Exploring Personality Traits in Sport:

An Analysis of Football Athletes Through Personality Assessments

Dissertation

Zur Erlangung des akademischen Grades eines Doktors der Philosophie

der Fakultät HW Bereich Empirische Humanwissenschaften

der Universität des Saarlandes

vorgelegt von

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Saarbrücken 2025

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Declaration

I hereby confirm that I have independently completed the submitted cumulative dissertation “Exploring Personality Traits in Sport: An Analysis of Football Athletes Through Personality Assessments” without any unauthorized assistance and without using sources or aids other than those specified. I have clearly marked the passages that have been taken verbatim or in substance from the works used. Furthermore, I confirm that the dissertation, in this or a similar form, has not been previously submitted or evaluated as a doctoral achievement elsewhere.

Saarbrücken, 16.12.2024

Jan Spielmann

Acknowledgements

My deepest gratitude goes to Prof. Dr. Jan Mayer, who, as my doctoral advisor and second examiner, made this dissertation possible and supported me as a mentor from the very beginning. Since our first meeting, he has taken me under his professional guidance, introduced me to sports psychology, and provided me with the opportunity to realize ideas inspired by him. A simple "thank you" feels insufficient to adequately express my profound appreciation for his support. Thank you for being always on my side!

I sincerely thank Prof. Dr. Sabine Schäfer for her willingness to take on the role of principal examiner for this doctoral procedure and her willingness to offer guidance.

I extend my thanks to Prof. Dr. Hans-Dieter Hermann for his pioneering contributions to sports psychology, particularly in football, for his inspiring presence, and for his respectful and egalitarian approach.

My appreciation goes to Dr. Sascha Härtel for establishing performance diagnostics at TSG Hoffenheim, which has served as the foundation for numerous innovative projects. I thank him for his open ear and his readiness to engage in demanding and critical discussions.

Dr. Adam Beavan deserves my heartfelt thanks for the excellent collaboration, his exceptionally open and internationally oriented approach, and the friendship that emerged from our work together.

I am grateful to Christoph Herr for the cooperation that began through the collaboration between the DFB and TSG and quickly developed into a mutually appreciative and friendly connection. Thank you, Chris, for your commitment and contributions to our German sports psychology network.

In addition, I would like to thank my co-authors for the exciting projects created as part of this dissertation and for the ongoing connection we share: Prof. Dr. Jan Mayer, Dr. Adam Beavan, Dr. Fabian Otte, Tom Schumacher, Prof. Dr. Stefanie Klatt, Dr. Stefan Altmann, Christoph Herr, and Dr. Lena Steindorf.

My thanks also go to the DFB and, in particular, to the circle of current and former sports psychologists of the German National Teams for their consistently critical discussions and support of this dissertation by providing access to athletes at the highest levels. Special thanks go to Andy Borchert for his diagnostic expertise, collegial manner, and constant helpfulness.

I would like to thank the entire TSG Hoffenheim organization for welcoming a young, ambitious student who was allowed to experiment, make mistakes, and contribute ideas. In particular, I am grateful to Rafael Hoffner for his collegial attitude, innovative spirit, and longstanding support.

My special thanks also go to my team at the TSG ResearchLab. All the colleagues who have contributed to this work over the years have played a decisive role in its success. Thank you for placing your trust in me and in our Lab. May the spirit of inquiry, motivation, and mutual support continue in future.

I am deeply grateful to my family for their unconditional support throughout my development. Their patience, understanding, and help have always strengthened me. For this, they deserve my profound thanks, which is all too rarely expressed.

Finally, I wish to thank Mr. Dietmar Hopp for his visionary foresight, his social commitment, and his invaluable contributions to TSG and to sport in general.

Abstract

German Abstract

Die Erfassung von psychologischen Merkmalen im Sport ist im Vergleich zur physiologischen Diagnostik noch immer unterrepräsentiert. Dies betrifft insbesondere die Diagnostik von Persönlichkeitsmerkmalen. Persönlichkeitsmerkmale gelten als relativ zeitstabile Eigenschaften einer Person und interagieren in vielfältiger Weise mit sportlicher Aktivität. Aus praktischer Sicht könnten geeignete Diagnostikinstrumente und daraus abgeleitete Trainingsinterventionen zur verbesserten Talentidentifikation beitragen und als Grundlage für zielgerichtete Coachingmaßnahmen dienen. Aus wissenschaftlicher Perspektive trägt die Untersuchung von Persönlichkeitsmerkmalen zu einem besseren Verständnis des Einflusses dieser Merkmale auf die sportliche Leistung und vice versa bei.

Im Vergleich zu anderen gesellschaftlichen Bereichen und Sportarten stellt der Fußball besondere Anforderungen an die Persönlichkeit. Insbesondere der leistungssportliche Fußball steht im Zentrum des öffentlichen Interesses, und die Anzahl der aktiven Fußballspielenden in Deutschland ist im Vergleich zu anderen Sportarten hoch. Der Grad der Professionalisierung variiert jedoch stark zwischen Mannschaften unterschiedlichen Geschlechts, Expertise-Niveaus und Altersgruppen. Obwohl der Fußball eine solch exponierte Stellung einnimmt, verdeutlicht die unzureichende Studienlage zu Persönlichkeitsmerkmalen von Fußballspielenden die Notwendigkeit eines tieferen wissenschaftlichen Diskurses. Dies betrifft insbesondere die Identifikation von Setting-spezifischen Diagnostikinstrumenten mit entsprechender wissenschaftlicher Güte. Darüber hinaus erfordert die Erforschung der Persönlichkeit von Fußballspielenden nicht nur die Analyse traditioneller Einflussfaktoren wie Geschlecht, Alter, Spielposition und Expertise, sondern auch eine vertiefte Auseinandersetzung mit weiteren potenziellen Einflussfaktoren. Insbesondere die Zusammenhänge zwischen kognitiven Fähigkeiten und der Persönlichkeitsstruktur der Fußballspielenden könnten zu einem umfassenderen Verständnis von Verhalten im sportlichen Kontext beitragen. Um diese

Forschungslücke zu schließen, wurde ein breit angelegtes Forschungsvorhaben zur Erfassung von Persönlichkeitsmerkmalen von Fußballspielenden initiiert, mit besonderem Fokus auf den leistungssportlichen Kontext des Fußballs.

In einer ersten Studie (Spielmann et al., 2022) wurden die Persönlichkeitseigenschaften von 378 Fußballspielenden mithilfe des etablierten Diagnostikinstrument NEO-FFI erfasst. Das Instrument gilt in Kontexten außerhalb des Sports als geeignetes Mittel zur Erfassung des Fünf-Faktoren Models der Persönlichkeit. Ziel war es, die Eignung des Fragebogens hinsichtlich interner Konsistenz und Faktorenstruktur im Fußball zu untersuchen. Eine Teilstichprobe von 86 Personen lieferte Erkenntnisse zur Test-Retest-Reliabilität über einen Zeitraum von sechs Wochen. Die Ergebnisse waren mit Untersuchungen außerhalb des Sports vergleichbar, zeigten jedoch geschlechtsspezifische Unterschiede in Bezug auf interne Konsistenz und Test-Retest-Reliabilität. Das NEO-FFI erwies sich somit als geeignet für den Einsatz im Fußball, obwohl Schwächen in der Faktorenstruktur berücksichtigt werden müssen.

In einer zweiten Studie (Spielmann et al., 2023) wurde das in der ersten Studie erprobte Instrument verwendet, um spezifische Fragestellung zu untersuchen. Fußballspielende eines Bundesligavereins (n = 138) lieferten Erkenntnisse über Zusammenhänge zwischen Persönlichkeitseigenschaften und Exekutiven Funktionen. Die Interaktion beider Konstrukte wird in der Forschung als Erklärungsansatz für die Organisation und Bewältigung von Verhaltensweisen und Entscheidungsprozessen angesehen. Ziel dieser Untersuchung war es, die Beziehung der Konstrukte innerhalb einer Stichprobe von Fußballspielenden besser zu verstehen. Mittels linearer Regressionsmodelle wurden Zusammenhänge zwischen Persönlichkeit und Exekutiven Funktionen wie Arbeitsgedächtnis, Inhibition und Kognitive Flexibilität sowie der Einfluss von Expertise und Geschlecht untersucht. Die Ergebnisse zeigten inkonsistente Zusammenhänge zwischen Persönlichkeitseigenschaften und Exekutiven Funktionen bei männlichen und weiblichen Fußballspielenden. Insgesamt konnten bis zu 23 % der Varianz der Exekutiven Funktionen durch Persönlichkeitsmerkmale sowie Altersklasse und

Teamzugehörigkeit erklärt werden. Dies deutet darauf hin, dass Exekutive Funktionen und Persönlichkeitsmerkmale von Fußballspielenden in Verbindung stehen, jedoch weitere unbeachtete Variablen eine erklärende Rolle im Gesamtbild einnehmen.

Nicht nur die Auseinandersetzung mit dem Zusammenspiel von Persönlichkeit und anderen psycho-kognitiven Einflussfaktoren im Fußball erscheint wissenschaftlich relevant. In einer dritten Studie (Spielmann et al., 2024) wurde sich mit der Frage beschäftigt, ob es eine positionsspezifische „Fußballpersönlichkeit“ gibt. Dabei wurden die Persönlichkeitsmerkmale von 132 Torhütenden unterschiedlicher Expertise-Niveaus und Altersgruppen untersucht. Die Studie stellte die erste Untersuchung von Persönlichkeitseigenschaften bei Fußballtorhüterinnen und -Torhütern dar. Der explorative Charakter dieser Studie zielte auf eine erste Analyse von Persönlichkeitsunterschieden bei verschiedenen Gruppen von Torhütenden ab. Übergeordnet zeigte sich, dass jugendliche Torhütende signifikant geringere Werte in Verträglichkeit aufwiesen als erwachsene Profi-Torhütende. Zudem waren Torhüter signifikant weniger verträglich und neurotisch als Torhüterinnen. Detailliertere Analysen zeigten Unterschiede in Verträglichkeit und Gewissenhaftigkeit bei Gruppen unterschiedlicher Expertise und Geschlechts. Diese Ergebnisse sind ein erster Schritt zu einem besseren Verständnis der Persönlichkeitseigenschaften von Torhütern sowie geschlechts- und expertise-spezifischer Unterschiede und können wichtige Impulse für das Coaching und Scouting geben.

Abschließend wurden in einer vierten Studie (Spielmann et al., under review) die Persönlichkeitsmerkmale von 2085 männlichen und weiblichen Probanden untersucht. Ziel war die Analyse von gruppenabhängigen Persönlichkeitsunterschieden in einer möglichst großen Stichprobe. Die Gesamtstichprobe wurde in drei Gruppen (Fußballspielende, Schüler*innen und Studierende, Inaktive) unterteilt. Die Analysen zeigten, dass Fußballspielende signifikant geringere Werte in Neurotizismus und höhere Werte in Offenheit, Gewissenhaftigkeit und Extraversion aufwiesen als beide Vergleichsgruppen. Innerhalb der Gruppe der Fußballspielenden (n = 1500) zeigte sich eine Abnahme von Neurotizismus und eine Zunahme

von Gewissenhaftigkeit mit steigender Expertise. Erwachsene Fußballer wiesen zudem höhere Verträglichkeitswerte auf als jugendliche Spieler. Im Geschlechtervergleich zeigten Fußballerinnen höhere Werte in Neurotizismus und Verträglichkeit als Fußballer. Diese Ergebnisse liefern erstmals Erkenntnisse über Persönlichkeitsunterschiede bei Fußballspielenden in Abhängigkeit von Expertise, Alter und Geschlecht in einer großen Stichprobe.

Zusammenfassend lässt sich festhalten, dass die Erfassung von Persönlichkeitsmerkmalen im leistungssportlichen Fußball sowohl aus wissenschaftlicher als auch aus praxisbezogener Sicht lohnend erscheint. Das Forschungsvorhaben konnte zeigen, dass das Diagnostikinstrument NEO-FFI wissenschaftlich fundierte Erkenntnisse über Persönlichkeitseigenschaften im Fußball liefert. Bei dessen Einsatz im Fußball zeigten sich im Vergleich zu Studien außerhalb des Sports ähnliche Ergebnisse bezüglich der Faktorstruktur und (Retest-)Reliabilität. Zudem konnte gezeigt werden, dass durch die Erhebung von Persönlichkeitseigenschaften keine ausreichenden Rückschlüsse auf die Ausprägung der Exekutiven Funktionen bei Fußballspielenden gezogen werden können. Die Analyse der Persönlichkeitseigenschaften von Torhütenden kam zum Ergebnis, dass sich hier kein eindeutiges Muster in Bezug auf eine klare Persönlichkeitsausprägung erkennen lässt. Dies macht eine individualisierte Betrachtung in Abhängigkeit von Alter, Geschlecht und Expertise notwendig. Die Analyse von Persönlichkeitseigenschaften bei einer großen Stichprobe von Fußballspielenden konnte klare Unterschiede in vier von fünf Persönlichkeitseigenschaften zu zwei Vergleichsstichproben zeigen. Detaillierte Analysen innerhalb der Fußballgruppe zeigten Unterschiede in Abhängigkeit von Alter, Geschlecht und Expertise. Neben dem wissenschaftlichen Erkenntnisgewinn sind die vorliegenden Ergebnisse in der Praxis vor allem für Scouting- und Coachinginterventionen von großem Interesse. Durch sie werden individualisierte Empfehlungen der Persönlichkeitsentwicklung ermöglicht und Fußballspielende in ihrer Potentialentfaltung unterstützt. Zukünftige Forschung sollte diese

Ergebnisse in anderen kulturellen Kontexten replizieren und praxisorientierte Interventionsstrategien entwickeln. Das beschriebene Dissertationsprojekt leistet somit einen bedeutenden Beitrag zum besseren Verständnis der Rolle von Persönlichkeitsdiagnostik und Persönlichkeitsmerkmalen im leistungssportlichen Fußball.

English Abstract

The assessment of psychological characteristics in sport is still underrepresented compared to physiological diagnostics. This applies in particular to the diagnosis of personality traits. Personality traits are considered to be relatively stable characteristics of a person over time and interact with sporting activity in a variety of ways. From a practical perspective, suitable diagnostic tools and the training interventions derived from them could contribute to improved talent identification and serve as the basis for targeted coaching measures. From a scientific perspective, the assessment of personality traits contributes to a better understanding of the influence of personality traits on sporting performance and vice versa.

Compared to other areas of society and sports, football places particular demands on personality. Competitive football in particular is at the center of public interest, and the number of active football players in Germany is high compared to other sports. However, the degree of professionalization varies greatly between teams of different genders, expertise levels and age groups. Although football occupies such an exposed position, the insufficient number of studies on the personality traits of football players highlights the need for more in-depth scientific discourse. This applies in particular to the identification of setting-specific diagnostic instruments with corresponding scientific quality. In addition, research into the personality of football players requires not only the analysis of traditional influencing factors such as gender, age, playing position and expertise, but also an in-depth examination of other potential influencing factors. In particular, the associations between cognitive abilities and the personality structure of football players could contribute to a more comprehensive understanding of behavior in a sporting context. In order to close this research gap, a broad-based dissertation project was initiated to record the personality traits of football players, with a particular focus on the high-level context of football.

In an initial study (Spielmann et al., 2022), the personality traits of 378 football players were examined using the established NEO-FFI diagnostic instrument. In contexts outside of

sport, the instrument is considered a suitable means of recording the five-factor model of personality. The aim was to investigate the suitability of the questionnaire in terms of internal consistency and factor structure in football. A sub-sample of 86 people provided findings on test-retest reliability over a period of six weeks. The results were comparable with studies outside of sport but showed gender-specific differences with regard to internal consistency and test-retest reliability. The NEO-FFI therefore proved to be suitable for use in football, although weaknesses in the factor structure must be taken into account.

In a second study (Spielmann et al., 2023), the instrument tested in the first study was used to investigate specific questions. Football players from a Bundesliga club (n = 138) were examined to provide insights into the correlations between personality traits and executive functions. The interaction between the two constructs is regarded in research as an explanatory approach for the organization and management of behavior and decision-making processes. The aim of this study was to better understand the relationship between the constructs within a sample of football players. Linear regression models were used to investigate relationships between personality and executive functions such as working memory, inhibition and cognitive flexibility, as well as the influence of expertise and gender. The results showed inconsistent relationships between personality traits and executive functions in male and female football players. Overall, up to 23% of the variance in executive functions could be explained by personality traits as well as age group and team affiliation. This indicates that executive functions and personality traits of football players are related, but that other unobserved variables play an explanatory role in the overall picture.

It is not only the examination of the interplay between personality and other psycho-cognitive influencing factors in football that appears to be scientifically relevant. A third study (Spielmann et al., 2024) focused on the question of whether there is a position-specific ‘football personality’. The personality traits of 132 goalkeepers of different expertise levels and age groups were examined. The study was the first to analyze personality traits in football

goalkeepers. The exploratory nature of this study aimed to analyze personality differences in different groups of goalkeepers. The overarching finding was that adolescent goalkeepers had significantly lower agreeableness scores than adult professional goalkeepers. In addition, goalkeepers were significantly less agreeable and neurotic than female goalkeepers. Further analyses revealed differences in agreeableness and conscientiousness across different expertise levels and between genders. These results are a first step towards a better understanding of the personality traits of goalkeepers as well as gender- and expertise-specific differences and can provide important impulses for coaching and scouting.

In a fourth study (Spielmann et al., under review), the personality traits of 2,085 male and female participants were examined. The objective was to analyze personality differences between groups within a large sample. The total sample was divided into three groups: football players, students, and inactive individuals. The analyses revealed that football players scored significantly lower on neuroticism and higher on openness, conscientiousness, and extraversion compared to both control groups. Within the football player group (n = 1,500), there was a decrease in neuroticism and an increase in conscientiousness with rising levels of expertise. Adult football players also exhibited higher agreeableness than younger players. In terms of gender, female football players scored higher on neuroticism and agreeableness compared to their male counterparts. These results provide novel insights into personality differences among football players, depending on expertise, age, and gender in a large sample.

In conclusion, the assessment of personality traits in high-level football appears valuable from both a scientific and practical perspective. The research project demonstrated that the NEO-FFI is a reliable tool for assessing personality traits in football, showing results similar to those found in studies conducted outside of sports in terms of factor structure and test-retest reliability. Additionally, the findings showed that personality traits do not provide sufficient insight into the development of executive functions among football players. The analysis of goalkeeper personality traits revealed no clear patterns of specific personality characteristics,

indicating that an individualized approach is necessary, taking into account factors such as age, gender, and expertise. The analysis of a large sample of football players revealed distinct differences in four out of five personality traits compared to two control samples. Detailed analyses within the football group showed differences depending on age, gender, and expertise. Beyond scientific insights, the results have significant practical implications for scouting and coaching interventions, as they enable individualized recommendations for personality development and help support players in realizing their full potential. Future research should aim to replicate these findings in different cultural contexts and develop application-oriented intervention strategies. This dissertation project thus makes a significant contribution to the understanding of the role of personality diagnostics and traits in high-level football.

Table of Contents

List of Symbols and Standard Abbreviations

A	Agreeableness
AD	Anno Domini
ANOVA	Analysis of Variance
BC	Before Christ
BSC	Berliner Sport-Club
Bundesliga	Germany's first football division
C	Conscientiousness
CI	Confidence Interval
DFB	German Football Association
DSGVO	Datenschutz-Grundverordnung
DT	Determination Test
E	Extraversion
EF	Executive Function
FB	Football Player
FFM	Five Factor Model
GK	Goalkeeper
Hz	Hertz
ICC	Intraclass Correlation Coefficient
INHIB	Response Inhibition Test
LL	Lower Limit
M	Mean
MANOVA	Multivariate Analysis of Variance
ME	Main Effect
ms	Milliseconds
n	Number of Participants
N	Neuroticism
N-Back	N-Back Nonverbal Test
NEO-FFI	NEO-Five Factor Inventory
NEO-PI	NEO-Personality Inventory

NEO-PI-R	NEO-Personality Inventory-Revised
O	Openness
p	Significance *p* - Value
PCA	Principal Component Analysis
Pro	Professional
SD	Standard Deviation
sec	Seconds
Std. Error	Standard Error
SQRT	Square Root Transformation
TSG	Turn- und Sportgemeinschaft
U	Under
UEFA	Union of European Football Associations
UL	Upper Limit
VFL	Verein für Leibesübungen
VTS	Vienna Test System
WHO	World Health Organization
Women's EURO	European Women's Championship
y	Years
ZDF	Zweites Deutsches Fernsehen
#	Number
%	Percentage
~	Approximately

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1 General Introduction

> "Before the season or after the preparation, I always take notes on how I assess the individual players, specifically on what can trigger them. There are different factors: Some are motivated by performance, some by power, and some are very relationship oriented. I try to make notes on a piece of paper about how I evaluate each player, and then we conduct psychological tests to confirm or refute my assessment […]. If you have a hunch or an idea of what triggers the player, what excites them, how to get them on your side, how to get them to perform at their best, then the psychological tests we conduct can help with that."
>
> Julian Nagelsmann, current head coach of Germany's National Football Team, discusses his use of personality assessments during his time at TSG 1899 Hoffenheim.
>
> Das aktuelle Sportstudio - ZDF 15.04.2017

Every day, we encounter both familiar and new people. In fractions of a second, guided by our past experiences, we try to assess how to interact with them, both verbally and nonverbally, and what kind of character we are dealing with. By choosing appropriate communication strategies, we can either engage with the person or deliberately create distance. Just as in everyday interactions, the ability to accurately assess and understand others is also of immense importance in sports. This is especially true in team sports like football, where group members depend on understanding one another and developing suitable communication strategies, with each personality finding its place within the team (Eccles & Tenenbaum, 2004). Beyond this team of athletes, there are several other individuals in a performance-oriented setting who play various roles, such as head coaches, assistant coaches, medical doctors, video analysts, physiotherapists, and sports psychologists, to name just a few (Arnold et al., 2019). During a season, there are moments characterized by significant changes in the team. This is particularly relevant during the pre-season preparation phases in summer and winter. Still, at any point during a season, fluctuations can occur. Individuals may be absent for extended periods due to injuries (Aus der Fünten et al., 2023; Obërtinca et al., 2024), or new members

may join (Campa, 2022; Poli et al., 2018). Given the high frequency of competitions, it is crucial that team members quickly learn to assess each other. Naturally, this does not always proceed as smoothly as intended: one might misjudge a character or personality, miscommunicate, or fail to connect. In such cases, it can be helpful to use supportive methods that aid in better understanding a person's personality. This can occur, for instance, in interactions with a third party, by discussing and asking questions like, "How do you see person X?" While similar opinions may emerge, the outcome can also differ significantly. An additional, more objective approach to understanding and dealing with people can involve tools that specifically assess a person's personality characteristics. As derived from the quote by Julian Nagelsmann (2017), the aim of this approach is not to discover a different truth, but rather to verify one's own assessment or to gain an additional perspective through objective data. World class coaches like Nagelsmann use this insight for individualized communication, tailored coaching, and as a key component of their coaching philosophy. The goal of this individualized communication strategy is to enhance attention and content retention through personality-appropriate conversation methods.

Such personality-appropriate communication methods are only meaningful if one can assume the existence of stable personality differences that can ideally be measured validly. The discipline of *Differential Psychology* deals with precisely these kinds of questions, which have been specifically investigated in the context of football in this dissertation. Differential Psychology explores whether different individuals or groups vary in specific personality traits (Revelle et al., 2011). In this context, one of the primary questions of this dissertation is whether (high-level) football players generally differ from the general population. Within the population of football players, further questions arise regarding differences in personality traits with respect to expertise, age, and gender. Identifying potential differences could contribute to the development of more comprehensive requirement profiles, particularly concerning the psychological aspects of football. Clusters of certain personality traits may provide insights into

selection and deselection mechanisms within the football system and offer valuable guidance for practical intervention strategies, especially in higher level settings. A closer look at the current state of research reveals an incomplete picture, making it challenging to answer the aforementioned questions. Therefore, the underlying work aims to address questions from differential psychology concerning personality traits in football and to discuss possible implications for practice.

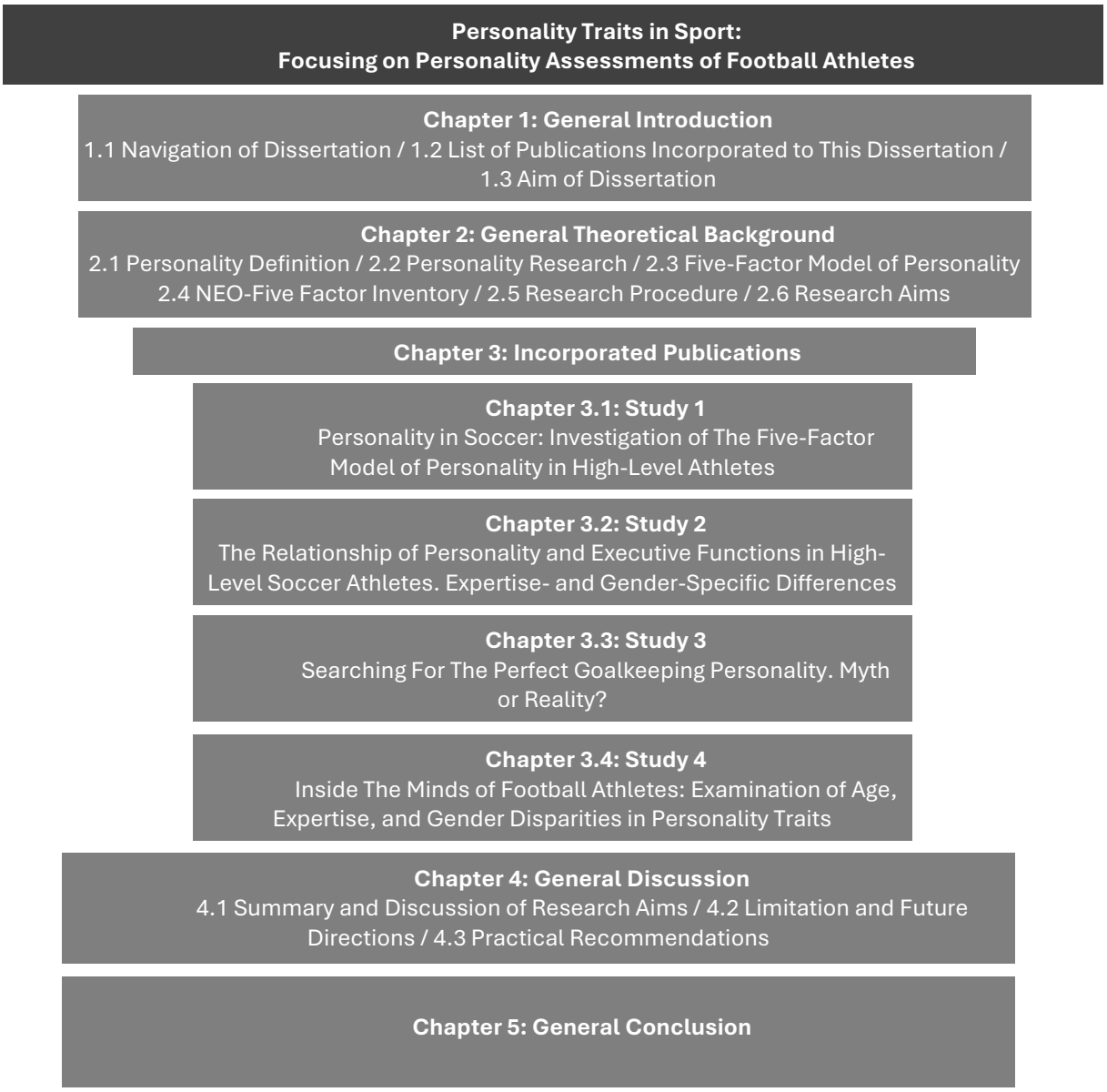
1.1 Navigation of Dissertation

The dissertation titled " Exploring Personality Traits in Sport: An Analysis of Football Athletes Through Personality Assessments" is structured into several key sections, each contributing to the overall understanding of the research topic (Figure 1). It begins by outlining the primary objectives of the dissertation, offering a comprehensive overview of the chosen focus within the broader context of personality traits in sports. This is followed by a detailed presentation of the studies that form the core of the cumulative dissertation, with each study appropriately cited and referenced.

In detail, the dissertation provides a bilingual summary of the dissertation at the beginning, presented as both a German and English abstract. This is followed by a preface (Chapter 1), which includes a list of the incorporated original studies and outlines the general aim of the dissertation. Chapter 2 provides the theoretical background, offering a foundation for the topic of personality by tracing relevant historical developments and discussing key theories. It also introduces the diagnostic tools employed in the dissertation, justifying their use based on theoretical considerations. The objectives of the individual research projects, along with the overall methodology, are also outlined.

Figure 1

Structure of Dissertation



Chapter 3 includes the four studies conducted for the dissertation, which have been published in international peer-reviewed journals (Studies 1 - 3) or are currently under review (Study 4). These papers address the previously derived research objectives in the form of original research.

Chapter 4 presents an in-depth discussion of the findings from the author's four core studies, situating the results within the broader context of existing research. This section also addresses the methodological limitations encountered, explores the practical implications of the

findings, and provides recommendations for future research. In the concluding Chapter 5, the author reflects on the overall outcomes of the research project and presents final conclusions.

Chapter 6 serves as an appendix, providing supplementary materials, including the demographic questionnaire used in the studies (Appendix A). It concludes with the author's curriculum vitae (Appendix B) and a list of publications (Appendix C). This structured approach ensures a coherent and thorough exploration of the intersection between personality traits and sports, with a particular emphasis on high-level football.

1.2 List of Publications Incorporated to This Dissertation

The list below comprises published studies and those currently under review, all of which are incorporated into this dissertation. These studies were part of the cumulative dissertation process, in accordance with the recommendations of the Faculty of Humanities and Social Sciences at Saarland University between 2022 and 2024. They are presented in detail in the following chapters. The studies are listed in ascending order of publication date, starting with the earliest one. All studies were written in English and submitted to international peer-reviewed journals. Studies 1, 2, and 3 have already been published, while study 4 is under review. All studies are empirical examinations in the field of sports psychology with Jan Spielmann as the lead author.

Study 1

Spielmann, J., Beavan, A., & Mayer, J. (2022). Personality in soccer: investigation of the five-factor model of personality in high-level athletes. *Frontiers in Sports and Active Living, 4*, 896934. https://doi.org/10.3389/fspor.2022.896934.

Study 2

Spielmann, J., Beavan, A., & Mayer, J. (2023). The relationship of personality and executive functions in high-level soccer athletes: expertise-and gender-specific differences. *Frontiers in Sports and Active Living, 5*, 1130759. https://doi.org/10.3389/fspor.2023.1130759.

Study 3

Spielmann, J., Otte, F. W., Schumacher, T., Mayer, J., & Klatt, S. (2024). Searching for the perfect goalkeeping personality. Myth or reality? *Frontiers in Psychology, 15*, 1418004. https://doi.org/10.3389/fpsyg.2024.1418004.

Study 4

Spielmann, J., Altmann, S., Steindorf, L., Herr, C. & Mayer, J. Inside the Minds of Football Athletes: Examination of Age, Expertise, and Gender Disparities in Personality Traits. Manuscript submitted for publication in *European Journal of Personality.*

1.3 Aim of Dissertation

The objective of this dissertation is to deliver an in-depth and scholarly review of research on personality and the assessment of personality traits within the context of sports, with a particular focus on the discipline of football. By providing a structured and critical overview of existing literature, this dissertation aims to trace the development and current trends in personality research as it pertains to athletic performance, particularly in high-performance environments such as professional football. The primary focus is on addressing the following aims:

I) The identification and evaluation of an instrument for assessing personality in high-level football.

II) The examination of associations between personality traits and executive functions in high-level football.

III) The analysis of personality differences based on expertise, age, and gender among football goalkeepers.

IV) The analysis of personality differences between football players and comparison samples, with a particular focus on personality differences in a larger sample of football players, considering expertise, age, and gender in football.

