty in things that others might not notice” (senso-aesthetic openness). Cronbach’s alpha for intellectual openness was .78 at t1 and .77 at t2. For

[18] These restrictions were imposed to ensure the validity and reliability of the career success criteria and to establish a temporal order between the predictors and the criteria.

senso-aesthetic openness, the values were .76 and .73, respectively. Retest-reliability (4;3 years) was .72 for intellectual openness and .73 for senso-aesthetic openness.

Mind-wandering was measured at both t1 and t2 using the Mind-Wandering-Questionnaire (MWQ; Mrazek et al., 2013), consisting of 5 items (e.g., "I do things without paying full attention"). Cronbach's alpha was .64 at t1 and .68 at t2, while retest-reliability was .58.

Self-assessed intelligence was measured only at t2, using the single item suggested by Chamorro-Premuzic and Furnham (2006b). It consisted of a brief description of the IQ concept (including its mean and standard deviation) and a visual depiction of a bell curve with ranges for *mild retardation*, *borderline retardation*, *low average*, *average*, *above average*, *superior*, and *gifted*. Participants indicated their self-assessed IQ by entering a numerical value.

Metacognition was measured only at t2, using two different scales. The first was the *Cognitive Self-Consciousness* subscale from the short form of the *Metacognitions Questionnaire* (Arndt et al., 2011). It consisted of six items (e.g., "I am aware of the way my mind works when I am thinking through a problem.") and had a Cronbach's alpha of .81. The second was the *Declarative Knowledge* subscale from the *Metacognitive Awareness Inventory* (Schraw & Dennison, 1994). It consisted of 8 items (e.g., "I understand my intellectual strengths and weaknesses.") and had a Cronbach's alpha of .74.

Academic Success

As a measure of academic achievement, participants reported their current GPA at t1 and their final GPA at t2. The standard Swiss grading system was used with 6.0 being the highest possible grade and 1.0 the lowest.

Academic satisfaction was measured at both t1 (current satisfaction) and t2 (respective overall satisfaction) with seven items (e.g., "I feel satisfied with the decision to major in my intended field.") from Lent et al. (2005). Cronbach's alpha was .82 at t1 and .86 at t2.

Intended study persistence was measured only at t1, using three items (e.g., "I am fully committed to getting my college degree in my intended major field.") from Lent et al. (2005). Because most undergraduate programs in Switzerland last three years,

this scale was not administered to students above the fifth (i.e., penultimate) semester. Cronbach's alpha was .66. At t2, participants indicated whether they had successfully completed their original study program (0 = *no*, 1 = *yes*).

Career Success

Objective career success was measured in two ways only at t2. First, participants reported their current gross monthly salary in Swiss Francs for their current working hours, from which the full-time salary (i.e., 42 hours per week) was calculated. Second, current hierarchical status was measured by the sum of three dichotomous items (0 = *no*, 1 = *yes*), as suggested by Abele and Spurk (2009). Participants indicated whether they were currently allowed to delegate work, had project responsibility, and held an official leadership position. The Kuder-Richardson reliability coefficient (KR20) for the resulting scale was .49.[19]

Subjective career success was measured only at t2, using the *Subjective Career Success Inventory* (SCSI; Haenggli & Hirschi, 2020). The SCSI contains 24 items, evenly distributed across eight subscales, namely *Recognition* (e.g., "I have been recognized for my contributions.") *Quality Work* (e.g., "I am proud of the quality of the work I have produced."), *Meaningful Work* (e.g., "I believe my work has made a difference."), *Influence* (e.g., "Decisions that I have made have impacted my organization.") *Authenticity* (e.g., "I have felt as though I am in charge of my own career."), *Personal Life* (e.g., "I have been able to spend the amount of time I want with my friends and family."), *Growth and Development* (e.g., "I have continuously improved by developing my skill set."), and *Satisfaction* (e.g., "I am enthusiastic about my career."). Cronbach's alpha for the subscales ranged from .62 (Influence) to .87 (Meaningful Work) and was .91 for the overall scale. This measure was only administered to participants who had at least 12 months of total work experience at t2.

Control Variables

Several control variables that have been previously found to affect career success (Abele & Spurk, 2009; Spurk et al., 2016) were measured at t2 for inclusion in the

[19] This value should be interpreted with caution because the three indicators of objective career success do not meet the underlying assumption of internal consistency (i.e., being tau-equivalent).

corresponding regression analyses, namely age (in years), gender (1 = *female*, 2 = *male*), contractual working hours, organization size (i.e., number of employees; 1 = *less than 5*, 2 = *5 to 9*, 3 = *10 to 49*, 4 = *50 to 249*, 5 = *250 to 999*, 6 = *1000 and more*), career length and job tenure (in months), occupational field, and final GPA (as described above).

8.3 Results

8.3.1 Bivariate Correlations

Descriptive statistics and bivariate correlations for all predictor and criterion variables at t1 and t2 are presented in Table 16. In the following paragraphs, only those that are relevant to the previously stated hypotheses are discussed.

Intellectual openness at t1 was positively related to GPA at t2 ($r = .23$, $p < .001$), whereas senso-aesthetic openness at t1 was not ($r = .02$, $p = .707$). This supported H1a, but not H1b.

Consistent with H2a, intellectual openness at t1 was positively related to academic satisfaction at t2 ($r = .13$, $p = .034$). However, the results were inconsistent with H2b, as senso-aesthetic openness at t1 did not correlate with academic satisfaction at t2 ($r = .00$, $p = .995$).

Supporting H3a, intellectual openness at t1 was positively related to intended persistence at t1 ($r = .12$, $p = .001$). However, contrary to H3b, it showed no association with graduation at t2 ($r = .02$, $p = .802$). Inconsistent with H3c, senso-aesthetic openness at t1 correlated positively with intended persistence at t1 ($r = .16$, $p < .001$) and negatively with graduation completion at t2 ($r = -.14$, $p = .018$).

Contrary to H4a, intellectual openness at t1 did not correlate with salary at t2 ($r = .13$, $p = .055$). However, in support of H4b and H4c, it showed positive correlations with hierarchical status ($r = .18$, $p = .005$) and subjective career success ($r = .30$, $p < .001$) at t2. Inconsistent with H4d and H4e, senso-aesthetic openness at t1 was not negatively correlated with salary ($r = -.09$, $p = .189$) or hierarchical status ($r = .12$, $p = .065$) at t2. However, consistent with H4f, it was also unrelated to subjective career success at t2 ($r = .12$, $p = .085$).

With regard to H5, intellectual openness at t2 showed significant correlations with metacognitive declarative knowledge ($r = .57$, $p < .001$), self-assessed intelligence ($r = .42$, $p < .001$), and cognitive self-consciousness ($r = .26$, $p < .001$) at t2. However, only the former was correlated with GPA at t2 ($r = .19$, $p = .002$), while the latter two did not ($r = .11$, $p = .081$ and $r = .08$, $p = .231$, respectively).

As to H6a and H6b, intellectual openness at t1 was negatively correlated with mind-wandering at t2 ($r = -.14$, $p = .020$), while senso-aesthetic openness at t1 did not show the expected positive association ($r = .02$, $p = .696$). Furthermore, mind-wandering at t1 did not show any relationship with GPA at t2 ($r = -.07$, $p = .287$), reducing the possibility of a significant mediation effect.

8.3.2 Path and Regression Analyses

Due to the study design and the fact that students were in different semesters at t1 the measure of GPA "at t2" actually was a measure of GPA "at some point between t1 and t2", which varied across the subjects. As noted earlier, the average time lag between t1 and the obtainment of the final GPA (i.e., GPA "at t2") in the academic subsample was 26.5 months ($SD = 8.6$). Consequently, any seemingly cross-sectional analysis at t2 that used GPA as the criterion also included a temporal component (i.e., the time lag between the obtainment of the final GPA and the measurement of the predictors at t2). To rule out that this affected the analyses, a stepwise regression analysis was first conducted to determine whether the time lag between t1 and graduation moderated the relationship between each relevant predictor (i.e., the two openness aspects at t1 and t2, mind-wandering at t1, and self-assessed intelligence and metacognition at t2) and final GPA. This was not the case, as none of the interaction terms reached statistical significance and their inclusion in the regression model did not significantly improve its coefficient of determination, $\Delta R^2 = .03$, $F(9, 150) = 0.67$, $p = .737$. Therefore, no additional tests for time lag moderation were included in the following analyses.

Hypotheses 1 and 2 (Academic Achievement and Satisfaction)

H1 and H2 were tested in the academic subsample without the 28 students who did not complete their studies and therefore did not provide a final GPA. A Maximum-Likelihood path analysis was computed using the *lavaan* package (Rosseel, 2012) for *R*

Table 16

Descriptive Statistics and Intercorrelations of the Personality and Criterion Variables at t1 and t2

Variable	*N*	*M*	*SD*	1	2	3	4	5	6	7
March 2018 (t1)										
1. O-INT	1,136	26.57	5.23	(.78)						
2. O-SAE	1,136	25.31	5.86	.25***	(.76)					
3. MW	1,136	10.06	2.97	−.23***	.11***	(.64)				
4. GPA	1,136	4.90	0.38	.26***	−.01	−.16***	—			
5. ASAT	1,136	20.38	3.92	.20***	.08*	−.21***	.17***	(.82)		
6. IPER	751	9.66	2.31	.12***	.16***	−.09*	.04	.36***	(.66)	
June 2022 (t2)										
7. O-INT	278	27.46	4.90	.72***	.13*	−.21***	.12	.14*	.12	(.77)
8. O-SAE	278	25.10	5.47	.12*	.73***	.12*	−.11	.09	.11	.13*
9. MW	278	9.97	3.07	−.14*	.02	.58***	−.09	−.06	−.13	−.25***
10. SAI	278	109.00	9.88	.33***	−.04	.10	.03	.05	.05	.42***
11. MC-CSC	278	13.66	4.11	.15*	.18**	.11	.03	.14*	−.02	.26**
12. MC-DK	278	23.20	3.50	.41***	.04	−.16**	.11	.16**	.02	.57***
13. GPA	250	5.08	0.28	.23***	.02	−.07	.65***	.08	−.06	.26***
14. ASAT	250	20.42	4.13	.13*	.00	−.26**	.09	.51***	.16*	.25**
15. GRAD	278	0.90	0.30	.02	−.14*	−.01	.27***	.00	−.04	.04
16. SAL	232	6,513.17	1,357.45	.13	−.09	.10	.19**	−.10	−.09	.06
17. HSTAT	236	1.24	0.93	.18**	.12	−.01	.04	.02	−.14	.14*
18. SCS	199	69.17	11.51	.30**	.12	−.12	−.10	.27***	.20*	.37***

continued on the next page

Table 16 (continued)

Descriptive Statistics and Intercorrelations of the Personality and Criterion Variables at t1 and t2

Variable	8	9	10	11	12	13	14	15	16	17	18
8. O-SAE	(.73)										
9. MW	.05	(.68)									
10. SAI	.02	.13*	—								
11. MC-CSC	.31***	.05	.11	(.81)							
12. MC-DK	.03	−.23***	.31***	.16**	(.74)						
13. GPA	.03	−.08	.11	.08	.19**	—					
14. ASAT	.09	−.16*	.00	.06	.20**	.11	(.86)				
15. GRAD	−.16**	.01	.00	−.06	.05	—	—	—			
16. SAL	−.16*	.16*	.09	.00	.01	.11	.02	.22***	—		
17. HSTAT	.06	.06	.06	.06	.05	.11	.08	.02	.22***	(.49)	
18. SCS	.05	−.14*	.14	.10	.37***	.00	.40***	−.07	.10	.17*	(.91)

Notes. O-INT = intellectual openness; O-SAE = senso-aesthetic openness; MW = mind-wandering; ASAT = academic satisfaction; IPER = intended persistence; SAI = self-assessed intelligence; MC-CSC = metacognition: cognitive self-consciousness; MC-DK = metacognition: declarative knowledge; GRAD = graduation (0 = no, 1 = yes); SAL = monthly full-time salary (42 hours per week); HSTAT = hierarchical status; SCS = subjective career success. Values in parentheses are Cronbach's Alphas.
* $p < .05$. ** $p < .01$. *** $p < .001$.

(R Core Team, 2019). The resulting path model, in which GPA and academic satisfaction at t2 were regressed on intellectual and senso-aesthetic openness at t1, is depicted in Figure 4.[20]

Intellectual openness at t1 predicted future academic achievement ($\beta = .27, p < .001$). Thus, H1a was accepted. On the other hand, the negative path coefficient from senso-aesthetic openness at t1 to GPA at t2 did not reach statistical significance ($\beta = -.13, p = .100$). Therefore, H1b was rejected.

Future academic satisfaction was predicted by intellectual openness at t1 ($\beta = .18, p = .021$), but not by senso-aesthetic openness at t1 ($\beta = -.06, p = .443$). Therefore, both H2a and H2b were accepted.

Hypothesis 3 (Student Persistence)

H3 was tested in the academic subsample with a reduced sample size of 174 due to missing data on the intended persistence criterion at t1 for 22 students. Because of the binary graduation criterion, a separate path model was computed using the *Weighted Least Square Mean and Variance Adjusted* estimator (Beauducel & Herzberg, 2006). The resulting path model, in which graduation at t2 was regressed on intellectual and senso-aesthetic openness and intended persistence at t1, is shown in Figure 5.

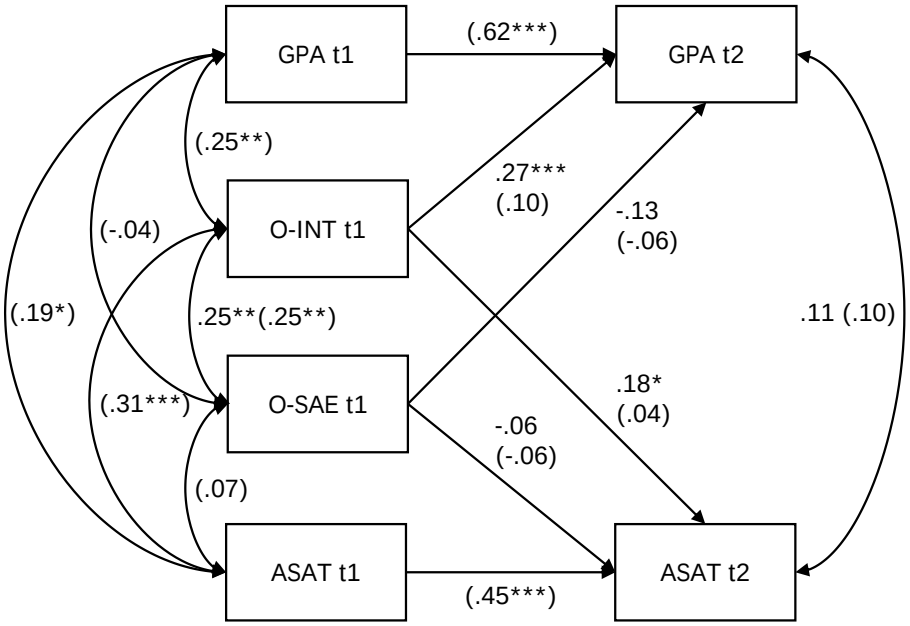
Intellectual openness at t1 was related to intended persistence at t1 ($r = .18$, $p = .025$). Thus, H3a was accepted. However, it did not predict future graduation ($\beta = .05$, $p = .618$), which led to the rejection of H3b.

Senso-aesthetic openness at t1, on the other hand, showed an unexpected positive correlation with intended persistence at t1 that barely missed statistic significance ($r = .15$, $p = .059$). Furthermore, it was a negative predictor of future graduation ($\beta = -.28$, $p = .014$). Thus, H3c was rejected.

[20] As noted by Morgan and Winship (2014), including a prior measure of the dependent variable as a covariate in a regression model can provide further insight into the main predictor, as it—among other things—controls for omitted variables and thus provides a more robust estimate of a possible causal effect of the main explanatory variable on the outcome. However, the interpretation of such a *lagged dependent variable model* warrants caution, as it may lead to biased parameter estimates (for a more in-depth discussion see Wilkins, 2018). Although the hypotheses did not assume a direct causal effect of the two aspects of openness on GPA and academic satisfaction, the results of the lagged dependent variable model are also included (in parentheses) in Figure 4. Notably, this reduced the path coefficients of intellectual openness to statistically insignificant levels for both GPA ($\beta = .10, p = .110$) and academic satisfaction ($\beta = .04, p = .565$).

Figure 4

Standardized Path Coefficients for the Prediction of Future Academic Success



Notes. $N = 168$; O-INT = intellectual openness; O-SAE = senso-aesthetic openness; ASAT = academic satisfaction. Values in parentheses are from the lagged depended variables model (see Footnote 20).
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 17

Summary of the Regression Analyses of the Three Career Success Criteria at t2 on the two Openness Aspects at t1

	Career Success Criterion (t2)		
Predictor	Salary	Hierarchical Status	Subjective Success
Control Variables (t2)			
Age	.18*	.03	−.06
Gender[a]	.08	.07	.08
Working hours	−.05	.17	.12
Organization size	.16*	−.13	−.29**
Career length	.19*	.04	−.09
Job tenure	−.04	.32**	.22*
Occupational field[b]	.04	.15	.00
GPA	−.07	.05	.10
Openness Aspects (t1)			
Intellectual openness	.11	.11	.30**
Senso-aesthetic openness	−.22**	.26**	.13

Notes. $N = 130$ for salary, $N = 132$ for hierarchical status and subjective career success.
[a] Female = 1, male = 2.
[b] Mean beta coefficient across all dummy-coded occupational fields.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Hypothesis 4 (Career Success)

H4 was tested in the career subsample. Although it was originally planned to conduct another path analysis, this proved impossible because the large number of dummy-coded control variables for occupational fields resulted in convergence failures. Therefore, separate multiple regressions were computed for each career success criterion. The results are presented in Table 17.

Intellectual openness at t1 did not predict either salary ($\beta = .11$, $p = .181$) or hierarchical status ($\beta = .05$, $p = .251$) at t2. Therefore, H4a and H4b were rejected. However, it was a positive predictor of subjective career success at t2 ($\beta = .30$, $p = .005$), so H4c was accepted.

Senso-aesthetic openness, on the other hand, was a negative predictor of salary at t2 ($\beta = -.22$, $p = .006$), but did not predict subjective career success at t2 ($\beta = .13$, $p = .209$). Thus, H4d and H4f were accepted. However, it was also a *positive* predictor of hierarchical status at t2 ($\beta = .26$, $p = .009$), leading to the rejection of H4e.

To gain further insight into the relationship between the two openness predictors and subjective career success, additional multiple regression analyses were computed for each dimension of subjective career success. The results are presented in Table 18.

Intellectual openness predicted four of the eight dimensions, namely quality work ($\beta = .29$, $p = .004$), growth and development ($\beta = .28$, $p = .009$), meaningful work ($\beta = .23$, $p = .016$), and influence ($\beta = .23$, $p = .028$). Senso-aesthetic openness, on the other hand, predicted only two dimensions, that is, recognition ($\beta = .25$, $p = .015$) and influence ($\beta = .22$, $p = .029$).

Hypothesis 5 (Incremental Validity)

Since H5 was not longitudinal in nature, it was tested in the total t2 sample (excluding the 28 dropouts) through stepwise regression analyses. First, GPA was regressed on either self-assessed intelligence and metacognition (model 1a) or intellectual openness alone (model 1b). Second, all of these predictors were included together in the regression model (model 2). The results are shown in Table 19.

The only significant predictor from model 1a, namely metacognitive declarative knowledge ($\beta = .17, p = .012$), became insignificant in model 2 ($\beta = .07, p = .370$), while intellectual openness was a positive predictor of GPA in both model 1b ($\beta = .26, p < .001$) and model 2 ($\beta = .22, p = .008$). Furthermore, intellectual openness explained variance in GPA above and beyond self-assessed intelligence and metacognition, $\Delta R^2 = .03$, $F(1, 245) = 7.39$, $p = .007$, but not vice versa, $\Delta R^2 = 0.00$, $F(3, 245) = 0.77$, $p = .846$. Thus, H5 was accepted.

Hypothesis 6 (Mediation)

H6 was tested in the academic subsample (excluding the 28 dropouts) through a separate path analysis. Following the approach suggested by Little et al. (2007), a path model was computed in which mind-wandering at t2 was regressed on intellectual and senso-aesthetic openness as well as on mind-wandering at t1. Moreover, GPA at t2 was regressed on mind-wandering, GPA, and the two openness aspects at t1. The standardized path coefficients are presented in Table 20.

The indirect effects of each openness aspect on GPA through mind-wandering was then determined by multiplying the two respective path coefficients. Confidence

Table 18

Summary of the Regression Analyses of the Eight Subjective Career Success Criteria at t2 on the two Openness Aspects at t1

	Subjective Career Success Dimension (t2)							
Predictor	REC	QW	MW	INF	AUT	PL	GD	SAT
Control Variables (t2)								
Age	−.03	−.13	−.06	−.05	.04	−.08	−.06	.05
Gender[a]	.02	−.18	.10	.11	−.02	.21	−.01	.09
Working hours	.11	.07	.00	.09	.18	.03	−.04	.21
Organization size	−.18	−.26*	−.13	−.29**	−.24*	−.11	−.15	−.32**
Career length	−.02	.10	−.19	−.05	−.18	.00	−.09	−.02
Job tenure	.05	.20*	.26**	.23*	.15	.08	.25*	.02
Occupational field[b]	.00	.11	−.01	.03	.01	.00	−.04	−.07
GPA	−.01	.04	.03	.03	.06	−.06	.02	−.03
Openness Aspects (t1)								
Intellectual openness	.14	.29**	.23*	.23*	.18	.19	.28**	.18
Senso-aesthetic openness	.25*	.09	.02	.22*	.07	−.04	.18	.00

Notes. $N = 132$. REC = recognition; QW = quality work; MW = meaningful work; INF = influence; AUT = authenticity; PL = personal life; GD = growth and development; SAT = satisfaction.

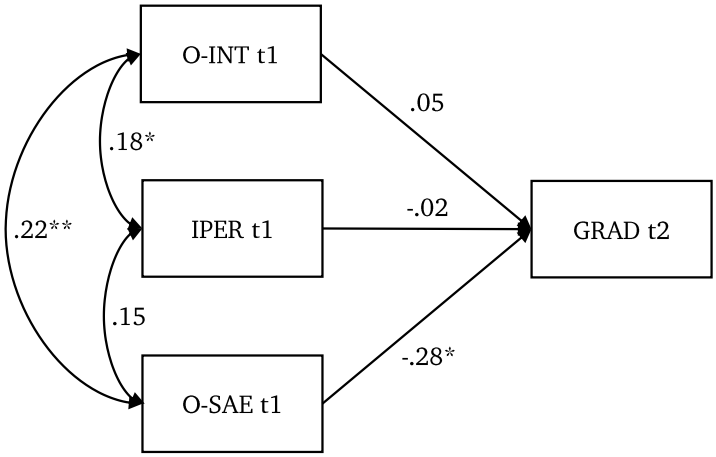
[a] Female = 1, male = 2.

[b] Mean beta coefficient across all dummy-coded occupational fields.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Figure 5

Standardized Path Coefficients for the Prediction of Future Graduation



Notes. $N = 174$; O-INT = intellectual openness; O-SAE = senso-aesthetic openness; IPER = intended persistence; GRAD = graduation (0 = no; 1 = yes). * $p < .05$. ** $p < .01$

Table 19

Summary of the Stepwise Regression Analyses of GPA on Self-Assessed Intelligence, Metacognition, and Intellectual Openness at t2

Predictor	Model 1a	Model 1b	Model 2
Self-assessed intelligence	.06		.00
Metacognition			
Cognitive self-consciousness	.04		.00
Declarative knowledge	.17*		.07
Intellectual openness		.26***	.22**
R^2	.04*	.07***	.07**
ΔR^2 over Model 1a/1b			.03**/.00

Notes. $N = 250$.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 20

Standardized Path Coefficients from the Time-Lagged Mediation Analyses

	Regressions		Correlations		
Predictor	GPA t2	MW t2	O-INT t1	O-SAE t1	MW t1
O-INT t1	.10	−.10[a]	—		
O-SAE t1	−.05	−.04[b]	.23**	—	
MW t1	−.04[a,b]	.55***	−.04	.24**	—
GPA t1	.71***	—	.21**	−.03	−.11

Notes. $N = 168$. O-INT = intellectual openness; O-SAE = senso-aesthetic openness; MW = mind-wandering. The product of indexed paths constitutes the indirect effect of (a) intellectual openness and (b) senso-aesthetic openness on GPA through mind-wandering.
** $p < .01$. *** $p < .001$.

intervals were calculated using 5,000 bootstrap samples as suggested by A. F. Hayes (2018). However, the 95% confidence intervals of the indirect effects did not exclude zero for either intellectual openness, [−.01, .03], or senso-aesthetic openness, [.00, .02]. Thus, H6a and H6b were rejected.

8.4 Discussion

The main goal of the present study was to examine the validity of intellectual and senso-aesthetic openness as predictors of future academic and career success. Using a time-lagged research design, divergent effects were found for the two aspects. Intellectual openness was a strong positive predictor of outcomes such as academic performance and satisfaction, as well as of subjective career success, whereas senso-aesthetic openness was largely unrelated or even negatively associated with those outcomes. The following sections discuss these findings—separately for each openess aspect—as well as the limitations of the present study and its implications.

8.4.1 Intellectual Openness as a Predictor of Academic Success

Consistent with previous cross-sectional research (Gatzka, 2021; Gatzka & Hell, 2018), intellectual openness was a strong positive predictor of academic achievement after an average time span of more than two years. The respective effect size was quite compa-

rable to some of the best predictors of academic performance within the individual difference domain, such as conscientiousness (Poropat, 2009), academic self-efficacy (Richardson et al., 2012), and even cognitive ability (Kuncel et al., 2004). This supported the notion that a positive attitude toward cognitive exploration and a preference for intellectual stimulation—or simply, a "hungry mind" (von Stumm, Hell, et al., 2011, p. 582)—might indeed be as important a determinant of objective academic achievement in postsecondary education as the ability and willingness to make cognitive or self-regulatory efforts for the sake of learning. Consequently, both research and educational practice would benefit from a better understanding of the nature of the relationship between intellectual openness and academic achievement.

In this regard, the results showed that intellectual openness predicted academic achievement above and beyond self-assessed intelligence and metacognition. Intellectual openness has previously been associated with cognitive abilities and processes (Bédard & Le Corff, 2020; DeYoung et al., 2014), and the cross-sectional analyses in the present study indeed suggested a substantial overlap with subjective intelligence and metacognition (especially declarative knowledge about one's own cognitive processes). However, the results also suggested that these components of intellectual openness were not the foundation of its relationship with academic achievement, as the regression coefficient for intellectual openness decreased only marginally when self-assessed intelligence and metacognition were controlled for. One possible interpretation is that the affective and behavioral components of intellectual openness (e.g., a positive attitude toward cognitive challenges and an active approach to learning opportunities) are more important drivers of academic achievement than the cognitive processes encompassed by that openness aspect (cf. Pytlik Zillig et al., 2002).

This notion would also be consistent with the finding that—contrary to the hypothesis—mind-wandering did not mediate the relationship between intellectual openness and academic achievement. Interestingly, the cross-sectional correlations at both t1 and t2 were consistent with one of the underlying assumptions of a mediation hypothesis, namely that intellectual openness is negatively related to mind-wandering. Thus, individuals with higher levels of intellectual openness did indeed appear to be less prone to habitual mind-wandering. However, contrary to the expectations and previous findings (N. A. Moon et al., 2020), mind-wandering was not consistently associated with lower GPA. Furthermore, the time-lagged path analysis did not support the assumptions

that intellectual openness prevents mind-wandering or that mind-wandering leads to deficits in academic performance. Taken together, these findings suggest that habitual mind-wandering is not a relevant part of the mechanism that causally links intellectual openness to academic achievement.

Intellectual openness was also a positive predictor of future academic satisfaction. This may be explained by the notion that academic satisfaction reflects a subjective evaluation of learning outcomes (Lent et al., 2005; York et al., 2015), whereas intellectual openness fosters both an active engagement in learning opportunities and a greater appreciation of intellectual growth (DeYoung et al., 2014; Ziegler, Danay, Heene, et al., 2012). Consequently, intellectually open students may have been predisposed to look back more favorably on their postsecondary educational experiences, because they have perceived a better fit between the learning opportunities provided by their academic environment and their individual needs for intellectual stimulation—as suggested by person-environment fit theory (Su et al., 2015). In addition, previous research has shown that intellectual openness is negatively correlated with distress and worry, while it is positively associated with positive affect toward cognitive performance (Zajenkowski & Matthews, 2019). Thus, the higher retrospective academic satisfaction of individuals with a higher intellectual openness may reflect that they perceived their time in higher education as less stressful and past educational challenges as welcome opportunities for intellectual growth.