After outlining the current state of research in this field in Chapter 2, four original empirical studies are presented (Chapter 3), each offering distinct insights into the assessment of personality traits among football athletes. These studies are carefully contextualized within the broader discourse of sports psychology, highlighting their relevance to both theory and practice. The analysis primarily centres on the examination of personality in high-level sports settings, with a specific emphasis on the unique psychological and performance-related challenges encountered in high-level football. The findings of the presented studies are critically evaluated considering existing literature. The dissertation also identifies methodological limitations, gaps in the research, and areas for further investigation.

In addition, the dissertation offers a detailed discussion of the practical implications of the research for stakeholders in the professional football environment, including coaches, sports psychologists, and talent developers. Practical recommendations are provided to enhance the application of personality assessments in optimizing player development. Ultimately, the aim is to contribute valuable insights that advance both the theoretical understanding of personality traits in sports and their practical utility within high-level football settings.

2 General Theoretical Background

2.1 Personality Definition

Personality has its origin in the Latin word *persona*, which refers to masks used by actors, for example in ancient Rome. It is easy to see the connection between a mask worn by a person and the characteristics this mask conveys to the resulting appearance. Actors used these masks to make their role more visible and understandable in a certain play. The audience observed these masks, and it helped them to describe the actors' facets and characteristics from the beginning. In other words, by observing visible characteristics, we try to infer a person's personality. However, personality is much more than the external appearance we present to others. Sometimes, personality is more hidden and not as obvious as well-designed masks used in role-playing. Especially when we have only known someone for a short time, they may attempt to conceal certain aspects of their personality or present traits that are not typically part of their true character. Additionally, people can be perceived differently in different settings or situations. While a person may be recognized as loud and extraverted in their private life, they may present a completely opposite demeanor in a professional environment. The underlying personality of an individual may, therefore, be "hidden" or obscured by situational influences. These external factors can mask core characteristics, making it challenging to accurately assess an individual's true personality (Funder, 2006).

Science provides methods to address this issue by employing appropriately designed approaches. It aims to uncover the "true" personality of individuals, seeking to identify it as objectively as possible, independent of situational influences. Through the use of robust, evidence-based methods, researchers aim to achieve a precise and unbiased understanding of an individual's personality. In scientific literature, personality is defined as a relatively stable and unique configuration of traits. Traits can manifest as predispositions to certain thoughts, emotions, and behaviors across different contexts. The expression of each trait leads to individual differences, contributing to the unique characteristics that make every human being

distinct (Hagemann et al., 2022; Wilson & Dishman, 2015). In the context of defining an individual's personality characteristics, a key distinction - often conflated in everyday language - exists between the terms "state" and "trait." Traits refer to enduring and stable personality constructs, whereas states are temporary and situation-dependent, manifesting as feelings, behaviors, and thoughts in response to specific circumstances (Roberts et al., 2017). Throughout this dissertation, references to personality primarily pertain to traits rather than behaviors tied to particular moments. In this context, a trait like conscientiousness indicates that an individual consistently exhibits a certain level of this characteristic across various settings, such as in a football club, in professional contexts, and in family environments. This behavior is maintained over an extended period of time. Nevertheless, the interaction between states and traits should be acknowledged, even though this work does not explicitly aim to elaborate on their differentiation (Geiser et al., 2017).

2.2 Personality Research

Historically, research on personality is one of the oldest branches of science. Approaches can be traced back to ancient philosophers like Hippocrates (c. 460 – c. 370 BC) and his *Four Temperament Theory*, which has its origin in earlier Greek philosophy (Stelmack & Stalikas, 1991). He described certain characteristics of a person as a result of excess or lack of body fluids. The fluids named *blood*, *phlegm*, *yellow*, and *black bile* were supposed to be responsible for different personality types and therefore influential aspects of a person's behaviours (Merenda, 1987). According to the *Theory of Humorism*, he connected the body humor blood to the person's characteristics of being sanguine (optimistic, hopeful), phlegm to phlegmatic (apathetic), yellow bile to choleric (irascible) and black bile to melancholic (sad, depressed). Later on, and in this tradition, Aristotle (384 – 322 BC) developed his *Four Temperaments Theory*, which is taken up by Galen (130 – 210 AD) and many other scholars. In the more modern age between the 17th and 19th century Nicholas Culpeper (1652), Immanuel

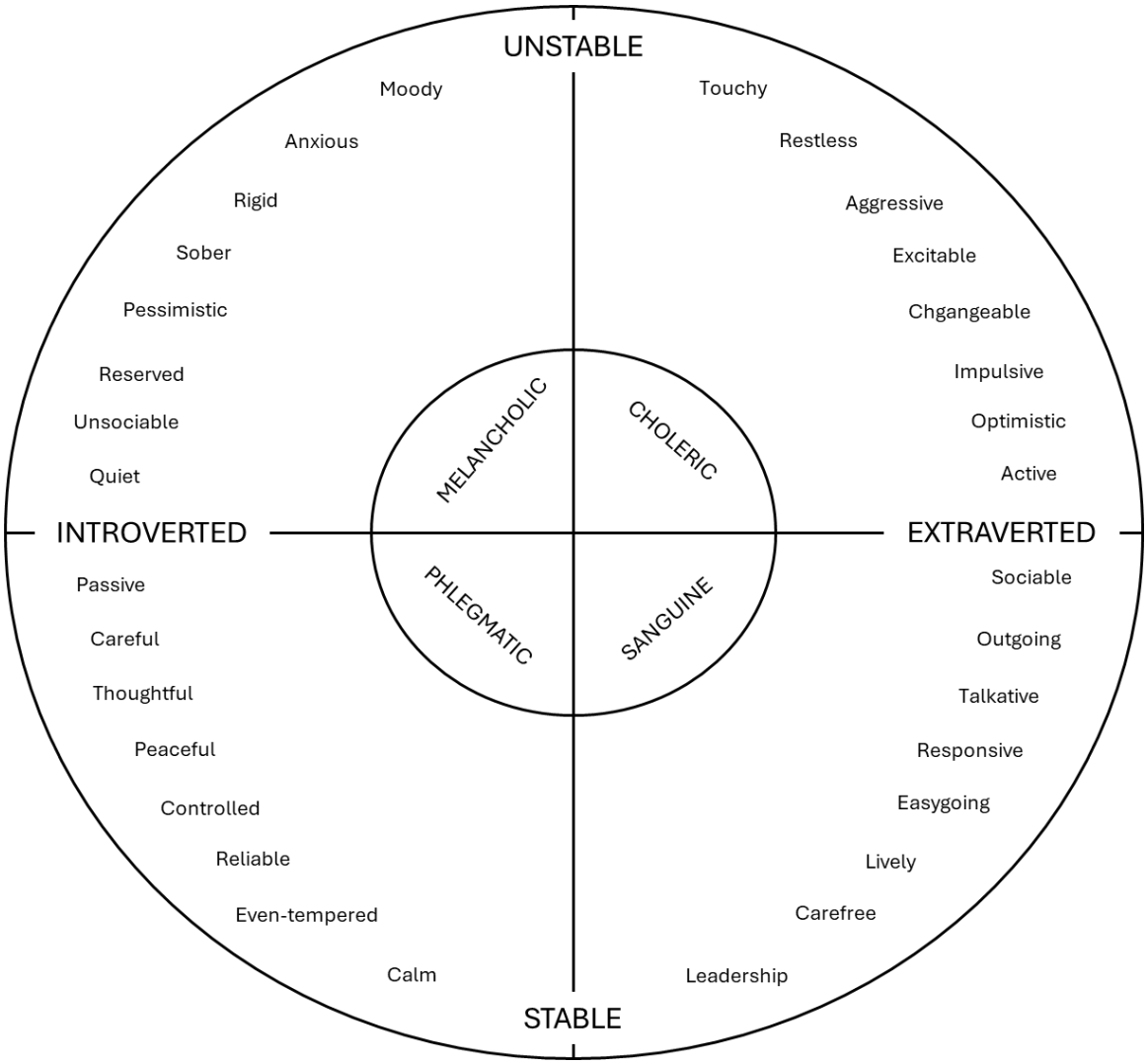
Kant (2006) and Wilhelm Wundt (1874) modified the ancient theories for their own models (see Winter and Barenbaum (1999) for a more detailed historical overview of the personality theory development). In the last century, Allport (1927) presented his *Idiographic Theory of Personality.* In his work, he adopted the approach of personality dimensions, which represented an influential part of most of the modern personality theories (Allen et al., 2013). He displays the hierarchy of "traits", which are seen as an individual combination of components in every human being (Allport, 1937).

In the second half of the 20th century, Hans Eysenck's *Psychobiological Theory of Personality* postulated the existence of two traits referred to as *Extraversion (E)* and N*euroticism (N)* (Eysenck & Bell, 1951). These two traits can be viewed as a continuation of the tradition of the historically applied temperaments (Figure 2). They were defined as normally distributed variables, with each individual displaying a specific range along a continuum (Eysenck, 1946). The continuum of N ranges from extremely unstable, poorly integrated, and neurotic (high) to extremely stable and well-integrated (low; Eysenck and Bell, 1951). E describes the continuum of the extremes extraverted (high) and introverted (low), which is why the scale is also often referred to as "extraversion-introversion" (Eysenck, 1956). In the 1970s, Eysenck introduced a third dimension, *Psychoticism*, which was orthogonal to the other two dimensions (Eysenck & Eysenck, 1976). Psychoticism ranged from realistic and adapted (low) to psychotic and antisocial (high). Compared to the first two traits, Psychoticism has never been widely accepted by the broader scientific community (for a detailed overview, see Heath and Martin, 1990).

Nevertheless, Eysenck's first two personality traits, neuroticism and extraversion were later adapted by several other researchers and got incorporated into various questionnaires. The most significant transition was the influential role in another theory of personality, the *Five-Factor Model* (*FFM*) or *Big Five*.

Figure 2

Diagrammatic Representation of Two Major Axes of Personality: Extraversion Versus Introversion, and Emotional Instability Versus Stability (Neuroticism; adapted from Eysenck, 1983, p. 14)



2.3 Five-Factor Model of Personality

In line with the tradition of normally distributed personality traits, the FFM (McCrae & Costa, 1987) adds the traits *Openness* (*O*; tendency to seek out new experiences), *Conscientiousness* (*C*; organization and goal-directed behavior) and *Agreeableness* (*A*; concern for cooperation and interpersonal harmony) to neuroticism and extraversion. These are viewed as higher-order traits, which subsume several more detailed and lower-order facets of an individual's personality characteristics (Table 1).

Table 1

Factors, Definers and Subfactors of the Five-Factor Model Traits

Trait	Adjective definers	Facets
Neuroticism	Calm - Worrying	Anxiety
	Even-tempered - Temperamental	Angry hostility
	Self-satisfied - Self-pitying	Depression
	Comfortable - Self-conscious	Self-consciousness
	Unemotional - Emotional	Impulsivity
	Hardy - Vulnerable	Vulnerability
Extraversion	Reserved - Affectionate	Warmth
	Loner - Joiner	Gregariousness
	Quiet - Talkative	Assertiveness
	Passive - Active	Activity
	Sober - Fun-loving	Excitement-seeking
	Unfeeling - Passionate	Positive emotions
Openness	Down-to-earth - Imaginative	Fantasy
	Uncreative - Creative	Aesthetics
	Conventional - Original	Feelings
	Prefer routine - Prefer variety	Actions
	Uncurious - Curious	Ideas
	Conservative - Liberal	Values
Agreeableness	Ruthless - Soft-hearted	Trust
	Suspicious - Trusting	Straightforwardness
	Stingy - Generous	Altruism
	Antagonistic - Acquiescent	Compliance
	Critical - Lenient	Modesty
	Irritable - Good-natured	Tender-mindedness
Conscientiousness	Negligent - Conscientious	Competence
	Lazy - Hardworking	Order
	Disorganized - Well-organized	Dutifulness
	Late - Punctual	Achieving striving
	Aimless - Ambitious	Self-discipline
	Quitting - Persevering	Deliberation

Note. Adapted from Costa and McCrae (1986), and Costa and McCrae (1992a).

The five factors were identified and named using two approaches: the lexical tradition and the questionnaire tradition. In brief, the lexical hypothesis (Ashton & Lee, 2005) is often used as a first step of researching dimensions of a specific and new construct, in this case personality. It emphasizes that all important differences between people will have been noted by speakers throughout the centuries. This process leads to the identification of trait terms. By

analysing these terms, the core dimensions of personality can be revealed, resulting in a clear classification of personality traits. In simple terms, researchers look for words used in everyday language to describe personality. This is also crucial for measuring these traits with self-report tools: the terms used must align with everyday language (McCrae & John, 1992).

The second approach uses questionnaires to identify specific aspects of personality theory. Eysenck (1983), for example, created instruments to assess the *Big-Two* (Wiggins, 1968) neuroticism and extraversion, and developed the trait psychoticism using this approach (Eysenck et al., 1976), when he administered his instruments to a sample consisting of different groups (normal, criminal, schizophrenic, endogenous depressive, personality disorder, anxiety state, and reactive depression). By measuring the range, in this case between "healthy" and "psychotic", researchers could proceed to a systematic mapping of the trait. By repeatedly applying established trait assessments and refining the explanations through approximation, researchers can identify previously unexplained commonalities, thereby advancing the underlying concept (McCrae & John, 1992).

The FFM of Costa and McCrae (2000) is a result of a combination of both approaches (Digman, 1979): Studies of natural language trait terms and questionnaire development (for a comprehensive overview of the process, see Costa and McCrae, 1992b). One of the main reasons why the model emerged under the influence of both approaches was their respective strengths and weaknesses. The lexical approach delivers a comprehensive analysis of language terms but is limited because of its origin in ordinary language. Experts such as personality researchers are much more interested in specific theoretical assumptions and emphasize particular fields rather than using all-encompassing language styles. To leverage the benefits of both approaches, it is important to compare instruments specifically designed for personality research with those used to measure the five traits identified through the lexical approach (McCrae & John, 1992).

2.3.1 Five-Factor Model of Personality - Research

In the late 20th century and early 2000s, the FFM of personality traits, as developed and refined by McCrae and Costa (2008), increasingly gained prominence in psychological research. Despite critical perspectives (Block, 2010; Paunonen & Jackson, 2000; Zuckermann, 2005), the FFM remains widely regarded as the gold standard in personality diagnostics (Allen et al., 2013; de Moor et al., 2012; Digman, 1989; Goldberg, 1993; O´Connor, 2002). Its traits have become foundational in understanding various individual behaviours across diverse contexts.

Current research on the FFM traits and their relationship to individual behaviours is supported by an growing body of literature, covering a wide array of domains. For instance, studies have linked specific expressions of the FFM traits to entrepreneurship (Brandstätter, 2011; Leutner et al., 2014), indigenous societies (Gurven et al., 2013), job performance (Judge et al., 2013; Judge & Zapata, 2015), well-being (Joshanloo, 2017; Soto, 2015), gender differences (Karwowski et al., 2013; Soto et al., 2011), academic performance (Giluk & Postlethwaite, 2015; Vedel, 2014), sexuality and sexual health (Allen et al., 2018), as well as mental health outcomes like depression and anxiety disorders (Hakulinen et al., 2015; Karsten et al., 2012).

However, as highlighted in reviews by Allen et al. (2013) and Wilson and Dishman (2015), the generalizability of FFM research findings to the context of sports and physical activity remains somewhat limited (Höner et al., 2023). While there are some parallels regarding a possible close relationship between personality traits and behaviours in both sports and other domains, direct applications are not always straightforward due to the distinct demands and contexts of sports compared to other domains. For example, in both work and sports contexts, performance is influenced by individual capacity, willingness to engage, sustained motivation, and the ability to navigate stressful situations (Allen et al., 2013). Yet,

certain nuances in sports settings - such as the unique demands on the discipline and the specific psychological pressures of competition - require further exploration.

Additionally, evidence concerning group dynamics, as evident in sports teams, suggests that variation in certain personality traits (e.g., Extraversion) and similarity in others (e.g., agreeableness) are linked to improved group performance (Kramer et al., 2014). This parallels findings from organizational psychology, where team performance often benefits from a strategic balance of diverse and complementary personality traits. Furthermore, sport psychological approaches, such as personality diagnostics and coaching, have been successfully applied in business settings to enhance consulting and training outcomes (Burnes & O'Donnell, 2011; Fletcher, 2011; Hermann & Mayer, 2014), underscoring the broader applicability of psychological insights across domains.

In the specific area of personality research within football, the evidence base remains underdeveloped. Previous studies that have researched personality traits of football players primarily investigated the relationships between personality traits and performance (Mirzaei et al., 2013; Piedmont et al., 1999), leadership (Rylander et al., 2014), and risky behavior (Levitch et al., 2018). Additionally, these studies examined differences in expertise among football players (Trninić et al., 2016) or compared football players to athletes from other sports (Geron et al., 1986). A key concern in relation to the present research interest is that previous studies investigating the relationship between personality traits and performance often included mixed-sport samples beyond football (Rylander et al., 2014; Trninić et al., 2016), focused solely on one gender or collegiate-level athletes (Piedmont et al., 1999), and did not account for high-level football players (Mirzaei et al., 2013). Moreover, these studies lack insights from the German-speaking region, limiting their relevance to this specific cultural and sporting context. In summary, research in this field is relatively sparse, and there is a considerable gap in up-to-date evidence-based findings. Consequently, the current research seeks to address this lack by contributing valuable insights for both scientific understanding and practical application in the

domain of high-level football. By expanding the knowledge base, this research aims to contribute to both theoretical advancements and practical interventions related to personality assessments in football settings.

2.4 NEO-Five Factor Inventory

When selecting diagnostic survey instruments in sports, several preliminary considerations should be made compared to other settings. Sports, and particularly high-level football, operate under unique rules and mechanisms. As athletes become more professional, factors such as time efficiency, social desirability, motivation, and skepticism towards data collection can become increasingly important (Beavan et al., 2020; Stiroh, 2007).

Specifically, the aim is to keep the duration of the survey within a setting-appropriate time frame. For instance, even in the majority of professional clubs within the top tiers of German football leagues, there is no standardized sports-psychological diagnostic process that would provide an appropriate time frame for surveys. As a result, a diagnostic framework must first be established, or individual athletes must be scheduled to participate in surveys outside of training sessions. Therefore, care should be taken to ensure that voluntary participation is not hindered by lengthy procedures.

Social desirability is also an important factor to consider. Besides psycho-cognitive measures, athletes are accustomed to being confronted with various diagnostic tools. Experience shows that the data collected is not only used as a basis for development processes, such as tailored training and coaching interventions, but can also serve as a selection or deselection criterion (Höner et al., 2023). When employing diagnostic instruments and collecting contextual variables, it is crucial to protect the individual's privacy in accordance with relevant data protection regulations (Rodriguez et al., 2003), such as the DSGVO. To obtain truthful responses, it is essential to prevent potential negative consequences, which requires tailored communication and instructions during data collection. Special consideration

is required when recruiting participants from high-profile groups, such as those in top leagues or national teams, as they represent a particularly vulnerable population. In the context of football, it is crucial to avoid labeling individuals with certain personality traits that could lead to negative consequences, such as diminished market value or unfavorable public perception.

These aspects may vary in importance depending on the setting. Some clubs or associations reject sports psychological diagnostic instruments due to a lack of acceptance, expertise, or staffing constraints. Others may not be able to provide an appropriate time frame or may attempt to use the findings to “identify the black sheep”. On an individual level, it is important to prevent misunderstandings during the survey process and to provide appropriate personnel for support during diagnostics and when communicating results. When recruiting suitable participants, these challenges must be addressed, and scientifically sound solutions should be identified. Therefore, special attention was paid to selecting an appropriate test instrument, taking into account the points mentioned above.

The FFM of personality is considered state-of-the-art in personality research. Various instruments assess these five factors in different ways. Due to its relative brevity and established nature, the German version of the NEO-Five Factor Inventory (NEO-FFI; Borkenau & Ostendorf, 2008) was ultimately chosen in the current work. The abbreviation "NEO" is recognized as an acronym for the traits neuroticism, extraversion, and openness, which are part of the Five-Factor Model (FFM). This instrument can be considered a short form of the much longer NEO Personality Inventory Revised (NEO-PI-R), which comprises 240 items (Costa & McCrae, 2008). Compared to the original version, the NEO-FFI provides a more time-efficient assessment of the FFM by utilizing only 60 items. With a completion time of about 10 to 15 minutes, the NEO-FFI captures approximately 75% to 85% of the variance explained by the NEO-PI-R. Considerations for using shorter methods (for an overview, see Hagemann et al., 2022) were dismissed due to insufficient scientific validation, a lack of research, or too little

variance explanation due to their screening character. The lack of translations into German (or English) for other instruments further limited the choice in favor of the NEO-FFI.

2.5 Research Procedure

In each of the four studies, a similar cross-sectional approach was employed: Prior to the initiation of the study, all participants gave their informed consent, and ethical approval was granted by the Institutional Ethics Committee. Participants were asked to complete the NEO-FFI questionnaire as well as a set of demographic questions (e.g., age, training frequency, playing position) via an online survey. The instrument used to collect demographic information is provided in Appendix A. Participants were able to consult a sports psychologist at any time during the diagnostic process. They were also informed that they could withdraw from the survey at any point, without facing any negative consequences. No compensation was offered for participation. The surveys were administered either as part of standardized diagnostic sessions organized by the respective football clubs or through direct personal contact. The diagnostic process took approximately 15 minutes. Only native German-speaking participants were included in the analyses to avoid misunderstandings in instructions or responses. The sampling strategy was opportunistic, aiming to maximize the sample size while adhering to the specified participant criteria.

2.6 Research Aims

Following the selection of the NEO-FFI as the diagnostic instrument for assessing the FFM of personality, it was decided to initially test it on a sample of football players to ensure the research project's success by confirming the quality and suitability of the test (Study 1). This step was considered necessary because insights into psychometrics, such as reliability and factor structure, were not yet available for the football context with its specific characteristics. Additionally, this approach was deemed sensible, as own pilot studies with the NEO-FFI and comparison instruments revealed comprehension problems among football athletes. For

example, participants often asked for clarification on specific terms, and inversely worded questions caused confusion. A further aim was to verify the handbook's (Borkenau & Ostendorf, 2008) suggested completion time to establish a reliable time frame for larger-scale studies.

After a successful examination of the applicability of the NEO-FFI in the football context, the subsequent aim was to investigate whether personality is related to other constructs, which might be more commonly assessed in (sport)psychological diagnostics. Although still underrepresented compared to physiological diagnostics, there are football clubs and associations, such as TSG Hoffenheim, VFL Wolfsburg, Hertha BSC Berlin, and the German Football Association (DFB), that use cognitive testing methods. Over the past ten years, the assessment of Executive Functions (EF), such as Cognitive Flexibility, Working Memory, and Inhibition, has become increasingly widespread. The interaction between EFs and personality traits is often seen as a potential explanation for the organization and regulation of behavior (Nikolašević et al., 2022) and is more strongly linked from a neuroscientific perspective (DeYoung, 2013; Forbes et al., 2014) than in traditional sports psychology research. This approach offers valuable insights into the cognitive and psychological mechanisms that govern how individuals manage and adapt their actions in everyday life. As a result, Study 2 examined the relationship between EFs and personality traits in a sample of high-level football players. If a strong significant correlation were identified, it could potentially allow for inferences between the two constructs, reducing the need for expanding sports psychological diagnostics in professional clubs and associations, or leading to time savings in the diagnostic process.

In personality research, examining specific subgroups in more depth is a common practice, enabling a detailed analysis of unique characteristics and variations within these groups (Berkowitz & Perkins, 1988; Eley et al., 2012; Malhotra et al., 2018). This approach helps to uncover patterns and relationships that may not be apparent when studying broader populations, providing deeper insights into how personality traits manifest and interact in different contexts. In Study 3, personality was further examined concerning a specific position

in football. The goalkeeper position was selected for this study due to its critical role in professional football, particularly regarding the "support ratio" concerning coaching staff, and the notable lack of research dedicated to this position. The focus was on a detailed analysis of personality differences in regard to gender, age, and level of expertise. Insights into the personality traits of football goalkeepers can refine profile requirements for this group, provide valuable scouting information, and guide coaching strategies. Additionally, this study served as a basis for the final Study 4, as the approach for a more detailed examination of personality traits across different groups of football players was to be investigated on a larger, cross-positional sample.

Finally, Study 4 investigated hypotheses in a large sample of football players, considering differences in gender, age, and levels of expertise. Additionally, the study aimed to examine how this sample differs from two comparison groups – students and inactive individuals. To the author's knowledge, this study represents the first large-scale investigation of personality traits in football players of different genders, ages, and levels of expertise. Thus, it could provide a significant contribution to understanding (de)selection processes, refining profile requirements, and developing sports psychological coaching strategies in football, particularly in the realm of professional sports. In conclusion, the goal of the present dissertation is to take a first targeted step towards establishing the assessment of personality traits in (high-level) football.

3 Incorporated Publications

3.1 Study 1: Personality in Soccer: Investigation of The Five-Factor Model of Personality in High-Level Athletes.

The content of Study 1 has been reformatted for the purpose of the dissertation. The full reference of the published manuscript is:

Spielmann, J., Beavan, A., & Mayer, J. (2022). Personality in soccer: investigation of the five-factor model of personality in high-level athletes. *Frontiers in Sports and Active Living, 4*, 896934. https://doi.org/10.3389/fspor.2022.896934.

Personality in soccer: investigation of the five-factor model of personality in high-level athletes

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Date of submission: 06.05.2022

3.1.1 Abstract

Background:

In high-level sports, rapid screening and diagnostic instruments are necessary considering limited access that researchers have to these athletes. In the area of sport psychological diagnostics, the NEO-FFI is a promising tool to gain information about an athlete's personality traits. The current study investigated the NEO-FFI's scientific quality criteria and general application to elite-level soccer.

Methods:

Personality traits of 378 elite-level soccer athletes were assessed using the NEO-FFI. Analysis focused on internal consistency, factor structure and gender differences. Additionally, a second measurement with a six-week interval was conducted with a sub-sample of 86 athletes to analyse test-retest reliability.

Results:

Overall, the results are in line with previous findings outside high-level sports. For the total sample, alpha-levels from .68 to .84 and intraclass correlation coefficients (ICC) for test-retest measures from .86 to .91 could be found. Item-level principal component analysis using both oblimin and oblique rotation showed better stability in neuroticism (N) and conscientiousness (C) than in extraversion (E), openness (O) and agreeableness (A). Gender differences could be found in values of internal consistency, ICC and NEO-FFI traits.

Conclusion:

The results of this study demonstrate good transferability of the NEO-FFI from settings outside high-level sports into this specific niche of sport psychological assessment. However, the same weaknesses of the applied instrument in general populations were also replicated in the sporting population.

Keywords: Big Five, Personality, NEO-FFI, Reliability, Item-analysis, high-level sports, soccer

3.1.2 Introduction

In comparison to physiological approaches, psychological assessments in professional sports are rather seldom, particularly in soccer. Yet measuring the psychological aspects of athletes is rapidly gaining popularity and many of the well-established measurements from domains external to sport (i.e., cognitive and differential psychology) are now being applied in sporting domains. Examples of assessments that have already made this transition is the measurement of athletes' EFs (Beavan et al., 2020), emotional behaviors (Schilaty et al., 2016), and of particular interest for this research, personality (Smith, 2008; Zhang et al., 2019). In the area of differential psychology, the classification of the Five Factor Model of Personality (FFM) is well-established (McCrae and Costa, 2008). The FFM assesses personality of an individual on five traits: Neuroticism (N), Extraversion (E), Openness (O), Agreeableness (A), and Conscientiousness (C); hence being commonly referred to as “the big five.” Despite some criticism of whether there are less (Eysenck and Eysenck, 1985; Gray, 1991; Zuckermann, 2005) or more than five dimensions (Paunonen and Jackson, 2000), the FFM is based on a general consensus in modern research and is widely accepted (O'Connor, 2002; de Moor et al., 2012; Allen et al., 2013; Bircher et al., 2017).

The NEO Personality Inventory (NEO-PI) and its subsequent revised version (NEO-PI-R) were developed as a measure of the FFM of personality (McCrae and Costa, 1985; Costa and McCrae, 1992). The NEO-PI-R contains 240 items that are grouped accordingly to one of the five personality dimensions. Despite the NEO-PI-R measuring narrower personality traits with more scales, the time commitment to complete the questionnaire is a limitation for many time-scarce populations, requiring up to 60 min to complete. In high performance settings where practitioners may be allocated limited time access to players, the use of the shorter version of the NEO-PI-R may be more appropriate (Egan et al., 2000). The NEO Five-Factor Inventory (NEO-FFI) is a shortened version of the NEO-PI-R, consisting of only 60 items that take between 10 and 15 min to complete (McCrae and Costa, 1987). It has demonstrated validity

and utility in several different contexts and languages and is one of the most used instruments to assess the FFM (Egan et al., 2000; Zillig et al., 2002).

Reliability measures of the NEO-FFI has first been mentioned by Costa and McCrae (1992) in an English-speaking sample, which has shown internal consistencies of 0.89 (N), 0.79 (E), 0.76 (O), 0.74 (A), and 0.84 (C) that were later supported (Holden and Fekken, 1994). Egan et al. (2000) similarly reported ranges between 0.72 (O) and 0.87 (N) on a large and diversified British cohort. Results from Eastern Europe and Iran also confirmed similar findings (Hrebíčková et al., 2002; Anisi, 2012). Of particular importance for the current study, the translation by Borkenau and Ostendorf (1993) found reliability indexes between 0.71 and 0.85 in a German population sample that were later on verified (Schmitz et al., 2001). Furthermore, test-retest reliability separated by a 2-week break has also been positively supported, ranging from 0.89 (N), 0.86 (E), 0.88 (O), 0.86 (A), and 0.90 (C) (Robins et al., 2001). Although the test-retest stability of the NEO-FFI is high, concerns for the factor structure of the NEO-FFI have been highlighted in the literature. Holden and Fekken (1994) conducted a factor analysis on the NEO-FFI using Canadian female students, reporting low loadings of ≥0.30 in 55 of 60 items. Various studies further reported some items not loading highly on their corresponding component when using factor analyses (Rolland et al., 1998; Egan et al., 2000; Aluja et al., 2005).

As a solution to the loading concerns, McCrae and Costa (2004) replaced 14 items of the original NEO-FFI with newer items taken from the NEO-PI-R in order to improve the instruments factor structure. The selection criteria were: (1) minimized effects of acquisition responding, (2) increased NEO-PI-R factor score correlation, and (3) diversification of item content in favor of underrepresented facets of remaining items of the scales. The newest version of the NEO-FFI showed correlations from 0.56 (O) to 0.62 (N) in self-report adjective factors, 0.39 (C) to 0.53 (O) in NEO-PI factors in spouse and 0.34 (C) to 0.59 (O) in peer ratings (Costa and McCrae, 2008). Convergent correlation ranges from 0.34 to 0.62. The newest version of

the NEO-FFI scales account for about 75–85% variance of the original NEO-PI factors for convergent criteria. However, remaining concerns about the loading were once more highlighted by Aluja et al. (2005) who compared the old and revised NEO-FFI version in a Swiss (n = 1,090) and Spanish (n = 1,006) sample with unsatisfying results, observing that 10 items did not fit into a perfect five-factor structure because of loadings being lower than 0.30.

Although the NEO-FFI has been described as a quick and effective inventory to measure the FFM and may be the preferable choice in time-scarce populations, the data on populations such as high-performance sport is insufficient. Practitioners and researchers alike would benefit from not having to rely on generalizations sourced from normative data outside sporting populations. Despite the wide range of studies using the NEO-FFI, there are less studies published that have specifically focused on physically active subjects (Allen et al., 2013; Wilson and Dishman, 2015; Piepiora, 2020). Moreover, no studies currently exist that target a large sample of athletes in elite-level populations, and specifically in soccer. Therefore, the current study aimed to examine the internal consistency, test-retest reliability, and trait-respective item-level analysis of the factor structure of the NEO-FFI on a sample of German national and international high-level soccer athletes. Additionally, a second aim was to analyse differences between male and female athletes in responding style and traits. It is hypothesized that the NEO-FFI will demonstrate to be reliable and suitable measure of the FFM in high-level athletes, consistent with the literature that has used this inventory in non-sporting populations.

3.1.3 Method

3.1.3.1 Participants

A total of 378 elite-level soccer athletes (210 male; 168 female) aged 16–37 (M = 19.86 years, SD = 4.38) participated in the study (Table 2). Inclusion criteria were German native speakers to prevent the dataset of biases sourced from aspects like misunderstanding or socialization in other cultural environments, age 16 and older, absence of self-reported suffer from a psychological disorder or any condition that would impair their results and being an

athlete in one of the German professional league teams' club academy. In sum, all athletes were representing clubs of the professional soccer leagues within Germany at the time of the study, totaling 21 male and 18 female clubs. All athletes were team members ranging from the U17's to senior professionals. Altogether, 200 athletes (52.91%) have been or were currently part of a youth or adult National team of 15 different countries (mainly Germany, Switzerland, Austria).

3.1.3.2 Personality Assessment

In order to determine the athletes' personality traits, the German NEO-FFI adaption by Borkenau and Ostendorf (2008) was used. The questionnaire consists of 60 items rated on a five-point Likert scale (strongly disagree, disagree, neutral, agree, strongly agree). It is a self-report measure that assesses the five personality dimensions: extraversion, neuroticism, openness, agreeableness, and conscientiousness. It was presented using an online survey (Microsoft Forms, Version 2020) in original form, order, and instruction.

3.1.3.3 Procedure

Athletes involved in the study were tested *via* an online survey. The assessment had a standardized introduction and familiarization protocol, and a staff-member with sport psychological background could always be consulted. Before the participants started, they were informed that all results would remain anonymous, and participation was voluntary. Prior to the commencement of this study, informed consent from all athletes was received, and the Institutional Ethics Committee approved this study.

Table 2

Participants' Information for *T1* and *T2*

		T1 (n = 378)	T2 (n = 87)
Gender	Males	n = 210	n = 62
	Females	n = 168	n = 25
Clubs (Pro League)	Male	1. division n = 15	1. division n = 1
		2. division n = 3	
		3. division n = 3	
		Total n = 21	
	Females	1. division n = 12	1. division n = 1
		2. division n = 6	
		Total n = 18	
Age (years)	Mean (SD)	19.86 (4.38)	19.62 (3.96)
	Males	19.17 (4.52)	19.37 (4.22)
	Females	20.73 (4.05)	20.24 (3.21)
	Range	16 - 37	16 - 35
	Males	16 - 37	16 - 35
	Females	16 - 34	16 - 26
Team Size	Males	U17 n = 75	U17 n = 15
		U19 n = 60	U19 n = 19
		U23 n = 37	U23 n = 17
		Pros n = 38	Pros n = 11
	Females	U17 n = 4	
		U20 n = 76	U20 n = 8
		Pros n = 86	Pros n = 17

Note. T1 represent the first measurement, T2 represent the second measurement 6 weeks post T1.

3.1.3.4 Testing Session 1 (T1)

The online survey of T1 was either forwarded by the team management of the different clubs or sent directly in terms of personal contact. In the case of one first division club (110 athletes, 71 males/39 females; *M* = 19.86 years, *SD* = 4.08), the questionnaire was part of a regular standardized, twice-yearly sports psychological performance diagnostics event recorded during pre-season. This team was chosen because of the test-retest reliability study as described below. Testing took ~10–15 min to read and complete the introduction, demographic information, and personality assessment.

3.1.3.5 Testing Session 2 (T2)

To assess test-retest reliability of the NEO-FFI, the first division club mentioned above were asked to complete the assessment again 6 weeks after T1. A window of +1 week was allowed for the retest. In total, 86 athletes (62 male, 24 female) aged between 16 and 35 (M = 19.62 years, SD = 3.96) participated at T2. The athletes completed the exact same testing as on T1.

3.1.3.6 Data Analysis

The dataset was screened and checked for any kind of missing values and the relevant assumptions for parametric tests (i.e. outliers, independence, normality, sphericity, and homogeneity of variance) were measured and met in accordance with Tabachnick and Fidell (2014). Inspections of descriptive and graphical data analysis were executed to prove absence of outliers and normality distribution. Cronbach's alpha determined internal consistency. Test-retest reliability was calculated *via* an intraclass correlation coefficient (ICC) based on the dataset of 86 athletes using a single measure two-way mixed effect model with an absolute agreement type. Confidence intervals (95% CI) are reported. Gender differences were analyzed using an independent-sample *t*-tests for parametric and Mann-Whitney-*U* for non-parametric variables. In addition, Cohens' d effect-size was calculated. Exploratory factor analysis on trait- and item-level were based on principal component analysis with both oblique and orthogonal rotations.

3.1.4 Results

3.1.4.1 Internal Consistency

Cronbach alpha's internal consistency measures for T1 (Table 3) showed a range from 0.68 (O/A) to 0.84 (N) for all athletes. Interestingly, females showed higher reliability scores than males in all traits, exhibited as 0.71 (A) to 0.87 (N), 0.56 (A) to 0.80 (C), respectively.

Table 3

Descriptive NEO-FFI Statistics (*n* = 378, Plus Gender Separation, Raw Scores)

Trait	All athletes (n = 378)			Males (n = 210)			Females (n = 168)		
	Mean	SD	Alpha	Mean	SD	Alpha	Mean	SD	Alpha
N	15.60	6.96	.84	13.80	6.08	.78	17.84	7.35	.87
E	31.06	5.05	.69	31.06	4.72	.64	31.07	5.45	.75
O	24.92	5.37	.68	23.73	4.59	.57	26.42	5.90	.73
A	32.22	4.80	.68	30.67	4.14	.56	34.15	4.87	.71
C	36.60	5.70	.83	37.04	5.13	.80	36.04	6.32	.86

3.1.4.2 Test-Retest Reliability

One outlier could be detected in accordance with Tabachnick and Fidell (2014). To minimize its impact and to keep it as part of the population, a SQRT-transformation of the N-variables was conducted. For the 86 athletes who were retested, ICC test-retest reliability scores from 0.86 (E) to 0.91 (A) was observed (Table 4). In comparison, females (*n* = 24) had, except for C (ICC = 0.84 vs. 0.92 in males), higher scores ranging from 0.84 (C) to 0.94 (N) than males (*n* = 62) ranging from 0.84 (O) to 0.92 (C).

3.1.4.3 Intercorrelations Between NEO-FFI Trait Scores

The NEO-FFI dimensions show various correlations (Table 5). Significant associations could be found for N with lower E and C, respectively, E with higher A and C. O was the only trait where no significant relations could be found. Principal component analysis with quartimax rotation of the orthogonal traits revealed a two-component solution (Figure 3) which converged in three iterations and explained 59.75% of the variance, with eigenvalues being 1.90 and 1.10. Table 6 shows results from component analysis. Component 1 had a high negative loading for N (−0.78) and high positive loadings for E (0.66), A (0.54), and C (0.67). Component 2 was defined by high loading of O (0.86) and lower loadings of E (0.42) and A (0.49).

Table 4

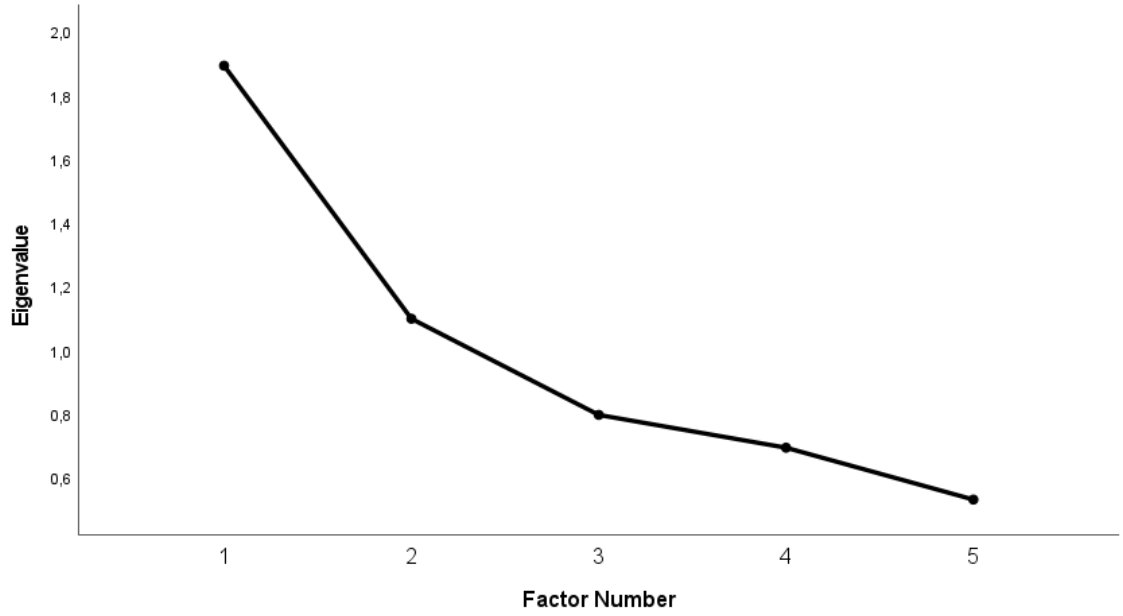
Test-Retest Reliability of NEO-FFI Traits, Separated by Gender

Trait	All athletes (n = 86)					Males (n = 62)					Females (n = 24)				
	T1 Mean (SD)	T2 Mean (SD)	ICC	CI 95% (LL, UL)	p	T1 Mean (SD)	T2 Mean (SD)	ICC	CI 95% (LL, UL)	p	T1 Mean (SD)	T2 Mean (SD)	ICC	CI 95% (LL, UL)	p
N	13.28 (6.15)	13.60 (4.72)	.91	.86 .94	.000	12.15 (5.26)	12.37 (6.11)	.89	.81 .87	.000	16.21 (7.35)	16.79 (7.30)	.94	.86 .97	.000
E	31.86 (4.96)	31.02 (4.19)	.86	.78 .91	.000	31.98 (4.96)	31.19 (4.18)	.86	.76 .91	.000	31.54 (5.05)	30.58 (4.26)	.87	.70 .94	.000
O	24.35 (4.69)	24.72 (4.60)	.88	.81 .92	.000	23.58 (4.39)	24.29 (4.40)	.84	.74 .91	.000	26.33 (4.95)	25.83 (5.03)	.93	.85 .97	.000
A	32.20 (4.27)	31.78 (4.36)	.90	.85 .94	.000	31.21 (3.90)	30.89 (3.86)	.89	.81 .93	.000	34.75 (4.20)	34.08 (4.79)	.89	.75 .95	.000
C	37.86 (4.58)	37.88 (4.89)	.89	.84 .93	.000	37.89 (4.56)	38.03 (4.81)	.92	.86 .95	.000	37.79 (4.72)	37.50 (5.15)	.84	.63 .93	.000

Note. T1 and T2 assessment distance of 6 weeks; ICC = intraclass correlation coefficient; CI = confidence interval with LL and UL representing the lower- and upper limit; p = significance value of ICC.

Figure 3

NEO-FFI Trait-Analysis. Component Scree Plot



3.1.4.4 Item-Level-Analysis of The NEO-FFI

For the analysis of sources of variance in the component solution, principal component analysis of the 60 items was conducted: 16 components with eigenvalues from 8.54 to 1.02 could be extracted. A total variance of 59.09% of the variance of the NEO-FFI could be explained. The components converged in 25 iterations in varimax rotation. Scree plot suggested a five-component solution with a 35.68% explanation of total variance as the main source of NEO-FFI (Figure 4).

3.1.4.5 Varimax Rotation of The NEO-FFI Items-5 Factor Solution

Table 7 displays loadings between the NEO-FFI Items and the first five orthogonal extracted components with varimax rotation. Items were re-ordered and labeled to improve readability.

Component 1 is clearly N, with all items except of N1 loading on the component. It also contains five items from the E component (E3, E8, E9, E10, E12), two from A (A2, A10) and one from C (C7). Component 2 represents unequivocally C, with all items loading on the dimension and one item of A (A7).

Table 5

Intercorrelations Between NEO-FFI Trait Scores (n = 378) on the Upper Right, p Values on the Lower Left, Plus Gender Separation

	[a]All athletes (n = 378)					[b]Males (n = 210)					[c]Females (n = 168)				
	N	E	O	A	C	N	E	O	A	C	N	E	O	A	C
N	-	-.329***	.046	-.160**	-.327***	-	-.214**	.017	-.098	-.403***	-	-.486***	-.046	-.527***	-.194*
E	p = .000	-	.163**	.384***	.257***	p = .002	-	.127	.310***	.281***	p = .000	-	.179*	.491***	.232**
O	p = .373	p = .001	-	.161**	.043	p = .808	p = .067	-	.033	.094	p = .555	p = .020	-	.081	.016
A	p = .002	p = .000	p = .002	-	.212***	p = .156	p = .000	p = .639	-	.297***	p = .000	p = .000	p = .296	-	.202**
C	p = .000	p = .000	p = .399	p = .000	-	p = .000	p = .000	p = .177	p = .000	-	p = .012	p = .002	p = .834	p = .009	-

Note. Two-tailed test, *** = p < 0.001, ** = p < 0.01, * = p < 0.05. [a/c] Person´s r for E and O; Spearman-Rho for N, A, and C. [b] Person´s r for E, O, and A; Spearman-Rho for N and C.

Table 6

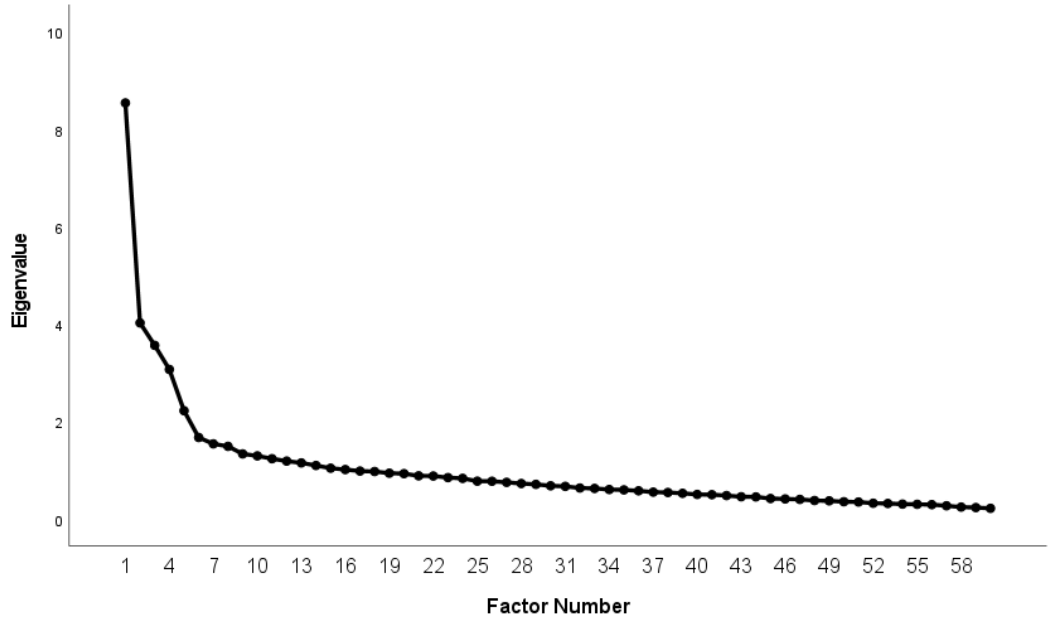
Component-Analysis of the First Two Quartimax Components Extracted from Analysis of the NEO-FFI Traits (n = 378)

Trait	Component 1	Component 2
N	**-.780**	.137
E	**.663**	**.416**
O	-.090	**.863**
A	**.537**	**.494**
C	**.666**	-.134

Note. Loadings ≥ .30 are bold and underlined.

Figure 4

NEO-FFI Item-Analysis. Component Scree Plot



Component 3 contains eight items of the trait E and three of A (A1, A7, A8). Component 4 contains nine items trait of O, but also E7. Component 5 contains eight items of A, with additional loadings of E (E5, E6) and C (C5, C7, C12).

Overall, the item-analysis showed quite separate traits for N, E, A, and C scales. O however is problematic, with three items which did not show any loadings ≥ 0.30 on any trait. In total, 47 of the 60 NEO-FFI Items represented unique items relating to specific traits. Four items (N1, O1, O4, O8) did not load on any of the first five factors (≥ 0.30). Seven items did not load on their intended dimension (E6, E7, E10, A1, A2, A7, A10).

Table 7

Component-Analysis of the First Five (Orthogonal) Varimax Factors Extracted from Analysis of the NEO-FFI (n = 378)

	Component 1	Component 2	Component 3	Component 4	Component 5
N1	-.104	.030	.078	.080	-.051
N2	**.666**	-.060	-.075	-.072	-.223
N3	**.635**	-.158	-.082	.060	.040
N4	**-.428**	-.105	.246	.052	-.092
N5	**.689**	-.049	-.060	-.013	.008
N6	**.746**	-.116	-.171	.033	.048
N7	**-.573**	-.092	-.025	.092	.115
N8	**.565**	-.061	.092	.089	.226
N9	**.675**	-.244	-.141	-083	-.076
N10	**-.588**	.103	.149	-.045	-.081
N11	**.747**	-.238	.004	-.009	.051
N12	**.533**	-.038	-.091	.079	-.128
E1	-.081	-.083	**.646**	-.034	-.147
E2	.094	.024	**.590**	-.016	-.201
E3	**.337**	-.010	**-.362**	-.025	.170
E4	-.082	.177	**.683**	.104	-.045
E5	-.108	-.153	**.483**	.112	**.347**
E6	.198	.100	-.182	.121	**.382**
E7	-.129	.057	.231	**.402**	.232
E8	**-.362**	.139	**.655**	.039	-.102
E9	**.328**	-.043	**-.528**	-.134	.117
E10	**.361**	-.276	.132	.182	.096
E11	-.184	.274	**.458**	.127	.078
E12	**.329**	-.205	-.212	-.023	.183
O1	-.128	.248	.082	-.126	.069
O2	-.052	.048	.030	**-.693**	.125
O3	.029	.000	.058	**.583**	-.019
O4	-.007	.067	.103	-.170	.113
O5	-.028	.119	-.073	**-.530**	-.039
O6	-.087	.144	.107	**.391**	-.074
O7	-.066	-.198	-.013	**-.308**	.183
O8	-.028	.156	.173	-.061	.250
O9	.007	-.051	-.093	**.604**	.097
O10	-.041	-.008	-.031	**-.664**	.114
O11	-.025	.262	.104	**.524**	-.017
O12	-.021	-.019	.119	**.622**	.163
A1	-.017	.221	**.437**	.106	-.141
A2	**.345**	-.199	-.186	.065	.266
A3	.008	-.205	.028	-.076	**.586**

Table 7 continues next page

	Component 1	Component 2	Component 3	Component 4	Component 5
A4	.106	-.049	.090	.120	**-.400**
A5	.299	.009	-.164	-.032	**.330**
A6	.189	.099	-.017	-.030	**.516**
A7	-.274	**.303**	**.348**	.039	-.041
A8	.107	-.171	**-.396**	-.125	**.456**
A9	-.026	.036	-.166	-.008	**.365**
A10	**.335**	.272	.274	.294	-.272
A11	-.010	-.076	-.135	-.026	**.466**
A12	.071	-.193	-.102	.140	**.507**
C1	.016	**.619**	.027	-.059	.057
C2	-.131	**.662**	-.022	.071	-.054
C3	-.094	**-.379**	.001	.009	.102
C4	-.087	**.615**	.094	.073	-.058
C5	-.278	**.409**	.222	.012	**.334**
C6	.238	**-.579**	-.031	-.010	-.035
C7	**-.398**	**.373**	.264	-.046	**.372**
C8	-.047	**.664**	.103	.086	-.069
C9	.107	**-.695**	-.037	-.060	.126
C10	-.086	**.688**	.149	.107	.141
C11	.217	**-.653**	-.016	.074	.002
C12	-.016	**.421**	.143	.059	**.400**

Note. Loadings ≥ .30 in bold.

3.1.4.6 Promax rotation of The NEO-FFI Items-5 Factor Solution

Table 8 shows loadings between the NEO-FFI Items and the first five oblique extracted components with promax rotation. Items were re-ordered and labeled for improved reading purposes.

Component 1 is clearly N, with all items except of N1 loading on the component. It also contains one item of E and C (E10, C7) and two of A (A2, A10). Component 2 represents unequivocally C, with all items loading on the dimension and no traits from other dimensions loading on this component. Component 3 contains eight items of the trait E and three of A (A1, A7, A8). Component 4 contains nine items of trait O, but also E7. Component 5 contains eight items of A, with additional loadings of E (E5, E6) and C (C5, C7, C12).

Table 8

Component-Analysis of the First Five (Oblique) Promax Factors Extracted from Analysis of the NEO-FFI (n = 378)

	Component 1	Component 2	Component 3	Component 4	Component 5
N1	-.097	.003	.059	.077	-.052
N2	**.691**	.041	.023	-.098	-.207
N3	**.639**	-.069	.010	.042	.052
N4	**-.428**	-.213	.220	.050	-.095
N5	**.723**	.053	.038	-.044	.025
N6	**.747**	.006	-.076	.019	.060
N7	**-.640**	-.176	-.107	.136	.095
N8	**.620**	-.002	.182	.045	.245
N9	**.664**	-.143	-.024	-.094	-.063
N10	**-.584**	.006	.075	-.036	-.090
N11	**.773**	-.150	.140	-.044	.072
N12	**.539**	.045	-.032	.064	-.119
E1	.045	-.202	**.723**	-.117	-.120
E2	.233	-.055	**.670**	-.105	-170
E3	.286	.095	**-.351**	.005	.164
E4	.083	.067	**.719**	.007	-.016
E5	-.029	-.255	**.535**	.057	**.364**
E6	.189	.162	-.196	.130	**.378**
E7	-.102	-.002	.190	**.382**	.233
E8	-.227	-.007	**.659**	-.037	-.082
E9	.241	.087	**-.522**	-.081	.104
E10	**.367**	-.269	.212	.158	.108
E11	-.061	.192	**.440**	.062	.095
E12	.283	-.138	-.162	-.005	.181
O1	-.071	.238	.060	-.145	.073
O2	.013	.057	.103	**-.715**	.138
O3	.000	-.020	.001	**.588**	-.025
O4	.042	.059	.128	-.192	.122
O5	.010	.147	-.038	**-.537**	-.033
O6	-.079	.114	.044	**.385**	-.077
O7	-.075	-.209	.037	**-.302**	.184
O8	.044	.138	.181	-.095	.260
O9	-.063	-.053	-.166	**.633**	.083
O10	.000	.008	.039	**-.675**	.122
O11	-.004	.247	.021	**.512**	-.019
O12	-.041	-.056	.062	**.622**	.157
A1	.101	.162	**.447**	.038	-.121
A2	**.303**	-.135	-.140	.079	.265
A3	.007	-.216	.073	-.078	**.588**

Table 8 continues next page

	Component 1	Component 2	Component 3	Component 4	Component 5
A4	.107	-.057	.103	.110	**-.396**
A5	.298	.080	-.135	-.031	**.332**
A6	.231	.138	.006	-.049	**.522**
A7	-.176	.230	**.309**	-.007	-.031
A8	.023	-.100	**-.387**	-.074	**.441**
A9	-.049	.063	-.188	.012	**.357**
A10	**.434**	.285	.284	.232	-.253
A11	-.037	-.057	-.135	-.008	**.460**
A12	.028	-.181	-.091	.158	**.501**
C1	.121	**.661**	-.033	-.095	.065
C2	-.054	**.690**	-.130	.053	-.054
C3	-.156	**-.418**	.033	.032	.096
C4	.012	**.627**	.012	.038	-.052
C5	-.180	**.365**	.163	-.025	**.340**
C6	.163	**-.580**	.068	.008	-.035
C7	**-.300**	**.305**	.205	-.082	**.377**
C8	.063	**.683**	.019	.045	-.061
C9	.011	**-.719**	.063	-.031	.123
C10	.039	**.697**	.063	.060	.149
C11	.128	**-.666**	.082	.095	.001
C12	.085	**.426**	.106	.018	**.410**

Note. Loadings ≥ .30 in bold.

Overall, the item-analysis showed quite separate traits for N, E, A, and C scales. O is problematic, with three items which did not show any loadings ≥ 0.30 on any trait. In total, 49 of the 60 NEO-FFI Items represented unique items relating to specific traits. Five items (N1, E12, O1, O4, O8) did not load on any of the first five components (≥0.30). Seven items did not load on their intended dimension (E6, E7, E10, A1, A2, A7, A10). In conclusion, the oblique rotation was able to make the factor-structure more coherent, due to a reduction of simultaneous item loadings from 18 (orthogonal) to 13 (oblique).

3.1.4.7 Differences between males and females T1

Independent-sample *t*-tests (E and O), respectively, Mann-Whitney-*U* tests (N, A, and C) were conducted to reveal differences in personality traits between males and females (Table 9). Males showed significantly lower levels of N $p \leq 0.0001$, $d = 0.71$), O ($p \leq 0.000$, $d = 0.51$), and A ($p \leq 0.0001$, $d = 0.16$). No significant differences were observed for E and C ($p \geq 0.05$).

Table 9

Gender Differences in NEO-FFI Traits (n = 378, Raw Scores)

Trait	Males (n = 210)		Females (n = 168)				
	Mean	SD	Mean	SD	t / U	p	d
N	13.80	6.08	17.84	7.35	11945	.000	.58
E	31.06	4.72	31.07	5.45	-0.016	.987	.00
O	23.73	4.59	26.42	5.90	-4.86	.000	.52
A	30.67	4.14	34.15	4.87	9547	.000	.86
C	37.04	5.13	36.04	6.32	16315	.209	.13

Note. Independent-sample t-test for O and A; Mann Whitney U-test for N, A and C; d = effect size (Cohen´s d).

3.1.5 Discussion

In settings with limited time access to participants, unable or unwilling compliance for long assessments, short and reliable instruments are necessary to measure relevant information for both research and practice. In the area of sport psychological diagnostics, the NEO-FFI delivers the possibility of rapid screenings to assess the big-five personality traits. In high-level sports and, respectively, soccer, researchers, coaches, and sports psychologists alike require information about quality criteria of the employed instrument such as internal and test-retest reliability, factor structure, and stability in their specific field to avoid over-generalizing or misinterpreting results based on non-comparable populations. As research of the FFM in high-performance athletes is lacking, the present study aimed to fill this gap and focus on the suitability of the NEO-FFI to measure personality traits specifically within elite-level soccer athletes.

Analysis of internal consistency across all athletes showed similar values in comparison to other results outside sport in the English (Caruso, 2000), French (Rolland et al., 1998) and German (Borkenau and Ostendorf, 2008) versions: N and C had the highest Cronbach's alpha levels (0.83 and 0.83, respectively), whereas E, O, and A all shared similar albeit lower alpha levels (0.69, 0.68, and 0.68, respectively). More specifically, females had higher internal consistency outcomes across each trait than males. This is in line with the large scale by Caruso (2000) who combined 51 samples in which the NEO Instruments PI, PI-R and FFI were

combined, also reporting that females displayed higher alpha levels for every personality trait. Our finding could be explained by higher preciseness during the answering process in the female group, which we perceived a lot in the assessments. Opposingly, not all research reports gender differences for internal consistencies in the NEO questionnaires. For example, some studies reported reliability measures to be similar across genders (Egan et al., 2000; Borkenau and Ostendorf, 2008). Together, the analogous findings of the components from the NEO-FFI in high performance sporting populations with other general populations supports the transfer and use of the NEO-FFI into professional soccer.

Additionally, results of test-retest reliability are again in a similar range to other studies, although the present study used a different interval between the assessments. Studies with longer intervals like two (Borkenau and Ostendorf, 1993) or four (Robins et al., 2001) years found lower reliabilities, and shorter two-week intervals found comparable results (Robins et al., 2001). A 6-week interval was chosen to reduce impacts of item or answer remembrance (which maybe occur in a 2-week interval) and have a more realistic view of stability and reflect true change with a minimized measurement error (Becker, 2000; Schmidt et al., 2003; Watson, 2004). The findings of the current study show a high level of robustness, without biases of different occasions separated by an interval where no rapid personality changes could be expected. It must also be noted that most of the long interval studies mentioned above are not made with the intention of giving a view into potential applicable instruments in certain setting; rather they focused on longitudinal changes in personality traits. That leads to a lack of information concerning studies with a theoretical background and a specific aim for test-retest data.

In the current study, intercorrelations for the total sample appeared largely in line with similar studies, but with slight differences. For instance, in comparison to Egan et al. (2000) and Borkenau and Ostendorf (2008), the present study reported intercorrelations between all traits except for a positive rather than a negative association between O and C.

Furthermore, apart from the correlations between N and E (for both the total and male sample only) and N and C (for female sample only), all correlation coefficients were higher in the present study than what is reported by Borkenau and Ostendorf (2008), whereas only four out of ten coefficients were higher in comparison to Egan et al. (2000).

Even if the non-orthogonality of the factors suggests an oblique rotation, an oblimin rotation was also conducted to determine differences in rotation-methods and have a comparison to previous studies. As expected, the oblique rotation showed better but not exceeding results than the oblimin. Only N and C scales appear to homogenously measure the traits as they should. Yet E, O, and A show more heterogeneity and variance amongst the factors. This is in line with previous findings, where also N and C show the best homogeneity (Egan et al., 2000; Aluja et al., 2005). The current study also replicated the pattern of weak and, respectively, missing loading of items on their intended factor (Egan et al., 2000; McCrae and Costa, 2004; Aluja et al., 2005; Borkenau and Ostendorf, 2008). These aspects of heterogeneous loadings may be attributed to the intercorrelations between the scales and their classification in two higher order factors. Principle component analysis (PCA) confirmed the consensus in literature, that the big five can be assigned to two higher order factors (Digman, 1997; Markon et al., 2005; Chang et al., 2012). PCA of the 60 items and the five-factor solution showed similar explanations of variances as previous studies (Egan et al., 2000; Aluja et al., 2005; Borkenau and Ostendorf, 2008).

3.1.6 Limitations

A limitation of our study is linked to the misunderstanding of terms. We had several cases where athletes asked for the meanings of different words like “depressed,” “abstract,” “poetry,” or whole statements like “I believe letting students hear controversial speakers can only confuse and mislead them.” The origin of those misunderstanding problems lie in the population, respectively, samples which were chosen for development and evaluation of the

NEO-FFI (Bodner, 2006). Those samples mostly exist of well-educated subjects and might not reflect the average type of elite-level soccer athletes. This case leads to difficulties when such questionnaires get applied without an immediately available consultant. As many instruments nowadays are applied using online software that can be answered from everywhere, future instruments should aim to prevent abstract and difficult expressions to understand. A second limitation lies in the biases like social desirability or role thinking when answering these questions. Athletes may often report what they believe is the right answer within a sporting context despite the instrument being a measure of non-sporting specific questions. Such mindsets may alter the way in which they answer the questions, as personality characteristics may be contextually dependent (i.e., different on and off the field). For instance, a team-captain get asked about leadership, and he/she may immediately think about their role in the team, despite them being not highly into leadership from a trait point of view. Additionally, the sample size could be one limitational aspect that influences the divergent factor loadings in our and similar studies with smaller or specific niche samples.

3.1.7 Conclusion

The current study implemented the NEO-FFI to measure the personality traits of a large sample of high-level soccer athletes and to examine the suitability of the use of NEO-FFI as a measure of the FFM for elite soccer players. The results demonstrated that the NEO-FFI had similar findings for (test-retest-) reliability, factor structure and stability in the elite-level soccer environment as previously reported in various other general populations. This study supports the use of the NEO-FFI as a time-efficient and reliable personality instrument that can inform staff, players, and researchers alike on the unique personality characteristics of each athlete. It would be beneficial for more studies to continue to investigate the NEO-FFI in various other high-performance sports in order to better generalize the findings of this study.