Results regarding the relationship between intellectual openness and student persistence were mixed. While cross-sectional data suggested a moderate positive correlation with intended persistence, intellectual openness did not predict future graduation. In other words, students with higher trait levels were more likely to *intend* to stay on track with their studies, but not more likely to *actually* graduate. Although previous research has shown that the relationship between intentions and actual behavior is rather modest (Bosco et al., 2015), this inconsistency is somewhat difficult to interpret, because the arguments for a link between intellectual openness and persistence (e.g., the willingness to exert cognitive effort) seem to pertain to both the intentional and behavioral levels. A possible—albeit tentative—explanation might be that the positive affect (Zajenkowski & Matthews, 2019) and uncertainty tolerance (Jach & Smillie, 2021) associated with intellectual openness facilitated a more positive out-

look among students with higher trait levels, but had a negligible effect on the actual decision-making process.

8.4.2 Intellectual Openness as a Predictor of Career Success

Contrary to the present hypotheses and some related previous research (Sutin et al., 2009), intellectual openness did not predict future career success in terms of objective indicators (i.e., salary and hierarchical status). On the one hand, this may suggest that the increased upward mobility into professional and managerial roles that has previously been associated with overall openness (Nieß & Zacher, 2015) may not be due to the intellectual aspect. On the other hand, while individuals with higher trait levels may seek cognitively challenging tasks and intellectually stimulating jobs, they may do so because of an intrinsic motivation and not necessarily because of monetary and hierarchical benefits. This would be consistent with previous research that found intellectual openness to be unrelated to power values or economic life goals (Douglas et al., 2016b).

As expected, intellectual openness was a positive predictor of subjective career success. In fact, the respective beta weight was well above the effect size that has been reported for overall openness (Ng & Feldman, 2014), further emphasizing the usefulness of a dichotomous operationalization of the openness dimension. Overall, the results suggest that individuals with higher trait levels were more positive in their evaluation of their career accomplishments.

Distinguishing the various components of subjective career success (Shockley et al., 2016) provided further insight into this relationship. Intellectual openness predicted four of the eight measured subdimensions of subjective career success, namely growth and development, quality work, meaningful work, and influence. Given that intellectual openness reflects curiosity and a positive attitude toward learning as well as cognitive engagement and efficiency (DeYoung, 2014), and has been associated with cognitive abilities (DeYoung, 2011), it seems reasonable to assume that it facilitates both the growth of professional expertise and a positive valuation of such a development. This interpretation would also be in line with previous research that found overall openness to be correlated with growth need strength (de Jong et al., 2001) and

training performance (Barrick et al., 2001), which may be mainly due to its intellectual components.

With regard to the other three aforementioned subdimensions of subjective career success, the findings suggest that individuals with higher trait levels of intellectual openness had a more positive perceptions of the quality, meaningfulness, and impact of their work. The principles of person-environment fit theory (B. Schneider et al., 1995; Su et al., 2015) suggest that intellectually open individuals are predisposed to seek out cognitively challenging work roles and environments (see also Bipp, 2010). It seems fair to assume that such jobs offer more opportunities to work on complex problems, to generate sophisticated solutions, and to establish oneself as a knowledgeable subject matter expert—especially for those with the "quickness, creativity, and ingenuity" (Judge et al., 2013, p. 876) associated with intellectual openness. In addition, the intellectually open individuals in the present sample may have been more willing and able to reflect on the distal impact of their work, thereby recognizing the quality and importance of their work-related accomplishments at a more abstract level.

8.4.3 Senso-Aesthetic Openness as a Predictor of Academic Success

Senso-aesthetic openness was not a negative predictor of either future academic achievement or satisfaction, suggesting that the role of senso-aesthetic openness as a determinant of academic achievement and satisfaction is, at best, minute. This seems plausible given that the core characteristics of this aspect (i.e., a preference for sensory information processing and aesthetic stimulation) have no apparent relevance to academic activities in general.

The picture was quite different with regard to the criterion of future graduation, for which senso-aesthetic openness was unexpectedly a strong negative predictor. In other words, students with higher trait levels were more likely to discontinue the pursuit of their postsecondary degree. Indeed, the absolute magnitude of the effect was quite on par with some of the strongest psychosocial predictors of student persistence identified in previous meta-analytic research such as institutional commitment, social support, and academic goals (Robbins et al., 2004). Interestingly, this finding is at odds with previous research that found no relationship between overall openness and student retention (Trapmann et al., 2007) and is more in line with the notion that openness

and its facets show a small positive association with turnover in the workplace (Barrick & Mount, 1991; Timmerman, 2006).

Indeed, the present result suggests that students with a higher senso-aesthetic openness may have been more volatile in their academic choices due to their general preference for a wide variety of nonintellectual experiences and the excitement by novelty associated with this openness aspect (Connelly, Ones, Davies, et al., 2014). From a person-environment fit perspective, the result may also be due to a low congruence between the artistic interests and aesthetic life goals associated with senso-aesthetic openness (Douglas et al., 2016b) and the academic majors that were present in the sample (e.g., psychology, economics, nursing science), which may have resulted in higher student attrition (B. Schneider et al., 1995).

8.4.4 Senso-Aesthetic Openness as a Predictor of Career Success

Surprisingly, senso-aesthetic openness predicted objective career success (i.e., salary and hierarchical status) after an average time span of more than two and a half years. The negative regression coefficient for salary seems somewhat reasonable, given that previous research has found senso-aesthetic to be negatively correlated with economic life goals in general (Douglas et al., 2016b) and concern for salary in particular (Schwaba et al., 2019). From this perspective, individuals with higher trait-levels may have been more likely to accept roles that were aligned with their preference for aesthetic stimulation and affective engagement (Kaufman, 2013), even if this resulted in a lower salary. The positive regression coefficient for hierarchical status, on the other hand, seems less plausible, especially when considering that individuals with a higher senso-aesthetic openness have been found to be less interested in exercising power over others (Douglas et al., 2016b). However, senso-aesthetic openness has also been associated with creativity (Kaufman et al., 2016; Nusbaum & Silvia, 2011), ethical decision-making (Rengifo & Laham, 2022), and a willingness to engage in contact with diverse groups (Hotchin & West, 2022). Given that such traits are important determinants of effective leadership (Hoch et al., 2018; Judge et al., 2002), individuals with higher trait levels may have been perceived as more suitable for managerial roles, which in turn may have been appealing to them due to their higher preference for self-direction (Douglas et al., 2016b).

Consistent with the hypothesis, senso-aesthetic openness did not predict overall subjective career success. However, more fine-grained analyses revealed time-lagged associations with the amount of recognition and influence individuals with higher trait-levels experienced in their careers. Analogous to the results for hierarchical status, this may reflect that they are valued as creative, open-minded thought-leaders, who generate unconventional solutions to complex problems.

8.4.5 Limitations and Further Research

One limitation of the present study is the use of a rather short, self-report measure of mind-wandering, which may have blurred meaningful effects through limitations in both reliability and content validity. For example, distinguishing between intentional and unintentional mind-wandering (Seli, Risko, et al., 2016) might reveal more nuanced relationships between mind-wandering and the two aspects of openness, as well as significant indirect effects on academic success criteria. Furthermore, it seems worthwhile to extend the present research—which focused on habitual mind-wandering as a stable personality trait—with measures of state mind-wandering, for example in experimental settings or through experience sampling (see also Rummel et al., 2021).

A second limitation is that only self-assessed intelligence was controlled for, but not psychometrically tested intelligence. Recent research has found substantial associations between intellectual openness and general mental ability (Bainbridge et al., 2019; Bédard & Le Corff, 2020), which in turn is a strong predictor of various academic and work-related outcomes (Kuncel et al., 2004). Given that the correlation between self-assessed and tested intelligence is far from perfect (Ackerman & Wolman, 2007), further studies should address the important question of whether intellectual openness predicts these outcomes above and beyond general mental ability (see also DeYoung, 2014).

Finally, there are two methodological shortcomings of the present study that should be considered. First, some scholars argue that two waves of data do not constitute a proper longitudinal research design and criticize that the confounding of true change and measurement error makes it difficult to examine causal relationships between the variables of interest (Ployhart & MacKenzie, 2015). Although no explicit causal hypotheses were formulated, both the mediation analysis and the assumption that

intellectual and senso-aesthetic openness are *determinants* of future academic and career success arguably imply the involvement of causal mechanisms. Furthermore, mediation analysis in a two-wave design also relies on some assumptions that cannot be tested (e.g., stationarity of the predictor-moderator path over time). Further longitudinal studies with more than two times of measurement could not only address these issues, but also extend those results of the present study that were based on cross-sectional analyses. Second, the restrictions imposed to ensure an appropriate time lag between the predictor and criterion variables substantially reduced the size of both the academic and the career subsample. As a result, the reduced statistical power might have obfuscated some of the more subtle associations between the two aspects of openness and the other variables of interest, especially in the mediation analysis.

8.4.6 Implications and Conclusion

The main implication of the present findings for further research is the apparent need to operationalize openness as a truly dichotomous personality dimension, when examining its relationships with indicators of academic and career success. The use of measures that properly distinguish between intellectual and senso-aesthetic openness (e.g., DeYoung et al., 2007; Soto & John, 2017b; Woo, Chernyshenko, Longley, et al., 2014) might not only promote a deeper understanding of the nomological network of openness. It might also enable researchers to revise some of the previously inconclusive findings for overall openness—for example, regarding career success (Ng et al., 2005), academic performance (Poropat, 2009), and leadership behavior (Bono & Judge, 2004)—by disentangling the specific effects of intellectual and senso-aesthetic openness.

From a practitioner's perspective, the findings underscore the usefulness of dichotomous measures of openness in postsecondary academic settings such as student admissions or guidance counseling, as both aspects complement each other in predicting academic achievement, academic satisfaction, and likelihood of graduation. Furthermore, the results of the present study challenge the notion that openness has little relevance to career success (Judge & Kammeyer-Mueller, 2007) and can be considered a proof of concept for the utility of openness assessment in both organizational career planning processes and vocational guidance.

Taken together, the present findings provide further support for openness as a relevant determinant of academic and career outcomes. They also emphasize that researchers should not rely on overall openness scales—as they may obfuscate meaningful relationships at the aspect-level—and illustrate that much more remains to be learned about these complex relationships.

9 Article 4: Situational Judgment Tests as an Alternative Measure for Personality Assessment (Mussel et al., 2018)

Abstract

Across many domains of applied psychology, personality traits are related to important outcomes such as well-being, psychological disorders, work performance, and academic achievement. However, self-reports, the most common approach to personality assessment, have certain limitations and disadvantages, such as being prone to faking. We investigated whether situational judgment tests, an established assessment technique to predict job performance, might serve as an alternative measure for the assessment of personality. Our results show that a situational judgment test specifically developed to assess narrow personality traits may possess high levels of construct validity. Additionally, our results indicate that the situational judgment was equivalent to a self-report personality measure with regard to predicting a number of theoretically related criteria. We conclude that situational judgment tests may serve as an alternative method for the assessment of personality and discuss potential theoretical and applied drawbacks.

Keywords: Personality Assessment, Situational Judgment Test, Alternative Predictor, Objective Personality Testing

CRediT Statement

Patrick Mussel: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing; **Thomas Gatzka:** Writing – original draft, Writing – review & editing; **Johannes Hewig:** Conceptualization, Writing – review & editing

9.1 Introduction

Numerous meta-analyses have shown that the Big Five personality traits are related to criteria such as burnout (Alarcon et al., 2009), psychological disorders (Kotov et al., 2010), and subjective well-being (DeNeve & Cooper, 1998). They are also valid predictors of job performance, job satisfaction, leadership styles, and academic achievement (e.g., Barrick et al., 2001; McAbee & Oswald, 2013; Vedel, 2014). Overall, personality matters and a proper personality assessment is a crucial task across many domains of psychology.

Unfortunately, there are some issues concerning the most common approaches in personality assessment, especially in work and educational domains. Specifically, the predominant self-report questionnaires have several disadvantages. They often are prone to faking, rely on the ability and motivation to introspect accurately, and can be influenced by a variety of biases and response sets (Griffith & Robie, 2013; Paulhus & Vazire, 2007). Alternative approaches to personality assessment have their own drawbacks. For example, observer ratings vary in their validity depending on the level of acquaintanceship of the observer and on the observability of behavior typical for a certain trait (Connelly & Ones, 2010). Objective personality tests often show low convergent validity (e.g., Ortner & Schmitt, 2014; Ziegler, Schmukle, et al., 2010).

We considered whether the situational judgment test (SJT) might act as an alternative method for personality assessment. In a typical SJT, a person is presented with hypothetical scenarios that usually contain a specific problem or dilemma. For each situation, there is a set of response alternatives. The person is then asked to either choose the best (and/or worst) solution or to rate the effectiveness of every response separately. For scoring, the person's choices are compared with a predefined scoring

key (Weekley et al., 2006). Thus, SJTs can be seen as a behavior-oriented mixture between self-report questionnaires and high-fidelity simulations such as work samples, similar to the situational interview.

Situational judgment tests are popular methods as they possess good criterion-related validity for job performance (Christian et al., 2010), low adverse impact (Whetzel et al., 2008) and are accepted among test-takers (Whetzel & McDaniel, 2009). Compared to self-report questionnaires, they are comparable in terms of time efficiency and ease of use, but are less susceptible to faking and are less dependent upon test-takers' ability regarding introspection (Hooper et al., 2006). However, there are some limitations to SJTs in terms of construct validity. Similar to assessment center ratings, it is often difficult to identify the constructs typically assessed by SJTs (Christian et al., 2010). One reason might be that SJT developers often prioritize content validity (i.e., representative scenarios) over construct validity. Thus, SJTs often assess multiple constructs simultaneously, even within a single item (McDaniel et al., 2007), which results in inconclusive factor structures and low overall internal consistencies (Campion et al., 2014). To our knowledge only one journal article has been published so far that describes the development of a SJT to measure specific personality traits (i.e., extraversion, agreeableness, and conscientiousness; Motowidlo et al., 2006), although the authors do not provide evidence of construct validity.

The present paper reports results regarding the development and validation of a SJT that assesses specific personality constructs. Answering the call from Christian et al. (2010) we pursued a construct-based development approach by focusing on well-defined personality traits within the Big Five domain. However, instead of aiming at the Big Five themselves, we focused on a single facet within each dimension. We expect the assessment of narrow, compared to broad constructs to be beneficial to the construct validity of our new SJT for at least three reasons: First, reducing the complexity of the target construct (i.e., the bandwidth) should improve the accuracy of its measurement (i.e., the fidelity) and therefore its validity (Cronbach, 1970). Second, narrow personality facets should be easier to translate into similar, yet distinct scenarios which in turn should facilitate the measurement of behavioral coherence (cf. Campion & Ployhart, 2013). Third, specific personality facets from different Big Five dimensions should be even less correlated than the dimensions themselves which should improve the factor structure and discriminant validity of the SJT. In the following sections,

we report the according empirical results, that is, reliability estimates, convergent and divergent validity with corresponding self-report measures and construct validity evidence with regard to positive and negative trait affect (DeNeve & Cooper, 1998; Watson & Clark, 1994). Furthermore, we examine the criterion-related validity of the SJT with regard to broad academic performance criteria (i.e., course grades and grade point average, GPA) which have been found to be predicted by personality (Mussel, 2013a, 2013b; von Stumm, Chamorro-Premuzic, & Ackerman, 2011) as well as several ad hoc criteria rooted in the definition of the respective facets.

9.2 Method

9.2.1 Sample

Data were collected on a total of 255 voluntary participants in Germany. Participants were between 18 and 60 years old ($M = 27.2$; $SD = 10.7$), 68% were female. Regarding their education, the majority has a university-entrance diploma (German “Abitur”; 87.3%), while some had secondary school (German “Realschulabschluss”; 10.2%) as highest education. Participants were recruited by students as part of university course work or as part of their thesis. Post hoc power analyses revealed $(1-\beta) = .99$ for a medium correlation of .30 (Cohen, 1988); correlations of .16 and larger are found with a power of $(1-\beta) > .80$.

9.2.2 Measures

Additionally to the newly developed SJT (see below), five facets from the German version of the NEO-PI R (Borkenau & Ostendorf, 1993) were applied, one from each Big Five factor. Each facet consists of eight items. The five facets are self-consciousness (from the Big Five factor neuroticism), gregariousness (from extraversion), openness to ideas (from openness to experience), compliance (from agreeableness), and self-discipline (from conscientiousness). Reliabilities can be found in Table 21.

The items for the SJT were developed by the first author of this paper together with well-informed students according to the recommendations by (Weekley et al., 2006). Each item consists of a short item stem, describing a specific situation. The description

Table 21

Bivariate Correlations Between the Five Facets Assessed by Either the SJT or the NEO-PI R

	α	SJT-N	SJT-E	SJT-O	SJT-A	SJT-C	NEO-N	NEO-E	NEO-O	NEO-A	NEO-C
SJT-N	.73										
SJT-E	.75	−.35									
SJT-O	.70	−.29	.19								
SJT-A	.56	.17	−.02	.13							
SJT-C	.55	.11	−.04	.19	.12						
NEO-N	.72	.60	−.23	−.22	.12	.07					
NEO-E	.78	−.26	.66	.07	.01	−.08	−.24				
NEO-O	.82	−.31	.10	.70	−.01	.19	−.24	−.01			
NEO-A	.68	.08	−.01	.11	.41	.02	.12	.07	−.10		
NEO-C	.87	.02	−.07	.19	.03	.52	−.13	−.04	.20	.06	

Notes. N = Self-Consciousness (Neuroticism); E = Gregariousness (Extraversion); O = Openness to ideas (Openness to experience); A = Compliance (Agreeableness); C = Self-Discipline (Conscientiousness); SJT = Situational Judgment Test. Correlations $r > .12$ are significant on $p < .05$ and correlations $r > .16$ on $p < .01$.

is followed by the question “What would you do?”, reflecting a behavioral tendency instruction (McDaniel et al., 2007). Participants were asked to choose one of four given response options according to the likelihood of their own behavior in this particular situation.

Each item was developed to assess one of the five Big Five facets outlined above. Item development started with a definition of one of the Big Five facets according to the manual of the NEO PI-R (Borkenau & Ostendorf, 1993). According to this definition, situations (ideally referring to student experiences) were generated in which individuals with high, compared to low levels on the particular facet will likely behave differently. Two of the four response options reflected behaviors of individuals with high levels, the other two behaviors of individuals with low levels on the particular facet. An example item from the facet self-consciousness would be:

> You are attending a public lecture together with approximately 100 other listeners. You find the talk very interesting and are keen on asking a question. What would you do?
>
> 1. I do not ask the question, because I feel inconvenient talking in front of so many people.
> 2. If at all, I ask my question after the lecture, in case I meet the speaker alone.
> 3. I ask my question as soon as I am sure that others will also ask questions.
> 4. I ask my question as soon as the speaker briefly pauses between two sentences.

A total of 198 items were initially written. Expert ratings were used to re-assign each item to the five facets and to estimate the total quality of the items. According to these two criteria, a total of 110 items (22 per facet) were chosen for the final version. Each item was coded as either “1” (for having chosen one of the response options reflecting a high level on the particular facet) or “0” (for the options reflecting a low level). Scores on the scale level were computed by summing up the 22 items pertaining to one facet.

Additionally to the facets of the NEO-PI R and the SJT, as described above, we included several external variables to compare the nomological net of both assessment methods. Regarding construct validity, we administered the positive and negative affect schedule (PANAS; Watson et al., 1988). The measure consists of 20 adjectives describing positive (e.g., active) or negative (e.g., guilty) emotional states. Participants were asked to indicate on a 5-point Likert scale how they feel in general. Reliabilities were .83 for positive affect and .88 for negative affect. As criterion variable, we assessed grades in the last term of secondary education in Math, German, English as a foreign language, as well as the grade point average (GPA). Grades were transformed according to the type of school (German "Hauptschule", "Realschule", and "Gymnasium") using the formula by Görlich and Schuler (2007) to account for differences in the aspiration level of these types of school.

Finally, we developed a short ad hoc criterion questionnaire consisting of a variety of behaviors and life events which might be associated with one of the five facets. The questions were chosen based on expected correlates with the personality constructs according to published findings as well as educated guesses. Specifically, for the facet self-consciousness, we asked how often, during the last year, they got into a conversation with a stranger and how often, during the last year, they asked someone the way, rather than using the smartphone or a map (both reversely coded). For the facet gregariousness, we asked for the number of facebook friends, the number of close friends, the number of acquaintances, the number of memberships they ever held, and the number of times they had sold something to another person. For the facet openness to ideas, we asked the number of times they visited the museum during the last year and the number of times they attended conferences or workshops to acquire new skills. For self-discipline, we asked for an estimate of the parenting style they received (authoritarian vs. permissive), and for a percentage of times they implemented a plan exactly as intended. Finally, for compliance, we asked the number of times they received a written warning during school and the number of individuals with whom they had a fierce quarrel so far (both reversely coded).

Questions regarding the number of friends (facebook friends, close friends, acquaintances) were open end; as all three variables were strongly skewed, they were log-transformed. All other questions were answered on 7-point scales with labels match-

ing the content of the question. Following a z-standardization, all items pertaining to one facet were aggregated.

9.2.3 Statistical Analyses

Statistical Analyses were conducted with IBM SPSS STATISTICS 22.0.0.1 on a Windows PC. Averages across correlations were computed via Fisher-Z transformation. Corrections for unreliability were conducted using the methods described by Hunter and Schmidt (2004). Latent Multitrait-Multimethod Analysis was conducted with IBM SPSS Amos 22.0.0, model fit was estimated according to the recommendations by Schweizer (2010).

9.3 Results

Reliability estimates for the SJT can be found in the first column of Table 21. For the facets self-consciousness, gregariousness, and openness to ideas, we found acceptable internal consistencies above .70. Contrary, for the facets compliance and self-discipline, low reliabilities were found, which is especially surprising given the relatively large number of items (22 per facet). For comparison, reliabilities for the facets of the NEO-PI R—each assessed by eight items only—were between .68 and .87.

All bivariate correlations between the five facets assessed by either the SJT or the NEO-PI R can also be found in Table 21. Convergent validities, that is, correlations between corresponding facets assessed by the SJT on one hand and the NEO-PI R on the other, are framed. These convergent validities were between .41 and .70, with an average of .59 (or .82 when corrected for unreliability), and can be considered to be high. Interestingly, differences in convergent validities between facets mirror results for internal consistencies, with notably lower coefficients for compliance and self-discipline, compared to the other three facets. Discriminant validities (off the framed diagonal) were on average $-.01$ ($SD = 0.19$). These results can be interpreted as positive indicators regarding the construct validity of the newly developed SJT.

Additionally, we conducted latent Multitrait-Multimethod Analysis (see Marsh, 1989) which allows for investigating the fit of the assumed five-factorial model and for estimating the amount of variance that can be attributed to either the assessment

method or the underlying trait. We used a model with five correlated latent variables representing traits (the five personality facets) and two correlated latent variables representing the method (SJT and NEO-PI R). Regarding manifest variables, to delimit model complexity, we computed parcels for each trait and each method by randomly assigning the corresponding items to one of three parcels. For example, three parcels were computed for the trait gregariousness and the method SJT by randomly assigning the 22 SJT-item of this facet to one of three parcels and, subsequently, averaging across the seven or eight items. Therefore, the model consisted of 30 manifest variables (5 facets × 2 assessment methods × 3 parcels). Using maximum likelihood estimates, we found acceptable Model fit, see Table 22, Model 1. Interestingly, latent trait variables accounted for substantially larger amount of variance than latent method factors (41% vs. 6%), supporting the valid assessment of the underlying traits. These results were further supported when comparing simpler models with only correlated traits (Model 2), only correlated methods (Model 3), and a one-factorial model, the latter assuming that all manifest variables load on one latent dimension (Model 4). Results strongly support the assessment of underlying traits, with largely improved model fit for Model 2, compared to Models 3 and 4.

As our Model 1 had less than perfect fit to the data, we thought to disentangle potential misfit by separately specifying a correlated trait model for either the SJT or the NEO-PI R. While we had no a priori hypotheses, we were still surprised that model fit indices indicated better model fit for the SJT (Model 5), compared to the NEO-PI R (Model 6, see Table 22).

Next, we compared the construct validity of the two assessment methods with regard to the intercorrelations between the facets, displayed in the upper left part of Table 21 for the SJT and the lower right part for the NEO-PI R. Generally, across the ten coefficients, a similar pattern could be observed. We compared the difference between each pair of corresponding coefficients on significance. After adjusting the significance level to 10 comparisons using the Sidak-Bonferroni method, we found no difference between either of these pairs of correlation coefficients, indicating that the two assessment methods show comparable construct validity.

Correlations with external criteria can be found in Table 23. For both assessment methods, we found a similar pattern between the five facets with positive and negative affect: Positive correlations of positive affect with gregariousness, openness to ideas, and

Table 22

Results for Latent Multitrait-Multimethod Analysis

Model	χ^2	df	χ^2/df	CFI	RMSR	RMSEA	AIC	CAIC	% error variance	% trait variance	% method variance
Model 1 CTCM	548	364	1.51	.93	.04	.05	750	1,208	53.4	40.6	6.0
Model 2 CT	715	395	1.81	.88	.05	.06	855	1,173	57.6	42.4	
Model 3 CM	2,257	404	5.59	.30	.13	.14	2,379	2,656	85.5		14.6
Model 4 1F	2,271	405	5.61	.29	.13	.14	2,391	2,663	86.4		13.6
Model 5 SJT CT	88	80	1.10	.99	.00	.02	168	350	59.6	40.5	
Model 6 NEO CT	183	80	2.29	.92	.09	.07	263	445	44.8	55.2	

Notes. CT = Correlated Trait; CM = Correlated Method; 1F = One latent factor model.

self-discipline, negative correlations with self-consciousness, and only small correlations with compliance. A reversed pattern was found for negative affect. We again compared the 10 corresponding correlation coefficients on significant differences (using the Sidak-Bonferroni method) and found no difference between either of these pairs of correlation coefficients.

For the SJT as well as for the NEO-PI R, grades were significantly predicted by openness to ideas. Again, no significant differences in these correlation coefficients were found by assessment method.

Correlations between the facets, assessed by either method, and corresponding criteria which were specifically developed to match each of the five facets are framed in the lower part of Table 23. For four of the five facets, these criteria were significantly predicted by corresponding facets, and this pattern held true for both, the SJT and the NEO-PI R. Only the criterion for the facet self-discipline was not significantly predicted by any corresponding facet. We again compared the pattern of these five criterion-related validities between assessment methods and found no significant difference in correlation coefficients.

In our final analysis, we used stepwise multiple regressions to investigate whether the two assessment methods may explain specific variance in a criterion and might, therefore, lead to incremental validity of one assessment method over the other; contrary, no evidence of incremental validity would support the notion that the two methods can be used interchangeably for the prediction of these criteria. For each of the five criteria, we included the corresponding facet assessed by the SJT and by the NEO-PI R as predictors in a stepwise regression with inclusion criterion of $p < .05$. Additionally, based on the results reported above, we performed a similar analysis for GPA as criterion and the openness to ideas facets of the SJT and the NEO-PI R, respectively. Results can be found in Table 24. We found the criterion for the facets self-consciousness and gregariousness as well as GPA as criterion to be significantly predicted by the corresponding facets assessed by the SJT. The corresponding NEO-PI R facet had no significant incremental validity. The criterion for openness to ideas was significantly predicted by the corresponding facet of the NEO-PI R; the SJT possessed no significant incremental validity. The only criterion for which both assessment methods were included in a stepwise procedure was compliance, with the corresponding facet of the NEO-PI R included in Step 1 and a significant increment on $p = .045$ for the

Table 23

Correlations Between the Five Facets Assessed by Either the SJT or the NEO-PI R with External Variables

	SJT-N	SJT-E	SJT-O	SJT-A	SJT-C	NEO-N	NEO-E	NEO-O	NEO-A	NEO-C
PANAS positive	−.31	.22	.23	−.07	.20	−.41	.24	.35	−.18	.36
PANAS negative	.34	−.14	−.28	−.01	−.11	.49	−.21	−.23	−.10	−.24
Math	−.01	.08	.26	.07	.13	−.04	.04	.22	.06	.17
German	−.03	.13	.25	.08	.07	.01	.13	.18	.00	.04
English a.a f.l.	−.08	.11	.24	.05	.03	.00	.09	.21	−.02	−.01
GPA	−.03	.11	.23	.07	.08	−.01	.13	.15	.03	.07
Criterion N	.28	−.29	−.22	−.07	.03	.25	−.23	−.15	.03	.03
Criterion E	−.26	.21	.17	−.01	.10	−.27	.19	.22	.02	.03
Criterion O	−.15	.06	.31	.09	.06	−.21	.07	.37	−.04	.11
Criterion A	.14	−.03	.01	.24	.07	.17	.01	−.08	.27	.12
Criterion C	−.04	.06	.07	.05	-.01	−.03	.03	.08	−.06	-.12

Notes. N = Self-Consciousness (Neuroticism); E = Gregariousness (Extraversion); O = Openness to ideas (Openness to experience); A = Compliance (Agreeableness); C = Self-Discipline (Conscientiousness); SJT = Situational Judgment Test.

SJT. Analogous to the bivariate correlations, the criterion for self-discipline was not significantly predicted by either predictor. Therefore, with the exception of one of these regression analyses (for the facet compliance) we have no indication of incremental validity, which supports the idea that both methods assess the same construct.

9.4 Discussion

The present research started with the question whether SJTs may serve as an alternative method for the assessment of personality. Therefore, we combined the method of SJTs with principles of personality psychology according to which situations vary in their relevance to any given trait and that trait differences, therefore, will matter to different extents in different situations (Allport, 1937; Ekehammar, 1974; Mussel & Spengler, 2015). We developed a new SJT according to these criteria and investigated its construct validity against corresponding self-report measures of personality. Overall, the results strongly support our approach, as we found high convergent and low discriminant validity with corresponding self-report measures. Additionally, the nomological net with regard to trait affect and the prediction of a number of theoretically related criteria was equivalent across these assessment methods.

SJTs possess a number of advantages compared to self-report measures of personality. Specifically, they have good criterion-related validity for job performance, low adverse impact and are accepted among test-takers. Compared to self-report questionnaires, they have been found to be less susceptible to faking and are less dependent upon test-takers' ability regarding introspection. However, according to the literature, a major drawback of SJTs is their low construct validity. We showed that, when developed according to the methods described above, SJTs may possess acceptable construct validity (cf. Campion et al., 2014). Our findings suggest that this approach indeed might reduce some of the psychometric issues that are typical for SJTs, such as low internal consistency, unclear factor structures, and a lack of distinct subscales (Whetzel & McDaniel, 2009). Therefore, we showed that SJTs can indeed be constructed to assess specific constructs instead of being a mere measure of practical intelligence, general situational judgment (Schmitt & Chan, 2006) or implicit trait policies (Krumm et al., 2015; Motowidlo et al., 2006). Future research should investigate whether

Table 24

Stepwise Multiple Regression, Separately for Criterion Indicators of Each of the Five Facets and GPA, Predicted by Corresponding Facets of the SJT and the NEO-PI R

	R	R^2	Adj. R^2	df N	df D	F	p	β	p(β)
Criterion for the facet self-consciousness (neuroticism)									
Step 1:	.26	.068	.065	1	249	18.3	<.01		
Predictor: SJT-N								−.26	<.01
Criterion for the facet gregariousness (extraversion)									
Step 1:	.24	.056	.053	1	249	14.9	<.01		
Predictor: SJT-E								.24	<.01
Criterion for the facet openness to ideas (openness to experience)									
Step 1:	.37	.135	.132	1	249	38.9	<.01		<.01
Predictor: NEO-O								.37	<.01
Criterion for the facet compliance (agreeableness)									
Step 1:	.27	.073	.069	1	249	19.6	<.01		<.01
Predictor: NEO-A								.27	<.01
Step 2:	.30	.088	.081	2	248	12.0	<.01		
Predictor: NEO-A								.21	<.01
Predictor: SJT-A								.13	.05
Criterion for the facet self-discipline (conscientiousness)									
No variables were entered into the equation.									
GPA									
Step 1:	.18	.034	.030	1	239	8.4	<.01		
Predictor: SJT-O								.18	<.01

Notes. N = Self-Consciousness (Neuroticism); E = Gregariousness (Extraversion); O = Openness to ideas (Openness to experience); A = Compliance (Agreeableness); C = Self-Discipline (Conscientiousness); SJT = Situational Judgment Test.

construct-oriented SJTs still possess the desirable attributes (i.e., lower fakeability, acceptance by test-takers) that have been reported for traditional SJTs.

In the present study, five out of 30 NEO-PI R facets were randomly chosen. Future research is necessary to investigate whether our results also pertain to other facets. Also, there might be systematic differences between facets with regard to their suitability to be assessed by SJTs, comparable to those in other behavior-oriented approaches such as observer ratings (Connolly et al., 2007). For example, measurement properties might be better for facets relating to overt behavior (e.g., activity) compared to more private facets which relate to feelings or inner states (e.g., vulnerability, openness to feelings).

A theoretical challenge of our endeavor was the need to infer personality from self-reported behavioral actions. Behavior is generally viewed as the resulting consequence of several latent personality traits which are activated to different degrees in response to situational requirements. Therefore, a single sequence of behavior might be the results of multiple latent constructs, and different constructs may account for the same behavioral outcome. Self-report questionnaires can directly investigate a construct as, in addition to pure behavior, they may ask for emotions, goals, cognitions, motivation, and so forth. As SJTs ask for pure behavior from which underlying constructs have to be inferred, they may be less accurate. As a consequence, a larger number of items might be necessary to obtain a valid assessment. In this regard, it is informative to note that in the present study, despite the large number of items, reliability estimates for the SJT were lower for four out of five dimensions, compared to the self-report measure.

In our view, the supporting evidence regarding construct validity, as reported above, is largely a result of our attempt to focus on narrow, compared to broad personality traits. Given the challenge that behavior is determined by multiple constructs and the need to obtain a large number of situations to assess construct-relevant behavior, it seems essential that the construct itself is not too heterogeneous.

The description of a specific situation in the item stem of SJTs usually makes SJTs less generic, compared to self-report personality tests. While the level of specificity of the item stem may vary, a certain minimum seems necessary such that test-takers can vividly imagine the situation, and to assure that a similar situation is evoked by each test-taker. However, the more specific the situation the less likely it is equally relevant for different test-takers. As a result, it might be necessary to develop separate measures

for different populations. However, the opportunity for developing items for specific populations might also possess benefits. Contextualized personality measures have been found to possess higher criterion-related validity, compared to generic measures. Accordingly, personality-based SJTs developed with a specific population and purpose in mind might also possess similar benefits. Additionally, the item content might be beneficial for test-takers, informing, for example, individuals applying for a job or considering starting to study at a university about typical upcoming situations.

We hope that our findings encourage the development of further SJTs for personality assessment. Considering our successful attempt to develop a construct valid SJT for specific personality facets, it seems plausible that one could extend our work by developing scenarios for other facets of the Big Five domain. Ultimately, an adequate composition of such facet-oriented situations might then be used to assess the Big Five dimensions themselves.

Part III

Discussion

10 Synthesis of the Findings

The overarching objective of this dissertation was to examine the role of openness—the dimension within the five-factor model of personality that reflects a person's fundamental attitude toward broadening their intellectual and cultural horizons by engaging in new experiences (DeYoung, 2014; McCrae, 2004)—in postsecondary academic success. As discussed in Chapter 3, previous empirical results showed that openness was much less related to postsecondary academic outcomes than one would expect from a personality dimension that reflects the "active, exploring mind ... of the true scientist" (Fiske, 1949, p. 337) and "a general tendency toward complexity and flexibility in information processing" (DeYoung, 2014, p. 371). This intriguing discrepancy was the starting point for this dissertation.

The output of this dissertation consisted of three original articles that focused on the relationship between openness and various indicators of academic success (see Chapters 6, 7, and 8). An additional article explored a situational judgment test an alternative approach to measure personality traits such as intellectual openness (see Chapter 9).

In summary, the findings of this dissertation suggest that openness is indeed a highly relevant personality factor in postsecondary educational settings, which is significantly correlated with various success criteria, but only fully reveals its importance when operationalized properly—that is, as a dichotomous construct including both intellectual and senso-aesthetic aspects. They also provide initial insight into the relationship between academic success and the two aspects of openness, showing their incremental validity above and beyond other predictors (i.e., conscientiousness, self-assessed intelligence, and metacognition), as well as an unexpected lack of meditation through mind-wandering.

10.1 Is Openness Related to Academic Success?

Educational researchers focus on objective academic achievement—especially grades—as an easily obtainable, reliable, and obviously relevant indicator of academic success, sometimes even using the two terms synonymously (Bacon & Bean, 2006; Goegan & Daniels, 2021). Accordingly, Articles 1, 2, and 3 of the this dissertation also relied on this important criterion to answer the question *whether* openness is related to academic success.

However, measures of academic performance may be subject to adverse effects such as grade inflation (V. E. Johnson, 2003), differences in grading standards (Beatty et al., 2015; Didier et al., 2006), and reporting biases (Kuncel et al., 2005). Furthermore, objective academic achievement it is only a single—arguably quite narrow—component of academic success (York et al., 2015). It does not take into account "an individual's feelings of achievement regarding intrinsic indices, such as perceptions of accomplishments and prospects" (Stadler et al., 2021, p. 283) or more distal outcomes, such as actual degree attainment or a successful transition into the workforce.

To address these issues, subjective academic achievement (i.e., a student's judgment about their own achievement in relation to their personal expectations and effort as well as the achievements of their peers; Stadler, Kemper, et al., 2015) was included as an additional criterion of academic success in Article 2. Heeding the call for a broader conceptualization of academic success, Article 3 also scrutinized the relationship between the two openness aspects and three additional indicators, namely academic satisfaction, student persistence, and postcollege career success.

10.1.1 Objective Academic Achievement

Initially, the meta-analytic results in Article 1 did indeed corroborate the notion of a rather modest correlation between overall openness and postsecondary academic performance (i.e., GPA). However, they also provided support for the assumption that the true potential of openness as a predictor of academic success may be obfuscated by its heterogeneous nature (Noftle & Robins, 2007; Paunonen & Ashton, 2001b) and by divergent effects of its narrow components (Tett et al., 2003).

First, the meta-analysis showed that the openness to ideas facet, which reflects intellectual curiosity and interests, showed an elevated—albeit still small—correlation with postsecondary GPA compared to the other five openness facets proposed by McCrae (1993). Second, different openness scales showed slightly varying criterion-related validity estimates. Those based on the lexical research tradition (e.g., Saucier, 1994), which emphasizes the intellectual components of the factor, performed better than those derived from the questionnaire approach, which propagates a broader conceptualization of openness (e.g., Costa & McCrae, 1992). Third, and arguably most important, a meta-analytic structural equation modeling approach (Cheung & Chan, 2005) demonstrated that the intellectual aspect of openness (reflected by the ideas facet) appeared to foster academic performance, while the senso-aesthetic aspect (reflected by the aesthetics, feelings, fantasy, and action facets) seemed to impede it.

On the one hand, this offers an explanation for the poor performance of overall openness as a predictor of academic achievement (i.e., opposing effects at a lower construct level that partially negate each other). On the other hand, it also underscores the necessity of a truly dichotomous operationalization and measurement of openness—at least in postsecondary educational settings.

Following up on these promising findings, Article 2 used a measure specifically designed to measure the two distinct aspects of openness, namely the openness scale from the Big Five Aspect Scales (DeYoung et al., 2007), to predict academic achievement in a sample of undergraduate students. This approach overcame an important methodological limitation of the aforementioned meta-analysis, namely the reliance on the ideas facet as the sole indicator of intellectual openness. Indeed, intellectual openness encompasses more academically relevant traits than just intellectual curiosity and interest (i.e., the core of the ideas facet; Costa & McCrae, 1992), such as a preference for abstract information processing, being quick-witted and intellectually engaged (DeYoung, 2014). Thus, it stood to reason that it should be more predictive of academic achievement if measured properly.

Accordingly, a positive correlation was found between intellectual openness and academic performance that could be classified as large in an applied setting (Bosco et al., 2015). In fact, the regression coefficients found for intellectual openness were on par with those for the industriousness aspect of the conscientiousness factor, which is generally considered the best predictor of academic achievement within the five-factor

model (Vedel & Poropat, 2017, see also Section 2.2). Similar results were found in two of the three other undergraduate samples that were used for replication of the results (see Appendix B.3). Article 3 extended these findings in a time-lagged research design and demonstrated that intellectual openness predicted academic performance after an average of more than two years. Thus, it seems reasonable to conclude that intellectual openness is indeed an important antecedent of postsecondary academic performance.

While the positive association between intellectual openness and objective academic achievement was consistent across studies, this was not the case for senso-aesthetic openness. The meta-analytic structural equation modeling in Article 1 demonstrated that the unique elements of senso-aesthetic openness impeded academic performance, with a negative effect size that was about two thirds of the positive effect size found for intellectual openness. This was consistent with the hypothesis that the unconventional and non-academic elements of openness might interfere with achievement in educational settings (DeYoung, 2014; Noftle & Robins, 2007). The negative relationship between senso-aesthetic openness and objective academic achievement was also found in Article 2, where senso-aesthetic openness showed significant negative regression coefficients that were about half the size of the positive beta-weights of intellectual openness.

However, these results could not be replicated in neither the three replication samples nor the time-lagged analyses in Article 3, where senso-aesthetic openness showed negative but statistically insignificant associations with academic performance. In conclusion, the detrimental effect of senso-aesthetic openness on academic achievement may be either quite small—perhaps even negligible—or subject to moderating effects that remain to be identified.

10.1.2 Subjective Academic Achievement

Intellectual openness was a strong positive predictor of subjective academic achievement, with even larger effect sizes than for objective academic achievement. This indicated that students with higher levels of intellectual openness evaluated their study progress and the return on their academic efforts more positively than students with lower levels of the trait. Given that an individual's perception and appraisal of a performance outcome is dependent on their personal frame of reference (Grebner

et al., 2010; Komarraju & Nadler, 2013), it seems plausible that students who value intellectual growth and enjoy academic endeavors may have a heightened sense of academic achievement, not only because they receive better grades, but also because they perceive both the acquisition of new knowledge and engagement in intellectual activities as inherently positive.

A complementary explanation for the positive relationship between intellectual openness and subjective academic achievement can be derived from expectancy and goal setting theory (Locke & Latham, 1990; Porter & Lawler, 1968; Vroom, 1964). These frameworks postulate, among other things, that individuals are more motivated to perform when they believe that reasonable effort will lead to desired outcomes and that they perform better when they set and pursue goals that are relevant to them (Friedman & Mandel, 2009). Intellectual openness may influence these processes by reducing perceived effort and increasing the likelihood of favorable outcomes (through intellectual efficiency and engagement), while simultaneously promoting the personal relevance and positive valence of outcomes (through an interest in learning and intellectual growth). This, in turn, may result in a positive evaluation of the balance between effort and reward as reflected in subjective academic achievement.

Analogous to objective academic achievement, senso-aesthetic openness was a significant negative predictor of subjective academic achievement in Article 2. In other words, students with higher trait levels tended to experience a disparity between their efforts and their academic accomplishments. It is possible that senso-aesthetic openness has steered the students' efforts in ways that satisfied their preferences for novelty, aesthetics, and perceptual stimulation but did not yield results that translated into satisfactory performance evaluations. This would be consistent with the findings on objective academic achievement discussed above. However, since this effect was not found in the three replication samples, the validity and generalizability of this interpretation remains tentative.

10.1.3 Academic Satisfaction

Academic satisfaction can be understood as the result of a student's evaluation of whether their educational experience meets or exceeds their expectations (Elliott, 2002). In contrast to subjective academic achievement, which focuses on the commensurability

of personal efforts and academic outcomes, it reflects an affective assessment of the services provided by the educational institution along criteria such as course quality, intellectual stimulation, and learning climate (Elliott & Shin, 2002; Wiers-Jenssen et al., 2002).

In Article 3, intellectual openness showed a moderate, positive association with academic satisfaction—in both the concurrent and the time-lagged analyses—suggesting that students with higher trait levels tended to be more content with their educational environment. This is in line with previous findings for overall openness (Etzel & Nagy, 2016; Grass et al., 2017; McIlveen et al., 2013; Pawlowska et al., 2014). A possible explanation can be derived from person-environment fit theory (Pervin, 1968; Rounds & Tracey, 1990). In short, this theoretical framework postulates that individuals are more satisfied when their individual traits meet the demands of the environment and the resources of the environment fulfill their personal needs (Su et al., 2015). This notion has received considerable empirical support in both occupational and educational settings (Kristof-Brown et al., 2005; Spokane et al., 2000).

Intellectual openness encompasses various traits that are required—or at least desirable—in academic environments (e.g., cognitive efficiency, scientific curiosity), which in turn provide opportunities to satisfy the desire for cognitive engagement and intellectual growth. Therefore, the higher base line for academic satisfaction in intellectually open students might be due the intellectual challenges and stimulation provided by the environment. This would be in line with recent meta-analytic findings that openness to ideas is positively related to both a sense of personal growth (Anglim et al., 2020), which is core component of psychological well-being and thereby an important determinant of both life and domain-specific satisfaction (Ryff, 1989).

Senso-aesthetic openness, on the other hand, does not have any apparent relevance for academic satisfaction in general. Thus, it is plausible that it was mostly unrelated to this indicator of academic success.

10.1.4 Student Persistence

Student persistence reflects the “focus, drive, and forward progression needed by students to complete a program of study” (York et al., 2015, p. 7). It is another

important indicator of academic success, especially since degree completion is arguably the ultimate educational goal for most students (Pascarella & Terenzini, 2005).

In Article 3, intellectual openness showed a moderately positive correlation with students' intention to persist in their studies. Thus, students with higher trait-levels were more determined to successfully conclude their studies, which challenges previous meta-analytic findings that openness is unrelated to student retention (Trapmann et al., 2007)[21].

Although there is a plethora of models and theories describing the antecedents and determinants of student persistence (for a comprehensive review, see Aljohani, 2016), most of them emphasize the crucial role that academic goal commitment plays in a student's decision to continue or abandon their educational endeavors (e.g., Lent et al., 1994). Indeed, a recent meta-analysis has identified academic goals as an important antecedent of student persistence (S. D. Brown et al., 2008). This provides an explanation for the association between intellectual openness and persistence, assuming that the well-established positive relationship between overall openness and learning goal orientation (Payne et al., 2007) is largely due to the intellectual aspect. Similarly, other correlates of student persistence, such as academic self-efficacy and academic skills (Robbins et al., 2004), have previously been linked to openness (Bidjerano & Dai, 2007; Lounsbury et al., 2009; J. Zhang & Ziegler, 2016), implying that they may be fostered by intellectual openness.

Interestingly, the time-lagged analysis in Article 3 showed no evidence that intellectual openness—or intended persistence, for that matter—predicted actual degree completion in the future. While this is somewhat difficult to explain, it is at least be consistent with the notion that the correlation between intentions and actual behavior is rather modest (Bosco et al., 2015).

Senso-aesthetic openness, on the other hand, was unexpectedly a strong negative predictor of future graduation, indicating that students with higher trait levels were less likely to successfully complete their degrees. This again not only contradicts the notion that openness is largely irrelevant to student retention (Trapmann et al., 2007), but also

[21] It should be noted, however, that persistence and retention are not entirely synonymous. While retention usually refers to the completion of a study program at the student's current institution, persistence takes into account the possibility of transferring to another institution to complete the degree. (York et al., 2015)

makes a case for using measures of senso-aesthetic openness in educational research and practice, especially since the effect size was comparable to strong environmental predictors of student persistence such as institutional commitment and social support (Robbins et al., 2004). One might therefore speculate that a high trait level of senso-aesthetic openness may be a serious risk factor in terms of degree completion.

Although an educated attempt to explain this finding is rather challenging given the scarcity on relevant empirical evidence—especially at the facet- and aspect-level—it appears to be a consistent with findings from organizational psychology research that overall openness is positively related to turnover in the workplace (Barrick & Mount, 1991; Timmerman, 2006), as well as internal and external job mobility (Nieß & Zacher, 2015; Wille et al., 2010). It seems possible that the general preference for excitement through novelty and variety (Connelly, Ones, Davies, et al., 2014), as well as the reduced desire for security associated with senso-aesthetic openness (Douglas et al., 2016b), makes individuals with higher trait level more open to exploring—and following—alternative courses of action in terms of their academic education. This may be especially true in educational environments that do not accommodate the students' artistic and aesthetic interests (B. Schneider et al., 1995; Su et al., 2015).

10.1.5 Career Success

Although measures of academic success are often situated within the academic environment (e.g., grades, student satisfaction, degree attainment), the path of higher education should not be considered to be an end in itself. Instead, its arguably most important long-term goals are the students' economic self-sufficiency and their capability to assume civic responsibility (Kinzie & Kuh, 2017). Therefore, some educational researchers argue that career success should be investigated as a more distal criterion of academic success (York et al., 2015).

Article 3 heeded this call by incorporating both objective and subjective elements of career success as criterion measures in a time-lagged research design. As foreshadowed by the striking inconsistency of previous findings on the relationship between overall openness and career success (Gelissen & de Graaf, 2006; Judge & Kammeyer-Mueller, 2007), this yielded a variety of both expected and unexpected results.

While intellectual openness did not predict future objective career success (i.e., salary and hierarchical status) it did predict its subjective component, which reflects "individuals' perceptual evaluations of, and affective reactions to, their careers" (Ng & Feldman, 2014, p. 170). This suggested that intellectually open individuals were generally more positive about their career progress and accomplishments. Further analyses of narrower components of subjective career success showed that those individuals were particularly content with their personal growth and development, the quality and meaningfulness of their work, and their impact on their work environment.

Intellectual openness reflects a general tendency to engage in cognitive endeavors for the purpose of broadening one's horizons, as well as the cognitive flexibility and efficiency that facilitate the effective execution of these endeavors (DeYoung, 2014). Thus, it seems plausible that individuals with higher trait levels are more likely to seek out, utilize, and appreciate learning and development opportunities throughout their careers. Furthermore, person-environment fit theory (Su et al., 2015) suggests that they are also more likely to deliberately choose more cognitively demanding tasks and responsibilities (Bipp, 2010), which arguably provide more opportunities to work on meaningful topics, gain recognition for intellectually challenging accomplishments, and ultimately exert influence within an organization as a knowledgeable and resourceful subject matter expert.

Senso-aesthetic openness, on the other hand, was unexpectedly a negative predictor of salary but a positive predictor of hierarchical status. The former result is somewhat plausible under the assumption that individuals with higher trait levels are more attracted to work environments that provide sensory and aesthetic stimulation (Kaufman, 2013), while at the same time being less interested in monetary gains (Douglas et al., 2016b; Schwaba et al., 2019). Although the latter result seems less intuitive at first, it may reflect the correlations of senso-aesthetic openness with various traits associated with effective leadership behavior, such as creativity (Kaufman et al., 2016) and openness to diversity (Hotchin & West, 2022), as well as with a preference for self-determination (Douglas et al., 2016b). Thus, individuals with higher trait levels may be perceived as more suitable for leadership positions, which in turn are associated with higher hierarchical status. This would also be consistent with previous findings that overall openness is a positive predictor of upward job mobility (Nieß & Zacher, 2015), and with the findings from Article 3 that senso-aesthetic openness was

a predictor of the amount of recognition and influence individuals with higher trait levels experienced in their careers.

Finally, there are two remarkable parallels between the findings for career success and academic success. First, for both criteria, previous research has yielded mixed results regarding the predictive validity of overall openness (Judge & Kammeyer-Mueller, 2007; Poropat, 2009), which could be disentangled by the dichotomous operationalization of openness in this dissertation. Second, in both cases, senso-aesthetic openness showed somewhat unexpected associations with certain success criteria (i.e., degree completion and hierarchical job status), suggesting that it is a useful complement to intellectual openness in research and applied settings.

10.2 How is Openness Related to Academic Success?

In addition to having established the relevance that the two aspects of openness have for academic success, this dissertation also examined the nature of these relationships in order to promote an understanding of *how* openness is related to academic success. Article 2, on the one hand, contributed to this endeavor by analyzing the incremental validity of the two aspects over the two conscientiousness aspects (i.e., industriousness and orderliness) proposed by DeYoung et al. (2009), as well as possible interactions with them. Article 3, on the other hand, examined mind-wandering as a possible mediator between the two openness aspects and academic achievement and explored the incremental validity of intellectual openness above and beyond related cognitive constructs, namely self-assessed intelligence and metacognition.

10.2.1 The Interplay Between Openness and Conscientiousness

The results from Article 2 showed that the two openness aspects explained variance in both objective and subjective academic achievement above and beyond the two conscientiousness aspects. Furthermore, the regression coefficients of intellectual openness decreased notably when the two conscientiousness aspects were controlled for. These findings were replicated in two of the three replication samples (see Appendix B.3).

Overall, they suggest that at least part of the mechanism linking intellectual openness to academic achievement stems from its covariance with industriousness. Indeed,

these two aspects were significantly correlated in all samples, despite being part of two factors that can be considered largely independent of each other (van der Linden et al., 2010). Thus, intellectual openness may affect academic achievement through its contribution to processes that are also associated with the industriousness aspect of conscientiousness.

In fact, previous research has identified several behavioral processes that mediate the effects of both openness and conscientiousness on academic achievement, for example, self-regulated learning (Bidjerano & Dai, 2007; Komarraju et al., 2011), deep and strategic learning (Duff et al., 2004; Swanberg & Martinsen, 2010), and learning goal orientation (Steinmayr et al., 2011). Although it should be noted that these are dimension-level findings, it seems reasonable to assume that these indirect effects originate mostly from intellectual openness and industriousness rather than from senso-aesthetic openness and orderliness. These processes appear to reflect behaviors that involve both motivational and volitional components, that is, the willingness to put forth effort in academic activities—as reflected by intellectual openness—and the discipline to consciously monitor, regulate, and sustain that effort—as reflected by industriousness.

However, these coalescing effects of intellectual openness and industriousness are not necessarily the primary mechanism linking intellectual openness to academic achievement, given that substantial incremental validity was found for the two openness aspects above and beyond the two conscientiousness aspects in three of the four samples for objective academic achievement and in all four samples for subjective academic achievement. Consequently, one could assume that the relationship between intellectual openness and academic achievement may be due to academically relevant processes that are associated with openness but largely independent of conscientiousness.

Unfortunately, it is surprisingly difficult to identify processes that fit this description, as even constructs that one would primarily associate with intellectual openness, such as need for cognition, epistemic curiosity, enjoyment of thinking, and intrinsic learning motivation, have been found to correlate with conscientiousness (Clark & Schroth, 2010; Komarraju & Karau, 2005; Mussel, 2010; Sadowski & Cogburn, 1997). In contrast, previous research has found that openness, but not conscientiousness, is associated with cognitive functions of the prefrontal cortex and dopaminergic system, which appear to promote cognitive exploration (DeYoung et al., 2011; DeYoung et al.,

2005; DeYoung et al., 2009), as well as with intelligence (DeYoung, 2014; von Stumm, Hell, et al., 2011). From this perspective, the unique effect of intellectual openness on academic achievement may be related to the facilitation of cognitive processes that are beneficial in educational environments. This would be in line with the notion that openness is more cognitive in nature than the other traits within the five-factor model of personality, including conscientiousness (Pytlik Zillig et al., 2002).

As described above, various learning-related processes that have been found to translate into academic achievement seem to be influenced by both openness and conscientiousness. In terms of motivation theory (Heckhausen, 2007), the former appears to be more closely related to motivational constructs such as the desire for personal growth, self-improvement, and learning goal orientation, while the latter has been linked to volitional behaviors such as planning, persistence, and study involvement (Poropat, 2016). According to the *motivation, volition, and performance model* (Keller, 2012), learning and academic performance are preceded by both effort direction (i.e., motivational components such as curiosity) and effort persistence (i.e., volitional components such as self-regulatory actions). Thus, one might expect a multiplicative effect of openness and conscientiousness on academic achievement (Lord, 2007). However, the results of this dissertation did not support this assumption, as no significant interaction was found between intellectual openness and industriousness in predicting academic performance in any of the samples.

Unexpectedly, there was a significant interaction between intellectual openness and the other aspect of conscientiousness, orderliness, in two of the four samples, although the effect was inconsistent. In the sample used in Article 2, the interaction term was positive, indicating that higher levels of orderliness increased the positive relationship between intellectual openness and academic performance, possibly due to a more structured, orderly approach to learning and cognitive exploration. However, in the psychology sample used to replicate these results, the interaction term was negative (see Table 32 in Appendix B.3), suggesting that higher levels of orderliness reduce the positive association between intellectual openness and academic performance. Thus, the interaction effect between orderliness and intellectual openness may vary across academic settings.