Data Availability Statement

The datasets presented in this article are not readily available because the dataset includes information about national and international elite-athletes. Therefore, the dataset is under restrictions. Requests to access the datasets should be directed to jan.spielmann@tsg-researchlab.de.

Ethics Statement

The studies involving human participants were reviewed and approved by Universität des Saarlandes Ethikkommission der Fakultät HW Campus A1 3 66123 Saarbrücken Ethics Approval Number: 19/19. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author Contributions

JS: conceptualization, methodology, formal analysis, investigation, writing - original draft, writing - review & editing, and project administration. AB: writing - original draft and writing - review & editing. JM: conceptualization, resources, and supervision. All authors contributed to the article and approved the submitted version.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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3.2 Study 2: The Relationship of Personality and Executive Functions in High-Level Soccer Athletes. Expertise- and Gender-Specific Differences.

The content of Study 2 has been reformatted for the purpose of the dissertation. The full reference of the published manuscript is:

Spielmann, J., Beavan, A., & Mayer, J. (2023). The relationship of personality and executive functions in high-level soccer athletes: expertise-and gender-specific differences. *Frontiers in Sports and Active Living, 5*, 1130759. https://doi.org/10.3389/fspor.2023.1130759.

The relationship of personality and executive functions in high-level soccer athletes.

Expertise- and gender-specific differences.

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Date of submission: 13.04.2023

3.2.1 Abstract

Background:

Psycho-cognitive factors such as personality and executive functions (EFs) are influential parameters when it comes to examining expertise in high-level soccer. Therefore, the profiles of those athletes are relevant both from a practical and scientific point of view. The aim of this study was to investigate the relationship between personality traits and executive functions with age group as an influential factor in high-level male and female soccer players.

Methods:

Personality traits and executive functions of 138 high-level male and female soccer athletes from the U17 - Pros teams were assessed using the big-five paradigm. A series of linear regressions investigated contributions of personality on EF assessments and team, respectively.

Results:

Linear regression models showed both negative and positive relationships between various personality traits, executive function performance and the influence of expertise and gender. Together, a maximum of 23% (R^2 = 6 – 23 %) of the variance between EFs with personality and various teams, demonstrating that many unaccounted-for variables remain at play.

Conclusion: The results of this study demonstrate the inconsistent relationship between personality traits and executive functions. The study calls for more replication studies to help strengthen the understanding of relationships between psycho-cognitive factors in high-level team sport athletes.

Keywords: Team sports, cognition, academy, football, big-five

3.2.2 Introduction

Searching for abilities that help to explain expertise in sport has a longstanding interest in research. Although athletic and physiological factors have largely dominated the research of expertise, psycho-cognitive factors such as personality and cognitive abilities are receiving more attention towards their association with expertise. In the last decade, elite athletes have been demonstrated to yield better general cognitive abilities known as executive functions (EFs; e.g., 1, 2) and further display different expressions of personality traits (3, 4) than their lesser-skilled and non-athletic counterparts. Research has largely examined cognitive abilities and personality traits independently in relation to expertise in sport, but there remains little overlap between these areas. Indeed, these notions have remained relatively distinct concepts in a sporting domain as there has not been a large basis for comparing them. Alternatively, a strong mediating relationship between these psycho-cognitive factors has been reported in domains external to sport. From a neuroscientific approach, both personality and EF constructs are associated with the prefrontal cortex (5). More specifically, the association of working memory and the trait openness rely heavily on the dorsolateral prefrontal cortex (6–8). Despite EFs and personality being conceptually distinct research areas in sport, they are considered to be on a common continuum in other domains with psychology. Therefore, expertise-related literature may benefit from better understanding the psycho-cognitive relationship in a sporting context.

The first construct of interest measuring the core cognitive abilities of athletes, known as their EFs. EFs refer to the family of top-down mental processes that subserve goal directed behaviour (9). EFs are a consciously controlled process that engages in deliberate, goal-directed thought and action (10), and play a role in the decision-making process helping to resolve conflict especially in situations that are new (11). The ability to engage in goal-directed thought and action while negating acting on impulsive decisions can be attributed to the simultaneous development of cognitive control functions such as working memory, inhibition, and flexibility (12, 13). Working memory is responsible for holding information in the mind and findings

relationships between the information. Inhibition helps to resist giving in to temptation and preventing acting impulsively and cognitive flexibility allows for the quick and flexible adaptation to changing circumstances or priorities (9). Together, they form the foundation that lower-order cognitive processes such as reasoning, planning or problem-solving rest upon. In a sporting context, EF research falls under the cognitive component skills approach which states that athletes' expertise extends outside a sporting domain and can also be observed in assessments that are decontextualized from their respective sport altogether (14). EFs play a key role in the decision making of athletes (11, 15), helping athletes navigate their environment and ensure that their thoughts and actions remain goal-oriented (10). A recent meta-analysis reported that higher-performing athletes also possess better EFs compared to lower level and non-sporting populations (16) making them an interesting aspect to focus on when relating to high-level athletes.

The second construct of interest for the current study is personality. The dominant theoretical framework for trait personality has been the Five-Factor Model (FFM) (17), also commonly referred to as the Big-Five model (18). The FFM has also been considered the gold standard of personality assessments (19, 20). The FFM framework assesses personality through five broad trait dimensions, consisting of extraversion (reflecting those who are sociable, outgoing, and active), neuroticism (describing individuals who are anxious, hostile, and irritable), openness (distinguishing those who are curious, creative, and imaginative), agreeableness (describing those who are good-natured, unselfish, and forgiving), and conscientiousness (defining those who are organized, punctual, and hardworking).

Outside of the sporting literature, many associations between EFs and FFM have been investigated, as their association explain the mechanisms of individual daily functioning (21). Unsworth et al. (22) reported that openness was moderately related to fluency (i.e., referred to here as cognitive flexibility) demonstrating a link between openness and creative aspects of EF. This is further supported by additional research by Murdock et al. (23), who found significant

positive correlations with cognitive flexibility and updating/shifting. Neuroticism, on the contrary, frequently is described to be negatively related to executive and other cognitive functions (4, 24). Results for extraversion are less clear. Some studies found a positive association with shifting/ updating (25) and working memory (26), and a negative relationship with behavioural inhibition in children (27) and vigilance (22). Whereas Murdock et al. (23) did not observe a relationship to personality. Although agreeableness has been related to a global EF-score, but there has been no relationship with any specific EF ability when EFs are analysed separately (22, 23). Last, despite conscientiousness being considered as acting with methodical planning and attention, research has yet to find clear relations with EF, which as characterised by being relevant to underpinning these attributes (22, 23). Buchanan (28) found associations of low conscientiousness-levels in children with poor self-report EF but interpreted with caution as the authors did not show any correlations between these self-reported and objective EF measures. A recent study by Johann and Karbach (29) showed a positive relationship between conscientiousness and cognitive flexibility in young adults.

Most research using the FFM rests within the general population whereas the use of this personality assessment in high-performance athletes is still in its early stages (30). The athletic difference between the general population and high-level athletes may yield different relationships between personality and EFs, as high-performing athletes are known to have different cognitive (2) and personality (4, 31) profiles compared to non-athletes. Importantly, as cognitive performance becomes more relevant as the level of competition is greater, this relationship may differ on a function of athlete's expertise levels (4, 14). Vaughan and Edwards (4) were the first to examine the moderating effect of athletic expertise on the link between EF and personality, using computerized assessments of EFs and related them to the FFM. Expertise offset the negative association between neuroticism and EFs, illustrating that although neuroticism was linked to poorer response inhibition, this was not true in the highest expertise group (4). Opposingly, higher neuroticism in more expert athletes lead to greater response

inhibition and similar trends were demonstrated in shifting and updating accuracy. This study is however constrained by the sample being comprised of an undisclosed combination of athletes recruited from both interceptive and strategic sports, as per the sport classification system proposed by Voss et al. (14). The study lacks specific information regarding the exact sports included in the sample, as well as the number of athletes sampled from each sport. This omission may hinder the ability to account for potential variations in the relationship between personality traits and EFs across different sports, as prior research has demonstrated that sport type (interceptive, strategic) determines EF differences in elite athletes (32). Consequently, pooling together athletes from diverse sports without considering such complexity may limit the findings and interpretation of the study. Moreover, Vaughan further eluded to the possibility that some of the contrasting findings between EF and FFM compared to previous research in the general population might be due to different age samples, ranging from late childhood [age 9–12 (27)], early adulthood [age 18–27 (4)], and older adults [age 60–85 (33)].

Together, additional research using objective computerized assessments for measuring cognitive abilities is needed (4, 22). Furthermore, narrowing the focus to a single sport eliminates potential confounding variables arising from variations in constraints across different sports, thus allowing for a clearer examination of the relationship between EFs and personality traits. Hence, the aim of this study is to investigate the personality traits of a cohort of elite soccer-only athletes utilizing the Five-Factor Model (FFM), and to establish correlations with each distinct EF ability. A second aim is to understand whether team (across the academy to senior pro teams) is an influential factor in this relationship, similar to how expertise has been reported in sporting populations (4). Therefore, between group differences are examined for each EFs and personality trait. It is hypothesised that high levels of neuroticism will be associated with reduced EF performance, whereas high levels of conscientiousness and openness will be associated with increased EF performance. It is further hypothesised that no relationship between EF and agreeableness or extraversion will exist.

3.2.3 Methods

3.2.3.1 Participants

In total, 138 high-level football players from six teams representing a single high-level German Bundesliga club participated in this study. A total of 44 females were recruited from the senior pro (21.8 ± 2.8) and U20 (17.9 ± 1.3 y) squads, and 94 males were recruited from the senior pro (26.92 ± 4.07 y), U23 (20.8 ± 3.0 y), U19 (17.4 ± 0.6 y), and U17 (16.0 ± 0.2 y) teams. Power analysis (0.80) suggested that a sample size of 98 would be required for linear regression with a medium (0.3) partial eta effect size (G*Power Version 3; 34). One inclusion criterion was that the athletes were German native speakers to prevent the dataset of biases such as misunderstanding the questionnaires or test instructions.

3.2.3.2 Personality Assessment

The German adaption by Borkenau and Ostendorf (35) of McCrae and Costa (36) NEO-FFI questionnaire was used to determine athletes' personality traits. The questionnaire consists of 60 items rated on a five-point Likert scale (strongly disagree, disagree, neutral, agree, strongly agree). It is a self-report measure that assesses the five personality dimensions: extraversion (E), neuroticism (N), openness (O), agreeableness (A), and conscientiousness (C). The NEO-FFI is a well-established questionnaire with quality criteria reported in various populations [see for further information McCrae and Costa (37)] and in elite soccer players, especially (30). Furthermore, reliability coefficients for the NEO-FFI are shown in Table 10.

3.2.3.3 Cognitive Assessments

All cognitive assessments were run on the Vienna Test System (VTS; Schuhfried GmbH, Austria). The validity and reliability of the VTS has been confirmed by a variety of studies (38–40) and been previously been used in high-level football players (41–43).

Table 10

Descriptive Statistics, Reliability Coefficients (Alpha), and Correlations for All Traits

Trait	All athletes (n = 138)						
	Mean	SD	Alpha	N	E	O	A
N	14.47	6.56	.80				
E	31.70	4.51	.62	-.31**			
O	24.60	5.03	.61	.13	.21*		
A	32.20	5.08	.73	-.16	.30**	.05	
C	36.91	5.74	.84	-.37**	.32**	.09	.14

Note: Person correlations for all traits except C (Spearman). *P < 0.05, **P < 0.01.

3.2.3.3.1 Determination Test

The Determination Test (form S1, Schuhfried GmbH, Austria) is a complex multi-stimuli reaction test involving the combination of five different coloured stimuli and two acoustic signals (2,000 Hz high and 100 Hz low tone) for finger pressing, and two pedal stimuli for the feet. These stimuli corresponded to the pressing of appropriate buttons on the response panel and foot pedals. The Determination Test (DT) aims to measure reactive stress tolerance and the associated reaction speed. The participant must remain composed whilst the quick succession of the single pairing of stimulus and response lasting 4 min. “Correct responses” describes the total number of accurate responses within the 4 min, and “response time” is the median response time (ms) from the appearance of a stimulus to pressing of the correct button. Incorrect reactions are the number of all inappropriate reactions to a stimulus. Omitted Reactions represents the number of stimuli to which no response was made. The validity and reliability of the Vienna Test System has been confirmed by a variety of studies (38–40) and previously been used in high-level soccer athletes (41–43).

3.2.3.3.2 Response Inhibition Test

The Response Inhibition Test (form S3; Schuhfried GmbH, Austria), uses a go/no-go paradigm. In each trial, the player is presented either a go-stimulus of a frequent triangle

(requires response on green button) or a no-go stimulus of an occasional circle (requires inhibition and no response). In addition, this succession builds up a dominant response tendency because of the similar responses. Each of the 250 of the Inhibition Test (INHIB) stimuli are displayed for 200 ms with an interval of 1 s. The test is displayed in two halves consisting of 101 triangles and 24 circles. The main variable is the number of commission errors, which describes how frequently inhibition of no-go stimuli was unsuccessful. Subsidiary variables represent omission errors which reports the number of omitted reactions to go stimuli; mean reaction time, which is calculated as the mean time for correctly processed go stimuli (44).

3.2.3.3.3 N-back Nonverbal Test

The N-back Nonverbal Test (form S2; Schuhfried GmbH, Austria), uses a 2-back paradigm. The player is presented 100 successive stimuli via abstract figures for 1.5 s Abstract stimuli were used, to prevent biases like familiarity of the shown targets in terms of context-specific or intelligence-tendency influences. Players must press a green button, if the actual figure is congruent to the figure, which was presented 2-figures prior. If the figure is incongruent, he does not have to give a response (45). Main variables of the N-back (NBN) are the number of correct reactions to target-stimuli, number of omitted reactions, false positive answers and the mean reaction time for correct responses.

3.2.3.4 Procedure

Players conducted one personality questionnaire and three cognitive assessments. All data were measured during a standardised, twice-yearly performance diagnostics event either during preparation time of pre-season (July-August) or midseason (January-February). The assessments all received a standardized introduction and familiarization protocol and a staff member remained in the test area for consulting and monitoring purposes. Before the participants started, they were informed, that all results would stay anonymous, and they will not get any negative consequence if they do not participate. Testing took approximately 40 min

per group accounting for adequate rest between each assessment. Participants did not get any compensation for being part of the study. If required, participants received an explanation of the findings of their individual results via a personal consultation with the club's sport psychologist. Prior to commencement of this study, informed consent for all players was received, and the Institutional Ethics Committee approved this study (approval number: 19-19).

3.2.3.5 Statistical Analysis

To investigate the contribution of each personality trait on a variety of EF assessments, a series of linear regression models were analyzed. A single model investigated one response variable (i.e., the Determination Test's number of correct responses). There were 11 performance variables of interest, therefore 11 separate linear models were conducted. Each model, neuroticism, extraversion, openness, agreeableness, conscientiousness was added as fixed factors. Furthermore, to account for the known moderation of expertise (4), team was also entered as fixed factor. Each model was run independently for the several parameters provided by the aforementioned tests of cognitive flexibility (DT), inhibition (INHIB) and working memory (NBN) to limit the multi-collinearity associated between EFs. Bonferroni *post-hoc* analyses were conducted where the model reported significant differences between the team. The significance level was set at $p < 0.05$, and an estimate precision was provided using Wald-based 95% confidence intervals. Prior to the analysis, the data were first screened for outliers, missing data, and checked for normality using visual inspection of box plots through a Shapiro-Wilk test of normality in accordance to Tabachnick and Fidell (46).

3.2.4 Results

Eleven separate linear regression models analyzed the contribution of each personality trait and team on a variety of EF assessment parameters. Collectively, these models indicated that both positive and negative linear relationships exist between various personality traits and

performance on EF tests. In other words, each of the five personality traits appeared to have a unique role in either benefiting or hindering EF performance.

Within cognitive flexibility, adding both team and the five personality traits as predictors in the linear regression models provided a significant model fit for response time ($F = 2.261_{10,\ 123}$, $p = 0.02$, $r^2 = 16$), the number of incorrect responses ($F = 2.332_{10,\ 125}$, $p = 0.01$, $r^2 = 16$) and the number of omitted responses ($F = 2.385_{10,\ 123}$, $p = 0.01$, $r^2 = 16$), but not for the number of correct responses ($F = 1.289_{10,\ 125}$, $p = 0.24$, $r^2 = 9$). These predictors did not improve model fit significantly for the inhibition's response time ($F = 1.227_{10,\ 119}$, $p = 0.28$, $r^2 = 9$) or number of commission errors ($F = 1.075_{10,\ 125}$, $p = 0.39$, $r^2 = 8$), but was significant for the number of omission errors ($F = 3.515_{10,\ 120}$, $p = <0.001$, $r^2 = 23$). No model was significant for working memory ($p > 0.05$, $r^2 = 6–14$). A combination of both personality traits and team explained a maximum of 23% ($R^2 = 6–23$) of the variance of EF; demonstrating that personality does have an effect on EF performance, but this effect is small. For a further detailed report on the output for each EF variable and the direction to which each personality trait influences each EF parameter, refer to Supplementary Table 1.

3.2.4.1 Personality & EFs

Personality did not appear to be strong contributor in the variance associated across most EF assessments. Furthermore, no individual personality trait had a consistent positive or negative contribution across all EF parameters. Furthermore, as detailed below, large confidence intervals exist for all variables demonstrating the widely varied relationships that each personality trait has with performance on the EF-based assessment battery.

Neuroticism was associated with poorer performance on all aspects of cognitive flexibility. For example, for each point increase in neuroticism, the number of incorrect responses increased (0.25 points, CI: −0.29 to 0.80, $p = 0.36$), representing those with higher neuroticism tended to made more incorrect errors. Opposingly, higher neuroticism was linked with better performance in inhibition, where each advancing point in neuroticism decreased

reaction time (−0.28 ms, CI: −1.08 to 0.58, $p = 0.50$) and number of omission errors (−0.14 points, CI: −0.48 to 0.20, $p = 0.42$). Performance within working memory varied with higher levels of neuroticism. For instance, each point increase in neuroticism lowered the amount of incorrect responses (−0.06 points, CI: −0.23 to 0.12, $p = 0.52$) and commission error response time (−2.15 ms, CI: −8.15 to 3.85, $p = 0.48$), yet higher neuroticism was also associated with a decrease performance in number of correct responses (−0.02 points, CI: −10 to 0.05, $p = 0.51$), response time (2.84 ms, CI: −1.27 to 6.96, $p = 0.17$) and number of omitted responses (0.02 points, CI: −0.05 to 0.10).

Extraversion was associated with poorer performance on all response variables on cognitive flexibility. For example, for each point increase in extraversion, a decrease in the amount of number of correct responses (−1.52 points, CI: −3.38 to 0.33, $p = 0.11$). Although higher extraversion led to a decrease in inhibition reaction time (0.52 ms, CI: −1.63 to 0.59, $p = 0.35$), and more commission (0.11 points, CI: −0.13 to 0.35, $p = 0.36$) and omission errors (0.18 points, CI: −0.28 to 0.64, $p = 0.44$). Within working memory, higher extraversion was positively associated with lower response times (−4.19 ms, CI: −9.85 to 1.47, $p = 0.15$), but negatively related to number of correct responses (−0.07 points, CI: −0.17 to 0.03, $p = 0.15$) and number of incorrect responses (0.09 points, CI: −0.17 to 0.34, $p = 0.26$).

Openness had a varied effect on performance in cognitive flexibility indicated by the confidence intervals being equally negative and positive. This can be observed in the number of correct responses (0.01 points, CI: −1.56 to 1.58, $p = 0.99$) and number of omitted responses (0.01 points, CI: −0.26 to 0.28, $p = 0.94$). The influence of higher openness was more apparent when assessing inhibition. Each point higher on openness negatively increased reaction time (0.79 ms, CI: −0.16 to 1.73, $p = 0.10$) but reduced omission errors (−0.31 points, CI: −0.71 to 0.08, $p = 0.44$), and the only personality trait to positively reduced the amount of commission errors (−0.24 points, CI: −0.44 to −0.04, $p = 0.02$). Openness was small but positively related to working memory's number of correct responses (0.03 points, CI: −0.05 to 0.12, $p = 0.41$),

was both positive and negatively related to slower response time (0.25 ms, CI: −4.58 to 5.08, $p = 0.92$), similar to incorrect and omitted responses.

Agreeableness improved the number of correct responses on cognitive flexibility (0.84 points, CI: −0.85 to 2.53 points, $p = 0.33$) and decreased response time (−0.67 ms, CI: −2.96 to 1.61, $p = 0.56$), there was also a negative relationship to improved number of incorrect responses (0.36 points, CI: −0.33 to 1.04, $p = 0.31$). Agreeableness also decreases reaction time in inhibition (−0.56 points, CI: −1.59 to 0.47, $p = 0.29$) and the amount of omission errors (−0.15 points, CI: −0.57 to 0.28, $p = 0.5$). Respective to working memory, agreeableness improved the number of correct responses (0.09 points, CI: 0 to 0.18, $p = 0.06$), and decreased the number of incorrect responses (−0.17 points, CI: −0.4 to 0.06, $p = 0.15$) and omitted responses (−0.09 points, CI: −0.18 to 0, $p = 0.06$).

Conscientiousness appeared to be positively across all variables on cognitive flexibility, being increases correct responses (0.25 points, CI: −1.20 to 1.70, $p = 0.73$), decreased response time (−0.31 ms, CI: −2.27 to 1.65, $p = 0.75$), and number of incorrect errors (−0.29 points, CI: −0.89 to 0.31, $p = 0.34$). In inhibition, conscientiousness was linked to slower response times (0.37 ms, CI: −0.49 to 1.24, $p = 0.39$), but no clear directional impact on commission or omission errors made. Conscientiousness did lean towards slower response times in working memory (0.48 ms, CI: −4.01 to 4.97, $p = 0.83$), but no direction for commission errors or number of missed responses.

Table 11

Descriptive Personality Trait and Executive Functions (EF) Statistics Across Each Team (*n* = 138, Mean; *SD* in Brackets)

		Females (n = 44)		Males (n = 94)			
	Variable	**U20**	**Pro**	**U17**	**U19**	**U23**	**Pro**
Personality							
Trait	Neuroticism	16.2 (7.1)	16 (5.6)	12.7 (6.5)[a]	17.6 (5.5)[a,$]	11.9 (5.2)[$]	11.6 (5.1)
	Extraversion	30.7 (5.2)	32.2 (4.6)	32.8 (4.9)	30.0 (3.0)	32.4 (4.7)	31.0 (2.2)
	Openness	24.6 (5.7)	25.6 (5.4)	23.9 (4.1)	24.3 (3.8)	24.5 (5.5)	23.8 (4.1)
	Agreeableness	34.2 (4.8)[#]	35.8 (5.3)[a,$]	30.8 (4.6)	29.0 (4.9)[a,#]	31.5 (3.1)[$]	32.5 (3.6)
	Conscientiousness	36.5 (4.2)	37.1 (6.2)	37.8 (5.8)[a]	33.4 (6.0)[a,$]	38.8 (4.8)[$]	37.3 (4.2)
Executive Functions							
Cognitive Flexibility	# of Correct	284.4 (39.9)	303.4 (33.0)	300.4 (43.4)	299.7 (36.0)	308.4 (50.3)	272.8 (39.7)
	Response Time (ms)	644 (55)[a,$]	610 (61)	579 (51)[a]	575 (45)[$]	601 (62)	619 (39)
	# of Incorrect	34.8 (16.7)	39.6 (20.1)	37.6 (18.4)	42.5 (15.4)[a]	27.5 (15.9)[a]	28.3 (9.9)
	# of Omissions	16.4 (7.5)	15.2 (6.5)	20.3 (6.4)[$]	19.3 (6.5)[#]	13.3 (8.0)[a,$,#]	20.6 (8.1)[a]
Inhibition	Response Time (ms)	236 (19)	233 (20)	227 (26)	242 (28)	234 (27)	245 (23)
	# of Commissions	15.7 (5.42)	13.8 (5.13)	15.7 (5.5)	15.0 (6.5)	13.9 (4.5)	13.9 (5.6)
	# of Omissions	9.1 (8.4)	5.4 (6.4)[a,$]	17.6 (11.9)[a,#,&]	17.8 (13.8)[$,d]	9.4 (9.8)[&]	6.9 (6.5)[#,d]
Working Memory	# of Correct	10.3 (2.4)	11.4 (2.3)	10.8 (2.2)	10.5 (1.9)	10.9 (2.3)	10.3 (2.4)
	Response Time (ms)	697 (158)	618 (116)[a]	711 (120)	696 (119)	747 (121)[a]	669 (96)
	# of Omissions	3.7 (2.4)	2.6 (2.3)	3.2 (2.2)	3.5 (1.9)	3.1 (2.3)	3.7 (2.4)
	# of Commissions	7.4 (3.5)	6.1 (4.4)	8.4 (5.9)	9.3 (5.5)	7.6 (4.9)	9.3 (7.4)

Note. Matching symbols [(a,$,#,&,d)] represent statistical significance between the two groups.

3.2.4.2 Team & EFs

Table 11 reports the differences between each personality trait and EF across each team measured. It is observed that the teams of male U19, female U20, and female Pro had similar, yet higher levels of neuroticism compared with the male teams U17, U23 and Pro. Similarly, the two female teams also had the highest levels of agreeableness whereas all the male teams had similar yet lower levels of agreeableness. No noteworthy differences amongst the teams were observed for extraversion and openness. However, differences were observed amongst conscientiousness, where the male U19 reported significantly lower conscientiousness scores compared to the other teams that remained relatively similar.

3.2.5 Discussion

The aim of the current study was to investigate the personality traits of high-level athletes using the FFM and measure their association to each separate executive function ability. Furthermore, it was also of interest to measure between group differences of this relationship for academy and senior teams. The main finding of the study was that each personality trait did not appear to have a significant positive or negative relationship with the performance variables across the EF battery.

3.2.5.1 Relationship Between Personality and Athletic Expertise

An early meta-analysis and review-article by Rhodes and Smith (47) reported that respectively physical active people tend to report higher levels in extraversion and conscientiousness and lower levels in neuroticism. Despite a relatively large number of studies measuring with physical active subjects that play sport at a recreational level, there are only a few studies that focus on athletes competing at a high-level. Recently, however, Vaughan and Edwards (4) were the first to investigate the relationship between personality and EF and whether these relationships were moderated by athletic expertise. The researchers recruited individuals with varying levels of expertise, ranging from non-athlete to the super-elite level.

Their main finding was athletes scored higher on extraversion, openness, and conscientiousness whereas non-athletes scored higher on neuroticism and agreeableness.

In our current study, using the same personality questionnaire (NEO-FFI) as Vaughan and Edwards (4), we report that the senior male team had the lowest levels of neuroticism, whereas the senior female team reported the highest level of neuroticism compared to the other teams. Extraversion, openness, and conscientiousness remained relatively stable across all teams throughout the youth academy to the adult professional teams. Last, both female teams displayed the highest levels of agreeableness while the senior men's team reporting the highest level across the male teams. The senior men's team displayed the lowest levels of neuroticism is supported by research observing that sport exposes athletes to repeated emotional highs and lows, allowing athletes autonomic nervous system to adapt, leading to lower neuroticism (48). Opposingly, the female Pros displayed one of the highest levels in comparison to the academy teams measures (only male U19 showed higher results). Therefore, it is not fully supported across both senior males and females teams that more experienced athletes have lower neuroticism due to higher accumulated exposure to emotionally taxing sporting experiences in their professional careers. However, as we did not record playing history questionnaires, this possibility is not voided. Furthermore, it was outside the scope of the current study to measure between-gender differences in personality traits. More studies should aim to overcome the gap in literature of between-gender differences in personality traits across the maturation of athletes competing in high-performance sports.

As previously mentioned, the male U19's team reported the highest levels of neuroticism. Moreover, the U19's did report distinct values compared to the other teams in the club. Alongside significantly higher neuroticism levels, the U19's had significantly lower agreeableness and conscientiousness levels. Furthermore, this team also scored the lowest on extroversion, but openness was even with the other teams. This team could be described as less sociable (extroversion), more nervous (neuroticism), less forgiving (agreeableness) and less

organized (conscientious) in comparison to the other teams within the club. These findings are contrary to previous studies examining personality traits with playing experience (49) and competitive level in sport (48, 50). This may be a result of the unique constraints of this stage in each athlete's career, where this age group is a highly competitive environment to secure a first team contract within the professional team.

3.2.5.2 Relationship Between EFs and Personality

Vaughan and Edwards (4) reported, that EFs was positively related to openness and conscientiousness, negatively related to neuroticism, bi-directionally related to extraversion, and unrelated to agreeableness. In the current study, we found EFs tended to be negatively related to neuroticism and extraversion, bi-directionally related to openness, and positively related to agreeableness and conscientiousness. However, it must be noted that many of the relationships between each separate personality trait and individual EF performance variable did not reach statistical significance, so although we get an indication of the direction of the relationships, our findings should be interpreted with caution. Furthermore, each personality trait appeared to have both positive and negative relationships with certain variables on the EF assessments, in some traits this was clearer than others. For example, openness was found to be equally positive and negative, with confidence intervals demonstrating that in some cases, it improves, and in others, it hinders EF performance. Vaughan and Edwards (4) reported that EFs was largely positively related to openness, whereas in the current study, higher openness was negatively related to increased response time and higher omission errors in the inhibition test opposing our hypothesis. No clear effect on working memory was observed.

Furthermore, we hypothesized that higher levels of neuroticism would be associated with reduced EF performance, as neuroticism has been shown to be negatively related to EFs in athletes (4). Our findings are partially in line with this notion, where a negative relation between neuroticism and poorer performance on cognitive flexibility and working memory was observed in the form of fewer correct responses, slower response times and higher number of

omitted responses. Previous research has demonstrated the susceptibility to experience negative emotions may be expressed as impulsivity, exhibited as an error-prone behavior on performance-based measures of EFs (51). In contrast, neuroticism was also positively related to a decreased response time and fewer omission errors on the inhibition test, and fewer incorrect responses made in the working memory test. The beneficial association observed between neuroticism and inhibition may be a result of the homogenous sample of high-level athletes recruited in the current study. To explain, Vaughan and Edwards (4) reported that although neuroticism was generally linked to worse response inhibition, this was not the case in the more elite athletic groups, where a higher neuroticism with higher expertise led to better response efficiency. Although higher neuroticism is associated with the inability to control desires, perhaps in sport athletes have learned to functionally use impulsivity when quick and firm decisions are required and jumping on opportunities when they seldomly present themselves (52).

Also contrary to our hypothesis, agreeableness appeared to have a positive benefit to performance on the EF assessments. Higher levels of agreeableness improved the number of correct responses and decreased response time on cognitive flexibility and working memory, and decreased response time and omission errors on the inhibition test. This contracts Vaughan and Edwards (4) study where the authors reported no link between agreeableness and EFs regardless of the moderation of athletic expertise. The two female teams did have higher levels of agreeableness than all the male teams, supporting the notion that agreeableness is associated with gender (53). Furthermore, the male professional team had the highest levels of agreeableness. A systematic review indicated that sport participants with high levels of agreeableness report more favorable relationships with their teammates and coaches (54). Opposingly, the younger team in the academy may have lower levels of agreeableness as it may be beneficial for sports achievement where younger athletes may require a higher need

competitiveness and aspirations to secure a first team contract (55). This is once more reinforced by the male U19 having the lowest levels of agreeableness.

Extraversion was largely related to negative performance across the EF assessment battery in the form of decreased response times, less total correct answers, and increased errors. For example, on inhibition, extraversion was linked to a decrease in response time but consequently a more erroneous performance. Furthermore, extraversion decreased response time in working memory test but also increased the number of incorrect responses. These results differ with the results reported by Campbell et al. (25), where higher extraversion levels were related to better inhibition and updating ability. Further performance differences were observed with an increase in task difficulty in favor of extroverts. Importantly, Campbell et al. (25) recruited university students and not athletes, and it must be considered that the relationship between EFs changes across the continuum of athletic expertise (4), so direct comparisons are not possible.