10.2.2 Mind-Wandering as a Potential Mediator

To further investigate the mechanisms underlying the relationship between the two openness aspects and academic achievement, Article 3 examined a possible mediation through mind-wandering. Reflecting "a shift of attention away from a primary task toward internal information" (Smallwood & Schooler, 2006, p. 946), mind-wandering has been found to interfere with a variety of cognitive tasks (Randall et al., 2014) and to be negatively related to academic performance (N. A. Moon et al., 2020; Wammes et al., 2016). Furthermore, previous research has linked mind-wandering to overall openness (Kane, Gross, et al., 2017; Marcusson-Clavertz & Kjell, 2019), opening up the possibility of mind-wandering as a mediator between the two openness aspects and academic performance. Unfortunately, the results of Article 3 were rather mixed.

On the one hand, the cross-sectional bivariate analyses in the full sample at the first time of measurement showed that intellectual openness was negatively correlated with mind-wandering. This suggests that students with higher levels of intellectual openness were less prone to habitual mind-wandering. This is consistent with previous research linking the openness to ideas facet to activity in the left anterior prefrontal cortex and posterior medial frontal cortex, which are associated with information integration and goal-directed performance monitoring (DeYoung et al., 2009). Consequently, intellectually open students may be better able to efficiently integrate their learning experiences and stay cognitively on track.

On the other hand, senso-aesthetic openness showed a positive correlation with mind-wandering, indicating that students with higher levels of senso-aesthetic openness were more likely to let their thoughts stray from the tasks at hand. This finding is consistent with the notion that senso-aesthetic openness encompasses traits such as fantasy proneness, apophenia, and absorption, which may facilitate the engagement in "cognitive processes akin to dreaming while awake" (DeYoung et al., 2012, p. 76). Senso-aesthetic openness has also been shown to correlate with implicit learning (Kaufman et al., 2010) and impulsivity (Kaufman, 2013). Thus, the elevated level of habitual mind-wandering in senso-aesthetically open students may reflect their tendency to automatically recognize patterns in their sensory experiences—either factual or overinterpreted—and their inclination to cognitively explore these patterns regardless of their relevance for the current learning situation.

However, these relationships could not be consistently replicated in the cross-sectional bivariate analyses at the second time of measurement or in the time-lagged regression analyses. Furthermore, they did not translate into higher or lower academic success, as the indirect effect of either openness on academic performance was not statistically significant. While this may be due to the lower statistical power resulting from a substantial reduction in sample size or the low reliability of the mind-wandering measure, it suggests that mind-wandering may either not be part of the mechanism linking openness and academic achievement or may be subject to specific conditions that remain to be identified.

10.2.3 Incremental Validity Over Related Cognitive Constructs

Previous research has shown that intellectual openness has strong associations with cognitive abilities (see Section 3.3). Some authors have even argued that intelligence should be considered a facet of intellectual openness (DeYoung et al., 2012), and factor analytic evidence has supported this notion (Kaufman, 2013). Consequently, measures of intellectual openness could be viewed—at least in part—as measures of self-assessed intelligence, which in turn has been found to correlate with both objectively tested intelligence (Ackerman & Wolman, 2007) and academic achievement (Chamorro-Premuzic & Furnham, 2006b). Thus, the predictive validity of intellectual openness for academic performance may have been due to its overlap with self-reported cognitive abilities.

Furthermore, measures of intellectual openness often contain items that reflect consciousness, awareness, and knowledge about one's thought processes or—in short—"metacognition"(Flavell, 1979, p. 906). Previous research identified metacognition as "a basic requirement for cognitive effectiveness" (Akturk & Sahin, 2011, p. 3733), an important determinant of successful learning (Veenman et al., 2006), and a valid predictor of academic achievement, even when intelligence is controlled for (Ohtani & Hisasaka, 2018). Thus, analogous to self-assessed intelligence, the overlap with metacognition could have been another explanation for why the intellectual openness predicts academic performance.

Indeed, cross-sectional analyses in Article 3 showed a positive correlation between intellectual openness and self-assessed intelligence. This is consistent with previous

findings (Zajenkowski & Matthews, 2019) and supports the notion that both constructs may be part of a higher-order "ability self-belief trait" (E. R. Peterson & Whiteman, 2007, p. 965). Positive beliefs about one's own abilities are important determinants of academic performance (Klassen & Usher, 2010; Richardson et al., 2012), as they promote effort regulation and deep processing strategies (Honicke & Broadbent, 2016). Given that intellectually open students were more confident in their cognitive abilities, the positive association with academic achievement may have been due to such processes that often have a self-fulfilling character (Talsma et al., 2018).

Similarly, intellectual openness showed positive correlations with two components of metacognition, namely declarative knowledge about one's own cognitions and—especially strong—cognitive self-consciousness. Thus, individuals with higher trait levels had a better understanding of their intellectual strengths and weaknesses, learning preferences, and thought processes. This seems quite plausible given that intellectual openness reflects an eagerness to actively engage in learning and cognitive effort (DeYoung, 2014; Ziegler, Danay, Heene, et al., 2012). The resulting exposure to such situations should, in turn, increase both the opportunity to develop and refine such an understanding and the need to do so, as it is a prerequisite for the application of successful learning strategies (Ohtani & Hisasaka, 2018). Consequently, the relationship between intellectual openness and academic achievement may have been due to an increased knowledge and awareness of learning-related cognitive processes.

However, the stepwise regression analyses in Article 3 challenge these interpretations, as intellectual openness explained a significant amount of unique variance in academic performance above and beyond self-assessed intelligence and metacognition, but not vice versa. Furthermore, the regression coefficient of intellectual openness was only slightly attenuated after controlling for the other two constructs, suggesting that its predictive validity for academic achievement is not primarily due to the cognitive processes assumed above. Instead, these results imply that affective and behavioral processes, such as positive attitudes toward intellectual stimulation and exploration, intrinsic learning motivation, and behavioral tendencies to seek out and engage with complex topics, may play an important role in linking intellectual openness to academic performance.

11 Limitations and Further Research

Like most research, the studies conducted for this dissertation have some limitations and shortcomings, both methodological and conceptual, that should be properly acknowledged and considered when interpreting the results. In addition, some relevant questions either could not be addressed in this work or arose from its findings. These may provide interesting perspectives for further research on the role of openness in academic success.

11.1 Psychometric and Methodological Issues

A first important limitation is that Articles 2 and 3 relied solely on the BFAS to measure the two aspects of openness. Despite its merit of being explicitly constructed to reflect the dichotomous nature of the openness dimension, the BFAS openness scales exhibited some problematic psychometric properties in the samples of this dissertation. Most importantly, both openness aspect scales yielded poor model fits in confirmatory factor analysis (see Appendix B.1), calling into question the assumed factor structure.

As noted by Hopwood and Donnellan (2010), this is not an uncommon phenomenon for personality measures—even arguably unidimensional ones—because even small item imperfections and seemingly minor methodological artifacts, such as negative item wording or response biases, can introduce unwanted sources of variation and correlated residuals. This would violate the strict model assumptions of confirmatory factor analysis and ultimately result in poor model fits. However, this imposed considerable limitations on the data analyses. For example, structural equation modeling was not feasible because the poor model fit of the aspect scales would substantially reduce the overall model fit—especially if controversial methods such as item parceling were

avoided (Marsh et al., 2013). For example, measurement error could not be accounted for in time-lagged analyses in Article 3, potentially resulting in biased parameter estimates. This is particularly problematic given the low internal consistency of the mind-wandering measure at both times of measurement.

Another concern were the unexpectedly low correlations between the two openness aspects, reaching als low as $r = .13$ in Article 3. This was considerably lower than both the correlation reported in the original scale development article (DeYoung et al., 2007) and in the meta-analytic structural modeling in Article1. Indeed, intellectual openness showed stronger associations with the industriousness aspects of conscientiousness that with senso-aesthetic openness. This raises questions about the construct validity of the BFAS openness scales and the notion of intellectual and senso-aesthetic openness as two components of the same dimension. Thus, further research should scrutinize the construct validity of the BFAS openness scales and consider the use of other measures that differentiate between the two openness aspects, such as the BFI-2 (Soto & John, 2017b) or the *Openness to Experience scale* developed by Woo, Chernyshenko, Longley, et al. (2014).

A second methodological shortcoming is the exclusive focus on self-report data in Articles 1, 2, and 3. As described in Section 4.1, self-report measures are prone to a variety of adverse effects such as flawed introspection (Dunning et al., 2004; Silvia & Gendolla, 2001; Vazire, 2010) and response biases such as socially desirable responding (Paulhus, 2002, 2017). This may be particularly true for measures of openness due to the high evaluativeness of the trait (John & Robins, 1993; Smeding et al., 2017).

Such effects may have been even more pronounced in Articles 2 and 3, given the strong emphasis of the BFAS intellectual openness scale on cognitive ability and efficiency (e.g., “Am quick to understand things.”, “Can handle a lot of information.”; see also Kaufman, 2013), as well as its correlation with self-assessed intelligence. Previous research suggests that self-reports of cognitive abilities are only moderately accurate (M. C. Howard & Cogswell, 2018), that people with lower objective intelligence tend to substantially overestimate their cognitive abilities (Dunning et al., 2003; Kruger & Dunning, 1999; von Stumm, 2014), and that women generally underestimate them (Syzmanowicz & Furnham, 2011; von Stumm et al., 2009). Taken together, there is a possibility that self-reported levels of intellectual openness may have been subject to some degree of distortion in the samples used in this dissertation.

Thus, further research on the relationship between the two openness aspects and academic success should consider alternative forms of personality assessment, such as forced-choice measures (e.g., Watrin et al., 2019) or other-ratings of the two openness aspects. While the latter seems particularly appealing given that other-ratings of overall openness have been found to show stronger associations with postsecondary academic performance than self-reports (Poropat, 2014), it also comes with the challenge of accurately assessing another person's personality traits that refer more to inner thoughts and feelings than to observable behavior (Pytlik Zillig et al., 2002).

Another approach might be to use a situational judgment test, as described in Section 4.4. Article 4 has shown that a construct-driven approach is feasible for developing a psychometrically sound SJT for the openness to ideas facet, which is a good indicator of intellectual openness. Future research could greatly benefit from the use of this or other comparable measures. From an applied point of view, such an instrument would also be attractive to practitioners, given the continuing trend to use SJTs in student admission procedures (e.g., Lievens, 2013; Webster et al., 2020).

11.2 Further Research on Cognitive Mediators

As discussed earlier, the lack of mediation through mind-wandering may be, at least in part, the consequence of methodological shortcomings (i.e., low reliability and statistical power). However, another explanation may be that the rather complex nature of the mind-wandering construct was not adequately represented in the measure used in this dissertation. Although early work on mind-wandering suggested that task-unrelated thoughts may be due to either *controlled* or *uncontrolled* shifts of attention (Giambra, 1995), subsequent research has often implicitly or explicitly treated mind-wandering as a primarily unintentional phenomenon (i.e., failures of executive control; McVay & Kane, 2010) and—like the study in Article 3—relied on measures of general mind-wandering (for a more comprehensive review, see Seli, Wammes, et al., 2016).

However, a growing body of research emphasizes the need to distinguish between *spontaneous* and *deliberate* types of mind-wandering (Seli et al., 2015; Smallwood & Schooler, 2015). Indeed, empirical findings have shown differential associations of intentional and unintentional mind-wandering with vigilance (Martínez-Pérez et al.,

2021), mindfulness (Carriere et al., 2013; Seli et al., 2015), and working memory (Robison & Unsworth, 2018). More recent research has also provided insights of direct relevance to this dissertation, namely that deliberate, but not spontaneous, mind-wandering was related to overall openness (Carciofo & Jiang, 2021; Martarelli et al., 2021), and that intentional mind-wandering had a negative effect on proximal measures of academic performance (i.e., in-class quizzes), whereas unintentional mind-wandering affected more distal outcomes (i.e., exam scores; Wammes et al., 2016). Overall, these findings encourage further investigation of mind-wandering as a mediator of the relationship between openness and performance in postsecondary education, despite the rather disappointing results in Article 3.

In addition, other cognitive functions may be worth considering as possible mediators. For example, overall openness has been associated with *executive functions*, that is, "a set of general-purpose control mechanisms ... that regulate the dynamics of human cognition and action" (Miyake & Friedman, 2012, p. 8), such as cognitive control (Beaty et al., 2018), cognitive flexibility (Murdock et al., 2013), and lateral inhibition (J. B. Peterson et al., 2002), which in turn have been found to correlate with academic achievement (Owens & Garcia, 2018; Ramos-Galarza et al., 2020; Titz & Karbach, 2014). Recent research has begun to disentangle the relationships of the two aspects of openness with these mechanisms and has yielded preliminary evidence for differential patterns of correlation (DeYoung et al., 2005; Vartanian et al., 2018). This may provide a promising avenue for further research that seeks to understand the process by which the two aspects of openness affect academic achievement.

Analogously, meta-analytic evidence suggests a positive relationship between openness and *mindfulness* (Giluk, 2009), that is, the "awareness that arises from paying attention, on purpose, in the present moment, non-judgmentally" (Kabat-Zinn, 1994, p. 4). This construct has received considerable attention in educational research and practice over the past two decades (Ergas & Hadar, 2019) and has been linked to determinants of student success such as learning, critical thinking, and self-control (Leland, 2015), as well as supporting factors such as student mental health and well-being (Halladay et al., 2019). Thus, future research that seeks to clarify the relationships between the various facets of dispositional mindfulness (Rau & Williams, 2016) and the two openness aspects may be rewarded with useful insights into the mechanisms linking the latter to academic success.

11.3 Toward a Comprehensive Causal Framework

Given the encouraging results of this dissertation, a worthwhile overarching goal for future research may be the development of a comprehensive framework that identifies, describes, and explains the relevant causal pathways between openness and academic success. Although the topic of causality in personality research is more complex than one might assume (Costantini & Perugini, 2018; J. J. Lee, 2012), most personality researchers view personality traits as largely resistant to modification and manipulation (Revelle, 2007), with some even arguing that the environment has little or no influence on them at all (McCrae et al., 2021). Consequently, they consider them to be at the beginning of unidirectional causal pathways that ultimately lead to behavioral outcomes (McCrae & Sutin, 2018). From this perspective, the findings of this dissertation imply that intellectual openness facilitates academic success, rather than that academic success leads to higher levels of intellectual openness.

However, since causal inferences cannot be drawn from cross-sectional correlational data, corroborating this notion and developing an according framework would rely heavily on more longitudinal research on the relationship between openness aspects and academic success. Such an approach may be particularly important since there is some empirical evidence that the relationship between openness and academic performance varies over time. Unfortunately, these results are rather inconclusive, as some studies reported the strongest associations at the end of a study program (Lievens et al., 2009), some at the beginning (S. Smithers et al., 2004), some in the middle (Poole et al., 2007), and some only at the beginning *and* the end (Chamberlain et al., 2005). Longitudinal studies that explicitly distinguish between the two openness aspects might not only help to disentangle these inconsistent findings, but also promote a deeper understanding of *how* and *when* intellectual and senso-aesthetic openness affect academic success.

While the development of such a causal framework would undoubtedly require both elaborate theory building and rigorous empirical research, its results could be of great utility in both research and educational practice. The following sections highlight avenues for research in three areas of such a causal framework, namely the predictors (i.e., the two openness aspects), the mechanisms and processes (i.e., moderation and mediation), and the outcomes (i.e., indicators of academic success).

11.3.1 Predictors

First, a more thorough understanding of intellectual and senso-asthetic openness—their precise nature, scope, and nomological network, as well as their proper measurement—should be established. While this dissertation has focused on the operationalization proposed by DeYoung et al. (2007), there are sound alternatives and complementary approaches that warrant further consideration.

Indeed, recent research on the lower-order taxonomy of openness has yielded valuable insights into its intermediate structure and components. For example, Woo, Chernyshenko, Longley, et al. (2014) presented factor analytic results across several personality inventories suggesting that intellectual openness includes *intellectual efficiency*, *ingenuity*, and *curiosity*, whereas senso-aesthetic openness subsumes *aesthetics*, *tolerance*, and *depth*. Using a similar approach, Kaufman (2013) differentiated senso-aesthetic openness into *affective engagement* and *aesthetic engagement*, and intellectual openness into *intellectual engagement* and *explicit cognitive ability*. Finally, Christensen et al. (2019), using psychometric network analysis (Costantini et al., 2015), identified *intellectual interests*, *self-assessed intelligence*, and *intellectual curiosity* as facets of intellectual openness and *aesthetic appreciation*, *openness to emotions*, *imaginativeness*, and *fantasy* as facets of senso-aesthetic openness.[22]

While these results are reasonably congruent with each other, they also contribute unique perspectives that further research should aggregate into a more comprehensive and universal description of intellectual and senso-aesthetic openness. This would not only facilitate the development of novel aspect-level measures, but also enable researchers to adequately contextualize the two openness aspects within broader domains of individual differences such as intellectual investment (von Stumm & Ackerman, 2013), intellect (Mussel, 2013a), and creativity (Batey & Furnham, 2006), ultimately improving the theoretical rationale for causal relationships between the two openness aspects and academic success.

[22] Interestingly, Christensen et al. (2019) also found a possible third aspect, namely *open-mindedness*, which subsumed *nontraditionalism*, *variety-seeking*, and *diversity*. This may provide an explanation for earlier findings that the openness to values facet of the NEO-PI-R is not a particularly good indicator of either intellectual or senso-aesthetic openness.

11.3.2 Mechanisms and Processes

Next, further research efforts should aim to identify the precise means by which the two aspects of openness affect academic success. In terms of the causal pathways in five-factor theory (McCrae & Sutin, 2018), this means examining the *characteristic adaptations* (e.g., habits, skills, and beliefs) and *external influences* (i.e., interactions with the environment) that translate the two openness aspects into behaviors that ultimately result in academic success.

Complementing the large body of research on psychological correlates of postsecondary academic success (Richardson et al., 2012), an equally impressive amount of studies has emphasized the crucial importance of environmental factors and conditions for student achievement, satisfaction, and persistence (Kuh et al., 2013). Integrating both perspectives, person-environment-fit theory postulates that students are more successful and satisfied in educational settings that they perceive as congruent with their individual needs, demands, and interests (Etzel & Nagy, 2016; Y. Li et al., 2013; Schmitt et al., 2008).

Consequently, it has been theorized that the association between openness and academic success may vary across educational settings according to their focus on critical and original thinking versus knowledge acquisition (Farsides & Woodfield, 2003). This is supported by empirical findings that show variations in the relationship between openness and academic performance between different academic majors (De Fruyt & Mervielde, 1996; Vedel et al., 2015); see also Article 1).

Thus, future research should consider using well-established and validated measures such as the *College and University Classroom Environment Inventory* (Fraser & Treagust, 1986), the *Course Experience Questionnaire* (Wilson et al., 1997), and the *College Classroom Environment Scales* (Winston et al., 1994) to further examine the role of learning environment characteristics as moderators of the relationship between openness and academic success in postsecondary education. Indeed, these instruments cover characteristics that could potentially act as moderators, such as student involvement and autonomy, innovativeness, and appropriateness of academic assessments, thereby offering promising research opportunities.[23]

[23]For example, although the results of this dissertation suggest that senso-aesthetic openness is either negatively or not related to academic success, this may not generalize to all academic majors. As

Another approach might be to consider interactions between the two openness aspects and other personality traits such as extraversion, that is, "individual differences in tendencies to experience and exhibit positive affect, assertive behavior, decisive thinking, and desires for social attention" (Wilt & Revelle, 2017, p. 57). Although meta-analytic findings suggest that extraversion is not a valid predictor of academic achievement per se (see Section 2.1), there are arguments for a possible interplay between openness and extraversion in predicting academic success. Recent research increasingly emphasizes the role of extraversion for "behavioral exploration and engagement with specific rewards (i.e., goals to approach)" (DeYoung, 2015, p. 42). In addition, there is the notion that openness and extraversion are not fully orthogonal factors, but together form the higher order metatrait *plasticity* (Chang et al., 2012; DeYoung et al., 2002), which reflects "a tendency to be exploratory and flexible, both behaviorally and cognitively" (DeYoung, 2014, p. 379).

In short, while openness reflects cognitive exploration and information-seeking, extraversion reflects exploratory behavior and reward-seeking. It seems plausible that academic success would benefit most from a combination of these traits: Extraversion—especially its *assertiveness* aspect, which includes agency and self-confidence (DeYoung et al., 2007)— could facilitate the translation of the desire for cognitive exploration and stimulation from intellectual openness into concrete exploratory behavior in educational settings. Consequently, both traits may interact in predicting of academic success.

As for other potential mediators, an obvious starting point would be psychological constructs that have already been shown to mediate the relationship between overall openness and academic achievement, namely deep learning approaches (Diseth, 2003), learning goal orientation (Steinmayr et al., 2011), and self-efficacy (J. Zhang & Ziegler, 2016), as well as other academically relevant constructs that have been associated with openness, such as self-regulated learning processes (Bidjerano & Dai, 2007; MacCann & Roberts, 2010) and academic engagement (Mahama et al., 2022; Qureshi et al., 2016).

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shown in Section 3.3, senso-aesthetic openness correlates with creative thinking and verbal intelligence. Furthermore, previous research has shown that it is positively related to creative achievement in the arts, but not in the sciences (Kaufman et al., 2016). This indicates that the aspect may promote academic success in majors that reward or even require creativity, unconventionality, and aesthetic engagement, such as fine arts, language and literature, journalism, marketing, architecture, and the plethora of design-related fields of study (e.g., graphic, instructional, and industrial design).

Another goal should be to examine the role that intelligence plays in any hypothesized causal effect of the two openness aspects on academic success. This is particularly challenging because, although posititve correlations with various cognitive abilities have been found for both overall openness (Ackerman & Heggestad, 1997) and the two openness aspects (see Section 3.3), the nature of these correlations is controversial. If one adheres to the traditional notion (Cronbach, 1949; Fiske & Butler, 1963) that tests of cognitive abilities usually measure maximum performance (i.e., what a person can do under optimal conditions), whereas noncognitive traits are typically assessed through measures of typical performance (i.e., what a person is likely to do under regular conditions), one would consider the two openness aspects to be distinct from intelligence. However, some researchers argue that intelligence should be considered a component of intellectual openness, highlighting the obvious conceptual overlap—going back to the earliest definitions of openness (Borgatta, 1964; Cattell, 1957)—as well as the difficulties of truly eliminating ability descriptions from personality traits (DeYoung, 2014). Indeed, this notion has been supported by factor analytic evidence yielding common factors for intellectual openness and psychometrically assessed intelligence (DeYoung et al., 2012; Kaufman, 2013), as well as evidence from behavioral genetic studies suggesting a common genetic factor (Wainwright et al., 2008).

In any case, when attempting to determine a causal effect of the two aspects of openness on academic success, further research should statistically control for measured intelligence, as it has been found to have strong associations with both openness and academic achievement (DeYoung, 2011). Theoretical frameworks such as the *openness-fluid-crystallized-intelligence model* (Ziegler, Danay, Heene, et al., 2012) could help to disentangle the relationship between the two openness aspects, intelligence and academic success, and to adequately model the respective causal pathways. In short, this model suggests that higher levels of openness provide more opportunities to learn and train one's cognitive abilities, thereby increasing both fluid and crystallized intelligence (i.e., domain-specific knowledge) over time and has received considerable empirical support (Rusche & Ziegler, 2022; Ziegler et al., 2018).

Complementing these efforts, which mostly focus on intellectual openness, further research could also examine creativity as a mediator of the causal relationship between both aspects of openness and academic success. Recent meta-analyses have shown that creativity is related to postsecondary academic achievement (Gajda et al., 2017), and

that overall openness is the strongest predictor of creative self-beliefs (Karwowski & Lebuda, 2016). As shown in Section 3.3, while both aspects are related to creative achievement, senso-aesthetic openness seems to have a stronger effect than intellectual openness. Thus, a proper consideration of creativity in the aforementioned causal framework could put into perspective the subordinate role that senso-aesthetic openness seems to play in academic success.

Another research avenue that may prove fruitful in modeling the causal path from the two openness aspects to academic success is the domain of vocational interests. Several meta-analyses have found substantial relationships between overall openness and two of the *Big Six* from Holland's (1997) model of vocational interests, namely *Artistic* and *Investigative* (Barrick et al., 2003; Hurtado Rúa et al., 2019; Larson et al., 2002). Although empirical research at the aspect-level is still sparse (for a notable exception see Douglas et al., 2016b), it seems reasonable to assume that the relationship with artistic interests is primarily due to senso-aesthetic openness, while investigative interests are more strongly related to intellectual openness. Given the impact that the congruence of interests and academic environment has on student achievement (Nye et al., 2012, 2017) and satisfaction (Tsabari et al., 2005), scrutinizing whether and how the two openness aspects affect the development and shaping of specific vocational interests may provide valuable insights into the mechanisms that link them to academic success. However, due to the stability of both personality and vocational interests in adulthood, such research would probably need to begin in childhood or adolescence (Costa et al., 1984).

11.3.3 Outcomes

Finally, modeling a comprehensive framework would both require and greatly benefit from a more nuanced perspective on academic success as the focal outcome. As noted by York et al. (2015), the common practice in educational research of relying primarily on academic achievement as a proxy for academic success may be ill-advised given the complex, multifaceted nature of the academic success construct. This dissertation addressed this issue by including other indicators of academic success, namely subjective academic achievement (in Article 2), academic satisfaction, student persistence, and future career success (in Article 3).

However, other important indicators of academic success suggested by York et al. (2015), such as the attainment of learning outcomes and the acquisition of skills and competencies, remained unexplored and should be addressed in further research. Unfortunately, studies of the relationship between overall openness—let alone its aspects—and standardized measures of learning outcomes, such as the *Scholastic Aptitude Test* or the *Graduate Record Examination*, are surprisingly sparse. However, there is some evidence that overall openness is related to such measures (Noftle & Robins, 2007; D. Powers, 2004).

Similarly, there is little empirical evidence on the possible relationship between openness and the successful acquisition of skills and competencies in postsecondary education. A notable exception is a study by Clifford et al. (2004), which showed that more open students demonstrated better critical thinking skills. Yet findings from organizational psychology paint a more optimistic picture of a possible causal relationship between openness and skill acquisition. Meta-analytic evidence suggests that openness is a strong predictor of training performance (Barrick et al., 2001), while other studies have found that openness positively affects continuous learning at work (Minbashian et al., 2013; Watanabe et al., 2011).

As discussed in Article 1, openness has been linked to various behavioral and motivational processes with relevance to learning. Furthermore, it has been shown to play an important role in knowledge acquisition (Rolfhus & Ackerman, 1999; Rusche & Ziegler, 2022). Therefore, the inclusion of according indicators of academic success and the examination of causal effects of openness on them seems like a promising avenue for future research.

12 Conclusion

As postsecondary educational attainment becomes increasingly important to individuals, organizations, and societies (see Chapter 1), scholars are continuously striving to identify those individual differences that are most relevant to academic success (see Chapter 2). Since the very emergence of the contemporary five-factor model of personality, openness has been theorized to be of great importance in educational settings, as it reflects a fundamental desire for cognitive exploration, engagement in new experiences, and a thorough understanding of one's environment (see Chapter 3).

Oddly enough, the large body of research that has accumulated over several decades has struggled to empirically establish consistent and substantial relationships between openness and indicators of academic success. For example, although openness could be plausibly related to academic performance on a theoretical level and had shown meaningful associations with other academically relevant constructs, its overall correlation with academic performance was surprisingly modest (see Chapter 6). While this lack of clear empirical evidence certainly encouraged some researchers to shift their focus to other, supposedly more relevant personality traits, such as conscientiousness or self-efficacy[24], others remained committed to investigating the role of openness in academic success.

Unfortunately, studying openness in depth often means accepting the challenge of working with a personality dimension that is not only far more controversial and heterogeneous than the other dimensions in the five-factor model of personality, but also is situated at the somewhat fuzzy intersection between non-cognitive traits and cognitive

[24]This can be illustrated—in an admittedly rather informal way—with the frequencies of the studies included in Richardson et al.'s (2012) meta-analysis. Openness ranked fourth among the dimensions of the five-factor model and had only about three-quarters of the studies that were included for conscientiousness and academic self-efficacy, respectively.

abilities (see chapter 3). Consequently, the difficulty of determining the precise scope and nature of openness makes it more challenging to explain whether and why it should be related to academic success. Unfortunately, those who face this challenge—especially when studying openness as part of a larger set of personality traits—are sometimes faced with the temptation to invoke its *obvious academic relevance* or to remain rather vague about the theoretical rationale behind the hypothesized associations between openness and academic success criteria. As a result, expected findings can be complacently accepted as confirmation of the aforementioned obvious relevance, while unexpected findings can be shrugged off as consistent with previous inconsistencies. It seems obvious that this makes further research even more challenging.

This dissertation took up the challenge and was rewarded with a number of meaningful findings. They supported the notion that openness consists of two distinct aspects, namely intellectual and senso-aesthetic openness, which can either facilitate or impede academic success (see Chapter 6), that intellectual openness is on par with conscientiousness as a predictor of academic achievement (see Chapter 7), and that the two openness aspects differentially predict a wide range of academic success criteria after more than two years (see Chapter 8). They also provided useful insights into the nature of these relationships, showing that intellectual openness explains variance in academic achievement above and beyond conscientiousness (see Chapter 7), that the predictive validity of intellectual openness is not simply due to overlap with self-assessed intelligence or metacognition, and that mind-wandering is not involved as a mediating variable (see Chapter 8). These findings vindicate openness as a personality trait highly relevant to academic success, resolve some of the inconsistencies from previous research, and provide concrete guidance and promising avenues for future research efforts.

This has not been accomplished by building on a recent theoretical breakthrough or using some novel research methodology, but rather by consequently applying a notion that was vigorously debated some 30 years ago, namely that openness is a truly dichotomous personality dimension and should be operationalized as such (see Chapter 3). Thus, the most important overall implication of this dissertation for further research on the relationship between openness and academic success is that scholars should avoid using openness measures that conflate intellectual and senso-aesthetic components of openness into an overall score, as the resulting obfuscation of distinct—

and possibly opposing—effects may be at the root of many of the aforementioned inconsistencies in previous findings. Consequently, using measures that properly reflect the dichotomous nature of openness (see Chapter 4) may enable researchers to revisit and properly address previous research questions—especially those that yielded unexpected or inconsistent results.

Similarly, the results of this dissertation strongly suggest that the dichotomous nature of openness needs to be considered when outlining theoretical models or formulating research questions about the role of openness in academic success. Deriving specific hypotheses for each openness aspect might be more cumbersome and challenging than taking the easy way out by focusing on overall openness—especially given the current scarcity of relevant research to build on. However, it will certainly facilitate more nuanced and meaningful theoretical rationales, thereby enhancing the contributions of further research to a more thorough and comprehensive understanding of *how* and *why* openness and academic success are related.

For educational practitioners, the most obvious recommendation derived from this dissertation is to reconsider the use of openness measures in student selection and assessment procedures. Shifting from overall openness scales to aspect-level measures of openness—ideally in combination with corresponding measures of conscientiousness—may enable them to make more valid predictions of an individual's future academic success and thereby optimize student admission or counseling processes. However, the results also caution against relying solely on intellectual openness, as neglecting to properly assess senso-aesthetic openness may result in overlooking potential risks regarding academic performance and persistence.

Furthermore, the results of this dissertation encourage decision-makers in post-secondary educational institutions to create curricula, performance evaluations, and learning environments that both require and reward student behaviors associated with intellectual openness. By ensuring that their undergraduate programs place greater emphasis on elements such as cognitive exploration, scientific curiosity, pluralistic perspectives, and original thinking, they may be able to better capitalize on the potential that this aspect of openness has for their students' academic success. On the other hand, providing opportunities for engaging in perceptual exploration and imaginativeness—where feasible—may mitigate some of the negative effects associated with senso-aesthetic openness.

Overall, the findings of this dissertation make a compelling case for the importance of openness in postsecondary academic success. However, they also demonstrate the clear need for more research on this equally intriguing and intricate relationship. May this work inspire, encourage, and guide those who are open to pursuing this challenging yet promising endeavor.

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References marked with an asterisk indicate studies that have been included in the meta-analysis (Chapter 6). Two asterisks indicate that supplemental data have been provided by the respective author(s).

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Appendices

A Appendix for Article 1

Table 25 lists all studies that were included in the meta-analysis in Article 6. The description of each sample, including all relevant statistical data, can be found in Table 26.

Table 25

References Used in the Meta-Analysis (Article 1)

ID	APA Reference	Type
1	Aviv et al. (2002)	article
2	Berg et al. (2011)	unpublished
3	Boyd (2009)	unpublished
4	Bülter et al. (2000)	unpublished
5	Chamorro-Premuzic and Furnham (2003b)	article
6	De Fruyt and Mervielde (1996)	article
7	Dollinger (1996)	article
8	Fezatte (2009)	unpublished
9	Klein and Lee (2006)	article
10	Lievens et al. (2009)	article
11	Lounsbury et al. (2009)	article
12	Mar et al. (2006)	article
13	Mussel et al. (2011)	article
14	Noftle and Robins (2007)	article
15	Paunonen (2003)	article
16	Paunonen and Ashton (2001a)	article
17	Salgado et al. (2014)	article
18	Scepansky and Bjornsen (2003)	article

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Table 25 (continued)

References Used in the Meta-Analysis (Article 1)

ID	APA Reference	Type
19	Wicherts and Bakker (2012)	article
20	Ziegler, Danay, Schölmerich, et al. (2010)	article
21	Ziegler, Schmukle, et al. (2010)	article
22	Arispe and Blake (2012)	article
23	Bakker et al. (2014)	article
24	K. W. Bauer and Liang (2003)	article
25	Bidjerano and Dai (2007)	article
26	Brackett and Mayer (2003)	article
27	Busato et al. (2000)	article
28	Caldwell and Burger (1998)	article
29	Cela-Ranilla et al. (2011)	article
30	Chamorro-Premuzic (2006)	article
31	Chamorro-Premuzic and Furnham (2003a)	article
32	Chamorro-Premuzic and Furnham (2008)	article
33	Chamorro-Premuzic et al. (2006)	article
34	Chamorro-Premuzic et al. (2009)	article
35	Chapman and Hayslip (2005)	article
36	Choi and Moran (2009)	article
37	Chowdhury (2006)	article
38	Clark and Cundiff (2011)	article
39	Conard (2006)	article
40	Corker et al. (2012)	article
41	Day et al. (2003)	article
42	Dollinger et al. (2008)	article
43	Dollinger and Orf (1991)	article
44	Duff et al. (2004)	article
45	Dwight et al. (1998)	article
46	Farsides and Woodfield (2007)	article
47	Ferguson et al. (2000)	article
48	Fritzsche et al. (2002)	article
49	Furnham and Chamorro-Premuzic (2004)	article
50	Furnham et al. (2003)	article
51	Furnham et al. (2013)	article

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Table 25 (continued)

References Used in the Meta-Analysis (Article 1)

ID	APA Reference	Type
52	Furnham et al. (2006)	article
53	Goff and Ackerman (1992)	article
54	Gray and Watson (2002)	article
55	Hair and Hampson (2006)	article
56	Hazrati-Viari et al. (2012)	article
57	Helle et al. (2010)	article
58	D. M. Higgins et al. (2007)	article
59	Hirsh and Peterson (2008)	article
60	Huws et al. (2009)	article
61	Kappe and Flier (2012)	article
62	Kilic-Bebek (2009)	dissertation
63	Klinkosz et al. (2006)	article
64	Komarraju et al. (2011)	article
65	de Koning et al. (2012)	article
66	Ku and Ho (2010)	article
67	Langford (2003)	article
68	Lounsbury et al. (2005)	article
69	Lounsbury et al. (2003)	article
70	MacCann et al. (2012)	article
71	McIlveen et al. (2013)	article
72	McKenzie and Gow (2004)	article
73	Musgrave-Marquart et al. (1997)	article
74	Okun and Finch (1998)	article
75	Oswald et al. (2004)	article
76	Parkinson and Taggar (2006)	article
77	Paunonen (1998)	article
78	Peeters and Lievens (2005)	article
79	Phillips et al. (2003)	article
80	Pozzebon et al. (2014)	article
81	Reid-Seiser and Fritzsche (2001)	article
82	Richardson and Abraham (2009)	article
83	Ridgell and Lounsbury (2004)	article
84	Rode et al. (2007)	article

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Table 25 (continued)

References Used in the Meta-Analysis (Article 1)

ID	APA Reference	Type
85	C. L. Rogers (2006)	dissertation
86	Saklofske et al. (2012)	article
87	Steele-Johnson and Leas (2013)	article
88	Swanberg and Martinsen (2010)	article
89	Tok and Morali (2009)	article
90	Tyler et al. (2005)	article
91	Vedel et al. (2015)	article
92	Ventura et al. (2012)	article
93	de Vries et al. (2011)	article
94	Waldman and Korbar (2004)	article
95	Wolfe and Johnson (1995)	article
96	Woolf et al. (2011)	article
97	Zyphur et al. (2008)	article
98	Chamorro-Premuzic and Arteche (2008)	article
99	Brannick et al. (2013)	article
100	Chamberlain et al. (2005)	article
101	Evans and Dirks (2001)	article
102	Geramian et al. (2012)	article
103	Grehan et al. (2011)	article
104	Kell (2011)	dissertation
105	Poole et al. (2007)	article
106	S. Smithers et al. (2004)	article
107	Stratton and Elam (2014)	article
108	Xia et al. (2009)	article
109	Barchard (2003)	article
110	Cucina and Vasilopoulos (2005)	article
111	Diseth (2003)	article
112	Pulford and Sohal (2006)	article
113	Schulze and Roberts (2006)	article
114	Clariana (2013)	article
115	Nguyen et al. (2005)	article
116	Oostrom et al. (2011)	article
117	Biderman and Reddock (2012)	article

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Table 25 (continued)

References Used in the Meta-Analysis (Article 1)

ID	APA Reference	Type
118	Reddock et al. (2011)	article
119	Dollinger (2011)	article
120	Dollinger (2015)	article
121	Grunschel et al. (2013)	article
122	S. M. Moon and Illingworth (2005)	article
123	Schmitt et al. (2011)	article
124	Thalmayer et al. (2011)	article
125	Westerman and Vanka (2005)	article
126	Ahmad (2010)	article

Table 26

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
1.1	psychology	NEO PI-R	O	.87[a]	sGPA	.86[a]	−.135	204	author
1.1	psychology	NEO PI-R	O1-FAN	.76[a]	O2-AES	.76[a]	.403	257	author
1.1	psychology	NEO PI-R	O1-FAN	.76[a]	O3-FEE	.66[a]	.386	257	author
1.1	psychology	NEO PI-R	O1-FAN	.76[a]	O4-ACT	.58[a]	.241	257	author
1.1	psychology	NEO PI-R	O1-FAN	.76[a]	O5-IDE	.80[a]	.282	257	author
1.1	psychology	NEO PI-R	O1-FAN	.76[a]	O6-VAL	.67[a]	.299	257	author
1.1	psychology	NEO PI-R	O1-FAN	.76[a]	sGPA	.86[a]	−.165	204	author
1.1	psychology	NEO PI-R	O2-AES	.76[a]	O3-FEE	.66[a]	.399	257	author
1.1	psychology	NEO PI-R	O2-AES	.76[a]	O4-ACT	.58[a]	.321	257	author
1.1	psychology	NEO PI-R	O2-AES	.76[a]	O5-IDE	.80[a]	.539	257	author
1.1	psychology	NEO PI-R	O2-AES	.76[a]	O6-VAL	.67[a]	.256	257	author
1.1	psychology	NEO PI-R	O2-AES	.76[a]	sGPA	.86[a]	−.106	204	author
1.1	psychology	NEO PI-R	O3-FEE	.66[a]	O4-ACT	.58[a]	.071	257	author
1.1	psychology	NEO PI-R	O3-FEE	.66[a]	O5-IDE	.80[a]	.332	257	author
1.1	psychology	NEO PI-R	O3-FEE	.66[a]	O6-VAL	.67[a]	.237	257	author
1.1	psychology	NEO PI-R	O3-FEE	.66[a]	sGPA	.86[a]	−.039	204	author
1.1	psychology	NEO PI-R	O4-ACT	.58[a]	O5-IDE	.80[a]	.270	257	author
1.1	psychology	NEO PI-R	O4-ACT	.58[a]	O6-VAL	.67[a]	.189	257	author
1.1	psychology	NEO PI-R	O4-ACT	.58[a]	sGPA	.86[a]	−.103	204	author
1.1	psychology	NEO PI-R	O5-IDE	.80[a]	O6-VAL	.67[a]	.286	257	author
1.1	psychology	NEO PI-R	O5-IDE	.80[a]	sGPA	.86[a]	−.073	204	author
1.1	psychology	NEO PI-R	O6-VAL	.67[a]	sGPA	.86[a]	−.003	204	author
2.1	psychology	NEO PI-R	O	.87	sGPA	.86[a]	−.155	77	author
2.1	psychology	NEO PI-R	O1-FAN	.78	sGPA	.86[a]	−.177	77	author
2.1	psychology	NEO PI-R	O2-AES	.71	sGPA	.86[a]	−.133	77	author
2.1	psychology	NEO PI-R	O3-FEE	.65	sGPA	.86[a]	−.068	77	author
2.1	psychology	NEO PI-R	O4-ACT	.68	sGPA	.86[a]	−.169	77	author
2.1	psychology	NEO PI-R	O5-IDE	.83	sGPA	.86[a]	−.050	77	author
2.1	psychology	NEO PI-R	O6-VAL	.48	sGPA	.86[a]	.031	77	author
3.1		NEO PI-R	O1-FAN	.76[a]	sGPA	.86[a]	.150	127	text
3.1		NEO PI-R	O2-AES	.76[a]	sGPA	.86[a]	.080	127	text
3.1		NEO PI-R	O3-FEE	.66[a]	sGPA	.86[a]	.350	127	text
3.1		NEO PI-R	O4-ACT	.58[a]	sGPA	.86[a]	−.250	127	text

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Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
3.1		NEO PI-R	O5-IDE	.80[a]	sGPA	.86[a]	.060	127	text
3.1		NEO PI-R	O6-VAL	.67[a]	sGPA	.86[a]	−.010	127	text
4.1	psychology	NEO PI-R	O	.87[a]	sGPA	.86[a]	−.096	50	author
4.1	psychology	NEO PI-R	O1-FAN	.76[a]	sGPA	.86[a]	.028	50	author
4.1	psychology	NEO PI-R	O2-AES	.76[a]	sGPA	.86[a]	−.076	50	author
4.1	psychology	NEO PI-R	O3-FEE	.66[a]	sGPA	.86[a]	−.112	50	author
4.1	psychology	NEO PI-R	O4-ACT	.58[a]	sGPA	.86[a]	−.115	50	author
4.1	psychology	NEO PI-R	O5-IDE	.80[a]	sGPA	.86[a]	.011	50	author
4.1	psychology	NEO PI-R	O6-VAL	.67[a]	sGPA	.86[a]	−.203	50	author
5.1	psychology	NEO PI-R	O	.87[a]	cGPA (20)	.92[a]	.020	247	text
5.1	psychology	NEO PI-R	O1-FAN	.76[a]	cGPA (20)	.92[a]	−.050	247	text
5.1	psychology	NEO PI-R	O2-AES	.76[a]	cGPA (20)	.92[a]	.060	247	text
5.1	psychology	NEO PI-R	O3-FEE	.66[a]	cGPA (20)	.92[a]	.010	247	text
5.1	psychology	NEO PI-R	O4-ACT	.58[a]	cGPA (20)	.92[a]	.020	247	text
5.1	psychology	NEO PI-R	O5-IDE	.80[a]	cGPA (20)	.92[a]	.020	247	text
5.1	psychology	NEO PI-R	O6-VAL	.67[a]	cGPA (20)	.92[a]	−.010	247	text
6.1	mixed	NEO PI-R	O1-FAN	.76[a]	oGPA	.94[a]	−.080	397	text
6.1	mixed	NEO PI-R	O2-AES	.76[a]	oGPA	.94[a]	−.090	397	text
6.1	mixed	NEO PI-R	O3-FEE	.66[a]	oGPA	.94[a]	−.020	397	text
6.1	mixed	NEO PI-R	O4-ACT	.58[a]	oGPA	.94[a]	−.030	397	text
6.1	mixed	NEO PI-R	O5-IDE	.80[a]	oGPA	.94[a]	−.030	397	text
6.1	mixed	NEO PI-R	O6-VAL	.67[a]	oGPA	.94[a]	−.010	397	text
6.2	mixed	NEO PI-R	O1-FAN	.76[a]	oGPA	.94[a]	−.180	343	text
6.2	mixed	NEO PI-R	O2-AES	.76[a]	oGPA	.94[a]	−.010	343	text
6.2	mixed	NEO PI-R	O3-FEE	.66[a]	oGPA	.94[a]	−.080	343	text
6.2	mixed	NEO PI-R	O4-ACT	.58[a]	oGPA	.94[a]	−.070	343	text

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Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
6.2	mixed	NEO PI-R	O5-IDE	.80[a]	oGPA	.94[a]	.040	343	text
6.2	mixed	NEO PI-R	O6-VAL	.67[a]	oGPA	.94[a]	−.100	343	text
6.3	humanities	NEO PI-R	O	.87[a]	oGPA	.94[a]	−.070	153	text
6.4	humanities	NEO PI-R	O	.87[a]	oGPA	.94[a]	−.070	121	text
6.5	STEM	NEO PI-R	O	.87[a]	oGPA	.94[a]	−.150	63	text
6.6	STEM	NEO PI-R	O	.87[a]	oGPA	.94[a]	−.230	115	text
6.7	business	NEO PI-R	O	.87[a]	oGPA	.94[a]	−.030	71	text
6.8	psychology	NEO PI-R	O	.87[a]	oGPA	.94[a]	−.170	96	text
6.9	STEM	NEO PI-R	O	.87[a]	oGPA	.94[a]	−.100	19	text
6.0	humanities	NEO PI-R	O	.87[a]	oGPA	.94[a]	.030	102	text
7.1	psychology	NEO PI-R	O1-FAN	.76[a]	sGPA	.88	.083	347	author
7.1	psychology	NEO PI-R	O2-AES	.76[a]	sGPA	.88	.096	347	author
7.1	psychology	NEO PI-R	O3-FEE	.66[a]	sGPA	.88	.097	347	author
7.1	psychology	NEO PI-R	O4-ACT	.58[a]	sGPA	.88	.052	347	author
7.1	psychology	NEO PI-R	O5-IDE	.80[a]	sGPA	.88	.168	347	author
7.1	psychology	NEO PI-R	O6-VAL	.67[a]	sGPA	.88	.088	347	author
8.1		NEO PI-R	O	.85	sGPA	.86[a]	.103	324	author
8.1		NEO PI-R	O1-FAN	.76	O2-AES	.77	.261	324	author
8.1		NEO PI-R	O1-FAN	.76	O3-FEE	.69	.274	324	author
8.1		NEO PI-R	O1-FAN	.76	O4-ACT	.51	.154	324	author
8.1		NEO PI-R	O1-FAN	.76	O5-IDE	.81	.127	324	author
8.1		NEO PI-R	O1-FAN	.76	O6-VAL	.60	.337	324	author
8.1		NEO PI-R	O1-FAN	.76	sGPA	.86[a]	−.034	324	author
8.1		NEO PI-R	O2-AES	.77	O3-FEE	.69	.386	324	author
8.1		NEO PI-R	O2-AES	.77	O4-ACT	.51	.267	324	author
8.1		NEO PI-R	O2-AES	.77	O5-IDE	.81	.344	324	author
8.1		NEO PI-R	O2-AES	.77	O6-VAL	.60	.222	324	author
8.1		NEO PI-R	O2-AES	.77	sGPA	.86[a]	−.022	324	author
8.1		NEO PI-R	O3-FEE	.69	O4-ACT	.51	.200	324	author
8.1		NEO PI-R	O3-FEE	.69	O5-IDE	.81	.241	324	author
8.1		NEO PI-R	O3-FEE	.69	O6-VAL	.60	.347	324	author
8.1		NEO PI-R	O3-FEE	.69	sGPA	.86[a]	.041	324	author
8.1		NEO PI-R	O4-ACT	.51	O5-IDE	.81	.184	324	author

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
8.1		NEO PI-R	O4-ACT	.51	O6-VAL	.60	.207	324	author
8.1		NEO PI-R	O4-ACT	.51	sGPA	.86[a]	.050	324	author
8.1		NEO PI-R	O5-IDE	.81	O6-VAL	.60	.314	324	author
8.1		NEO PI-R	O5-IDE	.81	sGPA	.86[a]	.231	324	author
8.1		NEO PI-R	O6-VAL	.60	sGPA	.86[a]	.120	324	author
9.1	business	NEO PI-R	O	.87	SPM (3)	.64[a]	.022	168	author
9.1	business	NEO PI-R	O1-FAN	.76[a]	O2-AES	.76[a]	.294	164	author
9.1	business	NEO PI-R	O1-FAN	.76[a]	O3-FEE	.66[a]	.449	162	author
9.1	business	NEO PI-R	O1-FAN	.76[a]	O4-ACT	.58[a]	.201	165	author
9.1	business	NEO PI-R	O1-FAN	.76[a]	O5-IDE	.80[a]	.273	164	author
9.1	business	NEO PI-R	O1-FAN	.76[a]	O6-VAL	.67[a]	.083	165	author
9.1	business	NEO PI-R	O1-FAN	.76[a]	SPM (3)	.64[a]	.096	165	author
9.1	business	NEO PI-R	O2-AES	.76[a]	O3-FEE	.66[a]	.367	164	author
9.1	business	NEO PI-R	O2-AES	.76[a]	O4-ACT	.58[a]	.409	167	author
9.1	business	NEO PI-R	O2-AES	.76[a]	O5-IDE	.80[a]	.410	166	author
9.1	business	NEO PI-R	O2-AES	.76[a]	O6-VAL	.67[a]	.161	167	author
9.1	business	NEO PI-R	O2-AES	.76[a]	SPM (3)	.64[a]	−.007	167	author
9.1	business	NEO PI-R	O3-FEE	.66[a]	O4-ACT	.58[a]	.145	165	author
9.1	business	NEO PI-R	O3-FEE	.66[a]	O5-IDE	.80[a]	.251	165	author
9.1	business	NEO PI-R	O3-FEE	.66[a]	O6-VAL	.67[a]	.133	165	author
9.1	business	NEO PI-R	O3-FEE	.66[a]	SPM (3)	.64[a]	.063	165	author
9.1	business	NEO PI-R	O4-ACT	.58[a]	O5-IDE	.80[a]	.426	167	author
9.1	business	NEO PI-R	O4-ACT	.58[a]	O6-VAL	.67[a]	.256	168	author
9.1	business	NEO PI-R	O4-ACT	.58[a]	SPM (3)	.64[a]	−.080	168	author
9.1	business	NEO PI-R	O5-IDE	.80[a]	O6-VAL	.67[a]	.083	167	author
9.1	business	NEO PI-R	O5-IDE	.80[a]	SPM (3)	.64[a]	−.049	167	author
9.1	business	NEO PI-R	O6-VAL	.67[a]	SPM (3)	.64[a]	.093	168	author
10.1	medicine	NEO PI-R	O	.87[a]	oGPA	.94[a]	.020	608	text
10.1	medicine	NEO PI-R	O1-FAN	.76[a]	oGPA	.94[a]	−.010	608	text
10.1	medicine	NEO PI-R	O2-AES	.76[a]	oGPA	.94[a]	.040	608	text
10.1	medicine	NEO PI-R	O3-FEE	.66[a]	oGPA	.94[a]	.010	608	text
10.1	medicine	NEO PI-R	O4-ACT	.58[a]	oGPA	.94[a]	−.090	608	text
10.1	medicine	NEO PI-R	O5-IDE	.80[a]	oGPA	.94[a]	.120	608	text

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
10.1	medicine	NEO PI-R	O6-VAL	.67[a]	oGPA	.94[a]	−.060	608	text
11.1		NEO PI-R	O	.87[a]	oGPA	.94[a]	.007	53	author
11.1	psychology	NEO PI-R	O	.87[a]	SPM (1)	.37[a]	.146	329	author
11.1	psychology	NEO PI-R	O1-FAN	.76[a]	SPM (1)	.37[a]	.278	36	author
11.1		NEO PI-R	O2-AES	.76[a]	oGPA	.94[a]	.038	53	author
11.1	psychology	NEO PI-R	O2-AES	.76[a]	SPM (1)	.37[a]	.089	329	author
11.1		NEO PI-R	O3-FEE	.66[a]	oGPA	.94[a]	−.184	53	author
11.1	psychology	NEO PI-R	O3-FEE	.66[a]	SPM (1)	.37[a]	.052	329	author
11.1		NEO PI-R	O4-ACT	.58[a]	oGPA	.94[a]	.140	53	author
11.1	psychology	NEO PI-R	O4-ACT	.58[a]	SPM (1)	.37[a]	.097	329	author
11.1		NEO PI-R	O5-IDE	.80[a]	oGPA	.94[a]	−.124	53	author
11.1	psychology	NEO PI-R	O5-IDE	.80[a]	SPM (1)	.37[a]	.167	329	author
11.1		NEO PI-R	O6-VAL	.67[a]	oGPA	.94[a]	−.002	53	author
11.1	psychology	NEO PI-R	O6-VAL	.67[a]	SPM (1)	.37[a]	.147	329	author
12.2		NEO PI-R	O	.90	oGPA	.94[a]	.087	131	author
12.2		NEO PI-R	O1-FAN	.76[a]	O2-AES	.76[a]	.394	245	author
12.2		NEO PI-R	O1-FAN	.76[a]	O3-FEE	.66[a]	.330	245	author
12.2		NEO PI-R	O1-FAN	.76[a]	O4-ACT	.58[a]	.315	245	author
12.2		NEO PI-R	O1-FAN	.76[a]	O5-IDE	.80[a]	.347	245	author
12.2		NEO PI-R	O1-FAN	.76[a]	O6-VAL	.67[a]	.312	245	author
12.2		NEO PI-R	O1-FAN	.76[a]	oGPA	.94[a]	−.028	131	author
12.2		NEO PI-R	O2-AES	.76[a]	O3-FEE	.66[a]	.508	245	author
12.2		NEO PI-R	O2-AES	.76[a]	O4-ACT	.58[a]	.309	245	author
12.2		NEO PI-R	O2-AES	.76[a]	O5-IDE	.80[a]	.406	245	author
12.2		NEO PI-R	O2-AES	.76[a]	O6-VAL	.67[a]	.382	245	author
12.2		NEO PI-R	O2-AES	.76[a]	oGPA	.94[a]	.049	131	author
12.2		NEO PI-R	O3-FEE	.66[a]	O4-ACT	.58[a]	.217	245	author
12.2		NEO PI-R	O3-FEE	.66[a]	O5-IDE	.80[a]	.226	245	author
12.2		NEO PI-R	O3-FEE	.66[a]	O6-VAL	.67[a]	.382	245	author
12.2		NEO PI-R	O3-FEE	.66[a]	oGPA	.94[a]	.152	131	author
12.2		NEO PI-R	O4-ACT	.58[a]	O5-IDE	.80[a]	.232	245	author
12.2		NEO PI-R	O4-ACT	.58[a]	O6-VAL	.67[a]	.320	245	author
12.2		NEO PI-R	O4-ACT	.58[a]	oGPA	.94[a]	−.066	131	author

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
12.2		NEO PI-R	O5-IDE	.80[a]	O6-VAL	.67[a]	.321	245	author
12.2		NEO PI-R	O5-IDE	.80[a]	oGPA	.94[a]	.079	131	author
12.2		NEO PI-R	O6-VAL	.67[a]	oGPA	.94[a]	.178	131	author
13.1		NEO PI-R	O	.87[a]	sGPA	.86[a]	−.001	133	author
13.1		NEO PI-R	O1-FAN	.76[a]	O2-AES	.76[a]	.352	199	author
13.1		NEO PI-R	O1-FAN	.76[a]	O3-FEE	.66[a]	.404	199	author
13.1		NEO PI-R	O1-FAN	.76[a]	O4-ACT	.58[a]	.160	199	author
13.1		NEO PI-R	O1-FAN	.76[a]	O5-IDE	.80[a]	.255	199	author
13.1		NEO PI-R	O1-FAN	.76[a]	O6-VAL	.67[a]	.266	199	author
13.1		NEO PI-R	O1-FAN	.76[a]	sGPA	.86[a]	.008	133	author
13.1		NEO PI-R	O2-AES	.76[a]	O3-FEE	.66[a]	.556	199	author
13.1		NEO PI-R	O2-AES	.76[a]	O4-ACT	.58[a]	.238	199	author
13.1		NEO PI-R	O2-AES	.76[a]	O5-IDE	.80[a]	.306	199	author
13.1		NEO PI-R	O2-AES	.76[a]	O6-VAL	.67[a]	.273	199	author
13.1		NEO PI-R	O2-AES	.76[a]	sGPA	.86[a]	−.063	133	author
13.1		NEO PI-R	O3-FEE	.66[a]	O4-ACT	.58[a]	.156	199	author
13.1		NEO PI-R	O3-FEE	.66[a]	O5-IDE	.80[a]	.183	199	author
13.1		NEO PI-R	O3-FEE	.66[a]	O6-VAL	.67[a]	.211	199	author
13.1		NEO PI-R	O3-FEE	.66[a]	sGPA	.86[a]	.019	133	author
13.1		NEO PI-R	O4-ACT	.58[a]	O5-IDE	.80[a]	.324	199	author
13.1		NEO PI-R	O4-ACT	.58[a]	O6-VAL	.67[a]	.209	199	author
13.1		NEO PI-R	O4-ACT	.58[a]	sGPA	.86[a]	−.016	133	author
13.1		NEO PI-R	O5-IDE	.80[a]	O6-VAL	.67[a]	.174	199	author
13.1		NEO PI-R	O5-IDE	.80[a]	sGPA	.86[a]	.040	133	author
13.1		NEO PI-R	O6-VAL	.67[a]	sGPA	.86[a]	.030	133	author
14.1	psychology	BFI	O	.79	sGPA	.86[a]	.060	10,497	text
14.2		NEO-FFI	O	.75	oGPA	.94[a]	.130	475	text
14.3	psychology	HECAXO PI	O	.87	sGPA	.86[a]	.050	470	text
14.4	psychology	NEO PI-R	O	.89	sGPA	.86[a]	.130	256	text
14.4	psychology	NEO PI-R	O1-FAN	.76	O2-AES	.80	.406	425	author
14.4	psychology	NEO PI-R	O1-FAN	.76	O3-FEE	.76	.415	425	author
14.4	psychology	NEO PI-R	O1-FAN	.76	O4-ACT	.53	.141	425	author
14.4	psychology	NEO PI-R	O1-FAN	.76	O5-IDE	.75	.398	425	author