Interestingly, conscientiousness had no clear negative or positive relationship with any measured test. Although there was a tendency for the majority of the relationships between conscientiousness and EF variables to be positively beneficial, they too did not reach statistical significance. The weak relationships from the current study do not support the stronger relationships reported by Vaughan and Edwards (4) where higher conscientiousness was associated with better performance across shifting, inhibition and updating or by Johann and Karbach (29) concerning cognitive flexibility. However, conscientiousness levels were similar across all teams in the current study, which is logical given that it is an important predictor of soccer performance over time (56). Conscientiousness is important throughout the career of an athlete as it represents the tendency to control behaviors in service of personal goals (57). This behavioral trait translates into helping athletes stay committed on the development towards expertise and disposition to sustain effort despite adversity. In practice, this could be related to showing up to practice despite exhaustion or soreness (58). However, given the similarity

between the goal-oriented role of the conscientiousness trait and that EFs' major role is to ensure one's thoughts and actions remain goal-oriented (9), it is not known why these two variables were not more positively related in the current study.

One similar result between the two studies was that Vaughan and Edwards (4) models explained 13%–27% of the variance between EF with athletic expertise and personality, whereas our models explained 6%–23% of the variance. Together, this represents that although EFs has a relation with the personality of the athlete, there remains many unaccounted-for variables at play. Future studies should aim to explore what other variables can better explain this relationship (48), such as sport-specific (i.e., a contact or non-contact sport, a team or individual sport, etc.) and athlete-specific criteria (i.e., differences in physical body build, sport participation history questionnaires).

The contrasting findings of how personality changed according to athletic expertise may be attributable to the key differences in the methodology between Vaughan and Edwards (4) and the current study. Both studies similarly examined the relationship between athletic expertise, personality and EFs. Vaughan and Edwards (4) recruited athletes from a range of interceptive and strategic sports, but no further details were provided from what actual sports the athletes were sampled from. It remains unknown whether the constraints of each sport has a unique influence. Our current study was a sample of only soccer athletes. This difference is important as both personality (59) and EFs (32) differ between sport type. Furthermore, Vaughan and Edwards (4) evaluated athletic expertise as a range between non-athletic individuals to the super-elite level athlete, whereas our study determined athletic expertise by the progression of the academy teams to the senior adult professional team in a homogenous sample of athletes all competing at the same high-performance soccer club. Last, our results differ from the research because other similar studies have measured EFs using self-reported questionnaires (28, 60, 61), but self-reported and objective measures of EFs have been found to have no relationship (28). Previous methods [apart from Vaughan and Edwards (4)] may

have over-simplified the EF construct. Some studies have considered EF a single global construct (33) while others have used separated executive functioning into three core abilities (4). As evidence exists for divergent links between specific EFs and personality, future methodologies should use multiple measures of EF and relate them to individual personality traits rather than a global EF-score (22).

3.2.6 Limitations and Future Directions

The findings of the current study should be considered in the context of the study's limitations. First, although the study recruited a large sample of athletes competing at a senior adult professional level, it fell short of the requirements for more complex statistical models that may better capture the complex interrelationships between personality traits and EFs such as structural equation modelling. Future research should look to recruit a larger sample size from a single sport or within the same sport classification to avoid unaccounted for differences in the interactions of personality and EFs that may be unique to each sport. Furthermore, this study did not contain a control group. While the aim of this study was to measure the associations of personality and EFs across different ages in only high-performance populations, not having a control group limits our ability to determine whether the observed relationships between personality and EFs are unique to high-level athletes or generalized to the general population. Last, similar to Vaughan and Edwards (4), the current study was cross-sectional in nature. Future studies should aim employ a longitudinal study with multiple measures to measure the stability of the relationship between measures of EFs and the FFM. Finally, the current study is specific to the athletes competing at the one German soccer academy. Future studies should aim to compare these results with athletes competing at a similar level in various other countries to ensure these findings are more representative to other populations.

3.2.7 Conclusion

In the current study, we measured whether high level athletes' EFs are predicted by their personality traits. The current study differs from other literature by assessing both male and female soccer athletes using several academy and professional teams. Each personality trait did not appear to have a consistent positive or negative relationship across the cognitive battery. Although one personality trait may demonstrate beneficial improvements in some aspects of executive functioning, each trait tended to equally share negative relationships in other aspects of the EF battery. Therefore, our findings are in line with previous research where personality does appear have a contributable relationship with EF performance, yet this relationship alone underrepresents the true complexity of such relationship. More research is needed on whether the associations between athletes' EFs and personality reported here can further be supported in other similar athletic groups to help generalize the current study's findings.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Universität des Saarlandes Ethikkommission der Fakultät HW Campus A1 3 66123 Saarbrücken. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

JS: conceptualization, methodology, formal analysis, investigation, writing - original draft, writing - review and editing, project administration. AB: writing - original draft, writing - review and editing. JM: conceptualization, resources, supervision. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fspor.2023.1130759/full#supplementary-material.

Supplementary Table 1

A Detailed Report on the Linear Model Output for Each Independent Variable Across Both Team and Personality Trait

Variable	Estimate	CI: 2.5%	CI: 97.5%	Std. Error	t-value	p-value
Determination Test: Correct Responses (points)						
(Intercept) Female Pro	317.78	223.86	411.70	47.45	6.70	0.00
Female U20	-25.35	-52.01	1.32	13.47	-1.88	0.06
Male U17	-0.36	-24.79	24.07	12.34	-0.03	0.98
Male U19	-1.56	-28.10	24.98	13.41	-0.12	0.91
Male U23	6.05	-18.57	30.66	12.44	0.49	0.63
Male Pro	-32.09	-62.49	-1.70	15.36	-2.09	0.04
N	-0.21	-1.55	1.13	0.68	-0.31	0.76
E	-1.52	-3.38	0.33	0.94	-1.62	0.11
O	0.01	-1.56	1.58	0.79	0.01	0.99
A	0.84	-0.85	2.53	0.86	0.98	0.33
C	0.25	-1.20	1.70	0.73	0.34	0.73
Determination Test: Response Time (ms)						
(Intercept) Female Pro	639.60	513.74	765.46	63.58	10.06	<0.001
Female U20	37.22	1.50	72.95	18.05	2.06	0.04
Male U17	-33.47	-66.22	-0.72	16.55	-2.02	0.05
Male U19	-40.29	-76.06	-4.51	18.07	-2.23	0.03
Male U23	-10.10	-43.10	22.89	16.67	-0.61	0.55
Male Pro	7.99	-34.00	49.98	21.22	0.38	0.71
N	0.15	-1.64	1.95	0.91	0.17	0.87
E	0.41	-2.08	2.91	1.26	0.33	0.74
O	-0.41	-2.51	1.69	1.06	-0.38	0.70
A	-0.67	-2.96	1.61	1.15	-0.58	0.56
C	-0.31	-2.27	1.65	0.99	-0.32	0.75
Determination Test: Incorrect Responses (points)						
(Intercept) Female Pro	-0.14	-38.54	38.26	19.40	-0.01	0.99
Female U20	-1.69	-12.49	9.12	5.46	-0.31	0.76
Male U17	1.38	-8.67	11.42	5.08	0.27	0.79
Male U19	6.61	-4.24	17.47	5.49	1.21	0.23
Male U23	-8.51	-18.51	1.48	5.05	-1.69	0.09
Male Pro	-7.11	-19.45	5.22	6.23	-1.14	0.26
N	0.25	-0.29	0.80	0.28	0.91	0.36
E	0.84	0.08	1.59	0.38	2.20	0.03
O	0.25	-0.39	0.89	0.32	0.77	0.44
A	0.36	-0.33	1.04	0.35	1.02	0.31
C	-0.29	-0.89	0.31	0.30	-0.97	0.34

Supplementary Table 1 continues next page

Variable	Estimate	CI: 2.5%	CI: 97.5%	Std. Error	t-value	p-value
Determination Test: Omission Errors (points)						
(Intercept) Female Pro	2.52	-14.02	19.07	8.36	0.30	0.76
Female U20	2.17	-2.47	6.82	2.35	0.93	0.36
Male U17	5.81	1.56	10.06	2.15	2.70	0.01
Male U19	4.88	0.28	9.49	2.33	2.10	0.04
Male U23	-1.06	-5.35	3.24	2.17	-0.49	0.63
Male Pro	6.68	1.38	11.98	2.68	2.50	0.01
N	0.15	-0.09	0.38	0.12	1.23	0.22
E	0.26	-0.06	0.59	0.16	1.61	0.11
O	0.01	-0.26	0.28	0.14	0.07	0.94
A	0.05	-0.25	0.35	0.15	0.33	0.74
C	-0.01	-0.26	0.24	0.13	-0.07	0.94
Response Inhibition Test: Response Time (ms)						
(Intercept) Female Pro	240.86	184.76	296.96	28.33	8.50	<0.001
Female U20	2.49	-13.62	18.61	8.14	0.31	0.76
Male U17	-8.92	-23.52	5.69	7.38	-1.21	0.23
Male U19	6.12	-10.28	22.52	8.28	0.74	0.46
Male U23	-2.73	-17.45	11.99	7.44	-0.37	0.71
Male Pro	9.03	-8.98	27.05	9.10	0.99	0.32
N	-0.28	-1.08	0.53	0.41	-0.68	0.50
E	-0.52	-1.63	0.59	0.56	-0.93	0.35
O	0.79	-0.16	1.73	0.48	1.65	0.10
A	-0.56	-1.59	0.47	0.52	-1.07	0.29
C	0.37	-0.49	1.24	0.44	0.86	0.39
Response Inhibition Test: Commission Errors (points)						
(Intercept) Female Pro	10.77	-1.47	23.00	6.18	1.74	0.08
Female U20	1.88	-1.59	5.35	1.76	1.07	0.29
Male U17	2.09	-1.10	5.27	1.61	1.30	0.20
Male U19	1.34	-2.11	4.80	1.75	0.77	0.44
Male U23	0.60	-2.61	3.81	1.62	0.37	0.71
Male Pro	0.53	-3.43	4.49	2.00	0.27	0.79
N	0.14	-0.03	0.32	0.09	1.64	0.10
E	0.11	-0.13	0.35	0.12	0.91	0.36
O	-0.24	-0.44	-0.04	0.10	-2.33	0.02
A	0.09	-0.13	0.31	0.11	0.79	0.43
C	0.01	-0.18	0.20	0.10	0.10	0.92
Response Inhibition Test: Omission Errors (points)						
(Intercept) Female Pro	17.70	-5.78	41.18	11.86	1.49	0.14
Female U20	3.67	-3.07	10.42	3.41	1.08	0.28
Male U17	10.47	4.36	16.59	3.09	3.39	0.00
Male U19	11.27	4.53	18.02	3.41	3.31	0.00
Male U23	2.53	-3.65	8.72	3.12	0.81	0.42
Male Pro	0.06	-7.48	7.60	3.81	0.02	0.99

Supplementary Table 1 continues next page

Variable	Estimate	CI: 2.5%	CI: 97.5%	Std. Error	t-value	p-value
N	-0.14	-0.48	0.20	0.17	-0.81	0.42
E	0.18	-0.28	0.64	0.23	0.77	0.44
O	-0.31	-0.71	0.08	0.20	-1.56	0.12
A	-0.15	-0.57	0.28	0.22	-0.67	0.50
C	-0.07	-0.43	0.29	0.18	-0.39	0.70
N-Back Test: Correct Answers (points)						
(Intercept) Female Pro	9.51	4.50	14.52	2.53	3.76	0.00
Female U20	-0.82	-2.25	0.60	0.72	-1.15	0.25
Male U17	0.01	-1.29	1.31	0.66	0.02	0.99
Male U19	-0.19	-1.60	1.23	0.72	-0.26	0.79
Male U23	-0.08	-1.39	1.24	0.66	-0.11	0.91
Male Pro	-0.78	-2.40	0.84	0.82	-0.96	0.34
N	-0.02	-0.10	0.05	0.04	-0.66	0.51
E	-0.07	-0.17	0.03	0.05	-1.43	0.15
O	0.03	-0.05	0.12	0.04	0.82	0.41
A	0.09	0.00	0.18	0.05	1.94	0.06
C	0.01	-0.07	0.09	0.04	0.29	0.78
N-Back Test: Response time (ms)						
(Intercept) Female Pro	641.88	355.35	928.41	144.74	4.44	0.00
Female U20	79.51	-1.66	160.68	41.00	1.94	0.05
Male U17	107.06	32.50	181.62	37.67	2.84	0.01
Male U19	70.67	-11.59	152.92	41.55	1.70	0.09
Male U23	142.85	67.79	217.92	37.92	3.77	0.00
Male Pro	59.52	-33.06	152.10	46.77	1.27	0.21
N	2.84	-1.27	6.96	2.08	1.37	0.17
E	-4.19	-9.85	1.47	2.86	-1.46	0.15
O	0.25	-4.58	5.08	2.44	0.10	0.92
A	1.26	-3.92	6.44	2.62	0.48	0.63
C	0.48	-4.01	4.97	2.27	0.21	0.83
N-Back Test: Commission errors (points)						
(Intercept) Female Pro	10.80	-2.53	24.14	6.73	1.61	0.11
Female U20	0.98	-2.46	4.41	1.74	0.56	0.57
Male U17	1.27	-1.98	4.53	1.64	0.78	0.44
Male U19	1.84	-1.84	5.52	1.86	0.99	0.33
Male U23	0.53	-2.77	3.84	1.67	0.32	0.75
Male Pro	2.51	-1.53	6.55	2.04	1.23	0.22
N	-0.06	-0.23	0.12	0.09	-0.64	0.52
E	0.09	-0.17	0.34	0.13	0.68	0.50
O	0.12	-0.09	0.33	0.11	1.14	0.26
A	-0.17	-0.40	0.06	0.12	-1.46	0.15
C	-0.09	-0.29	0.10	0.10	-0.93	0.36

Supplementary Table 1 continues next page

Variable	Estimate	CI: 2.5%	CI: 97.5%	Std. Error	t-value	p-value
N-Back Test: Omission Errors (points)						
(Intercept) Female Pro	4.49	-0.52	9.50	2.53	1.77	0.08
Female U20	0.82	-0.60	2.25	0.72	1.15	0.25
Male U17	-0.01	-1.31	1.29	0.66	-0.02	0.99
Male U19	0.19	-1.23	1.60	0.72	0.26	0.79
Male U23	0.08	-1.24	1.39	0.66	0.11	0.91
Male Pro	0.78	-0.84	2.40	0.82	0.96	0.34
N	0.02	-0.05	0.10	0.04	0.66	0.51
E	0.07	-0.03	0.17	0.05	1.43	0.15
O	-0.03	-0.12	0.05	0.04	-0.82	0.41
A	-0.09	-0.18	0.00	0.05	-1.94	0.06
C	-0.01	-0.09	0.07	0.04	-0.29	0.78

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3.3 Study 3: Searching for The Perfect Goalkeeping Personality. Myth or Reality?

The content of Study 3 has been reformatted for the purpose of the dissertation. The full reference of the published manuscript is:

Spielmann, J., Otte, F. W., Schumacher, T., Mayer, J., & Klatt, S. (2024). Searching for the perfect goalkeeping personality. Myth or reality?. *Frontiers in Psychology*, 15, 1418004. https://doi.org/10.3389/fpsyg.2024.1418004.

Searching for the perfect goalkeeping personality. Myth or reality?

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Date of submission: 25.06.2024

3.3.1 Abstract

Background:

Psychological factors such as personality characteristics are influential factors of the goalkeeping performance in football (soccer). Not only for individualized treatment in practice, also from a scientific point of view, profiling goalkeepers is a relevant part of understanding athletes. The aim of this study was to investigate personality traits of goalkeepers of different expertise, age, and sex.

Methods:

Using the Five Factor Model of personality we assessed personality traits of 132 male and female football goalkeepers ranging from youth to senior and low to elite level. A series of analysis investigated differences between the groups focusing on expertise, age, and sex.

Results:

Significant differences in the personality trait agreeableness between groups of different expertise and sex could be detected. Although a significant difference in neuroticism levels of males and females could be shown.

Conclusion:

This study was a first step of profiling football goalkeepers of different expertise, age, and sex. The study calls for more replication in this specific field of football and goalkeeping in general to understand the influence of personality characteristics on sport performance.

Keywords:

Personality, big-five, football, soccer, athletes

3.3.2 Introduction

"Goalkeepers need an element of insanity. Who else would want to stand there and allow people to shoot balls at their face or abdomen, and still think it's great?"

—Oliver Kahn, three-time winner of the IFFHS world's best goalkeeper award.

[cited from Gorris and Kubjuweit (2008)]

The narrative around football goalkeepers (GK) is often linked to a presentation of distinct psychological profiles with "strong" personalities that also may be perceived as "outside the norm" or, more jokingly, "not quite right" (Giertz, 2014). From a scientific point of view, current research does not provide conclusive answers to the question if top-level GKs generally differ in their personality profiles from those with lower performance levels. While, to date, there have only been few studies investigating GKs' personality traits, it remains largely unclear to what extent professional GKs embody certain personality characteristics. Empirical knowledge about potentially more dominant personality characteristics in professional GKs (compared with their rather less advanced counterparts), across male and female GKs at varying performance levels, could largely influence talent identification and scouting processes. Due to the lack of knowledge in this field and in order to support psychological consulting, training, and personality development, the following study investigates the existence of "a perfect goalkeeping personality profile" for performance at the professional level. We aim to examine whether this idea is close to reality or, rather, a full-on myth. For one, potential results indicating existence of an "idealized personality profile" for GKs at the professional level would assist researchers, psychologist and coaching practitioners in searching for certain personality traits when identifying and developing the future likes of world-class GKs, such as Mary Earps, Merle Frohms, Alisson Becker or Yann Sommer. In contrast, potential dispersed findings could make a case for an individual-environment-centered coaching approach (Otte et al., 2021). This

coaching perspective equally considers and entangles (i) individuality of and differences between each GK, independent of performance level, experience and gender; and (ii) the development and performance contexts that players are embedded into (Sullivan et al., 2021).

Finally, prior to diving into the presented research study, the following paragraphs provide deeper theoretical understanding into positional demands in football goalkeeping and current empirical knowledge about personality profiling in sports and its connections with athletic expertise and gender differences.

3.3.2.1 Research on Positional Demands in Football Goalkeeping

Concerning the positional requirements, goalkeeping in football arguably demands different skills that go beyond those of outfield players, not only from a tactical-technical point of view (for detailed overviews see Rechner and Memmert, 2010; Otte et al., 2022). In brief, the majority of the (limited number of) studies on goalkeeping deal with topics, such as physiological performance data on GKs' body composition, jumping power, sprint values (Sporis et al., 2009; Gil et al., 2014; Rebelo-Gonçalves et al., 2015), GKs' physical training loadings (e.g., White et al., 2020), position-specific behavior (Memmert et al., 2013; van der Kamp et al., 2018; Navia et al., 2019), GK-specific skill training periodization and coaching (Otte et al., 2019, 2020a,b), and perceptual-cognitive abilities (Savelsbergh et al., 2002; Woolley et al., 2015).

From a sport psychological standpoint, GKs are confronted with exceptional and distinctive challenges (West, 2018). For instance, a GK's game performance often is rated by an extreme dichotomy of either a successful or poor performance, which can be seen nearly every weekend: One save or, contrastingly, one goalkeeping mistake potentially determining the whole GKs rating. Thus, in professional football the outside perspective of fans, spectators, media, and other external parties seemingly has little room for gray areas. This leads to increased pressures for GKs to perform or, more drastically, to avoid mistakes. Put simple, the specific role of the GK in football appears highly demanding from a mental perspective and

therefore, requires a stress-resistant psychological profile (Otte et al., 2020c). The classical psychological field of personality research appears to be relatively underrepresented, although relevance is obvious: utilizing a comprehensive approach, Hughes et al. (2012) emphasize the importance of the categories of concentration, motivation, attitude, and body language when evaluating GKs. These categories may coherently be combined with the results of a recent study on GK training and the requirement profile for professional GKs (Otte et al., 2019). In their qualitative study, the authors asked professional goalkeeping coaches to holistically reflect on the question of: "What critical skills does a top goalkeeper need?". Among numerous physical and tactical-technical factors, the interviewed experts highlighted the area of "mentality" as an essential component in high-performance goalkeeping. Using keywords, such as "courage", "concentration", "work attitude and professionalism", coaches stressed the relevance of mental skills and a distinct GK "personality". Interestingly, it is precisely the latter term of "personality" that again bridges the gap to this research, analysis, and evaluation of personality traits of GKs. Finally, due to a lack of research on personality profiling in football (here, goalkeeping), this paper aims to investigate differences in personality traits of GKs on different performance levels (i.e., professional, semi-professional/amateur, and elite-youth GKs) and potential gender differences between male and female GKs. Current theoretical and scientific knowledge within the field of personality research in sport will be presented in the following paragraphs and later re-connected to the football goalkeeping context.

3.3.2.2 Current Scientific Knowledge About Personality Profiling in Sports

3.3.2.2.1 Personality and Sports

Personality can be assessed by the use of trait assessments. Differential psychology often uses the Five Factor Model of Personality (FFM; McCrae and Costa, 1999; Mc Crae and Costa, 2008), which can be associated with a wide acceptance throughout literature (de Moor et al., 2012; Allen et al., 2013; Bircher et al., 2017). It divides personality into five traits: openness (O; curious, creative, and imaginative), conscientiousness (C; organized, punctual,

and structured), extraversion (E; sociable, outgoing, and active), agreeableness (A; good-natured, unselfish, and forgiving), and neuroticism (N; anxious, hostile, and irritable). Besides scientific interest in assessments of personality traits, practical deductions can be used for everyday work. Therefore, scientific assessments can always provide objective perspectives of somebody's needs and motives as an addition to subjective estimations. Specifically in the world of high-performance sports, latter form of subjective estimations is overrepresented when it comes to talent identification, individualized action and developing processes (Cripps et al., 2019). Applied working personnel like sport psychologists and coaches can benefit from conclusions of an athlete's personality expression in terms of individualized intervention, consulting, coaching, and training. Depending on a certain characteristic or expression, communication and course of action should be adapted to each individual to provide best fittings possible. For example, literature shows beneficial interdependences between knowledge about athletes personality characteristics and important personal and career transitions (Laurin, 2009), integration processes (Beauchamps et al., 2007), and interpersonal relationships (Cuperman and Ickes, 2009; Jackson et al., 2011; Allen et al., 2013). Further, players can benefit from confronting themselves with their own trait-profile as an instrument of personality-development and setting-specific orientation. This could influence diverse factors of an athlete's life like training structuring (conscientiousness), risky decision making (neuroticism), diversify processes (openness), selfcentration (agreeableness), or relationship building (extraversion), which at best leads to enhanced player long-term development and improved performances, both on and off the pitch (Piedmont et al., 1999; García-Naveira et al., 2011.; Ruiz-Barquín and García-Naveira, 2013).

Additionally, several hypothesis and theories have been developed over the years to better understand the relationship between sports and personality. To further analyze the findings of this study, we also give a broad overview to these theories. One crucial distinction hereby is the difference between the "development hypothesis" and the "selection hypothesis".

Proponents of the development hypothesis argue that sport activity influences the athlete's personality, while proponents of the selection hypothesis argue that the influence is the other way around—personality characteristics make athletes choose certain sports (García-Naveira and Ruiz-Barquín, 2016).

In general, both hypotheses can be combined in a mixed approach, as the selection and active participation in a sport both influence an individual's psychological profile sports (García-Naveira and Ruiz-Barquín, 2016). This lines up with the theory of "performance hypothesis". The performance hypothesis, developed by García-Naveira and Ruiz-Barquín (2016), argue that certain personality traits are inherently linked to the heightened performance in a sporting context. As an example, could goalkeepers which personality type is considered extroverted, adapt more easily to the demands of the position compared to introverted ones and therefore play on a higher level? The performance hypothesis would agree to said question, which could theoretically allow a personality distinction between different levels of expertise in relevant sport positions.

3.3.2.2.2 Personality and athletic expertise

Personality characteristics of individuals and groups representing high expertise levels in any field of interest are often in focus of research; this, simply because these individuals have something unique, special and often the ability to do things "regular" humans are not capable of. For example, researchers investigated personality profiles of Mount Everest climbers (Egan and Stelmack, 2003), Olympic athletes (Piepiora et al., 2022b), or ultra-marathon participants (Hughes et al., 2003). As mentioned above, such an exposed role can also be applied to high-level football goalkeeping. Digging deeper into this specific clientele, it is worth using a bottom up approach by reviewing findings outside the goalkeeping field: focusing on the basic levels of physical activity, meta-analysis found positive correlations with extraversion, conscientiousness (Rhodes and Smith, 2006; Wilson and Dishman, 2015) and openness (Wilson and Dishman, 2015), whereas neuroticism was associated negatively (Rhodes and Smith, 2006;

Wilson and Dishman, 2015). Studies focusing on the bidirectional associations between the constructs are also worth to be highlighted (Tolea et al., 2012; Stephan et al., 2014; Allen et al., 2015). For example, Allen et al. (2017) could show, that personality has a relevant impact for change in physical activity, whereas physical activity is relatively unimportant for changing personality characteristics. Classifying these general considerations into expertise levels, there are other contexts (e.g., occasional or academia settings), in which personality has been proven to influence on domain-specific success (Poropat, 2009; Furnham, 2018). Similar results can be reported for the setting of sports.

There is an increased number of studies focusing on the role of personality on athletic expertise and success. Examples for this field are investigations of differences in personality profiles of selected and non-selected athletes for the Paralympics (Martin et al., 2011), athletes' match statistics throughout a season (Piedmont et al., 1999), and personality characteristics as a prediction criteria for expertise (Morgan and Johnson, 1978; Aidman, 2007; Martin et al., 2011). When examining expertise levels in sports, high-level athletes show lower expressions for neuroticism (e.g., Kirkcaldy, 1982; Allen et al., 2011; Stela et al., 2018; Vaughan and Edwards, 2020), and higher expressions for extraversion (e.g., Williams and Parkin, 1980; Newcombe and Boyle, 1995; Egloff and Gruhn, 1996), conscientiousness (e.g., Allen et al., 2011; Steca et al., 2018; Vaughan and Edwards, 2020), and openness (e.g., Goddard et al., 2019; Vaughan and Edwards, 2020). Results for agreeableness remain unclear, as both higher (Allen et al., 2011) and lower (Vaughan and Edwards, 2020) expressions have been found. Another approach is operationalizing expertise by age progression, as older athletes (in comparison to younger athletes) proved their ability to perform on a specific level for a longer period of time. From a longitudinal point of view, the affiliation to a certain stage of expertise is less influenced by short term specific biases like performance peeks, over- or underrating, and luck. Those examined athletes demonstrated their ability against all possible odds throughout their career. Here, one study investigating young and senior athletes showed larger expressions for

agreeableness, conscientiousness, and openness in the latter group (Trninić et al., 2016). This could support the approach of using age as a potential variable defining expertise, as at least conscientiousness and openness (as mentioned above) differentiate higher- from lower-level athletes. As specific characteristics and combinations of traits could be beneficial for different sports or expertise levels, these findings should always be interpreted considering their specific settings. As most of the current studies use samples of various disciplines representing various population sizes, profile requirements, and levels of professionalism, the mentioned findings are not generally transferable. To clarify, whether or not these trends of expertise levels are applicable to one specific discipline and playing position (i.e., football goalkeeping), this study aims to further investigate.

3.3.2.2.3 Personality and gender differences

The popularity of female sport is an obvious and increasing process of modern sport development, specifically in football. For example, the European Women's Championships (Women's EURO) made a progression in global audience from 116 million (2013) to 178 million (2017) to 365 million in the tournament of 2022 in England (UEFA, 2022). Although the popularity of female football is rising, women are still facing barriers such as lack of funding or basic concerns like finding suitable teams (O'Reilly et al., 2018). Similar circumstances can be found in the scientific world (Emmonds et al., 2019): female-specific research is dragging behind because of long-term inequality like distribution of resources which goes in line with levels of professionalism and participation. In this line, the field of goalkeeping is definitely not an exception.

Personality differences between males and females are one big field of interest for differential psychology. For norm populations, males tend to have lower levels of conscientiousness, neuroticism, agreeableness, and extraversion (Feingold, 1994; Costa et al., 2001; Schmitt et al., 2008). There is some evidence, that these findings could be transferred to the sporting context. For example, some researchers are of the opinion that physically active

females display personality characteristics closer to males than inactive females (Fleming, 1934; Williams and Parkin, 1980; Allen et al., 2013). Nevertheless, Allen et al. (2011) found males scoring lower in conscientiousness, neuroticism, and agreeableness in a sample of different expertise levels and sports. Later, Gyomber et al. (2013) showed lower scores for extraversion and openness in male than in female subjects. It is suggested, that those findings could be directly transferred to expressions found in comparisons between male athletes and non-athletic populations (Allen et al., 2013). Notably, compared to research outside sports, these findings are no more than trends, as there are also contrary results published (O'Sullivan et al., 1998; Rhodes and Smith, 2006; Sutin et al., 2016). The only trait which seems in line throughout most findings is neuroticism showing higher expressions for females in general (Kirkcaldy, 1982; Colley et al., 1985; Newcombe and Boyle, 1995; Ruiz-Barquín, 2005). Like in other scientific areas, further research to investigate general gender differences in athletic populations, specifically in high-level athlete samples, is needed.

3.3.2.3 Aims & Hypotheses

This study aims to investigate personality traits of a sample of football GKs with the Five-Factor Model. In detail, differences in trait-characteristics of various expertise and age groups together with a gender separation are point of interest. It is hypothesized that GKs of higher expertise levels show larger expressions of extraversion, conscientiousness, and openness and lower values in neuroticism than GKs of lower expertise levels (hypothesis 1). Regarding gender, it is assumed that female GKs show higher values for neuroticism than male GKs (hypothesis 2). Furthermore, we hypothesize that as female GKs progress in expertise, their neuroticism values will be closer to the lower expertise male GKs (hypothesis 3).

3.3.3 Methods & Materials

3.3.3.1 Participants

In total, 132 football goalkeepers (96 male; 36 female) aged 16–37 years (M = 20.43 years, SD = 4.94) participated in this study (Table 12). All participants were German native

speakers to prevent the dataset of biases such as misunderstanding the questionnaires or test instructions. In sum, all GKs were current players of 38 different clubs all over Germany, ranging from the U17's to senior level. Altogether, 37 GKs (28.03%) have been or were part of a youth or adult national team. Regarding our hypothesis, we ran several post-hoc analyses with the program G*Power (Version 3; Faul et al., 2007) to retrospectively determine the Power of our dataset. For hypothesis 1, we achieved a Power of 0.942 with a Pillai's V of 0.15. Hypothesis 2 had a Power of 0.999 with a Pillai's V of 0.255 and hypothesis 3 had a Power of 0.999 with a Pillai's V of 0.485.

3.3.3.2 Personality Assessment

The German adaptation by Borkenau and Ostendorf (2008) of McCrae and Costa's (1987) NEO-FFI questionnaire was used to determine athletes' personality traits. The questionnaire consists of 60 items rated on a five-point Likert scale (strongly disagree, disagree, neutral, agree, strongly agree). It is a self-report measure that assesses the five personality dimensions: extraversion (E), neuroticism (N), openness (O), agreeableness (A), and conscientiousness (C). The NEO-FFI is a well-established questionnaire with quality criteria reported in various populations (McCrae and Costa, 2004), especially in elite football players (Spielmann et al., 2022). Furthermore, reliability coefficients for the NEO-FFI in the current sample were N = 0.81, E = 0.66, O = 0.67, A = 0.69, and C = 0.81.