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
14.4	psychology	NEO PI-R	O1-FAN	.76	O6-VAL	.68	.345	425	author
14.4	psychology	NEO PI-R	O1-FAN	.76	sGPA	.86[a]	.050	256	text
14.4	psychology	NEO PI-R	O2-AES	.80	O3-FEE	.76	.522	425	author
14.4	psychology	NEO PI-R	O2-AES	.80	O4-ACT	.53	.194	425	author
14.4	psychology	NEO PI-R	O2-AES	.80	O5-IDE	.75	.538	425	author
14.4	psychology	NEO PI-R	O2-AES	.80	O6-VAL	.68	.325	425	author
14.4	psychology	NEO PI-R	O2-AES	.80	sGPA	.86[a]	.100	256	text
14.4	psychology	NEO PI-R	O3-FEE	.76	O4-ACT	.63	.043	425	author
14.4	psychology	NEO PI-R	O3-FEE	.76	O5-IDE	.75	.355	425	author
14.4	psychology	NEO PI-R	O3-FEE	.76	O6-VAL	.68	.375	425	author
14.4	psychology	NEO PI-R	O3-FEE	.76	sGPA	.86[a]	.120	256	text
14.4	psychology	NEO PI-R	O4-ACT	.53	O5-IDE	.75	.166	425	author
14.4	psychology	NEO PI-R	O4-ACT	.53	O6-VAL	.68	.070	425	author
14.4	psychology	NEO PI-R	O4-ACT	.53	sGPA	.86[a]	−.040	256	text
14.4	psychology	NEO PI-R	O5-IDE	.75	O6-VAL	.68	.410	425	author
14.4	psychology	NEO PI-R	O5-IDE	.75	sGPA	.86[a]	.090	256	text
14.4	psychology	NEO PI-R	O6-VAL	.68	sGPA	.86[a]	.170	256	text
15.1	psychology	other	O	.85	sGPA	.86[a]	.126	162	author
15.1	psychology	NEO-FFI	O	.72	sGPA	.86[a]	.099	257	author
15.1	psychology	composite	O		sGPA	.86[a]	.011	210	author
15.2	psychology	other	O	.82	sGPA	.86[a]	.169	137	author
15.2	psychology	NEO PI-R	O	.86	sGPA	.86[a]	.195	131	author
15.2	psychology	composite	O		sGPA	.86[a]	.182	134	author
15.2	psychology	NEO PI-R	O1-FAN	.76[a]	O2-AES	.76[a]	.408	131	author
15.2	psychology	NEO PI-R	O1-FAN	.76[a]	O3-FEE	.66[a]	.417	131	author
15.2	psychology	NEO PI-R	O1-FAN	.76[a]	O4-ACT	.58[a]	.170	131	author
15.2	psychology	NEO PI-R	O1-FAN	.76[a]	O5-IDE	.80[a]	.224	131	author
15.2	psychology	NEO PI-R	O1-FAN	.76[a]	O6-VAL	.67[a]	.344	131	author
15.2	psychology	NEO PI-R	O1-FAN	.76[a]	sGPA	.86[a]	.087	131	author
15.2	psychology	NEO PI-R	O2-AES	.76[a]	O3-FEE	.66[a]	.531	131	author
15.2	psychology	NEO PI-R	O2-AES	.76[a]	O4-ACT	.58[a]	.372	131	author
15.2	psychology	NEO PI-R	O2-AES	.76[a]	O5-IDE	.80[a]	.458	131	author
15.2	psychology	NEO PI-R	O2-AES	.76[a]	O6-VAL	.67[a]	.222	131	author

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
15.2	psychology	NEO PI-R	O2-AES	.76[a]	sGPA	.86[a]	.181	131	author
15.2	psychology	NEO PI-R	O3-FEE	.66[a]	O4-ACT	.58[a]	.178	131	author
15.2	psychology	NEO PI-R	O3-FEE	.66[a]	O5-IDE	.80[a]	.215	131	author
15.2	psychology	NEO PI-R	O3-FEE	.66[a]	O6-VAL	.67[a]	.314	131	author
15.2	psychology	NEO PI-R	O3-FEE	.66[a]	sGPA	.86[a]	.126	131	author
15.2	psychology	NEO PI-R	O4-ACT	.58[a]	O5-IDE	.80[a]	.294	131	author
15.2	psychology	NEO PI-R	O4-ACT	.58[a]	O6-VAL	.67[a]	.164	131	author
15.2	psychology	NEO PI-R	O4-ACT	.58[a]	sGPA	.86[a]	.075	131	author
15.2	psychology	NEO PI-R	O5-IDE	.80[a]	O6-VAL	.67[a]	.244	131	author
15.2	psychology	NEO PI-R	O5-IDE	.80[a]	sGPA	.86[a]	.235	131	author
15.2	psychology	NEO PI-R	O6-VAL	.67[a]	sGPA	.86[a]	.014	131	author
16.1		NEO PI-R	O1-FAN	.76[a]	O2-AES	.76[a]	.278	141	author
16.1		NEO PI-R	O1-FAN	.76[a]	O3-FEE	.66[a]	.525	141	author
16.1		NEO PI-R	O1-FAN	.76[a]	O4-ACT	.58[a]	.180	141	author
16.1		NEO PI-R	O1-FAN	.76[a]	O5-IDE	.80[a]	.294	141	author
16.1		NEO PI-R	O1-FAN	.76[a]	O6-VAL	.67[a]	.310	141	author
16.1		NEO PI-R	O1-FAN	.76[a]	oGPA	.94[a]	−.040	140	author
16.1		NEO PI-R	O2-AES	.76[a]	O3-FEE	.66[a]	.476	141	author
16.1		NEO PI-R	O2-AES	.76[a]	O4-ACT	.58[a]	.366	141	author
16.1		NEO PI-R	O2-AES	.76[a]	O5-IDE	.80[a]	.558	141	author
16.1		NEO PI-R	O2-AES	.76[a]	O6-VAL	.67[a]	.227	141	author
16.1		NEO PI-R	O2-AES	.76[a]	oGPA	.94[a]	.007	140	author
16.1		NEO PI-R	O3-FEE	.66[a]	O4-ACT	.58[a]	.158	141	author
16.1		NEO PI-R	O3-FEE	.66[a]	O5-IDE	.80[a]	.368	141	author
16.1		NEO PI-R	O3-FEE	.66[a]	O6-VAL	.67[a]	.335	141	author
16.1		NEO PI-R	O3-FEE	.66[a]	oGPA	.94[a]	.021	140	author
16.1		NEO PI-R	O4-ACT	.58[a]	O5-IDE	.80[a]	.271	141	author
16.1		NEO PI-R	O4-ACT	.58[a]	O6-VAL	.67[a]	.360	141	author
16.1		NEO PI-R	O4-ACT	.58[a]	oGPA	.94[a]	−.026	140	author
16.1		NEO PI-R	O5-IDE	.80[a]	O6-VAL	.67[a]	.204	141	author
16.1		NEO PI-R	O5-IDE	.80[a]	oGPA	.94[a]	.120	140	author
16.1		NEO PI-R	O6-VAL	.67[a]	oGPA	.94[a]	.123	140	author
17.1	mixed	NEO PI-R	O	.87[a]	oGPA	.87	−.030	406	author

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
17.1	mixed	other	O		oGPA	.87	−.110	406	author
17.1	mixed	composite	O		oGPA	.87	.070	406	text
17.1	mixed	NEO PI-R	O1-FAN	.76[a]	O2-AES	.76[a]	.430	410	author
17.1	mixed	NEO PI-R	O1-FAN	.76[a]	O3-FEE	.66[a]	.372	410	author
17.1	mixed	NEO PI-R	O1-FAN	.76[a]	O4-ACT	.58[a]	.282	410	author
17.1	mixed	NEO PI-R	O1-FAN	.76[a]	O5-IDE	.80[a]	.352	410	author
17.1	mixed	NEO PI-R	O1-FAN	.76[a]	O6-VAL	.67[a]	.270	410	author
17.1	mixed	NEO PI-R	O1-FAN	.76[a]	oGPA	.87	−.065	406	author
17.1	mixed	NEO PI-R	O2-AES	.76[a]	O3-FEE	.66[a]	.395	410	author
17.1	mixed	NEO PI-R	O2-AES	.76[a]	O4-ACT	.58[a]	.324	410	author
17.1	mixed	NEO PI-R	O2-AES	.76[a]	O5-IDE	.80[a]	.465	410	author
17.1	mixed	NEO PI-R	O2-AES	.76[a]	O6-VAL	.67[a]	.252	410	author
17.1	mixed	NEO PI-R	O2-AES	.76[a]	oGPA	.87	−.007	406	author
17.1	mixed	NEO PI-R	O3-FEE	.66[a]	O4-ACT	.58[a]	.363	410	author
17.1	mixed	NEO PI-R	O3-FEE	.66[a]	O5-IDE	.80[a]	.309	410	author
17.1	mixed	NEO PI-R	O3-FEE	.66[a]	O6-VAL	.67[a]	.206	410	author
17.1	mixed	NEO PI-R	O3-FEE	.66[a]	oGPA	.87	−.123	406	author
17.1	mixed	NEO PI-R	O4-ACT	.58[a]	O5-IDE	.80[a]	.269	410	author
17.1	mixed	NEO PI-R	O4-ACT	.58[a]	O6-VAL	.67[a]	.290	410	author
17.1	mixed	NEO PI-R	O4-ACT	.58[a]	oGPA	.87	−.100	406	author
17.1	mixed	NEO PI-R	O5-IDE	.80[a]	O6-VAL	.67[a]	.220	410	author
17.1	mixed	NEO PI-R	O5-IDE	.80[a]	oGPA	.87	.054	406	author
17.1	mixed	NEO PI-R	O6-VAL	.67[a]	oGPA	.87	.087	406	author
18.1	psychology	NEO PI-R	O	.87[a]	sGPA	.86[a]	.030	336	text
18.1	psychology	NEO PI-R	O1-FAN	.76[a]	O2-AES	.76[a]	.419	330	author
18.1	psychology	NEO PI-R	O1-FAN	.76[a]	O3-FEE	.66[a]	.338	330	author
18.1	psychology	NEO PI-R	O1-FAN	.76[a]	O4-ACT	.58[a]	.264	330	author
18.1	psychology	NEO PI-R	O1-FAN	.76[a]	O5-IDE	.80[a]	.294	330	author
18.1	psychology	NEO PI-R	O1-FAN	.76[a]	O6-VAL	.67[a]	.397	330	author
18.1	psychology	NEO PI-R	O1-FAN	.76[a]	sGPA	.86[a]	−.093	330	author
18.1	psychology	NEO PI-R	O2-AES	.76[a]	O3-FEE	.66[a]	.400	330	author
18.1	psychology	NEO PI-R	O2-AES	.76[a]	O4-ACT	.58[a]	.309	330	author
18.1	psychology	NEO PI-R	O2-AES	.76[a]	O5-IDE	.80[a]	.508	330	author

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
18.1	psychology	NEO PI-R	O2-AES	.76[a]	O6-VAL	.67[a]	.374	330	author
18.1	psychology	NEO PI-R	O2-AES	.76[a]	sGPA	.86[a]	−.003	330	author
18.1	psychology	NEO PI-R	O3-FEE	.66[a]	O4-ACT	.58[a]	.107	330	author
18.1	psychology	NEO PI-R	O3-FEE	.66[a]	O5-IDE	.80[a]	.148	330	author
18.1	psychology	NEO PI-R	O3-FEE	.66[a]	O6-VAL	.67[a]	.237	330	author
18.1	psychology	NEO PI-R	O3-FEE	.66[a]	sGPA	.86[a]	.051	330	author
18.1	psychology	NEO PI-R	O4-ACT	.58[a]	O5-IDE	.80[a]	.331	330	author
18.1	psychology	NEO PI-R	O4-ACT	.58[a]	O6-VAL	.67[a]	.236	330	author
18.1	psychology	NEO PI-R	O4-ACT	.58[a]	sGPA	.86[a]	.010	330	author
18.1	psychology	NEO PI-R	O5-IDE	.80[a]	O6-VAL	.67[a]	.411	330	author
18.1	psychology	NEO PI-R	O5-IDE	.80[a]	sGPA	.86[a]	.075	330	author
18.1	psychology	NEO PI-R	O6-VAL	.67[a]	sGPA	.86[a]	.111	330	author
19.1	psychology	NEO PI-R	O	.87[a]	sGPA	.86[a]	.104	300	author
19.1	psychology	NEO PI-R	O1-FAN	.76[a]	O2-AES	.76[a]	.306	500	author
19.1	psychology	NEO PI-R	O1-FAN	.76[a]	O3-FEE	.66[a]	.326	500	author
19.1	psychology	NEO PI-R	O1-FAN	.76[a]	O4-ACT	.58[a]	.162	500	author
19.1	psychology	NEO PI-R	O1-FAN	.76[a]	O5-IDE	.80[a]	.174	500	author
19.1	psychology	NEO PI-R	O1-FAN	.76[a]	O6-VAL	.67[a]	.152	500	author
19.1	psychology	NEO PI-R	O1-FAN	.76[a]	sGPA	.86[a]	−.023	300	author
19.1	psychology	NEO PI-R	O2-AES	.76[a]	O3-FEE	.66[a]	.433	500	author
19.1	psychology	NEO PI-R	O2-AES	.76[a]	O4-ACT	.58[a]	.301	500	author
19.1	psychology	NEO PI-R	O2-AES	.76[a]	O5-IDE	.80[a]	.362	500	author
19.1	psychology	NEO PI-R	O2-AES	.76[a]	O6-VAL	.67[a]	.250	500	author
19.1	psychology	NEO PI-R	O2-AES	.76[a]	sGPA	.86[a]	.054	300	author
19.1	psychology	NEO PI-R	O3-FEE	.66[a]	O4-ACT	.58[a]	.172	500	author
19.1	psychology	NEO PI-R	O3-FEE	.66[a]	O5-IDE	.80[a]	.174	500	author
19.1	psychology	NEO PI-R	O3-FEE	.66[a]	O6-VAL	.67[a]	.234	500	author
19.1	psychology	NEO PI-R	O3-FEE	.66[a]	sGPA	.86[a]	.097	300	author
19.1	psychology	NEO PI-R	O4-ACT	.58[a]	O5-IDE	.80[a]	.276	500	author
19.1	psychology	NEO PI-R	O4-ACT	.58[a]	O6-VAL	.67[a]	.301	500	author
19.1	psychology	NEO PI-R	O4-ACT	.58[a]	sGPA	.86[a]	.020	300	author
19.1	psychology	NEO PI-R	O5-IDE	.80[a]	O6-VAL	.67[a]	.259	500	author
19.1	psychology	NEO PI-R	O5-IDE	.80[a]	sGPA	.86[a]	.105	300	author

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
19.1	psychology	NEO PI-R	O6-VAL	.67[a]	sGPA	.86[a]	.189	300	author
20.1	STEM	NEO PI-R	O	.90	SPM (1)	.37[a]	.090	145	text
20.1	STEM	NEO PI-R	O1-FAN	.77	SPM (1)	.37[a]	.040	145	text
20.1	STEM	NEO PI-R	O2-AES	.77	SPM (1)	.37[a]	−.010	145	text
20.1	STEM	NEO PI-R	O3-FEE	.68	SPM (1)	.37[a]	−.010	145	text
20.1	STEM	NEO PI-R	O4-ACT	.73	SPM (1)	.37[a]	−.020	145	text
20.1	STEM	NEO PI-R	O5-IDE	.74	SPM (1)	.37[a]	.150	145	text
20.1	STEM	NEO PI-R	O6-VAL	.70	SPM (1)	.37[a]	.220	145	text
20.2	psychology	NEO PI-R	O1-FAN	.76[a]	O2-AES	.76[a]	.190	167	author
20.2	psychology	NEO PI-R	O1-FAN	.76[a]	O3-FEE	.66[a]	.190	167	author
20.2	psychology	NEO PI-R	O1-FAN	.76[a]	O4-ACT	.58[a]	.200	167	author
20.2	psychology	NEO PI-R	O1-FAN	.76[a]	O5-IDE	.80[a]	.270	167	author
20.2	psychology	NEO PI-R	O1-FAN	.76[a]	O6-VAL	.67[a]	.150	167	author
20.2	psychology	NEO PI-R	O2-AES	.76[a]	O3-FEE	.66[a]	.410	167	author
20.2	psychology	NEO PI-R	O2-AES	.76[a]	O4-ACT	.58[a]	.007	167	author
20.2	psychology	NEO PI-R	O2-AES	.76[a]	O5-IDE	.80[a]	.290	167	author
20.2	psychology	NEO PI-R	O2-AES	.76[a]	O6-VAL	.67[a]	.008	167	author
20.2	psychology	NEO PI-R	O3-FEE	.66[a]	O4-ACT	.58[a]	.030	167	author
20.2	psychology	NEO PI-R	O3-FEE	.66[a]	O5-IDE	.80[a]	−.020	167	author
20.2	psychology	NEO PI-R	O3-FEE	.66[a]	O6-VAL	.67[a]	.080	167	author
20.2	psychology	NEO PI-R	O4-ACT	.58[a]	O5-IDE	.80[a]	.370	167	author
20.2	psychology	NEO PI-R	O4-ACT	.58[a]	O6-VAL	.67[a]	.380	167	author
20.2	psychology	NEO PI-R	O5-IDE	.80[a]	O6-VAL	.67[a]	.290	167	author
21.1	STEM	NEO PI-R	O	.87	SPM (1)	.37[a]	.039	152	author
21.1	psychology	NEO PI-R	O1-FAN	.76[a]	O2-AES	.76[a]	.421	152	author
21.1	psychology	NEO PI-R	O1-FAN	.76[a]	O3-FEE	.66[a]	.415	152	author
21.1	psychology	NEO PI-R	O1-FAN	.76[a]	O4-ACT	.58[a]	.280	152	author
21.1	psychology	NEO PI-R	O1-FAN	.76[a]	O5-IDE	.80[a]	.232	152	author
21.1	psychology	NEO PI-R	O1-FAN	.76[a]	O6-VAL	.67[a]	.276	152	author
21.1	STEM	NEO PI-R	O1-FAN	.76[a]	SPM (1)	.37[a]	.038	152	author
21.1	psychology	NEO PI-R	O2-AES	.76[a]	O3-FEE	.66[a]	.588	152	author
21.1	psychology	NEO PI-R	O2-AES	.76[a]	O4-ACT	.58[a]	.337	152	author
21.1	psychology	NEO PI-R	O2-AES	.76[a]	O5-IDE	.80[a]	.280	152	author

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
21.1	psychology	NEO PI-R	O2-AES	.76[a]	O6-VAL	.67[a]	.130	152	author
21.1	STEM	NEO PI-R	O2-AES	.76[a]	SPM (1)	.37[a]	−.043	152	author
21.1	psychology	NEO PI-R	O3-FEE	.66[a]	O4-ACT	.58[a]	.228	152	author
21.1	psychology	NEO PI-R	O3-FEE	.66[a]	O5-IDE	.80[a]	.066	152	author
21.1	psychology	NEO PI-R	O3-FEE	.66[a]	O6-VAL	.67[a]	.136	152	author
21.1	STEM	NEO PI-R	O3-FEE	.66[a]	SPM (1)	.37[a]	.042	152	author
21.1	psychology	NEO PI-R	O4-ACT	.58[a]	O5-IDE	.80[a]	.320	152	author
21.1	psychology	NEO PI-R	O4-ACT	.58[a]	O6-VAL	.67[a]	.389	152	author
21.1	STEM	NEO PI-R	O4-ACT	.58[a]	SPM (1)	.37[a]	−.012	152	author
21.1	psychology	NEO PI-R	O5-IDE	.80[a]	O6-VAL	.67[a]	.207	152	author
21.1	STEM	NEO PI-R	O5-IDE	.80[a]	SPM (1)	.37[a]	.047	152	author
21.1	STEM	NEO PI-R	O6-VAL	.67[a]	SPM (1)	.37[a]	.112	152	author
22.1	humanities	BFI	O	.81[a]	SPM (1)	.37[a]	−.140	64	text
23.1	psychology	HECAXO PI	O	.90[a]	SPM (1)	.37[a]	.180	45	text
24.1	mixed	NEO-FFI	O	.73	oGPA	.94[a]	−.016	263	text
25.1	mixed	MM	O	.77	sGPA	.86[a]	.310	219	text
26.1	psychology	NEO PI-R	O	.87[a]	oGPA	.94[a]	.120	164	text
27.1	psychology	other	O		SPM (1)	.37[a]	.030	409	text
28.1	mixed	NEO-FFI	O	.73[a]	oGPA	.94[a]	.240	83	text
29.1	mixed	other	O	.85	oGPA	.94[a]	.006	509	text
30.1	psychology	NEO-FFI	O	.78	cGPA (10)	.87	.020	307	text
30.1	psychology	NEO-FFI	O	.78	SPM (1)	.79	.350	307	text
31.1	psychology	NEO-FFI	O	.73[a]	cGPA (5)	.75[a]	.000	70	text
31.1	psychology	NEO-FFI	O	.73[a]	SPM (1)	.37[a]	−.030	70	text
32.1		NEO PI-R	O	.79	cGPA (6)	.78[a]	.210	137	text
33.1	psychology	NEO-FFI	O	.81	cGPA (30)	.82	−.020	104	text
33.1	business	NEO-FFI	O	.81	SPM (1)	.37[a]	−.130	104	text
34.1		NEO-FFI	O	.79	SPM (1)	.80	−.050	248	text
35.1	mixed	NEO-FFI	O	.62	sGPA	.86[a]	.070	292	text
36.1	business	other	O	.79	sGPA	.86[a]	.230	185	text
37.1	business	other	O		SPM (1)	.37[a]	.279	130	text

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Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
38.1	psychology	IPIP-50	O	.82[a]	oGPA	.94[a]	.042	435	text
39.1	psychology	NEO-FFI	O	.73[a]	sGPA	.86[a]	−.020	300	text
39.1	psychology	NEO-FFI	O	.73[a]	SPM (3)	.64[a]	.110	300	text
40.1	psychology	IPIP-50	O	.80	SPM (5)	.75[a]	.080	344	text
41.1	psychology	other	O	.85	sGPA	.86[a]	.150	384	text
42.1	psychology	BFI	O	.81[a]	sGPA	.86[a]	.030	338	text
42.1	psychology	BFI	O	.81[a]	SPM (5)	.82	.140	338	text
43.1	psychology	NEO PI-R	O	.87[a]	SPM (5)	.75[a]	.200	90	text
43.1	psychology	NEO PI-R	O5-IDE	.80[a]	SPM (5)	.75[a]	.220	90	text
43.1	psychology	NEO PI-R	O6-VAL	.67[a]	SPM (3)	.64[a]	.290	90	text
43.1	psychology	NEO PI-R	O3-FEE	.66[a]	SPM (3)	.64[a]	.230	90	text
44.1	humanities	other	O	.85	sGPA	.86[a]	.066	146	text
45.1	psychology	other	O	.86	sGPA	.86[a]	−.030	341	text
45.1	psychology	MM	O	.86	sGPA	.86[a]	−.050	341	text
45.1	psychology	composite	O		sGPA	.86[a]	−.040	341	text
45.1	psychology	other	O	.86	SPM (3)	.64[a]	.060	341	text
45.1	psychology	MM	O	.86	SPM (3)	.64[a]	.020	341	text
45.1	psychology	composite	O		SPM (3)	.64[a]	.040	341	text
46.1	mixed	NEO-FFI	O	.73[a]	oGPA	.94[a]	.240	780	text
47.1	medicine	other	O	.71	oGPA	.87	.010	101	text
48.1	mixed	NEO PI-R	O	.87[a]	oGPA	.94[a]	.040	387	text
49.1	STEM	NEO-FFI	O	.73[a]	SPM (2)	.54[a]	−.060	91	text
50.1	psychology	NEO PI-R	O	.87[a]	cGPA (5)	.75[a]	−.160	93	text
51.1	mixed	other	O	.71	SPM (3)	.64	.040	1,013	text
52.1	psychology	NEO PI-R	O	.87[a]	cGPA (6)	.78[a]	−.150	64	text
53.1		NEO PI-R	O	.87[a]	oGPA	.94[a]	−.004	138	text
54.1	mixed	NEO-FFI	O	.74	sGPA	.86[a]	.180	300	text
55.1	psychology	BFI	O	.81[a]	cGPA (6)	.78[a]	.000	236	text
55.1	STEM	BFI	O	.81[a]	SPM (1)	.37[a]	−.100	236	text
56.1		NEO-FFI	O	.73[a]	sGPA	.86[a]	.180	217	text
57.1	medicine	BFI	O	.81[a]	SPM (1)	.37[a]	−.470	52	text
58.1	psychology	NEO PI-R	O	.87[a]	oGPA	.84	.170	70	text
58.2		NEO PI-R	O	.87[a]	oGPA	.82	.090	133	text

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Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
59.1		BFI	O	.81[a]	oGPA	.94[a]	−.090	98	text
59.1		other	O		oGPA	.94[a]	−.020	98	text
59.1		composite	O		oGPA	.94[a]	−.055	98	text
60.1	psychology	NEO-FFI	O	.60	sGPA	.86[a]	.210	110	text
61.1	business	NEO-FFI	O	.72	oGPA	.94[a]	−.120	137	text
61.1	business	NEO-FFI	O	.72	SPM (1)	.37[a]	−.080	137	text
62.1	STEM	MM	O	.71	SPM (1)	.37[a]	.150	163	text
63.1		NEO-FFI	O	.73[a]	sGPA	.86[a]	−.070	34	text
63.2		NEO-FFI	O	.73[a]	sGPA	.86[a]	.360	25	text
63.3		NEO-FFI	O	.73[a]	sGPA	.86[a]	−.110	34	text
63.4		NEO-FFI	O	.73[a]	sGPA	.86[a]	.410	12	text
64.1	mixed	NEO-FFI	O	.68	sGPA	.86[a]	.130	258	text
65.1	psychology	other	O		cGPA (4)	.84	.022	1,753	text
66.1	mixed	NEO-FFI	O	.73[a]	sGPA	.86[a]	.030	137	text
67.1	business	other	O	.71	oGPA	.94[a]	.010	237	text
67.2	business	other	O	.69	oGPA	.94[a]	−.100	203	text
68.1	mixed	other	O		sGPA	.86[a]	.130	434	text
69.1	psychology	other	O	.84	SPM (1)	.37[a]	.160	143	text
70.1	mixed	IPIP-50	O	.76	sGPA	.86[a]	.130	556	text
71.1	mixed	NEO-FFI	O	.73[a]	sGPA	.86[a]	.140	529	text
72.1		NEO-FFI	O	.73[a]	oGPA	.94[a]	.060	1,193	text
73.1	psychology	NEO PI-R	O	.75	oGPA	.94[a]	.240	161	text
74.1	psychology	BFI	O	.79	oGPA	.94[a]	−.090	240	text
75.1		IPIP-50	O	.76	oGPA	.94[a]	.030	611	text
76.1	business	NEO-FFI	O	.73[a]	sGPA	.86[a]	.150	305	text
77.1		NEO-FFI	O	.75	sGPA	.86[a]	.080	96	text
77.2		NEO-FFI	O	.68	sGPA	.86[a]	.190	96	text
78.1	psychology	NEO-FFI	O	.74	oGPA	.94[a]	.070	290	text
79.1	mixed	NEO-FFI	O	.73	oGPA	.94[a]	.190	125	text
80.1	mixed	HECAXO PI	O	.82	oGPA	.94[a]	.040	179	text
81.1	psychology	NEO PI-R	O	.88	oGPA	.94[a]	.120	72	text
82.1	mixed	BFI	O	.80	oGPA	.94[a]	.020	437	text
82.2	mixed	BFI	O	.70	oGPA	.94[a]	.090	133	text

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
83.1	psychology	other	O	.78	sGPA	.86[a]	.060	131	text
83.1	psychology	other	O	.78	SPM (1)	.37[a]	.060	131	text
84.1	business	other	O	.70	oGPA	.94[a]	.010	378	text
85.1		other	O		sGPA	.86[a]	.210	550	text
86.1		MM	O	.79	oGPA	.94[a]	.100	152	text
87.1	psychology	IPIP-50	O	.73	sGPA	.86[a]	.050	719	text
88.1	psychology	NEO-FFI	O	.75	SPM (1)	.37[a]	.080	687	text
89.1	humanities	other	O	.79	sGPA	.86[a]	.210	295	text
90.1	business	NEO-FFI	O	.73[a]	sGPA	.86[a]	−.120	128	text
90.1	business	other	O		sGPA	.86[a]	−.150	131	text
90.1	business	composite	O		sGPA	.86[a]	−.135	130	text
91.1	medicine	NEO-FFI	O	.73[a]	oGPA	.94[a]	−.030	131	text
91.2	psychology	NEO-FFI	O	.73[a]	oGPA	.94[a]	−.080	97	text
91.3	humanities	NEO-FFI	O	.73[a]	oGPA	.94[a]	−.130	96	text
91.4	business	NEO-FFI	O	.73[a]	oGPA	.94[a]	.120	84	text
91.5	humanities	NEO-FFI	O	.73[a]	oGPA	.94[a]	.230	70	text
91.6	STEM	NEO-FFI	O	.73[a]	oGPA	.94[a]	.080	217	text
91.7	humanities	NEO-FFI	O	.73[a]	oGPA	.94[a]	.070	372	text
92.1		BFI	O	.82	sGPA	.86[a]	.006	252	text
93.1	mixed	HECAXO PI	O	.89	oGPA	.94[a]	.040	226	text
93.2		other	O	.87	oGPA	.94[a]	−.040	1,262	text
94.1	business	IPIP-50	O	.86	oGPA	.94[a]	.160	137	text
95.1	psychology	other	O	.68	oGPA	.94[a]	.100	201	text
96.1	medicine	other	O	.54[a]	oGPA	.94[a]	.006	594	author
97.1		other	O	.93	oGPA	.94[a]	−.074	207	text
98.1		NEO PI-R	O	.87[a]	cGPA (20)	.92[a]	.130	473	text
99.1	medicine	NEO PI-R	O	.69	oGPA	.94[a]	−.240	192	text
100.1	medicine	NEO PI-R	O	.89	oGPA	.94[a]	.150	85	text
100.1	medicine	NEO PI-R	O1-FAN	.72	oGPA	.94[a]	.020	85	author
100.1	medicine	NEO PI-R	O1-FAN	.72	O2-AES	.83	.330	85	author
100.1	medicine	NEO PI-R	O1-FAN	.72	O3-FEE	.74	.331	85	author
100.1	medicine	NEO PI-R	O1-FAN	.72	O4-ACT	.65	.326	85	author

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
100.1	medicine	NEO PI-R	O1-FAN	.72	O5-IDE	.77	.408	85	author
100.1	medicine	NEO PI-R	O1-FAN	.72	O6-VAL	.58	.352	85	author
100.1	medicine	NEO PI-R	O2-AES	.83	oGPA	.94[a]	.070	85	author
100.1	medicine	NEO PI-R	O2-AES	.83	O3-FEE	.74	.546	85	author
100.1	medicine	NEO PI-R	O2-AES	.83	O4-ACT	.65	.410	85	author
100.1	medicine	NEO PI-R	O2-AES	.83	O5-IDE	.77	.566	85	author
100.1	medicine	NEO PI-R	O2-AES	.83	O6-VAL	.58	.269	85	author
100.1	medicine	NEO PI-R	O3-FEE	.74	oGPA	.94[a]	.010	85	author
100.1	medicine	NEO PI-R	O3-FEE	.74	O4-ACT	.65	.182	85	author
100.1	medicine	NEO PI-R	O3-FEE	.74	O5-IDE	.77	.266	85	author
100.1	medicine	NEO PI-R	O3-FEE	.74	O6-VAL	.58	.250	85	author
100.1	medicine	NEO PI-R	O4-ACT	.65	oGPA	.94[a]	.220	85	author
100.1	medicine	NEO PI-R	O4-ACT	.65	O5-IDE	.77	.339	85	author
100.1	medicine	NEO PI-R	O4-ACT	.65	O6-VAL	.58	.397	85	author
100.1	medicine	NEO PI-R	O5-IDE	.77	oGPA	.94[a]	.170	85	author
100.1	medicine	NEO PI-R	O5-IDE	.77	O6-VAL	.58	.177	85	author
100.1	medicine	NEO PI-R	O6-VAL	.58	oGPA	.94[a]	.160	85	author
101.1	medicine	NEO PI-R	O	.87[a]	cGPA (3)	.64[a]	.102	80	author
101.1	medicine	NEO PI-R	O1-FAN	.76[a]	cGPA (3)	.64[a]	.170	80	author
101.1	medicine	NEO PI-R	O1-FAN	.76[a]	O2-AES	.76[a]	.312	80	author
101.1	medicine	NEO PI-R	O1-FAN	.76[a]	O3-FEE	.66[a]	.350	80	author
101.1	medicine	NEO PI-R	O1-FAN	.76[a]	O4-ACT	.58[a]	.224	80	author
101.1	medicine	NEO PI-R	O1-FAN	.76[a]	O5-IDE	.80[a]	.264	80	author
101.1	medicine	NEO PI-R	O1-FAN	.76[a]	O6-VAL	.67[a]	.187	80	author
101.1	medicine	NEO PI-R	O2-AES	.76[a]	cGPA (4)	.64[a]	−.101	80	author
101.1	medicine	NEO PI-R	O2-AES	.76[a]	O3-FEE	.66[a]	.332	80	author
101.1	medicine	NEO PI-R	O2-AES	.76[a]	O4-ACT	.58[a]	.221	80	author
101.1	medicine	NEO PI-R	O2-AES	.76[a]	O5-IDE	.80[a]	.427	80	author
101.1	medicine	NEO PI-R	O2-AES	.76[a]	O6-VAL	.67[a]	.180	80	author
101.1	medicine	NEO PI-R	O3-FEE	.66[a]	cGPA (4)	.64[a]	.091	80	author
101.1	medicine	NEO PI-R	O3-FEE	.66[a]	O4-ACT	.58[a]	.135	80	author
101.1	medicine	NEO PI-R	O3-FEE	.66[a]	O5-IDE	.80[a]	.240	80	author
101.1	medicine	NEO PI-R	O3-FEE	.66[a]	O6-VAL	.67[a]	.229	80	author

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
101.1	medicine	NEO PI-R	O4-ACT	.58[a]	cGPA (4)	.64[a]	.123	80	author
101.1	medicine	NEO PI-R	O4-ACT	.58[a]	O5-IDE	.80[a]	.089	80	author
101.1	medicine	NEO PI-R	O4-ACT	.58[a]	O6-VAL	.67[a]	.211	80	author
101.1	medicine	NEO PI-R	O5-IDE	.80[a]	cGPA (4)	.64[a]	.036	80	author
101.1	medicine	NEO PI-R	O5-IDE	.80[a]	O6-VAL	.67[a]	.181	80	author
101.1	medicine	NEO PI-R	O6-VAL	.67[a]	cGPA (3)	.37[a]	.035	80	author
102.1		BFI	O	.81[a]	sGPA	.86[a]	.393	146	text
103.1	psychology	NEO PI-R	O	.87[a]	oGPA	.94[a]	−.070	58	author
103.1	psychology	NEO PI-R	O1-FAN	.76[a]	oGPA	.94[a]	.075	58	author
103.1	psychology	NEO PI-R	O1-FAN	.76[a]	O2-AES	.76[a]	.310	58	author
103.1	psychology	NEO PI-R	O1-FAN	.76[a]	O3-FEE	.66[a]	.471	58	author
103.1	psychology	NEO PI-R	O1-FAN	.76[a]	O4-ACT	.58[a]	.176	58	author
103.1	psychology	NEO PI-R	O1-FAN	.76[a]	O5-IDE	.80[a]	.066	58	author
103.1	psychology	NEO PI-R	O1-FAN	.76[a]	O6-VAL	.67[a]	.149	58	author
103.1	psychology	NEO PI-R	O2-AES	.76[a]	oGPA	.94[a]	−.157	58	author
103.1	psychology	NEO PI-R	O2-AES	.76[a]	O3-FEE	.66[a]	.439	58	author
103.1	psychology	NEO PI-R	O2-AES	.76[a]	O4-ACT	.58[a]	.201	58	author
103.1	psychology	NEO PI-R	O2-AES	.76[a]	O5-IDE	.80[a]	.663	58	author
103.1	psychology	NEO PI-R	O2-AES	.76[a]	O6-VAL	.67[a]	.335	58	author
103.1	psychology	NEO PI-R	O3-FEE	.66[a]	oGPA	.94[a]	.039	58	author
103.1	psychology	NEO PI-R	O3-FEE	.66[a]	O4-ACT	.58[a]	.108	58	author
103.1	psychology	NEO PI-R	O3-FEE	.66[a]	O5-IDE	.80[a]	.377	58	author
103.1	psychology	NEO PI-R	O3-FEE	.66[a]	O6-VAL	.67[a]	.384	58	author
103.1	psychology	NEO PI-R	O4-ACT	.58[a]	oGPA	.94[a]	−.148	58	author
103.1	psychology	NEO PI-R	O4-ACT	.58[a]	O5-IDE	.80[a]	.395	58	author
103.1	psychology	NEO PI-R	O4-ACT	.58[a]	O6-VAL	.67[a]	.396	58	author
103.1	psychology	NEO PI-R	O5-IDE	.80[a]	oGPA	.94[a]	−.094	58	author
103.1	psychology	NEO PI-R	O5-IDE	.80[a]	O6-VAL	.67[a]	.485	58	author
103.1	psychology	NEO PI-R	O6-VAL	.67[a]	oGPA	.94[a]	.001	58	author
104.1	medicine	IPIP-50	O	.80	sGPA	.95	−.050	207	text
105.1	medicine	NEO PI-R	O	.88	oGPA	.94[a]	.010	354	text
105.1	medicine	NEO PI-R	O1-FAN	.75	oGPA	.94[a]	−.050	144	author
105.1	medicine	NEO PI-R	O1-FAN	.75	O2-AES	.81	.494	261	author

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
105.1	medicine	NEO PI-R	O1-FAN	.75	O3-FEE	.71	.578	261	author
105.1	medicine	NEO PI-R	O1-FAN	.75	O4-ACT	.67	.587	261	author
105.1	medicine	NEO PI-R	O1-FAN	.75	O5-IDE	.82	.538	261	author
105.1	medicine	NEO PI-R	O1-FAN	.75	O6-VAL	.61	.635	261	author
105.1	medicine	NEO PI-R	O2-AES	.81	oGPA	.94[a]	−.020	144	author
105.1	medicine	NEO PI-R	O2-AES	.81	O3-FEE	.71	.695	261	author
105.1	medicine	NEO PI-R	O2-AES	.81	O4-ACT	.67	.585	261	author
105.1	medicine	NEO PI-R	O2-AES	.81	O5-IDE	.82	.653	261	author
105.1	medicine	NEO PI-R	O2-AES	.81	O6-VAL	.61	.561	261	author
105.1	medicine	NEO PI-R	O3-FEE	.71	oGPA	.94[a]	−.150	144	author
105.1	medicine	NEO PI-R	O3-FEE	.71	O4-ACT	.67	.613	261	author
105.1	medicine	NEO PI-R	O3-FEE	.71	O5-IDE	.82	.563	261	author
105.1	medicine	NEO PI-R	O3-FEE	.71	O6-VAL	.61	.629	261	author
105.1	medicine	NEO PI-R	O4-ACT	.67	oGPA	.94[a]	.020	144	author
105.1	medicine	NEO PI-R	O4-ACT	.67	O5-IDE	.82	.575	261	author
105.1	medicine	NEO PI-R	O4-ACT	.67	O6-VAL	.61	.679	261	author
105.1	medicine	NEO PI-R	O5-IDE	.82	oGPA	.94[a]	.140	144	author
105.1	medicine	NEO PI-R	O5-IDE	.82	O6-VAL	.61	.576	261	author
105.1	medicine	NEO PI-R	O6-VAL	.61	oGPA	.94[a]	.030	144	author
106.1	medicine	NEO PI-R	O	.70	oGPA	.94[a]	.020	145	text
106.1	medicine	NEO PI-R	O1-FAN	.76[a]	oGPA	.94[a]	.060	134	author
106.1	medicine	NEO PI-R	O1-FAN	.76[a]	O2-AES	.76[a]	.167	141	author
106.1	medicine	NEO PI-R	O1-FAN	.76[a]	O3-FEE	.66[a]	.218	141	author
106.1	medicine	NEO PI-R	O1-FAN	.76[a]	O4-ACT	.58[a]	.148	141	author
106.1	medicine	NEO PI-R	O1-FAN	.76[a]	O5-IDE	.80[a]	.172	141	author
106.1	medicine	NEO PI-R	O1-FAN	.76[a]	O6-VAL	.67[a]	.288	141	author
106.1	medicine	NEO PI-R	O2-AES	.76[a]	oGPA	.94[a]	−.071	134	author
106.1	medicine	NEO PI-R	O2-AES	.76[a]	O3-FEE	.66[a]	.567	141	author
106.1	medicine	NEO PI-R	O2-AES	.76[a]	O4-ACT	.58[a]	.271	141	author
106.1	medicine	NEO PI-R	O2-AES	.76[a]	O5-IDE	.80[a]	.442	141	author
106.1	medicine	NEO PI-R	O2-AES	.76[a]	O6-VAL	.67[a]	.324	141	author
106.1	medicine	NEO PI-R	O3-FEE	.66[a]	oGPA	.94[a]	.001	134	author
106.1	medicine	NEO PI-R	O3-FEE	.66[a]	O4-ACT	.58[a]	.372	141	author

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
106.1	medicine	NEO PI-R	O3-FEE	.66[a]	O5-IDE	.80[a]	.335	141	author
106.1	medicine	NEO PI-R	O3-FEE	.66[a]	O6-VAL	.67[a]	.291	141	author
106.1	medicine	NEO PI-R	O4-ACT	.58[a]	oGPA	.94[a]	.101	134	author
106.1	medicine	NEO PI-R	O4-ACT	.58[a]	O5-IDE	.80[a]	.199	141	author
106.1	medicine	NEO PI-R	O4-ACT	.58[a]	O6-VAL	.67[a]	.322	141	author
106.1	medicine	NEO PI-R	O5-IDE	.80[a]	oGPA	.94[a]	−.010	134	author
106.1	medicine	NEO PI-R	O5-IDE	.80[a]	O6-VAL	.67[a]	.322	141	author
106.1	medicine	NEO PI-R	O6-VAL	.67[a]	oGPA	.94[a]	.039	134	author
107.1	medicine	NEO PI-R	O1-FAN	.76[a]	oGPA	.94[a]	−.086	311	author
107.1	medicine	NEO PI-R	O1-FAN	.76[a]	O2-AES	.76[a]	.412	311	author
107.1	medicine	NEO PI-R	O1-FAN	.76[a]	O3-FEE	.66[a]	.341	311	author
107.1	medicine	NEO PI-R	O1-FAN	.76[a]	O4-ACT	.58[a]	.378	311	author
107.1	medicine	NEO PI-R	O1-FAN	.76[a]	O5-IDE	.80[a]	.305	311	author
107.1	medicine	NEO PI-R	O1-FAN	.76[a]	O6-VAL	.67[a]	.197	311	author
107.1	medicine	NEO PI-R	O2-AES	.76[a]	oGPA	.94[a]	−.057	311	author
107.1	medicine	NEO PI-R	O2-AES	.76[a]	O3-FEE	.66[a]	.322	311	author
107.1	medicine	NEO PI-R	O2-AES	.76[a]	O4-ACT	.58[a]	.442	311	author
107.1	medicine	NEO PI-R	O2-AES	.76[a]	O5-IDE	.80[a]	.506	311	author
107.1	medicine	NEO PI-R	O2-AES	.76[a]	O6-VAL	.67[a]	.263	311	author
107.1	medicine	NEO PI-R	O3-FEE	.66[a]	oGPA	.94[a]	−.046	311	author
107.1	medicine	NEO PI-R	O3-FEE	.66[a]	O4-ACT	.58[a]	.240	311	author
107.1	medicine	NEO PI-R	O3-FEE	.66[a]	O5-IDE	.80[a]	.107	311	author
107.1	medicine	NEO PI-R	O3-FEE	.66[a]	O6-VAL	.67[a]	.246	311	author
107.1	medicine	NEO PI-R	O4-ACT	.58[a]	oGPA	.94[a]	−.202	311	author
107.1	medicine	NEO PI-R	O4-ACT	.58[a]	O5-IDE	.80[a]	.401	311	author
107.1	medicine	NEO PI-R	O4-ACT	.58[a]	O6-VAL	.67[a]	.397	311	author
107.1	medicine	NEO PI-R	O5-IDE	.80[a]	oGPA	.94[a]	−.069	311	author
107.1	medicine	NEO PI-R	O5-IDE	.80[a]	O6-VAL	.67[a]	.261	311	author
107.1	medicine	NEO PI-R	O6-VAL	.67[a]	oGPA	.94[a]	−.229	311	author
108.1	STEM	IPIP-50	O	.82[a]	SPM (1)	.37[a]	.220	42	text
109.1		other	O		oGPA	.94[a]	.171	150	text
110.1	psychology	other	O	.84	oGPA	.94[a]	.020	262	text
111.1	psychology	NEO PI-R	O	.75	SPM (1)	.37[a]	.030	127	text

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source
111.2	humanities	NEO PI-R	O	.76	SPM (1)	.37[a]	.220	101	text
112.2	psychology	IPIP-50	O	.82[a]	oGPA	.94[a]	.162	124	author
113.3	psychology	other	O		SPM (1)	.37[a]	.090	136	author
113.3	psychology	other	O		oGPA	.94[a]	.131	135	author
114.1	mixed	other	O	.72[a]	sGPA	.86[a]	.034	620	text
115.1	business	IPIP-50	O	.77	SPM (1)	.37[a]	.115	200	text
115.1	business	IPIP-50	O	.77	oGPA	.94[a]	.074	200	text
116.1	psychology	other	O	.90	oGPA	.97	−.090	153	text
117.1		IPIP-50	O	.88	oGPA	.94[a]	.062	206	author
117.1		other	O	.83	oGPA	.94[a]	−.022	206	author
117.1		composite	O	.92	oGPA	.94[a]	.035	206	author
118.1		IPIP-50	O	.79	oGPA	.94[a]	.070	329	text
119.1	mixed	BFI	O	.81[a]	sGPA	.86[a]	.028	470	author
119.1	psychology	BFI	O	.81[a]	SPM (4)	.70[a]	.114	441	author
120.1	mixed	BFI	O	.81[a]	sGPA	.86[a]	.020	528	author
120.1	psychology	BFI	O	.81[a]	SPM (5)	.75[a]	.084	533	author
121.2	mixed	other	O	.70	sGPA	.86[a]	.108	519	author
122.1	psychology	MM	O	.78[a]	cGPA (5)	.91	.201	316	author
123.1		IPIP-50	O	.80	oGPA	.90	.089	2,552	author
124.1	mixed	NEO-FFI	O	.73[a]	oGPA	.94[a]	.090	203	author
124.1	mixed	BFI	O	.81[a]	oGPA	.94[a]	.030	203	author
124.1	mixed	IPIP-50	O	.82[a]	oGPA	.94[a]	.080	203	author
124.1	mixed	HECAXO PI	O	.90[a]	oGPA	.94[a]	.030	203	author
124.1	mixed	other	O		oGPA	.94[a]	.150	203	author
124.1	mixed	composite	O		oGPA	.92	.087	203	author
125.1	business	NEO-FFI	O	.73[a]	SPM (1)	.37[a]	.154	145	author
125.2	business	NEO-FFI	O	.73[a]	SPM (1)	.37[a]	−.160	49	author
126.1	mixed	NEO-FFI	O	.40	oGPA	.94[a]	.090	291	text

continued on the next page

Table 26 (continued)

Samples and Statistics Used in the Meta-Analysis (Article 1)

ID	Major	Measure	X	Rel_X	Y	Rel_Y	*r*	*N*	Source

Notes. Numbers before the decial point in the ID column corresponds to numbers in the ID column in Table 25. Numbers in parentheses in the Y column show the number of aggregated performance variables. Rel = Reliability.

BFI = Big-Five Inventory (John et al., 1991), HEXACO PI = HEXACO Personality Inventory (K. Lee & Ashton, 2004), IPIP-50 = International Personality Item Pool (50-itemversion Goldberg et al., 2006), MM = Mini-Markers (Saucier, 1994), NEO-FFI = NEO Five-Factor Inventory (Costa & McCrae, 1992), NEO PI-R = NEO Personality Inventory Revised (Costa & McCrae, 1992), composite = average or composite (see Hunter & Schmidt, 2004) of multiple openness measures (depending on available information).

O = overall openness, O1-FAN = openness to fantasy, O2-AES = openness to aesthetics, O3-FEE = openness to feelings, O4-ACT = openness to actions, O5-IDE = openness to ideas, O6-VAL = openness to values.

cGPA = composite GPA (multiple multi-course grades); oGPA = official GPA; sGPA = self-reported GPA; SPM = single performance measure (single or multiple course, exam, or project grades)

[a] No reliability coefficient was provided, therefore it was derived from relevant literature (see Article 1 for details).

B Appendix for Article 2

B.1 Exploratory Factor Analyses

As noted by an anonymous reviewer during the peer-review process for Article 2, it is important to examine the internal structure of newly translated measures in order to ensure measurement invariance between the translated measure and the original and to identify items that may have been inadvertently altered in the translation process. This section reports factor-analytic results for the translated measures of openness and conscientiousness aspects as well as recalculations of the correlation and regression analyses described in Article 2 (see Chapter 7).

In the course of this dissertation project, a sample of 1.307 students (424 of whom constituted the sample in Article 2) from 15 Swiss universities completed the translated openness and conscientiousness measures. The mean age in the total sample was 25.0 years ($SD = 5.5$) and 70% of the students were female. They were enrolled in 64 different majors with economics (19%), applied psychology (12%), and nursing sciences (11%) being the three most frequent ones.

This total sample was used to conduct a confirmatory factor analysis of the openness and conscientiousness scales from the present study. The overall model fit of the assumed two-factor solution was rather poor for both, openness (CFI= .73, TLI= .70, SRMR= .10, RMSEA= .09) and conscientiousness (CFI= .84, TLI= .82, SRMR= .07, RMSEA= .08) when compared to the widely-used cutoff criteria suggested by Hu and Bentler (1999). However, this is quite common in personality research due to the discrepancy between the strict theoretical constraints of confirmatory factor analysis models and the more interconnected structure of personality traits in the field (Hopwood & Donnellan, 2010).

In a second step, exploratory factor analyses (EFA) were conducted. Three procedures were used to determine the appropriate number of factors to be extracted, namely *Parallel Analysis* (PA; Horn, 1965), the *Minimum Average Partial Test* (MAP; Velicer et al., 2000), and the *Very Simple Structure* index (VSS; Revelle & Rocklin, 1979).

For the 20 openness items, the number of suggested factors ranged from 2 (VSS-C1, MAP) to 5 (PA). While a higher number of factors seems plausible given that aspects are intermediate levels of trait organization (i.e., encompass narrow lower-level traits), a two-factor solution was in line with the theoretical background. Thus, two factors were extracted and an corresponding principal axis factor analysis with Oblimin rotation was computed. As shown in Table 27, two translated items deviated from the expected factor structure. First, the item "Have difficulty understanding abstract ideas." showed a notable secondary loading. Second and more importantly, the item "Avoid philosophical discussions." loaded on the senso-aesthetic factor, but not on the intellectual factor.

For the 20 conscientiousness items, the number of suggested factors ranged from 1 (VSS-C1) to 4 (PA). Again, a two-factor solution was preferred based on theoretical considerations. As can be seen in Table 28, again two items deviated from the expected factor structure. First, the loading of the item "Dislike routine." barely missed the threshold of .30 on its target factor. Second and more importantly, the item "Follow a schedule." loaded higher on the industriousness factor, but not on the orderliness factor.

B.2 Re-Calculations With the Re-Scored Openness and Conscientiousness Scales

Consequently, the openness and conscientiousness scales were re-scored according to the results of the EFA by moving the two items that loaded on the wrong factor from their original aspect scale to the respective other aspect scale. The correlation and regression analyses from the main article were then recalculated. These results can be found in Table 29 and Table 30, respectively. Overall, there were only minute differences in the results, none of which changed the interpretation of the findings presented in Article 2.

Table 27

Exploratory Factor Analysis Results for the German Translation of the BFAS Openness Scale

Original Item	German Translation	Factor 1	Factor 2
Intellectual Openness			
Am quick to understand things.	Ich bin schnell im Verstehen von Dingen.[a]	**.77**	−.05
Have difficulty understanding abstract ideas.	Mir fällt es schwer, abstrakte Ideen zu verstehen.[b]	**−.43**	**−.30**
Can handle a lot of information.	Ich kann mit einer Menge von Information umgehen.[a]	**.67**	−.02
Like to solve complex problems.	Ich mag es, komplexe Problemstellungen zu lösen.[b]	**.54**	.16
Avoid philosophical discussions.	Philosophische Diskussionen vermeide ich.[b]	−.12	**−.56**
Avoid difficult reading material.	Ich vermeide schwierigen Lesestoff.[a]	**−.35**	−.26
Have a rich vocabulary.	Ich habe einen reichen Wortschatz.[a]	**.40**	.25
Think quickly.	Ich denke schnell.	**.67**	−.01
Learn things slowly.	Ich lerne Dinge langsam.	**−.70**	.08
Formulate ideas clearly.	Ich formuliere Ideen klar.	**.39**	.04
Senso-Aesthethic Openness			
Enjoy the beauty of nature.	Ich erfreue mich der Schönheit der Natur.[b]	−.03	**.31**
Believe in the importance of art.	Ich halte Kunst für sehr wichtig.[b]	−.04	**.73**
Love to reflect on things.	Ich mache mir gerne Gedanken über Dinge.[b]	.10	**.43**
Get deeply immersed in music.	Ich tauche tief in Musik ein.	−.03	**.46**
Do not like poetry.	Lyrik mag ich nicht.[b]	−.05	**−.58**
See beauty in things that others might not notice.	Ich kann Schönheit in Dingen erkennen, die andere nicht wahrnehmen.[b]	−.03	**.58**
Need a creative outlet.	Ich brauche ein kreatives Ventil.	−.02	**.52**
Seldom get lost in thought.	Nur selten verliere ich mich in Gedanken.[b]	.25	**−.35**
Seldom daydream.	Ich verliere mich nur selten in Tagträumen.	.26	**−.37**
Seldom notice the emotional aspects of paintings and pictures.	Ich bemerke nur selten die emotionalen Aspekte von Gemälden und Bildern.	.01	**−.59**

Notes. $N = 1306$. Loadings above .30 or below −.30 appear in bold.

[a] Translation adopted from Streib and Wiedmaier (2001).

[b] Translation adopted from Schreiber and Iller (2016).

Table 28

Exploratory Factor Analysis Results for the German Translation of the BFAS Conscientiousness Scale

Original Item	German Translation	Factor 1	Factor 2
Industriousness			
Carry out my plans.	Ich führe meine Pläne aus.	**−.59**	.00
Waste my time.	Ich vertrödele meine Zeit.[a]	**.69**	−.04
Find it difficult to get down to work.	Mir fällt es schwer, an die Arbeit zu gehen.[a]	**.63**	−.01
Mess things up.	Ich vermassele Dinge.	**.46**	.02
Finish what I start.	Ich beende, was ich anfange.	**−.58**	.07
Don't put my mind on the task at hand.	Ich bin gedanklich nicht bei der Sache.	**.65**	.05
Get things done quickly.	Ich erledige Dinge schnell.	**−.45**	.03
Always know what I am doing.	Ich weiss immer, was ich tue.	**−.48**	.09
Postpone decisions.	Entscheidungen schiebe ich auf.[a]	**.57**	.05
Am easily distracted.	Ich lasse mich leicht ablenken.	**.59**	.06
Orderliness			
Leave my belongings around.	Ich lasse meine Sachen herumliegen.[b]	.22	**−.58**
Like order	Ich mag Ordnung.[b]	.02	**.81**
Keep things tidy.	Ich halte die Dinge ordentlich.	−.14	**.70**
Follow a schedule.	Ich folge einem Plan.[b]	**−.45**	.17
Am not bothered by messy people.	Ich störe mich nicht an unordentlichen Leuten.[a]	−.08	**−.61**
Want everything to be "just right".	Ich möchte, dass alles „genau richtig" ist.	−.04	**.44**
Am not bothered by disorder.	Ich störe mich nicht an Unordnung.[a]	−.11	**−.76**
Dislike routine.	Ich mag Routine nicht.	−.15	−.28
See that rules are observed.	Ich achte darauf, dass Regeln eingehalten werden.	.00	**.42**
Want every detail taken care of.	Ich will, dass auf jedes Detail achtgegeben wird.	−.07	**.41**

Notes. $N = 1306$. Loadings above .30 or below −.30 appear in bold.
[a] Translation adopted from Schreiber and Iller (2016).
[b] Translation adopted from Streib and Wiedmaier (2001).