Table 12

Descriptive NEO-FFI Statistics (*n* = 132, Plus Gender and Level Separation, Raw Scores)

	Level		Trait				
			N	E	O	A	C
All athletes (n = 132)	Pro	M	15.79	30.28	26.34	34.86	37.28
		SD	5.75	5.09	4.79	3.99	5.81
	Elite youth	M	15.17	30.91	24.97	31.37	38.26
		SD	6.46	4.49	5.34	4.85	4.48
	Semi-pro / amateur	M	16.71	30.67	26.29	32.19	35.81
		SD	7.48	3.44	5.28	4.92	5.67
Males (n = 96)	Pro	M	13.62	29.31	25.15	33.77	40.08
		SD	4.50	6.50	4.26	4.78	4.89
	Elite youth	M	14.56	30.67	24.98	30.33	37.72
		SD	6.70	4.61	5.26	4.93	4.70
	Semi-pro / amateur	M	16.11	30.22	26.33	31.33	35.22
		SD	6.50	3.49	5.69	4.54	5.68
	Amateur youth	M	15.00	30.25	24.42	31.25	36.00
		SD	4.65	6.41	5.09	4.80	6.07
Females (n = 36)	Pro	M	17.56	31.06	27.31	35.75	35.00
		SD	6.16	3.62	5.11	3.09	5.62
	Elite youth	M	17.25	31.75	24.94	34.88	40.06
		SD	5.24	4.09	5.80	2.28	3.13
	Semi-pro / amateur	M	20.33	33.33	26.00	37.33	39.33
		SD	13.31	1.53	2.00	4.51	5.03

3.3.3.3 Procedure

Prior to the commencement of this study, informed consent from all athletes (and a legal guardian for all participants under 18 years of age) was received, and the Institutional Ethics Committee approved this study (approval number: 19-19). Players answered the personality questionnaire via an online survey. The assessment had a standardized introduction and familiarization protocol, and a sport psychologist could always be consulted. Before the participants started, they were informed, that all results would stay anonymous, and they will not get any negative consequence if they do not participate. They did not get any compensation for being part of the study. The online survey was either presented during the professional clubs' standardized sport psychological diagnostics battery or sent directly in terms of personal contact. In the former case, the survey was conducted in small group settings in a separate room.

In the latter case, the survey was answered in an individual environment. Reading and answering the assessment took ~15 min. Finally, GKs' statements about their current and past playing levels were used to create participant groupings for statistical analysis. Using an applied approach based on football knowledge about the German senior and youth league systems and playing levels, six groups and their respective selection criteria were established (Supplementary Table 2).

3.3.3.4 Statistical Analysis

For most of the hypotheses a MANOVA with a protected F-Approach was used. The effects were subsequently controlled with the usage of a *post-hoc* Tukey Test. To analyze possible differences for effects of gender, post-hoc tests were conducted using a student's *t*-test. For the last hypothesis, we also used multiple pairwise comparisons to obtain specific differences between our diverse goalkeeper groups. The significance level was set at $p < 0.05$, and an estimate precision was provided using Wald- based 95% confidence intervals. Prior to the analysis, the data were first screened for outliers, missing data, and checked for normality using visual inspection of box plots through a Shapiro-Wilk test of normality in accordance to Tabachnick and Fidell (2014). Bonferroni correction was used to adjust a with a new level of $\alpha = 0.01$.

3.3.4 Results

3.3.4.1 Preliminary Analysis

All studies were preliminary checked for their assumptions. Due to the highly specialized sample size of elite athletes, certain outliers were noticeable and problems regarding univariate, especially regarding the personality trait of Neuroticism. This unusually large distribution of values may be of interest when considering future analysis but may be due to the unique sample size. A removal of the factor Neuroticism resulted in no changes regarding the significance of the analysis and therefore remained in the analysis. Due to some of the preliminary assumptions being violated, the authors opted out to use Pillai's trace in the

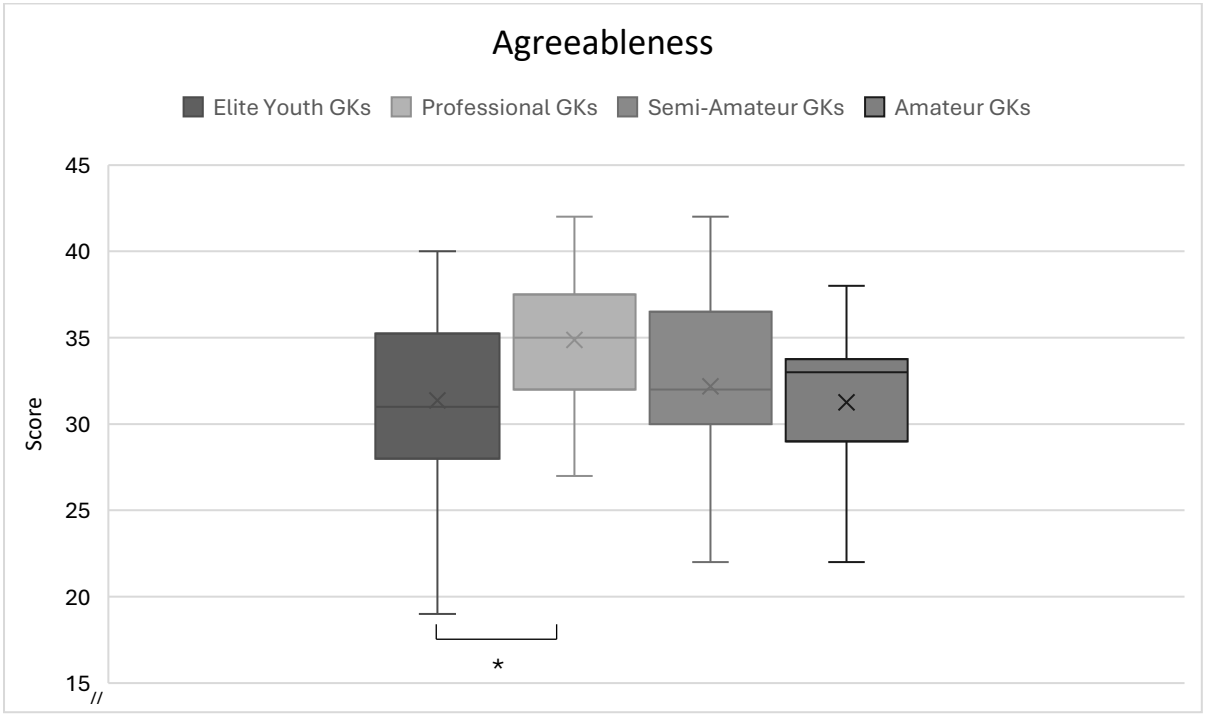
MANOVA analysis. This is because of the high robustness regarding violations of assumptions (Pillai, 1955).

3.3.4.2 Expertise Related Differences

The first objective of the study was to examine differences in personality characteristics depending on expertise level and age respectively. The MANOVA was significant at $F_{(5)}$ = 4.045, p = 0.002, η^2 = 0.138. As the five personality values were compared with each other, a Bonferroni correction in the singular ANOVA with a new critical α of 0.01 was used. This value was only reached by agreeableness with $F_{(3)}$ = 3.983, p = 0.009, η^2 = 0.085. This effect size indicates a medium effect. *Post-hoc* analysis using Bonferroni were done to clarify these results. As shown in Figure 5, they showed a significant difference between elite youth (M = 31.43, SD = 4.91) and pro GKs (M = 34.86, SD = 4.06). This indicates that pro GKs have a higher agreeableness score than elite youth GKs. No significant differences were found for the other personality traits or for the amateur groups and thus, hypothesis 1 is rejected.

Figure 5

Comparison of Agreeableness Scores Between Expertise Levels



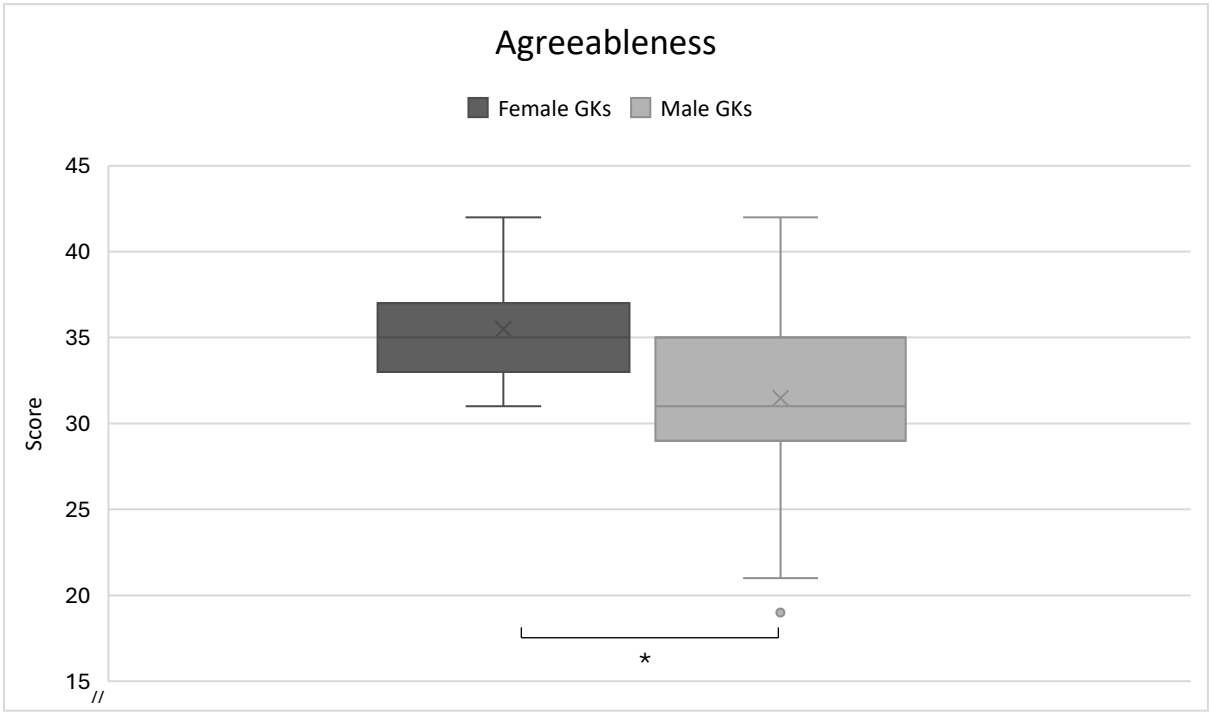
Note. Significant differences are marked with a *.

3.3.4.3 Gender Related Differences

As a second objective, differences between genders were determined. A MANOVA revealed a significant finding at $F_{(5)} = 8.372$, $p < 0.001$, $\eta^2 = 0.249$. Additional ANOVAS according to protected F-Measure were performed to find exact difference. These showed, after Bonferroni correction, a trend in gender differences for neuroticism [$F_{(1)} = 5.550$, $p = 0.02$, $\eta^2 = 0.041$)] and significant gender differences for agreeableness [$F_{(1)} = 24.865$, $p < 0.001$, $\eta^2 = 0.161$] scores ($\alpha = 0.01$). Further *t*-tests were used to clarify the differences. Significant findings could be shown for neuroticism [$t_{(130)} = 2.328$, $p = 0.023$, $d = 0.04$] and agreeableness [$t_{(130)} = 4.987$, $p < 0.001$, $d = 0.088$]. In detail male GKs scored lower in both agreeableness ($M = 31.09$; $SD = 4.912$ vs. $M = 35.49$; $SD = 2.86$; Figure 6), and neuroticism ($M = 14\text{-}77$; $SD = 6.17$ vs. $M = 17.66$; $SD = 6.32$; Figure 7) as female GKs. The low effect sizes in this analysis could stem from the fact that we analyzed two samples with very different sizes. To obtain a higher effect size, future studies with more female goalkeepers should be conducted to fully understand possible personality differences between male and female GKs.

Figure 6

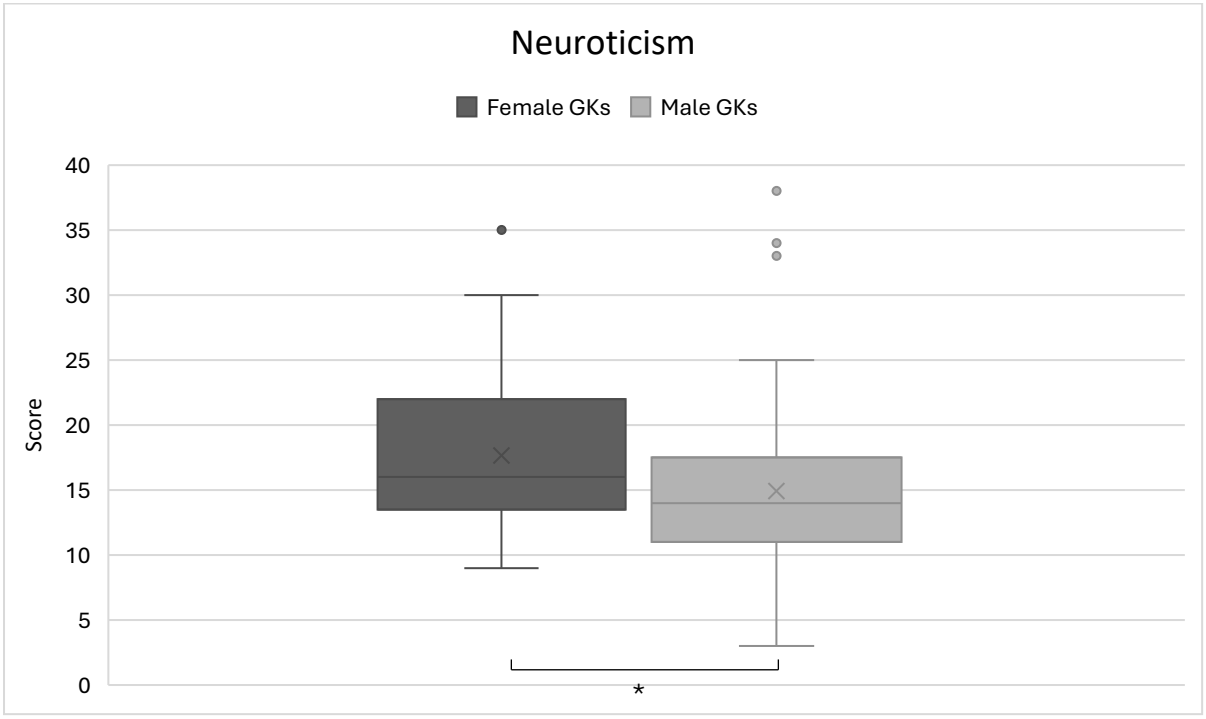
Comparison of Agreeableness Scores Between Female and Male Goalkeepers (GKs)



Note. Significant differences are marked with a *.

Figure 7

Comparison of Neuroticism Scores Between Female and Male Goalkeepers (GKs)



Note. Significant differences are marked with a *.

3.3.4.4 Expertise and Gender Related Differences

Lastly, the third objective of the study was to investigate if female GKs as progressing in expertise, their personality characteristics show closer comparability to lower expertise male GKs. The MANOVA itself was significant at $F_{(30)} = 2.229$, $p < 0.001$, $\eta^2 = 0.097$. The additional ANOVAS showed significant effects for agreeableness [$F_{(6)} = 5.082$, $p < 0.001$, $\eta^2 = 0.205$] and one less strong effect for conscientiousness [$F_{(6)} = 2.323$, $p = 0.037$, $\eta^2 = 0.106$]. All of these effect sizes are generally deemed as medium – large. As hypothesis 3 focused on significant effects in neuroticism only, the assumption is rejected. After applying Bonferroni correction, conscientiousness is no longer significant, however this can be seen by the reason of the limiting sample size. Regardless and due to the intriguing sample, we will continue the analysis, however we must interpret conscientiousness findings with care.

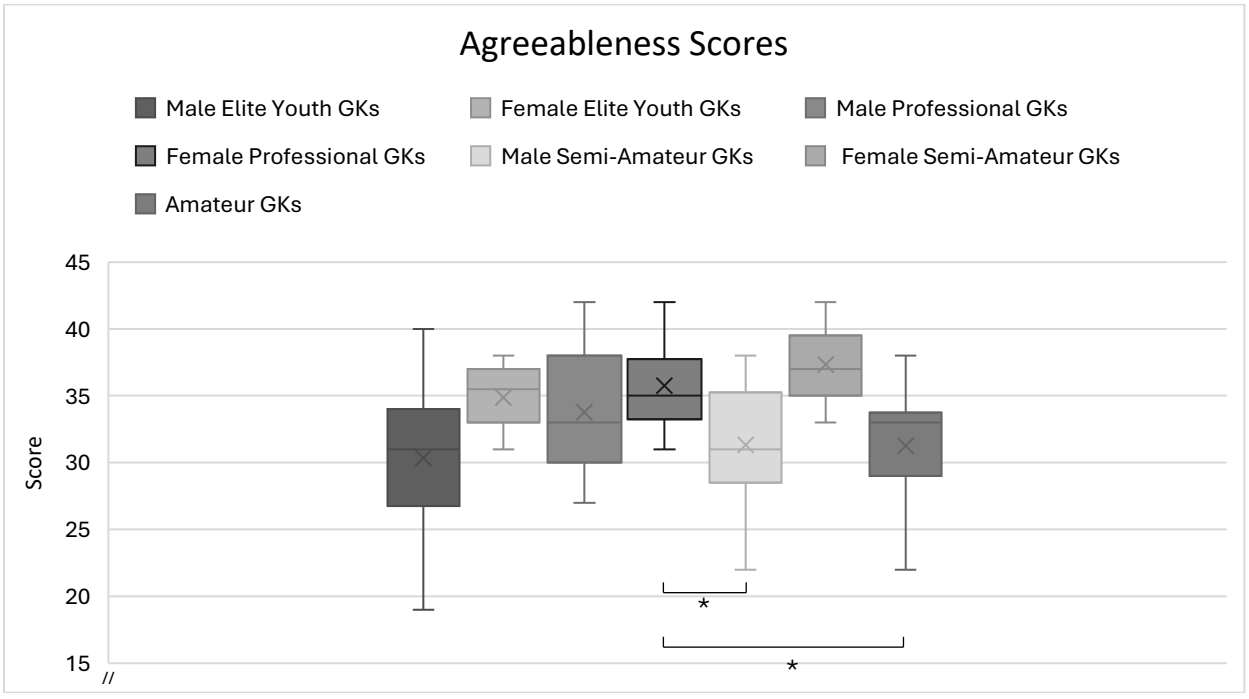
Pairwise comparisons further analyzed the differences in agreeableness and conscientiousness. In agreeableness, male elite youth GKs have significantly lower

agreeableness scores than female elite youth GKs (difference = -4.60, $p < 0.001$), male pro GKs (difference = -3.26, $p = 0.021$), female pro GKs (difference = -5.35, $p < 0.001$) and female semi-pro/amateur GKs (difference = -6.93, $p = 0.009$). Furthermore, female pro GKs have higher scores than male semi-pro/amateur GKs (difference = 3.265, $p = 0.021$) and male youth semi-pro/amateur GKs (difference = 3.750, $p = 0.03$). For an overview of these results, refer to Figure 8. The last finding is in line with hypothesis 3 in the way that the female group of highest expertise (pro GKs) show higher agreeableness scores than male groups of lower expertise (semi-pro/amateur).

In conscientiousness, we can see that female elite youth goalkeepers have significantly higher values than female pro GKs (difference = 5.27, $p = 0.003$), as well as male semi-pro/amateur (difference = 3.77, $p = 0.034$) and youth semi-pro/amateur male GKs (difference = 4.27, $p = 0.029$). Additionally male pro GKs showed significantly higher scores in conscientiousness compared to female pro GKs (difference = 4.83, $p = 0.011$). For an overview of these results, refer to Figure 9.

Figure 8

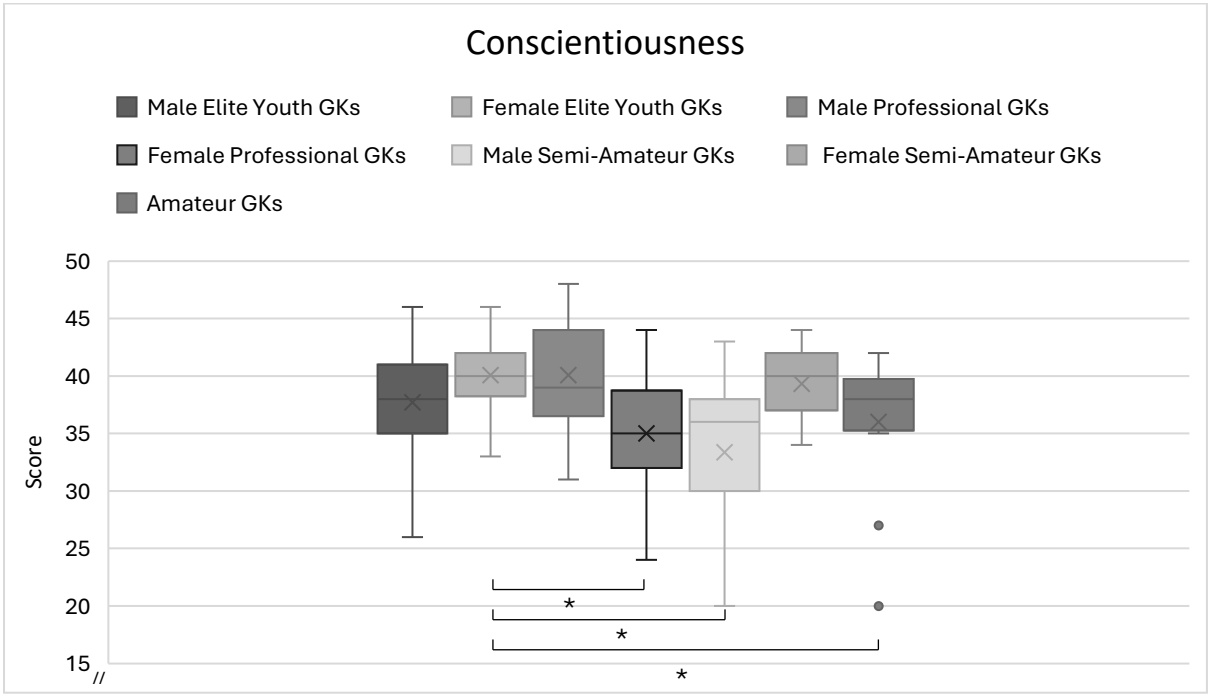
Comparison of Agreeableness Scores With Expertise and Gender Separation



Note. Significant differences are marked with a *.

Figure 9

Comparison of Conscientiousness Scores With Expertise and Gender Separation



Note. Significant differences are marked with a *.

3.3.5 Discussion

Using the FFM of personality, the aim of the current study was to investigate personality traits of youth and adult football goalkeepers of various expertise levels, ranging from amateur to professional level. Furthermore, it was of interest to gain a more detailed view on gender-specific differences. Findings revealed heterogenous results for expertise levels and gender, mainly for the personality trait agreeableness, and are discussed from an individual-environment-centered perspective.

3.3.5.1 Expertise Related Differences Between Senior Professional and Elite Youth GKs

Interestingly, analysis only revealed a significant difference for the personality trait agreeableness. For differences in expertise, we initially suggested the exact opposite (hypothesis 1). From an individual-environment-centered focus on player development, the non-significant findings for hypothesis 1 (i.e., the prediction that higher expertise levels show larger extraversion, conscientiousness, and openness and lower values in neuroticism) appear

remarkable. Since none of these personality traits seem to differentiate the group of professional goalkeepers from their younger or semipro/ amateur counterparts, it could be interpreted as contrary to the performance hypothesis (García-Naveira and Ruiz-Barquín, 2016). Two main discussion points arise.

One, the often-cited notion of "context is everything" (Davids et al., 2021) for practice design and coaching transfers nicely to the domain of psychological GK profiling. Being aware of each player's individual context, constraints and socio-cultural background appears critical in performance sport. Clearly, every player must be regarded as a unique individuum that displays specific characteristics and demands; these, coaches and psychological support staff must recognize to individualize psychological development and maximize performance preparation. For example, when tasked to speak to a group of media representatives (i.e., a very common task for professional football players these days), a GK scoring high in openness and extraversion and low in neuroticism may feel and behave much differently about this scenario than a GK scoring lower/higher in these areas, respectively. In other words, only by understanding a GK's personality profile, coaches and psychologists may be able to support this (professional) player and assist in preparing for common events, such as media interviews, press conferences or likewise, in an individualized way.

Two, due to non-significant differences when comparing experts' personality traits with lower level or skillful GKs, it may be stated (by some) that using psychological diagnostics and profiling of individual GKs could be seen as an inefficient use of time and resources. However, we would argue the opposite: by profiling GKs' personality traits, practitioners within high-performance player development programs will be assisted in becoming aware of and understanding each individual GK's demands. In a recent investigation of coaches' views on their responsibilities regarding the coaching process and practice design, Selimi et al. (2023) emphasized the importance of relationship building with players and the coaches' initial responsibility of "developing people". This idea aligns closely with our findings in a way that

it appears invaluable for coaching and support staff within teams, clubs and national federations to gain in-depth understanding of each individual player's history and her personality traits. Here, use of standardized FFM of personality tests can be of instrumental help for practitioners.

Lastly, for our significant findings on agreeableness, in comparison to the other FFM traits, the status quo of current research is rather unclear. Nevertheless, our finding is in line with Allen et al. (2011) who also showed higher scores for agreeableness in higher level athletes. Thereby, we are in opposition to Vaughan and Edwards (2020). Using an approach where expertise is defined by age progression, a linkage to the studies of Trninic et al. (2016) and Piepiora et al. (2022a) is apparent and revealed similar results. From our view, different explanations could potentially underline this finding. Senior professional GKs, due to their numerous years of top-level playing and their "secure and stable" status within a club/team, may feel less under pressure to outperform competitors compared to youth elite GKs. In contrast, in an academy setting young GKs pursue the goal of signing a professional contract and hence, compete with an enlarged number of further GKs to achieve this aim; this, over time, could possibly lead to youth elite GKs displaying less agreeable behavior than their professional counterparts. Additionally, changing socio-cultural expectations, values and norms within modern-day societies have been shown to highlight stronger value-directedness toward elitism and individual competition (e.g., shown in younger generations in Swedish football; (Vaughan et al., 2022). Possibly regarding the trait of agreeableness, as much as this evolving value-directedness may shape skill development in football practice, it may also influence personality development and social behavior of aspiring elite footballers. Put simply, given the evolving socio-cultural constraints that influence and shape young adults when growing up, changes in personality traits toward less agreeable behaviors may be a consequence. Notably, this interpretation is strongly speculative and warrants further research.

3.3.5.2 Gender Related Differences Between Male and Female GKs

The primary results indicated that male GKs scored noticeably lower in agreeableness compared to their female counterparts. The disparities in neuroticism can only be considered a tendency due to the application of the Bonferroni correction. Despite this, it remains valuable to closely examine this particular insight. Our findings correspond to results from norm populations (Feingold, 1994; Costa et al., 2001; Schmitt et al., 2008). In sports, significant differences were shown for neuroticism (Kirkcaldy, 1982; Colley et al., 1985; Newcombe and Boyle, 1995; Allen et al., 2011) and agreeableness (Allen et al., 2011). The tendency for neuroticism could be explained by several reasons. First, the pure number of active athletes could lead to an increased selection effect in favor of football players with lower neuroticism, as it is associated with negative effects on athletic success (McKelvie et al., 2003; Piepiora, 2021) and mental health (De Moor et al., 2006). For example, the German Football Association (DFB) reports a number of 2.022.123 active male vs. 186.646 active female football players for the 2021/2022 season (DFB, 2023). Also, the still existing inequality of professionalism in terms of resources invested into coaching staffs and consulting (e.g., sport psychologists, psychotherapists, licensed coaches, etc.) could have an impact on neurotic behavior, like increased levels of anxiety or nervousness. Additionally, on a basis of masculine stereotypes (Chalabaev et al., 2013), neuroticism and its associations are yet interpreted as a sort of weakness (Sebbens et al., 2016). Leastwise, this bias appears with a higher quote in male football than in female settings.

The differences between male and female GKs in agreeableness are harder to explain as they are inconsistent in the sporting context. People with high levels of agreeableness tend to have higher standards in morality, sympathy, and cooperation. Like with neuroticism, the pressure in male football could favor athletes with lower levels of agreeable behavior. Also, as stated above, the professional system in football sometimes educates and forces youth athletes to show such a behavior when they need to always be the best, outperform others and be less

compassionate (Beavan et al., 2022). This trend could even be stronger when it comes to special characters like GKs, where in most cases there is only one clear number one that needs to protect their status and position from potential rival candidates.

3.3.5.3 Expertise and Gender Related Differences

The subdivision of male and female groups showed male elite youth GKs scoring significantly lower in agreeableness. The finding could be a result of the aforementioned high pressures in this male age group, given that elite youth players play their final years in football academies with the hope of being awarded a senior professional contract, and the fear of having to transfer to semi-pro/amateur leagues or even end their ambitious careers. To showcase oneself in the best way possible, an aspiring youth elite GK may be well-aware of the situation that all manageable aspects in their last years of academy football may influence chances of becoming a professional or not. This awareness could result in a behavior which is informed by egocentricity and suspiciousness, even if that can be interpreted negative from an ethical standpoint. One explanation, why this finding could not be detected in the female elite youth group could be that female players pass through this transition period at a younger age. This has various reasons related to the organizational structure of female pro sport (specifically in Germany), being maybe the most influential aspect. For example, the second highest league in German senior female football (i.e., 2. Frauen-Bundesliga) consists approximately one half of first division clubs' reserve/U-21s teams. These "farm teams" mainly focus on highly talented young players, which are often allowed to still play in U-17s youth leagues. As strength density in those leagues is rather weak, clubs potentially elevate young female players earlier into senior teams than they would do with male football players. As the current study implemented GKs with an age of 16 plus, future research should also implement younger age groups of the highest performance level to dig deeper into male/female differences.

3.3.6 Limitations and Future Directions

The current study should be considered in the context of some limitations that we would like to address. We decided to investigate personality traits of both male and female goalkeepers of various ages and expertise levels. As the circumstances under which male and female GKs are identified and developed can differ from rather equal to extreme, it is hard to compare these individual GKs and groups on specific characteristics. As literature-based grouping strategies could not be transferred to the field of goalkeeping, we tried to group the participants using an applied approach (Supplementary Table 2). This grouping strategy could arguably lead to different results dependent on whether a specific GK would be classified as a "professional", "semi-professional" or "elite youth". For example, some male football players can finance their lives with an affiliation to a club in the 5th division (i.e., amateur-level football according to our grouping), whereas female players often have a second mainstay besides playing first division football (i.e., still grouped as senior professional due to playing at the highest level).

Next, the overall sample size displays a limitation of our study, which can be seen in the interpretation of the personality trait conscientiousness after Bonferroni correction (hypothesis 3). Nevertheless, as we targeted the specific football position of the GK with significantly lesser player numbers compared to outfield players and managed to recruit an enlarged number of GKs playing at the highest performance level possible (e.g., the 1st German Bundesliga), we are convinced of the high-quality insights into an often called "closed door world" of professional football.

Moreover, it is important to mention, that only European German native speakers were assessed to prevent the dataset from misunderstanding biases. As the European academy system can differ from countries outside Europe, the findings should be transferred carefully.

3.3.7 Practical Applications

Assessing personality profiles in athletes has several practical applications for different peer groups. Our findings could show that there is no clear pattern that elevates an

ambitious goalkeeper to a professional level. Incorporating age and gender diversity further complicates this generalized approach. Nevertheless, assessing and focusing on an athlete's personality characteristics is practically necessary to find the most suitable settings and provide a basis for sport psychological consulting. When athletes concentrate on their individual profiles, they are able to understand the interdependencies between relationships in both their personal (e.g., parents, partners, etc.) and their sporting contexts (e.g., coaches, teammates). By identifying similarities and differences, they can discover potential pathways for healthy and constructive circumstances, which could be a beneficial aspect of an athlete's life. Clubs, associations, and organizations can benefit from personality assessments for scouting purposes and to build suitable team cohesion. It is important to emphasize that such questionnaire-based instruments should not be used to identify "black sheep" in an existing team, but rather to identify missing characteristics that need to be recruited. The former approach would only lead to higher rates of social desirability and therefore miss the mark.