Table 29

Means, Standard Deviations, Reliabilities, and Intercorrelations of the Personality and Criterion Variables for the Re-Scored Openness and Conscientiousness Scales (cf. Table 13)

Variable	*M*	*SD*	1	2	3	4	5	6	7	8
Personality traits										
1. Openness (overall)	50.87	8.50	(.79)							
2. Intellectual openness	22.94	4.77	.71***	(.80)						
3. Senso-aesthetic openness	27.93	6.09	.84***	.22***	(.73)					
4. Conscientiousness (overall)	48.93	9.16	−.05	.25***	−.26***	(.85)				
5. Industriousness	26.70	5.65	.09	.42***	−.19***	.85***	(.83)			
6. Orderliness	22.24	5.25	−.19***	−.02	−.25***	.83***	.41***	(.79)		
Academic achievement										
7. Grade point average	4.82	0.32	.16**	.33***	−.04	.19***	.27***	.04	–	
8. Subjective academic achievement	13.62	3.10	.19***	.41***	−.06	.19***	.32***	−.02	.60***	(.80)

Notes. $N = 424$. Values in parentheses are Cronbach's Alphas.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 30

Summary of the Regression Analyses of Academic Achievement on Openness and Conscientiousness Aspects for the Re-Scored Openness and Conscientiousness Scales (cf. Table 14)

		GPA			SUB		
Model	Predictor	β	R^2		β	R^2	
M1a	C-IND	.31***			.40***		
	C-ORD	−.09			−.18**		
			.08			.13	
M1b	O-INT	.36***			.45***		
	O-SAE	−.12**			−.16***		
			.12			.19	
M2	C-IND	.15**			.21***		
	C-ORD	−.04			−.13*		
	O-INT	.28***			.35***		
	O-SAE	−.08			−.13**		
			.14	ΔR^2_{M1a}: .06***		.22	ΔR^2_{M1a}: .09***
				ΔR^2_{M1b}: .01*			ΔR^2_{M1b}: .03***
M3	C-IND	.16**			.21***		
	C-ORD	−.06			−.13*		
	O-INT	.28***			.36***		
	O-SAE	−.07			−.13**		
	C-IND × O-INT	−.06			.03		
	C-IND × O-SAE	−.03			−.01		
	C-ORD × O-INT	.12*			.03		
	C-ORD × O-SAE	.04			−.01		
			.16	ΔR^2_{M2}: .02		.23	ΔR^2_{M2}: .00
M4	C-IND	.16**					
	C-ORD	−.05					
	O-INT	.28***					
	O-SAE	−.08					
	C-ORD × O-INT	.12**					
			.15	ΔR^2_{M2}: .01*			

Notes. $N = 424$. GPA = grade point average; SUB = subjective academic achievement; C-IND = industriousness; C-ORD = orderliness; O-INT = intellectual openness; O-SAE = senso-aesthetic openness. * $p < .05$. ** $p < .01$. *** $p < .001$.

B.3 Replications of the Results in the Other Undergraduate Samples

Table 31

Means, Standard Deviations, Reliabilities, and Intercorrelations of the Personality and Criterion Variables in the Psychology Sample from the Fachhochschule Nordwestschweiz

Variable	*M*	*SD*	1	2	3	4	5	6	7	8
Personality traits										
1. Openness (overall)	54.93	8.89	(.82)							
2. Intellectual openness	27.92	4.99	.81***	(.78)						
3. Senso-aesthetic openness	27.01	5.67	.86***	.39***	(.75)					
4. Conscientiousness (overall)	51.55	9.19	−.11	.04	−.21**	(.85)				
5. Industriousness	26.23	5.05	.06	.25**	−.12	.83***	(.81)			
6. Orderliness	25.32	5.72	−.23**	−.15	−.23**	.87***	.45***	(.79)		
Academic achievement										
7. Grade point average	5.06	0.30	.07	.14	−.01	.09	.10	.05	–	
8. Subjective academic achievement	14.33	3.02	.21**	.29***	.08	.09	.13	.03	.64***	(.75)

Notes. $N = 167$. Values in parentheses are Cronbach's Alphas.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 32

Summary of the Regression Analyses of Academic Achievement on Openness and Conscientiousness Aspects in the Psychology Sample from the Fachhochschule Nordwestschweiz

		GPA			SUB		
Model	Predictor	β	R^2		β	R^2	
M1a	C-IND	.09			.14		
	C-ORD	.01			−.03		
			.01			.02	
M1b	O-INT	.16			.30***		
	O-SAE	−.07			−.04		
			.02			.08	
M2	C-IND	.03			.03		
	C-ORD	.05			.06		
	O-INT	.15			.30***		
	O-SAE	−.05			−.02		
			.03	ΔR^2_{M1a}: .02		.09	ΔR^2_{M1a}: .07**
				ΔR^2_{M1b}: .01			ΔR^2_{M1b}: .01
M3	C-IND	.06			.02		
	C-ORD	.04			.06		
	O-INT	.17			.30***		
	O-SAE	−.06			−.03		
	C-IND × O-INT	−.10			−.02		
	C-IND × O-SAE	−.08			.01		
	C-ORD × O-INT	−.10			−.06		
	C-ORD × O-SAE	−.07			.01		
			.10	ΔR^2_{M2}: .07*		.09	ΔR^2_{M2}: .00
M4	C-IND	.02					
	C-ORD	.04					
	O-INT	.15					
	O-SAE	−.06					
	C-ORD × O-INT	−.20**					
			.07	ΔR^2_{M2}: .04**			

Notes. $N = 167$. GPA = grade point average; SUB = subjective academic achievement; C-IND = industriousness; C-ORD = orderliness; O-INT = intellectual openness; O-SAE = senso-aesthetic openness. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 33

Means, Standard Deviations, Reliabilities, and Intercorrelations of the Personality and Criterion Variables in the Economics Sample from the Fachhochschule Nordwestschweiz

Variable	*M*	*SD*	1	2	3	4	5	6	7	8
Personality traits										
1. Openness (overall)	50.16	8.70	(.79)							
2. Intellectual openness	26.91	5.01	.73***	(.76)						
3. Senso-aesthetic openness	23.25	6.09	.83***	.22***	(.78)					
4. Conscientiousness (overall)	52.47	9.30	.01	.22***	−.17**	(.85)				
5. Industriousness	26.21	5.03	.12	.41***	−.16*	.82***	(.80)			
6. Orderliness	26.26	5.90	−.09	.00	−.13*	.87***	.44***	(.81)		
Academic achievement										
7. Grade point average	4.90	0.38	.17*	.27***	.02	.21**	.25***	.11	–	
8. Subjective academic achievement	13.68	3.05	.20**	.37***	−.01	.26***	.30***	.16*	.62***	(.76)

Notes. $N = 231$. Values in parentheses are Cronbach's Alphas.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 34

Summary of the Regression Analyses of Academic Achievement on Openness and Conscientiousness Aspects in the Economics Sample from the Fachhochschule Nordwestschweiz

		GPA			SUB		
Model	Predictor	β	R^2		β	R^2	
M1a	C-IND	.24***			.28***		
	C-ORD	.01			.03		
			.06			.09	
M1b	O-INT	.28***			.39***		
	O-SAE	−.04			−.10		
			.07			.14	
M2	C-IND	.14			.11		
	C-ORD	.05			.10		
	O-INT	.21**			.33***		
	O-SAE	.00			−.05		
			.10	ΔR^2_{M1a}: .04*		.17	ΔR^2_{M1a}: .08***
				ΔR^2_{M1b}: .02			ΔR^2_{M1b}: .03*
M3	C-IND	.14			.11		
	C-ORD	.05			.09		
	O-INT	.22**			.33***		
	O-SAE	.00			−.05		
	C-IND × O-INT	.02			−.01		
	C-IND × O-SAE	−.08			−.06		
	C-ORD × O-INT	−.04			−.02		
	C-ORD × O-SAE	−.04			−.06		
			.11	ΔR^2_{M2}: .01		.18	ΔR^2_{M2}: .01
M4	C-IND	.14					
	C-ORD	.05					
	O-INT	.21**					
	O-SAE	.01					
	C-ORD × O-INT	−.04					
			.10	ΔR^2_{M2}: .00			

Notes. $N = 231$. GPA = grade point average; SUB = subjective academic achievement; C-IND = industriousness; C-ORD = orderliness; O-INT = intellectual openness; O-SAE = senso-aesthetic openness. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 35

Means, Standard Deviations, Reliabilities, and Intercorrelations of the Personality and Criterion Variables in the Miscellaneous Undergraduate Sample

Variable	*M*	*SD*	1	2	3	4	5	6	7	8
Personality traits										
1. Openness (overall)	52.96	8.56	(.78)							
2. Intellectual openness	27.03	5.32	.73***	(.79)						
3. Senso-aesthetic openness	25.89	5.96	.79***	.15**	(.77)					
4. Conscientiousness (overall)	48.41	9.90	−.01	.25***	−.24***	(.86)				
5. Industriousness	23.87	5.64	.08	.39***	−.23***	.83***	(.84)			
6. Orderliness	24.54	6.06	−.10	.05	−.18**	.86***	.43***	(.81)		
Academic achievement										
7. Grade point average	4.94	0.46	.07	.18**	−.06	.15**	.16**	.10	–	
8. Subjective academic achievement	13.46	3.35	.17**	.31***	−.03	.26***	.30***	.15**	.64***	(.80)

Notes. $N = 314$. Values in parentheses are Cronbach's Alphas.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 36

Summary of the Regression Analyses of Academic Achievement on Openness and Conscientiousness Aspects in the Miscellaneous Undergraduate Sample

		GPA			SUB		
Model	Predictor	β	R^2		β	R^2	
M1a	C-IND	.14*			.29***		
	C-ORD	.03			.02		
			.03			.09	
M1b	O-INT	.20***			.32***		
	O-SAE	−.09			−.07		
			.04			.10	
M2	C-IND	.05			.19**		
	C-ORD	.05			.06		
	O-INT	.17**			.23***		
	O-SAE	−.07			−.01		
			.05	ΔR^2_{M1a}: .02*		.14	ΔR^2_{M1a}: .05***
				ΔR^2_{M1b}: .01			ΔR^2_{M1b}: .04**
M3	C-IND	.06			.19**		
	C-ORD	.04			.04		
	O-INT	.15*			.22***		
	O-SAE	−.06			.00		
	C-IND × O-INT	−.03			−.06		
	C-IND × O-SAE	−.06			−.02		
	C-ORD × O-INT	−.04			.08		
	C-ORD × O-SAE	−.14*			−.12		
			.08	ΔR^2_{M2}: .03*		.16	ΔR^2_{M2}: .02
M4	C-IND	.05					
	C-ORD	.05					
	O-INT	.17**					
	O-SAE	−.06					
	C-ORD × O-INT	.01					
			.05	ΔR^2_{M2}: .00			

Notes. $N = 314$. GPA = grade point average; SUB = subjective academic achievement; C-IND = industriousness; C-ORD = orderliness; O-INT = intellectual openness; O-SAE = senso-aesthetic openness. * $p < .05$. ** $p < .01$. *** $p < .001$.

C Appendix for Article 4

Table 37 contains the 22 items that were used to measure openness to ideas. Each item consisted of an item stem and four response options. The first and second response option for each items reflect a high trait level, the third and fourth a low trait level.

Tabelle 37

Openness to Ideas Items form the SJT (Article 4)

Item ID	Item Stem	Response Options
1	Ein Bekannter schickt dir eine Ausschreibung für einen Innovationswettbewerb, bei dem kreative Ideen gesucht werden, um mehr Nachhaltigkeit in Deutschland zu fördern. Wie verhältst du dich?	Der Hinweis auf den Innovationswettbewerb weckt mein prinzipielles Interesse und ich mache ein kurzes Brainstorming, um zu überlegen, ob ich daran teilnehme. Ich freue mich über die Information, weil es mir grundsätzlich Spaß macht über neue Ideen und Innovationen nachzudenken. Zeitlich entscheide ich mich jedoch dagegen, da ich momentan andere Prioritäten habe. Ich schreibe meinem Bekannten eine Email zurück und bedanke mich für den Hinweis, aber teile ihm mit, dass ich bei solchen Wettbewerben meist eher wenig Motivation aufbringen kann. Ich beschäftige mich nicht sonderlich mit seinem Vorschlag, da mein Interesse dafür eher gering ist und teile ihm irgendwann mit, dass so etwas nichts für mich ist.
2	Du erhältst Post von einem seriösen Forschungsinstitut. Im Briefumschlag befinden sich einige Knobel- und Denksportaufgaben. Das Forschungsinstitut zahlt dir für die Bearbeitung der Aufgaben kein Geld, bittet dich aber die Aufgaben anonym zu lösen und zurückzuschicken. Der Rückumschlag ist bereits frankiert. Wie verhältst du dich?	Ich freue mich über die intellektuelle Herausforderung und versuche die Knobel- und Denksportaufgaben zu lösen. Ich denke angestrengt nach und versuche alle Aufgaben zu lösen. Zur Bearbeitung der Aufgaben benutze ich manchmal entsprechende Hilfsmittel. Ich löse die Aufgaben nicht, da ich wichtigere Dinge zu tun habe. Das ist mir viel zu kompliziert. Damit will ich mich in meiner Freizeit nicht auseinandersetzen.

continued on the next page

Table 37 (continued)

Openness to Ideas Items form The SJT (Article 4)

Item ID	Item Stem	Response Options
3	Du sitzt im Wartezimmer deines Hausarztes und blätterst in einer Zeitschrift. Auf einmal entdeckst du ein Zahlenrätsel (Sudoku). Wie verhältst du dich?	Ich fange an das Zahlenrätsel zu lösen und schaue, wie weit ich komme. Ich fange an das Zahlenrätsel zu lösen und hoffe, dass es in der Zeitschrift noch weitere Knobelaufgaben gibt. Solche Zahlenrätsel sind mir momentan zu kompliziert. Deshalb blättere ich in der Zeitschrift weiter. Ich blättere in der Zeitschrift weiter, denn Zahlenrätsel interessieren mich nicht.
4	Du liest in deiner Freizeit ein unterhaltsames Buch, in dem abrupt eine komplizierte wissenschaftliche Theorie erklärt wird. Du merkst schnell, dass für die weitere Handlung des Buches die wissenschaftliche Theorie nicht bedeutsam ist. Wie verhältst du dich?	Ich lese mir den Abschnitt mit der wissenschaftlichen Theorie durch und freue mich intellektuell etwas gefordert zu sein. Ich versuche die wissenschaftliche Theorie bis ins Detail zu verstehen. Ich lese mir den Teil mit der wissenschaftlichen Theorie zwar durch, aber ohne ihn verstehen zu wollen. Ich überspringe den Teil des Buches mit der wissenschaftlichen Theorie.
5	In einer Unterhaltung gebraucht dein Gesprächspartner ein lateinisches Wort, das du noch nie gehört hast. Den Inhalt des Satzes hast du grob verstanden. Wie verhältst du dich?	Ich schlage das Wort zu einem späteren Zeitpunkt in einem Fremdwörterduden nach. Ich frage meinen Gesprächspartner nach der Bedeutung des Wortes. Ich beschäftige mich nicht weiter mit diesem Fremdwort. Ich versuche mir die Wortbedeutung mit meinem bisherigen Wissen zu erschließen.

continued on the next page

Table 37 (continued)

Openness to Ideas Items form The SJT (Article 4)

Item ID	Item Stem	Response Options
6	Du stößt beim Fernsehen zufällig auf eine Sendung zum Thema Klimawandel. Einer der Talkshowgäste bringt einige neue, unkonventionelle Argumente für den langsameren Ausbau an erneuerbaren Energien. Ein anderer Talkshowgast vertritt die entgegengesetzte Meinung. Wie verhältst du dich?	Ich schaue die Sendung an, wäge alle Argumente, die für und gegen den Ausbau von erneuerbaren Energien sprechen ab, und bilde mir eine Meinung. Ich schaue die Sendung an und bin gegenüber neuen Argumenten zum Thema erneuerbare Energien aufgeschlossen. Zu diesem Thema habe ich bereits eine eindeutige Meinung. Deshalb interessiert mich die Sendung weniger. Ich schalte den Fernseher aus oder wechsle das Programm. Solche Themen und Sendungen interessieren mich nicht.
7	Du kommst nach einem anstrengenden Tag nach Hause. Im Fernsehen laufen verschiedene Programme, darunter ein Dokumentation und unterhaltsame Spielfilme. Wie verhältst du dich?	Ich schaue die Dokumentation an, weil man sich nie genug weiterbilden kann. Das Fernsehen nutze ich generell fast nur, um Bildungsprogramme zu schauen. Ich entscheide mich für einen der Spielfilme, um endlich abschalten zu können. Ich schaue mir die Dokumentation nur an, wenn es um ein Thema geht, das mich interessiert und mit dem ich mich gerne beschäftige.

continued on the next page

Table 37 (continued)

Openness to Ideas Items form The SJT (Article 4)

Item ID	Item Stem	Response Options
8	In einem Wissensgebiet, in dem du dich besonders gut auskennst, gibt es neue wissenschaftliche Erkenntnisse. Diese neuen Erkenntnisse sind sehr theoretisch und recht abstrakt. Du nimmst zufällig und kurz von diesen Neuigkeiten Notiz. Wie verhältst du dich?	Ich informiere mich über die neuen Erkenntnisse umfassend und versuche diese bis in das letzte Detail zu verstehen. Ich setzte mich mit den neuen Erkenntnissen auseinander und versuche diese in mein bisheriges Wissen zu integrieren. Ich bin mehr an praktischen Dinge interessiert und setzte mich mit den neuen Erkenntnissen kaum auseinander. Mein bisheriges Wissen ist groß genug, so dass ich mich mit den neuen Erkenntnissen nicht weiter beschäftige.
9	Du hast dir einen neuen Laptop gekauft und willst ein Softwareprogramm, das du bereits kennst, erstmals benutzen. Einige Softwarefunktionen sind für dich bei dieser Version neu. Wie verhältst du dich?	Ich mache mich in verschiedenen Quellen über die neuen Funktionen schlau. Ich benutze das Softwareprogramm und versuche mir die neuen Funktionen durch Ausprobieren selbst beizubringen. Ich benutze das Softwareprogramm und wende die neuen Funktionen kaum an. Ich ärgere mich darüber, dass das Softwareprogramm aktualisiert wurde. Ich versuche mit meinem alten Softwareprogramm weiterzuarbeiten.
10	In ein paar Tagen ist es bald wieder so weit. Es gibt eine Mondfinsternis zu bewundern. Wie verhältst du dich?	Ich schaue mir die Mondfinsternis an und versuche den astronomischen Hintergrund zu verstehen. Ich schaue mir die Mondfinsternis zwar nicht an, finde es aber spannend zu erfahren, wie solch ein Phänomen zustande kommt. Ich schaue mir die Mondfinsternis an, aber mehr auch nicht. Ich mache gar nichts, denn solch ein astronomisches Phänomen interessiert mich nicht.

continued on the next page

Table 37 (continued)

Openness to Ideas Items form The SJT (Article 4)

Item ID	Item Stem	Response Options
11	Während du durch die Fußgängerzone läufst, fällt dir ein Mann auf, der auf einer Bühne zum Thema Ïst der Mensch gut oder böse?"referiert. Du bist nicht unter Zeitdruck und findest den Mann auf den ersten Blick sympathisch. Wie verhältst du dich?	Ich versuche herauszubekommen, worüber der Mann genau referiert und höre mir seinen Vortrag an. Ich höre mir den Vortrag für ein paar Minuten an und entscheide danach, ob ich den Ausführungen des Redners noch weiter folge. Ich höre mir den Vortrag nicht an, denn solche Diskussionen empfinde ich als viel zu abstrakt und theoretisch. Ich laufe weiter, denn solche philosophischen Fragen interessieren mich nicht.
12	Beim Durchschalten des Fernsehprogrammes entdeckst du eine Talksendung zu einem philosophischen Thema. Wie verhältst du dich?	Mich interessieren solche Themen und ich schaue mir die Sendung an. Ich schaue mir den Anfang der Sendung an und mache es vom Thema und den Gästen abhängig, ob ich weiter zusehe. Ich schaue mir die Sendung nur an, wenn ich wirklich überhaupt nichts Besseres währenddessen machen kann. Ich schaue mir die Sendung keinesfalls an.
13	Ein Bekannter fragt dich, ob du mit ihm in ein naturwissenschaftliches Museum gehen möchtest, in dem unterschiedlichste Themenbereiche ausgestellt sind. Der Bekannte sagt aber dazu, dass er dir nicht böse ist, wenn du absagst. Wie verhältst du?	Ich sage gerne zu und freue mich darauf, Neues kennenzulernen und sich den ganzen Tag in verschiedene Themenbereiche hineinzudenken. Ich sage zu und frage den Bekannten, ob wir weitere Personen mitnehmen können, um uns im Museum auszutauschen und angeregt zu diskutieren. Ich sage zu, möchte allerdings nicht den ganzen Tag in dem Museum verbringen und beschränke mich deshalb nur auf einige Themenbereiche, in denen ich bereits Vorwissen habe. Ich sage ab, da ich für solche Themen kein Interesse habe.

continued on the next page

Table 37 (continued)

Openness to Ideas Items form The SJT (Article 4)

Item ID	Item Stem	Response Options
14	Ein Freund fragt dich nach deiner Meinung zu einer neuen wissenschaftlichen Entdeckung, welche du nicht komplett verfolgt hast. Wie verhältst du dich?	Du bittest ihn um einen Tag Zeit, um dich ausgiebig mit dem Thema zu befassen und bist gespannt auf eine anschließende Diskussion. Du lässt dir von ihm genauer erklären, worum es sich handelt und freust dich, dass dein Freund dir regelmäßig von neuen und interessanten Entdeckungen berichtet. Du teilst deinem Freund mit, dass du leider noch nicht viel über das Thema gehört hast und deshalb wenig interessiert bist. Du bist genervt, weil dieser Freund ständig über hochintellektuelle Themen sprechen möchte.
15	Es ist mal wieder Ende März. Das bedeutet in vielen europäischen Ländern: Die Sommerzeit fängt an und die Uhr wird um eine Stunde nach vorne gestellt. Wie verhältst du dich?	Ich interessiere mich für die Hintergründe der Sommerzeitregelung und informiere mich darüber. Ich verfolge interessiert aktuelle Diskussionen, die sich mit den Vor- und Nachteilen der Sommerzeit beschäftigen. Ich finde die Uhrumstellung lästig und würde sie am liebsten abschaffen. Ich stelle die Uhr um und das wars.
16	Du läufst durch die Fußgängerzone und erhältst einen seriösen Gratisgutschein für einen Museumsbesuch deiner Wahl. Wie verhältst du dich?	Ich freue mich über den Gutschein und besuche ein Museum meiner Wahl. Ich informiere mich vorab über das Ausstellungsangebot in verschiedenen Museen und gehe in die interessanteste Ausstellung. Ich habe für Museumsbesuche wenig übrig und lasse den Gutschein verfallen. Ich interessiere mich nicht für Museen und verschenke den Gutschein.

continued on the next page

Table 37 (continued)

Openness to Ideas Items form The SJT (Article 4)

Item ID	Item Stem	Response Options
17	Du erhältst eine Einladung zu einer Informationsveranstaltung für einen Debattierclub. Wie verhältst du dich?	Ich debattiere gerne und folge der Einladung. Ich debattiere zwar gerne über weltpolitische Themen mit meinen Freunden, aber nicht in einem Club. Das, was dort diskutiert wird, interessiert mich wenig. Für solche Clubs habe ich wenig übrig.
18	Du nimmst an einem Spieleabend teil. Da sich nicht alle Teilnehmer auf ein gemeinsames Spiel einigen können, wird anonym abgestimmt. Zur Auswahl stehen verschiedene Spiele. Für welches Spiel entscheidest du dich?	Ein Spiel, welches ich noch nicht kenne und das hohe geistige Anforderungen stellt. Ein für mich neues Spiel, das einfache Regeln hat und leicht zu verstehen ist. Ein leicht zu verstehendes Spiel, das ich bereits kenne. Ein mir bekanntes Spiel, das eher schwer zu verstehen ist.
19	Deine Tante hat dir ein neues Spiel geschenkt, bei dem es darum geht geometrische Figuren nach Anzahl, Farbe, Füllung und Form zu kombinieren. Das Spiel erfordert hohe Konzentration und dein Freund weigert sich, es mit dir zu spielen. Wie verhältst du dich?	Ich tue alles, um ihn davon zu überzeugen, dass es sich um ein tolles Spiel handelt und man nur etwas Übung braucht, um die Kombinationen schnell zu entdecken. Ich bin traurig, dass mein Kumpel das Spiel nicht mag, aber akzeptiere seine Entscheidung. Ich bin erleichtert, dass er das Spiel ebenfalls nicht mag und es ihm auch zu anstrengend ist. Ich tausche mich mit ihm darüber aus, dass wir beide lieber andere Aktivitäten vorziehen. Wir sind uns einig, dass es unglaublich ist, wie dieses Spiel manchen Menschen Spaß machen kann.

continued on the next page

Table 37 (continued)

Openness to Ideas Items form The SJT (Article 4)

Item ID	Item Stem	Response Options
20	Ein Bekannter macht dich darauf aufmerksam, dass es dieses Semester eine spannende universitäre Ringvorlesung gibt. Du kannst als Zuhörer an der Vorlesung teilnehmen, ohne eine Prüfungsleistung erbringen zu müssen. Die Vorlesung handelt von einem Themengebiet, in dem du ein solides Vorwissen hast und dich relativ gut auskennst. Wie verhältst du dich?	Ich nehme an der Ringvorlesung teil. Ich schaue mir die erste Vorlesung an und entscheide danach, ob ich die Ringvorlesung weiterhin besuche. Ich gehe Dinge lieber praktisch an und nehme deshalb nicht an der Ringvorlesung teil. Ich nehme nicht an der Ringvorlesung teil, denn ich weiß zu diesem Themengebiet bereits einiges.
21	Du nimmst dir für deinen Strandurlaub auf einer Insel viele neue Bücher/Hörbücher mit, da du gehört hast, dass es außer Strand und Palmen auf der kleinen Insel nicht viel gibt. Du kommst dort an und merkst, dass es doch einige alternative Aktivitäten zu tun gibt. Wie verhältst du dich?	Ich freue mich schon seit langem darauf neue intellektuelle Anstöße zu den aktuellen Themen zu bekommen und lese bzw. höre wie geplant alles, was ich mitgenommen habe. Die anderen Aktivitäten klingen zwar unterhaltsam, aber wären eher wie Zeitvertreib, sodass es mir lieber ist, mich mit etwas Sinnvollem wie meinen neuen Büchern/Hörbüchern zu beschäftigen. Sobald ich merke, dass es auch andere Dinge gibt, mit denen ich die Zeit vertreiben kann, ist mir das im Urlaub lieber, als mich mit schwieriger Literatur zu beschäftigen. Ich fühle mich im Zwiespalt, weil ich mir vorgenommen habe, dieses Mal wirklich mein Allgemeinwissen zu erweitern, aber kann mich einfach nicht dazu aufraffen.

continued on the next page

Table 37 (continued)

Openness to Ideas Items form The SJT (Article 4)

Item ID	Item Stem	Response Options
22	Du erhältst als Treueprämie von einer Firma ein Gratiszeitschriftenabonnement und darfst dir aus folgenden Zeitschriftengattungen eine auswählen. Für welche Zeitschriftengattung entscheidest du dich?	Für eine Wissenschafts-/Kulturzeitschrift. Für ein Nachrichten-/Wirtschaftsmagazin. Für eine Illustrierte-/Boulevardzeitschrift. Für eine Sport-/Natur-/Computerzeitschrift.