In the end, the strongest impact of personality profile assessments in practice is achieved when they are used as supportive instruments for all kinds of sport psychological work and not as (de)selection criteria. Their greatest benefit lies in using them to understand an athlete's characteristics in more detail and to help them find or build the most suitable setting for their individual potential development.

3.3.8 Conclusion

In the current study, we aimed to investigate differences in personality traits of football goalkeepers. Compared to previous research, we used the well-established FFM to assess both male and female GKs of different age and expertise levels. Besides gender-specific differences, our findings were not in line with results of comparable studies focusing on expertise in the sporting context. From an individual-environment-centered coaching perspective, however, non-significant differences between various player groups and for some personality traits

display invaluable findings. It appears critical for coaches to understand each individual player's context, constraints, and background. Hence, psychological profiling and consulting work remain highly beneficial to support individualized player development and coaching, at academy and senior levels, as well as in men's and women's football. In other words, results of this study would argue against the existence of "*an idealized goalkeeping personality profile*" for performance at the professional level. Thus, there appears to be no silver bullet and researchers, psychologists and coaching practitioners remain (positively) challenged when identifying and developing top-level GKs. Notably, as this research displays a first attempt at assessing personality traits of GKs, the interpretation and placement into the current scientific discourse has to be handled with caution. More research is encouraged and needed on whether (our first step into) studying personality traits of GKs is replicable, and to support both scientists and practitioners to generalize the current study's findings.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Universität des Saarlandes Ethikkommission der Fakultät HW Campus A1 3 66123 Saarbrücken. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

JS: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Writing – original draft, Writing – review & editing. FO: Conceptualization, Writing – original draft. TS: Visualization, Writing – review & editing. JM: Supervision, Writing – review & editing. SK: Data curation, Formal analysis, Supervision, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Conflict of interest

FO was employed by Borussia Mönchengladbach. JM was employed by TSG Hoffenheim. The remaining authors declare that the research was conducted in the absence of

any commercial or financial relationships that could be construed as a potential conflict of interest. The author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2024.1418004/full#supplementary-material

Supplementary Table 2

Applied Participant Groupings Based on Expertise and Playing Levels Within the German Football Structure

Category	Criteria	Sample size (n)
Pro GK (male)	Senior-pro GKs playing in either the German 1st, 2nd or 3rd division Men's Bundesliga; including GKs over 23 years of age playing for reserve teams of German Bundesliga clubs. ~8 training sessions / week.	13
Pro GK (female)	Senior-pro GKs playing in the German 1st division Frauen-Bundesliga. ~7 training sessions / week.	16
Elite youth GK (male)	GKs playing in farm/reserve (2nd) teams of German first division clubs; in the German U17s/ U19s youth Bundesliga, or minimum, in the second highest youth division in an official certified academy. ~6 training sessions / week.	54
Elite youth GK (female)	GKs playing in either the German U17s youth Bundesliga or in the 2nd Frauen-Bundesliga. ~5 training sessions / week.	16
Semi-pro/amateur GK (male)	Senior GKs playing below the German first three professional divisions (i.e., Regionalliga). ~ < 5 training sessions / week.	18
Semi-pro/amateur GK (female)	Senior GKs playing below the German 1st division Frauen-Bundesliga; exception full-time senior first teams of clubs playing in the 2nd Frauen-Bundesliga (i.e., then considered as senior pro). ~ < 5 training sessions / week.	3
Amateur youth GK (male)	Youth GKs playing below the German 2nd youth divisions + nonofficial certified academy players (i.e., Regionalliga). ~ < 5 training sessions / week.	12
Total		132

3.3.9 References

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3.4 Study 4: Inside The Minds of Football Athletes: Examination of Age, Expertise, and Gender Disparities in Personality Traits.

The manuscript of study 4 is under review at:

Spielmann, J., Altmann, S., Steindorf, L., Herr, C. & Mayer, J. Inside the Minds of Football Athletes: Examination of Age, Expertise, and Gender Disparities in Personality Traits. Manuscript submitted for publication in *European Journal of Personality.*

Inside the Minds of Football Athletes:

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Date of submission: 26.11.2024

3.4.1 Abstract

Personality research holds a longstanding position in scientific exploration. Yet, there remains a significant gap in the study of personality characteristics of football athletes and their interaction with performance. Utilizing the Five Factor Model (FFM) of personality we assessed personality traits of 2085 males and females. First, differences between football players and two comparison samples of students and inactives were analysed. Subsequently, a series of analyses examined variations within the football player group, considering expertise, age, and gender. Football players, in contrast to both comparison samples, exhibited distinct expressions of the FFM traits (e.g., lower neuroticism and openness levels, higher conscientiousness and extraversion levels). When focusing on football players as a distinct sample, several differences concerning expertise (performance levels), gender, and age emerged. Generally, greater expertise was linked to lower Neuroticism and higher conscientiousness. Male adult players further displayed higher agreeableness compared to male youth players, and females generally exhibited higher levels of neuroticism and agreeableness than males. These findings provide new scientific and practical insights regarding the special personality characteristics of football players, including expertise-, age-, and gender-related differences at the trait level.

Keywords: soccer, big five, FFM, players, sport psychology

3.4.2 Introduction

The field of personality research provides valuable insights concerning the factors underlying children's initial involvement, sustained motivation, and, possibly, eventual proficiency in a particular sport. In the context of football, there is no doubt that several exceptionally successful individuals like Cristiano Ronaldo, Zlatan Ibrahimovic, and Megan Rapinoe stand out as distinctive personalities with trait expressions that deviate from the norm. Interestingly, while such unique personality types could be viewed through a negative lens (they might be interpreted as overly competitive, arrogant, or controversial in their actions or statements), they could also be considered as integral components contributing to exceptional levels of expertise. Although it is widely accepted that certain individuals in competitive football have a distinctive personality, the following research questions have not yet been answered on a more comprehensive level: Do elite football athletes generally exhibit distinct personality traits in comparison to their counterparts at lower skill levels? Furthermore, is this potential divergence applicable to both male and female players as well as to different age groups? The present work aimed to address these questions by conducting an extensive survey among female and male adolescent as well as adult football players across various performance levels. This approach allowed us to investigate differences in personality traits among the groups.

The subsequent sections will delve deeper into the intricate demands of football and explore the current scientific understanding of the interplay between personality traits, sports performance, and potential disparities based on expertise level and gender.

3.4.2.1 Research on Demands in Football

Football is a multifaceted sport, with physical (Dolci et al., 2020), technical (Aquino et al., 2017), tactical (Goes et al., 2021), and psycho-cognitive factors (Slimani et al., 2016) all being considered important performance requirements. Regarding the latter, besides perceptual-cognitive abilities such as executive functions, decision-making, and anticipation (Casanova et

al., 2009; Vestberg et al., 2012), the investigation of personality traits as a facilitator of personal and career transitions, integration processes, and interpersonal relationships has not been researched in a satisfying way (Allen et al., 2013; Spielmann et al., 2022; Wilson & Dishman, 2015).

3.4.2.2 Current Scientific Knowledge About Personality Profiling in Sports

3.4.2.2.1 Personality and Sports

When evaluating personality, trait assessments are commonly used in Differential Psychology. One widely accepted conceptualization is the Five Factor Model of Personality (FFM; (Costa & McCrae, 2008; McCrae & Costa, 1999). This model categorizes personality into five traits: openness (O; characterized by curiosity, creativity, and imagination), conscientiousness (C; associated with being organized, punctual, and structured), extraversion (E; reflecting sociability, outgoingness, and activity), agreeableness (A; indicating being good-natured, unselfish, and forgiving), and neuroticism (N; characterized by anxiety, hostility, and irritability). The FFM has garnered significant attention in the literature, with various studies supporting its use (Allen et al., 2013; Bircher et al., 2017; de Moor et al., 2012).

The FFM's relevance extends beyond scientific interest, as it has practical implications for professionals like sports psychologists and coaches who must deal in an adapted way with different individuals in their work. Understanding athletes' personality characteristics can have positive effects on significant personal and career transitions (Laurin, 2009), integration processes (Beauchamps et al., 2007), and interpersonal relationships (Allen et al., 2013; Cuperman & Ickes, 2009; Jackson et al., 2011). Moreover, athletes can benefit from examining their own trait-profile as a tool for personality development and setting specific orientations. This introspection may influence various aspects of an athlete's life, such as training structuring (conscientiousness), decision making in risky situations (neuroticism), fostering creativity and adaptability (openness), developing cooperative behaviors (agreeableness), and building effective relationships (extraversion).

3.4.2.2.2 Personality and Athletic Expertise

When examining the relationship between athletic expertise and personality, research often focuses on very specific individuals and groups who excel in sports due to their unique and extraordinary abilities like Mount Everest climbers (Egan & Stelmack, 2003), Olympic athletes (Piepiora et al., 2022), and ultra-marathon participants (Hughes et al., 2003). Further, operationalizing expertise as the extend of basic physical activity engaged in by individuals, meta-analyses have revealed positive correlations with extraversion, conscientiousness (Rhodes & Smith, 2006; Wilson & Dishman, 2015), and openness (Wilson & Dishman, 2015), while neuroticism showed a negative association (Rhodes & Smith, 2006; Wilson & Dishman, 2015). These general results are also found in other contexts, such as occasional or academic settings, where personality has been shown to influence domain-specific success (Furnham, 2018; Poropat, 2009).

Besides focusing on basic physical activity and special individuals or groups, recent studies have increasingly examined the role of personality within various athletic-expertise levels. This is particularly interesting because different levels of expertise also operate in different settings. For instance, researchers have investigated personality differences between selected and non-selected athletes for the Paralympics (Martin et al., 2011), examined football athletes' match statistics (Piedmont et al., 1999), and explored personality characteristics as predictors of expertise levels (i.a. Aidman, 2007; Martin et al., 2011; Morgan & Johnson, 1978). High-level athletes, when compared to lower expertise levels, tend to exhibit lower scores of neuroticism (i.a. Allen et al., 2011; Kirkcaldy, 1982b; Vaughan & Edwards, 2020), and higher scores of extraversion (i.a. Egloff & Gruhn, 1996; Newcombe & Boyle, 1995; Williams & Parkin, 1980), conscientiousness (i.a. Allen et al., 2011; Vaughan & Edwards, 2020), and openness (i.a. Goddard et al., 2019; Vaughan & Edwards, 2020). However, findings regarding agreeableness remain inconclusive, with some studies reporting higher (Allen et al., 2011) and

others showing lower agreeableness expressions (Vaughan & Edwards, 2020) in high-level athletes.

It is, however, essential to consider the specific settings and contexts when interpreting previous findings, as certain traits and trait combinations might be more advantageous for different sports or expertise levels. Since most current studies with larger sample sizes (e.g. Allen et al., 2011; Kirkcaldy, 1982a,b; Steca et al., 2018) encompass samples from various disciplines with diverse population sizes, profile requirements, and levels of professionalism, the mentioned findings cannot be universally applied. Traits like extraversion or agreeableness, for example, might be more dependent on the discipline (e.g., individual versus team sports) than on expertise levels, potentially distorting results when different disciplines are assessed simultaneously. To clarify whether the aforementioned expertise-level trends are applicable to a specific discipline like football, this study aims to conduct further investigation.

3.4.2.2.3 Personality and Gender Differences

The popularity of female football has been steadily increasing as a part of modern sport development. A clear example of this growth is the European Women's Championship (Women's EURO), which has seen a significant rise in global viewership, increasing from 116 million in 2013 to 178 million in 2017, and reaching 365 million viewers in the 2022 tournament held in England (UEFA, 2022). Despite this rising popularity, women in football still face various barriers, including insufficient funding and challenges in finding suitable teams (O'Reilly et al., 2018). Similar circumstances are observed in the sports-scientific world, where female-specific research lags behind due to long-term inequalities in resource distribution that align with levels of professionalism and participation (Emmonds et al., 2019).

In general, Differential Psychology has shown a keen interest in examining personality differences between males and females. Normative studies have indicated that males tend to score lower in conscientiousness, neuroticism, agreeableness, and extraversion compared to females (Costa et al., 2001; Feingold, 1994; Schmitt et al., 2008). Some evidence suggests that

these findings can be extended to the context of sports: For example, researchers have noted that physically active females exhibit personality characteristics more closely aligned with males than inactive females (Allen et al., 2013; Fleming, 1934; Williams & Parkin, 1980). However, Allen et al. (2011) found that males scored lower in conscientiousness, neuroticism, and agreeableness in a sample comprising individuals from various expertise levels and sports. Subsequently, Gyomber et al. (2013) reported lower scores for extraversion and openness in males compared to females. It is worth noting that, compared to research outside of sports, these findings are merely trends, as some contradictory results have also been published (O´Sullivan et al., 1998; Rhodes & Smith, 2006; Sutin et al., 2016). The only trait that seems to consistently show higher expressions in female athletes is neuroticism (Colley et al., 1985; Kirkcadly, 1982a; Newcombe & Boyle, 1995). As with other scientific areas, further research is needed to explore general gender differences in athletic populations, especially in football.

3.4.2.3 Aims and Hypotheses

Initially, the study addressed its subject by contrasting football players with comparison groups of students and inactive individuals, aiming to underscore the unique characteristics of the present football-player sample. Derived from literature research, our hypothesis posited that football players would demonstrate greater levels of extraversion, conscientiousness, and openness in contrast to the comparison groups. Additionally, we predicted that levels of neuroticism would be higher in the comparison groups than in football players.

The primary objective of this study was to examine the personality traits of a large sample of football players using the FFM. Specifically, the research aimed to investigate the differences in trait characteristics among players of varying expertise levels (ranging from recreational to elite) and age groups (from U17 to adult), while also considering gender differences. By only considering the discipline of football, we rule out potential confounding effects of discipline-specific factors, such as distinct demands or the level of individualization inherent in the sport.

Based on the current state of empirical research, we expect players with higher levels of expertise to demonstrate more pronounced expressions of extraversion, conscientiousness, and openness, while exhibiting lower levels of neuroticism compared to those with lower expertise levels. We further hypothesize gender differences in the form of female players exhibiting higher levels of neuroticism compared to their male counterparts. For the sake of completeness, we assessed and analysed all traits of the FFM. Analysis for traits with no specific hypotheses were considered exploratory due to previously inconclusive study results.

3.4.3 Methods and Materials

3.4.3.1 Participants

A total of 2085 subjects participated in the study, of which116 had to be excluded because of unclear statements concerning sport discipline, training routine, age, league affiliation, etc. This resulted in a sample of 1969 (1284 male; 685 female; aged 16 - 39 years) of which 1500 were active football players (1104 male; 396 female; age: M = 20.24 years, SD = 4.52) and 469 (180 male; 289 female; age: M = 19.91 years, SD = 3.60) belonged to the comparison groups of students and inactive individuals. All participants were native German speakers to ensure that the dataset remained unbiased due to potential misunderstandings of questionnaires or test instructions. Our strategy for sample planning prioritized maximizing participant inclusion through opportunistic sampling, which was chosen due to sample specificity. We refrained from conducting and reporting post-hoc power analyses, as their results are redundant with the information provided by p-values and do not assure a priori power (Hoenig & Heisey, 2001).

3.4.3.2 Personality Assessment

In this study, the German adaptation of the NEO-FFI questionnaire by Borkenau and Ostendorf (2008) was employed to assess the personality traits of athletes. The questionnaire comprises 60 items, and participants were asked to rate each item on a five-point Likert scale ranging from "strongly disagree" to "strongly agree". As a self-report measure, the NEO-FFI

evaluates five key personality dimensions: extraversion (E), neuroticism (N), openness (O), agreeableness (A), and conscientiousness (C). The NEO-FFI questionnaire is well-established and has been widely used across various populations. It boasts robust quality criteria, as reported in previous studies conducted by McCrae and Costa (2004). Moreover, its suitability has been demonstrated in football players, as highlighted by the research conducted by Spielmann et al. in 2022. Furthermore, reliability coefficients for the NEO-FFI in the current sample were N = .85, E = .70, O = .68, A = .72, and C = .82.

3.4.3.3 Procedure

Before the initiation of this study, all athletes provided informed consent, and the Institutional Ethics Committee granted approval for the research. Athletes completed the personality questionnaire through an online survey, which included a standardized introduction and familiarization protocol. Throughout the study, athletes had the option to consult with a sport psychologist if needed. Prior to participation, they were assured that their responses would remain anonymous, and there would be no negative consequences for opting out. No compensation was given to the participants for their involvement in the study. The survey was either administered as part of the professional clubs' standardized sport psychological diagnostics battery or distributed directly through personal contact. The participants needed approximately 15 minutes to complete the personality assessment including both reading the instructions and answering the questions. Additionally, athletes' statements regarding their current and past playing levels were utilized to form participant groups of similar expertise for statistical analysis. Using the categorization approach of McKay et al. (2021) and knowledge about the German and European senior and youth league systems and playing levels, groups and their respective selection criteria were established (Table 13).

Table 13

Participant Groupings Based on Expertise and Playing Levels Based on the German League System (adapted from McKay et al., 2022)

Category	Criteria
Elite (Football Players)	-Competing at international level -League I athletes -Athletes on a national team
Highly Trained (Football Players)	-Competing at national level -League II and III athletes -Training towards maximal/ nearly maximal norm of sport
Trained (Football Players)	-Local-level representation -Football training ~3 times per week -Purpose to compete
Recreational (Football Players)	-May participate in multiple sports/forms of activity -Meet WHO minimum activity guidelines
Students (Comparison Sample)	-Sample exhibiting a normative representation of activity levels spanning from inactive to competitive levels -Recruited from typical universities and schools
Inactives (Comparison Sample)	-Fail to meet the minimum activity guidelines set by the WHO -Occasional and /or incidental physical activity

3.4.4 Results

3.4.4.1 Football Players Versus Comparison Samples

The first set of analyses examined whether football players, across various expertise levels, generally showed personality differences compared to an inactive and a student subsample. Further, we tested for gender differences.

We conducted five 3 (factor: subsample, categorized as football players, inactives, and students) x 2 (factor: gender, categorized as female and male) between-subjects analyses of variance (ANOVA) with the respective personality trait as the dependent variable.

Following, we tested the football players, as our participants of interest, against the comparison samples of inactives and students using post hoc tests. For simplicity reasons, further group comparisons as well as interactions concerning the two comparison samples were not considered. Due to substantial differences in group sizes and significant Levene tests (all ps

< .001), we confirmed the ANOVAs' main effects using additional Welch tests as a robust test procedure to examine equality of means, and employed Games-Howell post hoc tests. Because of the large sample sizes, when interpreting the results, a stronger emphasis was placed on effect sizes than on significance levels. According to Cohen's criteria (2013), we used the common interpretation of Hedges' g which categorizes effect sizes of 0.2 as small, 0.5 as medium, and 0.8 as large. Table 14 presents the means and standard deviations of the personality traits separately for the examined groups (for a graphical comparison see Supplementary Figure 1). Table 15 shows the inferential-statistical results for the first set of analyses.

3.4.4.1.1 Neuroticism

For neuroticism, there were significant main effects for subsample and gender. The interaction remained non-significant. Female participants indicated higher levels of neuroticism than male participants, and football players' neuroticism scores were lower than those of inactives and students.

3.4.4.1.2 Conscientiousness

For conscientiousness, the main effect for subsample was significant with football players having reported higher levels of conscientiousness than inactives and students. Regarding the significance of the main effect of gender, ANOVA and Welch test yielded different results. The very small effect size, however, underscored the Welch test's non-significant result. Since the significant interaction between gender and subsample only pertained to the comparison groups of students and inactives (as visually evident, Supplementary Figure 1), it was not further considered.

Table 14

Descriptive NEO-FFI Statistics (Level and Gender Separation, Raw Scores, Outlier Adjusted). Means and SDs (Brackets)

Category	Age	Gender	Trait				
			N	E	O	A	C
Elite (n = 529)	Adult (n = 160)	Male (n = 57)	11.75 (5.23)	30.84 (4.21)	23.82 (4.97)	31.81 (5.14)	37.65 (4.70)
		Female (n = 103)	17.05 (6.44)	31.34 (5.22)	27.38 (5.81)	34.75 (4.55)	36.44 (6.10)
	Youth (n = 364)	Male (n = 343)	14.59 (6.17)	30.63 (4.61)	23.36 (4.86)	30.18 (4.62)	36.27 (5.60)
		Female (n = 21)	18.24 (6.22)	30.10 (5.31)	25.43 (6.12)	33.52 (5.38)	38.33 (5.04)
Highly Trained (n = 366)	Adult (n = 329)	Male (n = 181)	14.13 (5.93)	30.17 (4.88)	24.71 (5.05)	31.56 (4.31)	36.79 (5.54)
		Female (n = 148)	18.79 (6.87)	30.95 (5.34)	25.51 (6.40)	33.98 (4.63)	36.08 (5.41)
	Youth (n = 37)	Male (n = 35)	16.83 (6.86)	28.49 (5.12)	24.66 (4.28)	30.51 (4.80)	34.63 (5.25)
		Female (n = 2)	20.00 (8.49)	27.50 (3.54)	16.50 (6.36)	28.50 (3.54)	35.50 (6.36)
Trained (n = 383)	Adult (n = 182)	Male (n = 105)	14.98 (6.31)	30.30 (4.54)	24.49 (5.02)	31.92 (5.09)	36.33 (5.58)
		Female (n = 77)	20.16 (6.78)	29.36 (5.84)	25.27 (5.73)	34.05 (5.16)	35.45 (6.07)
	Youth (n = 201)	Male (n = 192)	16.06 (5.50)	30.30 (4.43)	23.80 (4.97)	30.29 (5.01)	34.82 (6.05)
		Female (n = 9)	19.67 (7.42)	30.78 (3.60)	24.67 (7.02)	32.56 (3.24)	31.78 (4.87)
Recreational (n = 227)	Adult (n = 181)	Male (n = 147)	16.94 (6.35)	30.03 (5.53)	26.55 (5.71)	31.88 (5.49)	33.07 (6.20)
		Female (n = 34)	22.06 (5.96)	30.38 (5.46)	26.21 (6.28)	34.71 (4.20)	34.65 (5.65)
	Youth (n = 46)	Male (n = 44)	15.95 (5.64)	30.93 (5.06)	23.89 (5.35)	30.27 (5.07)	34.18 (7.16)
		Female (n = 2)	22.00 (1.41)	21.50 (12.02)	21.00 (12.73)	33.50 (4.95)	25.50 (3.54)
Comparison Sample Students (n = 280)		Male (n = 87)	20.17 (6.74)	27.99 (5.28)	25.44 (5.16)	27.23 (5.80)	31.83 (7.03)
		Female (n = 193)	25.79 (7.18)	27.12 (6.34)	25.73 (6.07)	28.96 (6.10)	32.25 (6.15)
Comparison Sample Inactive (n = 189)		Male (n = 93)	22.82 (8.14)	25.22 (6.69)	28.86 (7.59)	29.62 (6.78)	28,90 (7.60)
		Female (n = 96)	26.44 (7.56)	25.41 (6.40)	28.41 (6.49)	32.67 (6.11)	33.16 (7.03)
Total (n = 1969)		Male (n = 1284)	16.00 (6.73)	29.81 (5.16)	24.69 (5.49)	30.57 (5.21)	34.88 (6.41)
		Female (n = 685)	21.90 (7.81)	28.88 (6.20)	26.21 (6.25)	32.49 (5.79)	34.48 (6.30)

Note. N = neuroticism, C = conscientiousness, E = extraversion, A = agreeableness, O = openness, ME = main effect, FB = football player.

3.4.4.1.3 Extraversion

For extraversion, there was a significant main effect for subsample with football players having indicated higher levels of extraversion than both comparison samples. Similar to conscientiousness, ANOVA and Welch test yielded different results regarding the main effect of gender, and the effect size was negligible. There was no statistical evidence for an interaction between subsample and gender.

3.4.4.1.4 Agreeableness

For agreeableness, the main effects for subsample and gender, but not the interaction were significant. Higher agreeableness scores were found among female compared to male participants. Further, football players showed higher levels of agreeableness than students but did not differ statistically from inactives.

3.4.4.1.5 Openness

For openness, there was a significant main effect for subsample with football players having reported lower openness scores than inactives and students, although the latter differed only marginally from the football players (not-even-small effect size). The small effect size suggests that female participants had slightly higher openness scores than males, with ANOVA and the Welch test contradicting each other regarding the significance of the gender main effects. The significant interaction can be described by the presence of a significant gender effect in the football-player sample, but not in the two comparison samples and will not be further addressed.

3.4.4.2 Football players as a special sample

Overall, and mostly independent from gender effects, we observed that football players, in comparison to students and inactive individuals, exhibited distinct expressions of the FFM traits. They tended to have higher scores for conscientiousness, extraversion, and agreeableness, as well as lower scores for neuroticism and openness.

Table 15

Results of All Inferential Statistical Analyses Examining Differences Between Subsamples and Genders

		ANOVA				Welch test			Post hoc comparisons		
Trait		***df***	***F***	***p***	η^2_p	***df***	***t***	***p***		$p_{\text{Games-Howell}}$	g_{Hedges}
N	ME subsample	2, 1963	166.93	< .001	.15	2, 358	215.53	< .001	**FP vs inactives**	**< .001**	**1.28**
	ME gender	1, 1963	95.49	< .001	.05	1, 1230	279.18	< .001	**FP vs students**	**< .001**	**1.19**
	Interaction	2, 1963	2.03	.131	.00				**Male vs female**		**-0.83**
C	ME subsample	2, 1963	74.29	< .001	.07	2, 358	63.69	< .001	**FP vs inactives**	**< .001**	**-0.76**
	ME gender	1, 1963	15.96	< .001	.01	1, 1416	1.70	.193	**FP vs students**	**< .001**	**-0.60**
	Interaction	2, 1963	8.74	< .001	.01				Male vs female		-0.06
E	ME subsample	2, 1963	94.40	< .001	.09	2, 352	77.92	< .001	**FP vs inactives**	**< .001**	**-0.99**
	ME gender	1, 1963	0.16	.687	.00	1, 1197	11.22	< .001	**FP vs students**	**< .001**	**-0.59**
	Interaction	2, 1963	1.10	.334	.00				Male vs female		0.17
A	ME subsample	2, 1963	74.02	< .001	.07	2, 353	38.02	< .001	FP vs inactives	.498	-0.12
	ME gender	1, 1963	57.75	< .001	.03	1, 1276	52.44	< .001	**FP vs students**	**< .001**	**-0.64**
	Interaction	2, 1963	2.12	.121	.00				**Male vs female**		**-0.35**
O	ME subsample	2, 1963	31.72	< .001	.03	2, 360	28.72	< .001	**FP vs inactives**	**< .001**	**0.69**
	ME gender	1, 1963	1.65	.199	.00	1, 1249	28.92	< .001	FP vs students	.036	0.17
	Interaction	2, 1963	3.66	.026	.00				**Male vs female**		**-0.27**

Note. For clarity, all group comparisons with at least a small effect size ($g_{\text{Hedges}} > .20$) were bolded. N = neuroticism, C = conscientiousness, E = extraversion, A = agreeableness, O = openness, ME = main effect, FB = football players.

The effect sizes mostly fell within the medium to large range. For the subsequent analyses, we take these results as a basis to suggest that football players represent a special sample that warrants closer examination. Therefore, the following analyses will exclusively delve into the collected data of football players, exploring expertise, age, and gender effects.

3.4.4.2.1 Relationship Between Football Players' Personality and Expertise, Age, Gender

In the second set of analyses, we examined different demographic groups of football players within different levels of expertise. As apparent from Table 14, the sample sizes for female youth players across all expertise levels were too low to consider them in our statistical

analyses. Therefore, we excluded these players for the following five ANOVAs resulting in n = 1466. We conducted 4 (factor: expertise, categorized as recreational, trained, highly trained, and elite) x 3 (factor: demographics, categorized as adult female, adult male, and youth male) between-subjects ANOVAs with the respective FFM trait as the dependent variable. Following, given a significant main effect of expertise, polynomial contrasts for the expertise levels were employed to further describe the trajectory of a personality trait with increasing expertise. Given a significant main effect of demographics, we used post hoc tests to compare all three demographic groups with each other. Unless otherwise specified (see openness), the Levene tests for these analyses were not significant, so that no additional robust testing was necessary. Figures 10a-e display the means in the examined groups.

3.4.4.2.2 Neuroticism

For neuroticism (Figure 10a), the main effects of expertise, $F(3, 1454) = 15.97$, $p < .001$, $\eta^2_p = .03$, and demographics, $F(2, 1454) = 55.68$, $p < .001$, $\eta^2_p = .07$, reached statistical significance while the interaction did not, $F(6, 1454) = 1.94$, $p = .072$, $\eta^2_p = .01$. For expertise, the linear trend was significant, $p < .001$, but the quadratic, $p = .290$, and cubic, $p = .166$ were not. In general, neuroticism scores decreased with increasing expertise. The effect size between the lowest and highest expertise level was $g_{Hedges} = -0.43$. Regarding demographics, adult female players had higher neuroticism scores than both adult male, $p < .001$, $g_{Hedges} = -0.60$, and youth male, $p < .001$, $g_{Hedges} = -0.57$, players. There was no statistical evidence for a difference in neuroticism levels between male players from the two different age groups, $p = .852$, $g_{Hedges} = 0.07$.

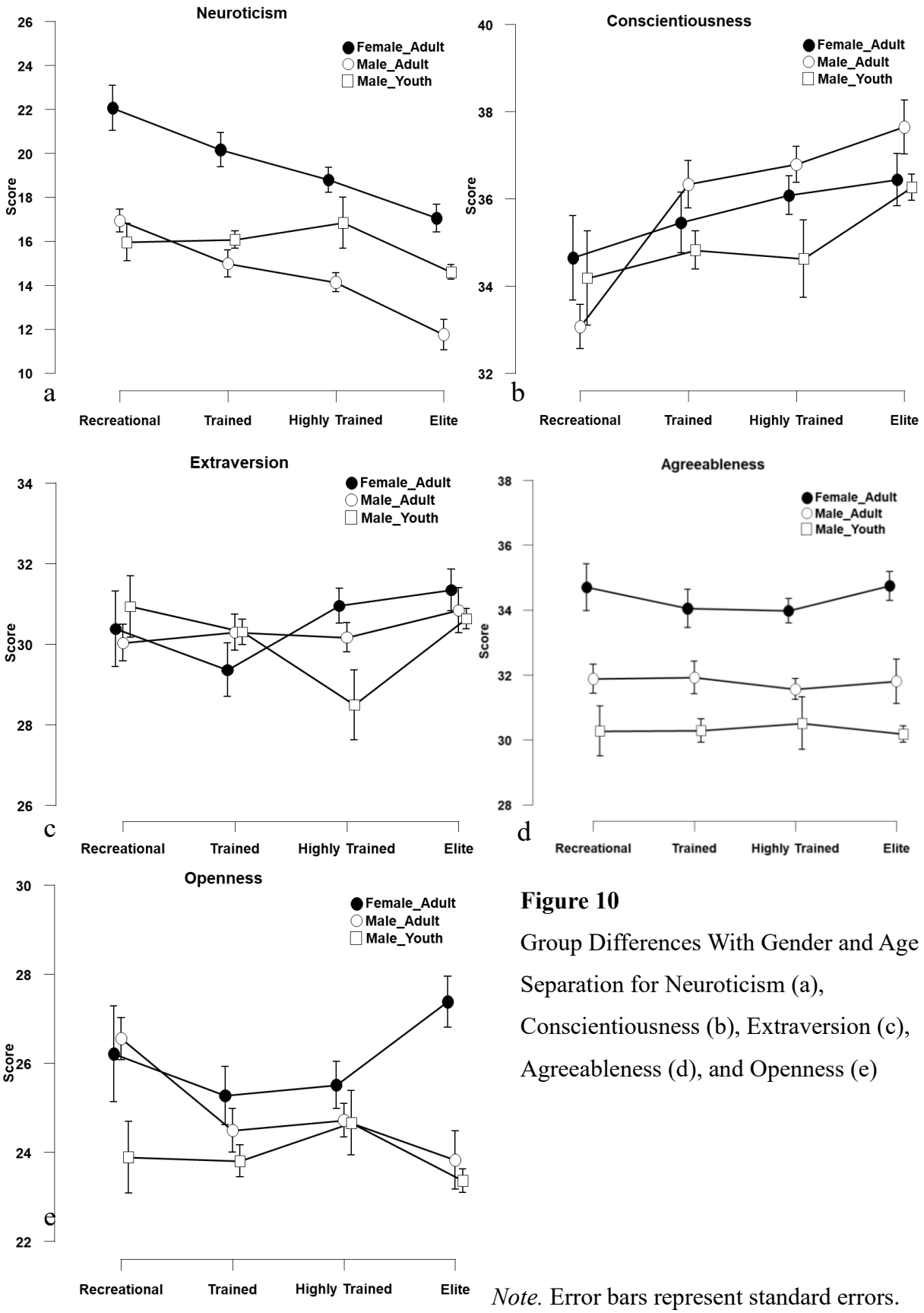

Figure 10

Group Differences With Gender and Age Separation for Neuroticism (a), Conscientiousness (b), Extraversion (c), Agreeableness (d), and Openness (e)

Note. Error bars represent standard errors.

3.4.4.2.3 Conscientiousness

For conscientiousness (Figure 10b), the main effect of expertise, $F(3, 1454) = 8.23$, $p < .001$, $\eta^2_p = .02$, was significant while the one for demographics was not, $F(2, 1454) = 2.38$, $p = .093$, $\eta^2_p = .00$. The interaction remained non-significant, $F(6, 1454) = 1.51$, $p = .173$, $\eta^2_p = .01$. Polynomial contrasts suggested a linear trend of expertise, $p < .001$, but no quadratic, $p = .417$, nor cubic trend, $p = .233$. With increasing expertise, the level of conscientiousness rose. The effect size between the lowest and highest expertise level was $g_{Hedges} = 0.50$.

3.4.4.2.4 Extraversion

For extraversion (Figure 10c), there was a significant main effect of expertise, $F(3, 1454) = 2.70$, $p = .045$, $\eta^2_p = .01$. The main effect of demographics, $F(2, 1454) = 0.50$, $p = .606$, $\eta^2_p = .00$, as well as the interaction, $F(6, 1454) = 1.83$, $p = .090$, $\eta^2_p = .01$, remained non-significant. For expertise, the quadratic trend was significant, $p = .019$, but neither were the linear, $p = .381$ nor the cubic, $p = .541$ trend. However, since the largest of all effect sizes between the levels of expertise ($g_{Hedges} = 0.15$ between trained and elite) cannot even be categorized as small, the significant main effect and the quadratic trend should not be overly emphasized.

3.4.4.2.5 Agreeableness

For agreeableness (Figure 10d), the main effect for demographics, $F(2, 1454) = 49.45$, $p < .001$, $\eta^2_p = .06$, was significant, but neither the one for expertise, $F(3, 1454) = .15$, $p = .928$, $\eta^2_p = .00$, nor the interaction, $F(6, 1454) = 0.28$, $p = .946$, $\eta^2_p = .00$, reached significance. All demographic groups differed significantly from each other. Adult female players reported higher levels of agreeableness than adult male, $p < .001$, $g_{Hedges} = -0.52$, and youth male, $p < .001$, $g_{Hedges} = -0.85$, players. Further, adult male players scored higher on agreeableness than youth males, $p < .001$, $g_{Hedges} = -0.32$.

3.4.4.2.6 Openness

For openness (Figure 10e), there was no statistical evidence for a main effect of expertise, $F(3, 1454) = 1.31$, $p = .269$, $\eta^2_p = .00$. The main effect of demographics, $F(2, 1454) = 11.22$, $p < .001$, $\eta^2_p = .02$, and the interaction, $F(6, 1454) = 2.96$, $p = .007$, $\eta^2_p = .01$, however, reached statistical significance. Due to several issues with the data structure of openness (significant Levene test, indication of an interaction that would require too many individual group comparisons), we decided to refrain from further significance testing and opted to describe the data based on the visualization (Figure 10e) and with the assistance of effect sizes. The most obvious group difference concerning openness pertained to the highest level of expertise. Elite adult female players reported higher levels of openness than elite adult males, $g_{Hedges} = -0.64$, 95% CI [-0.98, -0.31], and elite youth males, $g_{Hedges} = -0.79$, 95% CI [-1.02, -0.56] with medium to large effect sizes. Descriptively comparing all adult female and male players, gender differences were observed only at the highest level of expertise (all other $g_{Hedges} < 0.15$). Further, in general, youth male players seemed to have the lowest openness scores of all groups with almost no visible influence of the expertise level. They differed from the groups of adult female, $g_{Hedges} = 0.46$, 95% CI [0.32, 0.59], and adult male, $g_{Hedges} = 0.30$, 95% CI [0.18, 0.414] players.

3.4.5 Discussion

This study aimed to firstly explore the distinctiveness of football players as a special sample with its own set of characteristics compared to samples of students and inactive individuals. Secondly, we sought to delve deeper into this distinctive sample and investigate potential differences related to gender, age, and expertise.

3.4.5.1 Football Players Versus Comparison Samples

In alignment with our hypotheses and the findings of Wilson and Dishman (2015) and Rhodes and Smith (2006), we found that athletes exhibited lower levels of neuroticism and higher levels of conscientiousness and extraversion compared to students and inactive

individuals. Since our study exclusively utilized cross-sectional data, we can only speculate about the potential causality: The question remains whether football fosters particular trait expressions, or if individuals select football as their discipline based on their inherent character traits. Nonetheless, it appears logical that active football players would exhibit higher levels of traits associated with positive sporting attributes, such as self-control (neuroticism), discipline (conscientiousness), and group orientation (extraversion).

However, contrary to our expectations and the meta-analysis by Wilson and Dishman (2015), football players displayed lower levels of openness compared to the comparison samples. This finding is particularly surprising when considering that openness is associated with the inclination to seek out new experiences, which could be perceived as a fundamental aspect of engaging in organized sports (Allen et al., 2013).

The results regarding agreeableness remain somewhat ambiguous, which aligns with existing literature suggesting that agreeableness tends to exhibit similar levels in both athletic and non-athletic samples (Fasold et al., 2019; Malinauskas et al., 2014; McKelvie et al., 2003).

3.4.5.2 Football Players as a Special Sample

In total, it is thus not surprising that footballers exhibited differences in personality traits when contrasted with comparison samples. Ultimately, we viewed these differences to students and inactive persons as justification for examining footballers as a special sample in greater detail. Therefore, investigated personality in relation to expertise, age, and gender.

3.4.5.2.1 Neuroticism

Our results regarding neuroticism and its negative relationship with increasing expertise levels (Allen et al., 2011; Allen et al., 2013; Steca et al., 2018; Vaughan & Edwards, 2020) as well as gender related differences (Allen et al., 2011; Allen et al., 2013; Colley et al., 1985; Kirkcadly, 1982a) are in line with previous findings within a sporting context and can be considered as one of the main findings.

In high level football, negative emotions and tendencies such as fear, worry, or anxiety can be counterproductive for player performance and well-being. This could result in struggling with the high-pressure environments, the need for effective communication and cohesion among players, or the requirement of effective emotion-regulation. These circumstances could result in (self-)selection biases in favor of players with lower levels of neurotic behavior. Furthermore, (sport-)psychological coaching staff are more prevalent in more professional environments and can be consulted easily. For instance, all youth academies of German clubs from the first to the third league are required to comply with a regulation set forth by the German Football League, which stipulates that a sports psychologist must be employed (DFL, 2021). Sport psychological coaching could potentially influence neurotic behavior, leading to a reduction in its expression.

Several factors can contribute to lower neuroticism levels in male football players compared to their female counterparts. One key factor is the difference in the level of professionalism between male and female football. Female football is generally played in conditions with lower levels of professionalism across all expertise levels. For instance, there is no regulation requiring the presence of sport psychologists in female academies, coaches' licensing restrictions are more flexible, and the gender pay gap is among the widest in this context resulting in the need for dual-career paths (Ehnold et al., 2024). Thus, the circumstances are such that they favor stress and at the same time, there are fewer support systems in place to help female players effectively regulate their emotions.

Furthermore, the selection process in German male football, and the parameters that influence it, are much more stringent due to the sheer inequality in the number of active players. As of the 2021/2022 season, there were approximately 2 million male football players compared to around 190,000 female players in Germany (DFB, 2023). This significant disparity in the number of players could contribute to more rigorous selection criteria and potentially lower neuroticism levels among male players. Media attraction and arena spectator numbers

(~42k/game in males vs. ~1.7k/game in females 2022/2023 first league season; (DFB, 2024)) are two additional examples of influential aspects for neurotic behavior that may result in lower levels of neuroticism in male footballers compared to females. This difference in media attention and audience size could lead to different levels of perceived pressure and expectation placed on male and female players, potentially influencing neurotic behavior.

Lastly, gender differences in neuroticism are not unique to athletic populations. Previous studies, including Feingold (1994) and Schmitt et al. (2008), have found gender differences in neuroticism in non-athletic populations. Similar results could be shown for our sub-sample analysis with inactive individuals and students.

3.4.5.2.2 Conscientiousness

The positive relationship between the expression of conscientiousness and the level of expertise is consistent with previous findings in the field of sports (Allen et al., 2011; Allen et al., 2013; Fasold et al., 2019; Steca et al., 2018; Vaughan & Edwards, 2020).

High-level football players are advised to demonstrate self-discipline, structure, and systematic preparation. This is evident in essential aspects such as training and match preparation, as well as basic elements like the precise timing of nutrition intake. Players who exhibit a more opposite behavior, characterized by being less goal-oriented and laid back, are more likely to drop out of a high-level setting. They could also be perceived as lazy or unreliable by the respective selectors, which diminishes their chances of being chosen for higher-level teams. Moreover, playing football at a higher level concurrently educates players to be more structured, develop routines, and be deliberate.

Gender differences were not evident in our findings, which contrasts with findings from larger studies conducted outside of the sporting domain (Costa et al., 2001; Feingold, 1994; Schmitt et al., 2008), where women typically exhibit higher levels of conscientiousness compared to men. However, in the realm of sports (Allen et al., 2011) did show similar results. One possible explanation for the contradictory findings in our study could lie in the diverse

sample comprising various sports disciplines Allen and colleagues focused on. It appears that female and male footballers exhibit a closer parity in conscientiousness compared to athletes in other sports.

3.4.5.2.3 Extraversion

There was a significant main effect for expertise with a significant quadratic trend. However, given that the largest effect size between expertise levels cannot even be considered small, we concluded that there is no clear pattern of results. Our hypothesis, based on literature, was that there would be a positive relationship between extraversion and expertise level. However, since we only focused on team-sport athletes, this relationship could potentially only be demonstrable in mixed samples (Vaughan & Edwards, 2020) or in individual athletes (Egloff & Gruhn, 1996; Khan et al., 2016). It could be inferred that extraversion could play a role in choosing a specific sport discipline (possibly in favor of choosing individual sports), but it is not necessarily connected to higher expertise within team sports.

Our findings regarding gender differences in the field of football support previous studies that suggest gender plays no role (Allen et al., 2011; Allen et al., 2013; O´Sullivan et al., 1998) as opposed to studies that do support gender differences (Gyomber et al., 2013).

3.4.5.2.4 Agreeableness

The results for agreeableness and its relationship with expertise are as hypothesized and therefore support the findings of studies reporting that there is no relationship between expertise and agreeableness levels (Gyomber et al., 2013; Vaughan & Edwards, 2020).

Additionally, we found higher levels of agreeableness among older male football players compared to youth football players. Similar results have been reported by Trninić et al. (2016) in a sample of team sport athletes and by Donnellan and Lucas (2008) in a large cross-sectional norm sample. As a potential explanation, the latter study suggested that adolescents seek more autonomy from authority figures and stronger question values, rules, and norms in order to develop their own personality. This pattern could also be visible in the sporting context,

where male youth players may need to display higher levels of selfishness, competitiveness, and ego-centric behavior to outperform potential competitors. This situation is strongly related to the pressure within the male football environment, which could also explain the higher expressions of agreeableness in female players compared to male players. The aforementioned points of inequality in the numbers of active players and therefore increased selection pressure on every expertise level in male football could lead to behavior that is more connected to lower agreeableness expressions or simply favor low-agreeable players.

3.4.5.2.5 Openness

Openness did not exhibit a positive relationship with expertise in general. This contradicts the hypothesis and previous findings by Goddard et al. (2019) and Vaughan and Edwards (2020).

Interestingly, when examining the influence of gender, a notable disparity was observed between male and female athletes at the elite level, which was not visible at any other level. This observation is consistent with the findings of Gyomber et al. (2013) in athletes outside the realm of football. A potential explanation for this difference might (again) lie in the level of professionalism within football. While elite male players can dedicate themselves fully to their careers from a financial perspective, elite female players often have to balance their careers alongside other responsibilities (Ehnold et al., 2024). This means they must be more open to new experiences and cannot rely solely on the status quo.

3.4.6 Limitations and Future Directions

We encountered difficulties in locating female youth players as counterparts to male youth players, particularly noticeable from the highly trained level downwards. This disparity can be attributed to the structure of the German league system and the relatively smaller number of female players. Therefore, female youth players progress to adult football faster than males, especially from the age of 16 onwards, which represented the cutoff value for participation in the current study. Additionally, unlike male teams, most clubs with female departments lack

squads in each age group. Moreover, the limited availability of contact addresses on the highly-trained level and downwards makes it challenging to contact female teams, especially when compared to the male environment. Despite these challenges, the majority of findings related to expertise were consistent across genders. However, we were not able to analyze data from female youth players due to the low sub-sample size, which represents a first limitation of the present work.

The representation of highly trained male youth players was lower compared to other youth male groups. This discrepancy can be partially explained by the German league system and our grouping strategy based on McKay et al. (2021), as this particular expertise level was predominantly present in the second-highest youth league only. While the grouping approach of McKay et al. (2021) is widely accepted as a standard across sports, it does not seamlessly align with the German football league system. Consequently, we had to adapt the grouping method to achieve a strict separation of different expertise levels. Another significant issue influenced by the German league system is the disparity between male and female players. Due to the uneven distribution of active football athletes, the hierarchical structure of the female league is reduced compared to their male counterpart. For instance, while male football comprises three professional leagues, females only have two. Additionally, many teams in the second-tier female league are the second teams of first-tier clubs, a scenario not permitted in the male system due to federation laws. Thus, comparing expertise levels between males and females at each stage becomes challenging.

Our grouping strategy for expertise level was based on the current squad affiliation. However, individual player histories may pose challenges, as players might have experienced higher or lower expertise levels during their past careers. Given the stability of personality traits, this could lead to interdependence between the separated levels. Still, while acknowledging this potential for overlap or ambiguity, the benefits of using current squad affiliation may outweigh the challenges posed by individual player backgrounds. Relying on current squad affiliation

provides a practical and effective method for grouping expertise levels, and past-careers effects ideally average out with large group sizes.

Finally, the cross-sectional nature of the study limits our ability to determine whether certain trait expressions stem from selection, adaptation, or unique coaching outcomes. Future research should therefore incorporate contextual information, such as income, training conditions, and staff support. Also, many of our explanatory approaches remain speculative, as there is limited representation of concrete comparison studies. Lastly, to gain deeper insights and establish causality, longitudinal data are necessary.

3.4.7 Conclusion

The present study approached personality characteristics in football players in a dichotomous manner: first, by comparing them with samples of inactive individuals and students, and second, by delving into details to examine differences related to expertise, gender, and age. This was a novel approach, as we aimed to focus solely on football players, excluding discipline-influences which were present in previous studies that used samples from various sport disciplines. We found that football players differ in their trait characteristics from students and inactive individuals, and that gender, age, and expertise play a role in their personality expression. In contrast to both comparison samples, football players showed lower neuroticism and openness scores as well as higher conscientiousness and extraversion levels. Within this distinct group of athletes, we found greater expertise to be linked to lower neuroticism and higher conscientiousness. Further, male adult players showed higher agreeableness scores compared to male youth players, and females generally exhibited higher levels of neuroticism and agreeableness than males. The complexity of mechanisms that could explain these differences emphasizes the need for further research conducted longitudinally and in a more contextual manner.

In addition to contributing to the scientific understanding of personality research, our findings can also benefit practitioners in fields such as talent identification, coaching, and addressing individual needs and preferences. Given that personality traits are stable and consistent, interventions aimed at changing an individual's trait expressions may not be effective. Instead, it is important to focus on understanding where an individual is best suited and how they can fulfill their full potential. Moreover, if negative tendencies are identified, they should not simply serve as criteria for deselection, but rather as opportunities for personalized personality development.

Data Availability Statement

The datasets presented in this article are not readily available because the dataset includes information about national and international elite-athletes. Therefore, the dataset is under restrictions. Requests to access the datasets should be directed to janspielmann@t-online.de.

Ethics Statement

The studies involving human participants were reviewed and approved by Universität des Saarlandes Ethikkommission der Fakultät HW Campus A1 3 66123 Saarbrücken Ethics Approval Number: 19/19. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author Contributions

JS: conceptualization, methodology, formal analysis, investigation, writing - original draft, writing - review & editing, and project administration. SA: writing - original draft and writing - review & editing. LS: formal analysis, writing - original draft and writing. CH: methodology, review & editing. JM: conceptualization, resources, and supervision. All authors contributed to the article and approved the submitted version.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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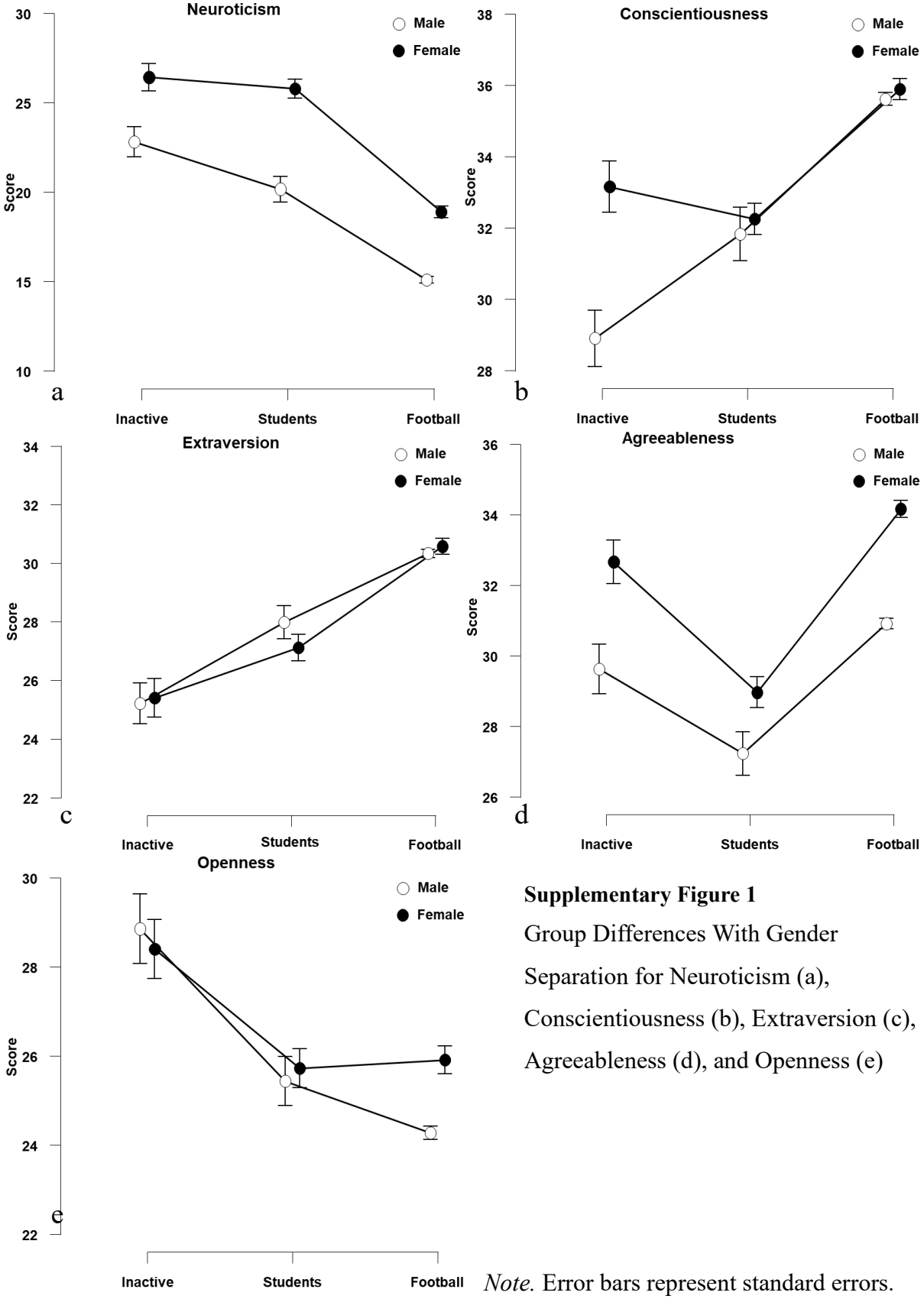
Supplementary Figure 1



Supplementary Figure 1

Group Differences With Gender Separation for Neuroticism (a), Conscientiousness (b), Extraversion (c), Agreeableness (d), and Openness (e)

Note. Error bars represent standard errors.

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4 General Discussion

4.1 Summary and Discussion of Research Aims

The present dissertation took an initial step toward establishing the assessment of personality traits in football through sports psychology. Therefore, the FFM of personality (McCrae & Costa, 2008) with its traits openness, conscientiousness, extraversion, agreeableness, and neuroticism was assessed using the NEO-FFI (Borkenau & Ostendorf, 2008).

The first study focused on testing the NEO-FFI diagnostic instrument, which measures the FFM of Personality, on a sample of football players both male and female. The analysis of reliability and factor structure demonstrated its suitability in the context of football, showing similar results to comparable studies outside of sports. However, similar weaknesses in the factor structure were also observed, consistent with previous findings.

The second study focused on the relationship between personality traits and EFs. Linear regression models revealed inconsistent relationships between personality and EF among football players. A maximum of 23% of the variance in Executive Functions could be explained by personality traits and team affiliation. This suggests that while executive functions and personality traits of football players are related, additional unobserved variables likely contribute to a more comprehensive understanding of this relationship.

The third study analyzed the personality traits of football goalkeepers across different genders, ages, and levels of expertise. The difference analyses showed inconsistent results, with no clear pattern of a distinct goalkeeper personality profile emerging. However, the findings provided the first and important insights into understanding the profile requirements for the goalkeeper position and offered guidance for individualized coaching and scouting.

The fourth study was the most comprehensive assessment of personality traits and the largest undertaking of the dissertation. The approach from the more detailed analyses in Study 3 was extended to a larger, cross-positional sample of football players. Additionally, the sample

was compared with two control groups outside of football. Generally, football players exhibited higher levels of openness, conscientiousness, and extraversion, and lower levels of neuroticism compared to both students and inactive individuals. Within football players, increasing expertise was associated with lower levels of neuroticism and higher levels of conscientiousness. Adult male footballers showed higher levels of agreeableness compared to younger footballers, while female footballers exhibited higher levels of neuroticism and agreeableness compared to their male counterparts. Based on a large sample, these results provide initial insights into the differences between football players and comparison samples. Detailed analyses within the footballers represent a first step toward understanding the influence of personality in football and its varying significance depending on gender, age, and expertise.

Overall, the current dissertation provides important insights for both the scientific community and the applied field of sports psychology in football. One key focus was the identification of the NEO-FFI (Borkenau & Ostendorf, 2008) as a setting-appropriate instrument for assessing the FFM of personality (McCrae & Costa, 2008) in football. Since the analyses yielded similar results to previous studies conducted outside of sports and with non-German-speaking samples (Aluja et al., 2005; Baudin et al., 2011; Caruso, 2000), the results suggest that the NEO-FFI could be used as a context-independent and linguistically neutral instrument for assessing the Five-Factor Model of personality. Afterwards, the dissertation aimed to analyze the personality traits of a large sample of football players for the first time, with the goal of exploring correlations with other common sports-psychological tests, such as those assessing EFs (Beavan et al., 2020; Scharfen & Memmert, 2019). The results were inconsistent and only partially supported the findings of previous, similarly structured studies conducted outside of sports (Buchanan, 2016; Sperandeo et al., 2018; Zhang et al., 2019) and within the sports context (Vaughan & Edwards, 2020). Differences, particularly those observed in the latter study, may be attributed to methodological factors, such as variations in the sample composition regarding the operationalization of expertise levels or the specific sports

disciplines examined. Ultimately, the detailed examination of the personality traits of football players provided deeper insights into group-dependent differences among personality traits. In line with the findings of Wilson and Dishman (2015) and Rhodes and Smith (2006), football players exhibited distinct expressions of personality traits in neuroticism, conscientiousness, and extraversion compared to two comparison groups outside of football. Whether the results can be explained by the sport-specific conditioning of the football players in the context of sports or by certain selection effects remains speculative, as this cannot be determined due to the cross-sectional design of the study. Nevertheless, the findings provide justification for considering football players as a distinct and specialized sample. In summary, the difference analyses regarding expertise, age, and gender within the football players generally aligned with the current research findings in the context of sports (Allen et al., 2013; Gregory et al., 2010; Vaughan & Edwards, 2020; Wilson & Dishman, 2015). Multiple explanatory factors could account for the observed results. For example, the level of professionalism may be correlated with all three variables examined: expertise, age, and gender. This is reflected in factors such as the availability of qualified personnel like sports psychologists (DFL, 2021), the obligation to pursue dual careers (Ehnold et al., 2024), or unequal media attention (DFB, 2024). Additionally, factors like the highly heterogeneous within population size (DFB, 2023) and the potentially resulting selection pressure on male and female football players could have a more pronounced effect on gender-specific differences. Furthermore, findings from non-athletic contexts provide additional explanatory perspectives, as men and women exhibit differences not only within sports but also in non-athletic settings (Feingold, 1994; Schmitt et al., 2008). Differences in extraversion or openness between groups with varying levels of expertise could be explained by sample composition differences (e.g., team vs. individual sports or the specific sport discipline studied, such as team sports vs. endurance sports) or methodological aspects in general.

4.2 Limitation and Future Directions

The current dissertation showcases important findings, and by considering its limitations, we can identify areas for improvement and future research opportunities. One limitation of the selected German NEO-FFI test instrument (Borkenau & Ostendorf, 2008) is that it is only applicable to participants aged 16 and above. While comparable diagnostic instruments might cover a broader age range, they would have been harder to compare with previous research or may not have the same level of scientific acceptance. Additionally, data collection could not be uniformly standardized across all participants. While most participants completed the instruments during individually organized appointments at their clubs, this could not be ensured for all respondents, requiring data collection in less controlled environments. Furthermore, it cannot be ruled out that, particularly in the context of elite sports, socially desirable responses were more frequent. Efforts to mitigate this, such as pseudonymization, assurances of no negative consequences, and clear instructions, were implemented, but it remains a limitation of self-report methods.

Moreover, only participants who were proficient in German or indicated that German was one of their native languages took part in the studies. As a result, participant recruitment was primarily concentrated in the German-speaking regions of Europe. Only a small number of German-speaking participants, such as those affiliated with clubs in non-German-speaking countries like Turkey or Italy, were included in the study. Thus, the findings primarily reflect the experiences of German-speaking football players within the German-speaking regions. Due to the exclusion of non-German-speaking participants within the German-speaking countries, any conclusions regarding "the German league system" should be interpreted with caution. Future research efforts should extend the methodology to other countries and include non-German-speaking football players in the analyses.

Aside from the focus on the goalkeeper position in Study 3, no detailed analysis was conducted based on playing positions. Several studies deliberately exclude goalkeepers from

analyses, as the demands of this position often differ significantly from those of outfield players (Di Salvo et al., 2007; Najah et al., 2015). In the current dissertation, this exclusion was intentionally not implemented, as the objective was to provide a cross-positional insight. The potential impact of this inclusion on the results should be further investigated in future research.

This dissertation adopted a cross-sectional approach to analyzing the personality traits of football players. Conclusions regarding the development of personality traits through participation in football, depending on age, expertise, or gender, can only be speculated upon. However, due to the relatively large sample size and the group categorizations, recommendations for future research can be derived. For instance, a longitudinal study tracking players across different levels of expertise would be a logical next step to identify causality in future research. Ultimately, this investigation represents the first large-scale study in the German-speaking context, involving a substantial sample and considering differences in gender, expertise, and age.

4.3 Practical Recommendations

The dissertation demonstrated that the NEO-FFI diagnostic tool is both suitable and practical for assessing the FFM of personality in the context of football. It is scientifically well-justified and applicable in practice. Compared to other more comprehensive tools, the NEO-FFI is concise, making it a practical and time-efficient instrument for assessing the FFM personality traits. This is particularly relevant for goal-oriented applications, such as scouting and personality development interventions in sports psychology. It also supports personalized coach-athlete relationships and tailored training designs. However, in high-performance sports, there is often limited time to administer tools like the NEO-FFI. Considering the broad diagnostic battery used in elite sports, which includes medical, functional, physiological, and psycho-cognitive assessments, even shorter screening procedures may be required. Building on these initial screenings, more detailed tests can be administered when specific personality

insights are needed. It is also important to note that assessing only the five broad personality traits without facet-level analyses does not provide a comprehensive understanding of an individual's personality characteristics. In particular, when the goal of the assessment is to support sports psychological coaching interventions only, more detailed instruments that examine multiple facets of an athlete's personality would be advisable.

Another key focus of the present dissertation was to highlight the applicability and advantages of psychological-cognitive assessments in sports. In high-performance settings, physiological testing at the beginning of each season is highly standardized, widely accepted, and regarded as essential by coaches and staff. These tests are well-integrated into training management and are seen as essential components of daily practice by coaches and staff members. In contrast, psychological assessments, including those in sports psychology, are less commonly integrated and often viewed as tools primarily for the sport psychologist's benefit. Despite the privacy concerns related to psychological data, appropriate and risk-free recommendations based on these assessments could also benefit other stakeholders within a football team. The findings regarding distinct personality differences, particularly in relation to expertise levels, are of significant interest and have practical applications in areas like scouting, talent identification, and intervention strategies. This dissertation should be used to promote collaboration between scientifically established methods, the expertise of sport psychologists in interpreting developmental potential, and other stakeholders in sports practice.

5 General Conclusion

The overarching aims of the dissertation “Exploring Personality Traits in Sport: An Analysis of Football Athletes Through Personality Assessments”, which framed the project, were as follows:

I) The identification and evaluation of an instrument for assessing personality in high-level football.

II) The examination of associations between personality traits and executive functions in high-level football.

III) The analysis of personality differences based on expertise, age, and gender among football goalkeepers.

IV) The analysis of personality differences between football players and comparison samples, with a particular focus on personality differences in a larger sample of football players, considering expertise, age, and gender in football.

The first study demonstrated that the NEO-FFI is a suitable diagnostic tool for assessing the FFM of personality in football, with strengths and weaknesses comparable to other contexts, making it practical for application in sports settings. The second study investigated the relationships between personality traits and executive functions. The results revealed inconsistent relationships between traits and EF tests, underscoring the complexity of these constructs. The third study, focusing on goalkeepers, did not reveal a distinct “goalkeeper personality”. The fourth study, comparing football players with two control groups, identified distinctive features in the personality profiles of football players. Detailed analyses within the football player group showed differences based on expertise, age, and gender. The research offers a comprehensive initial analysis of personality traits in a large sample of football players.

The dissertation contributes several important insights to enhance the understanding of personality traits in sports psychology. Beyond advancing scientific knowledge, it also offers valuable practical recommendations for sports practitioners. Practitioners can benefit from the dissertation's guidance in selecting appropriate diagnostic tools, applying them effectively, and making informed interpretations of the results. This area of sports psychology research is far from being fully understood, which is why this dissertation also serves as a call for future research initiatives. Further research is needed to replicate these findings and explore the longitudinal development of personality traits in football athletes, especially in the context of high-level competition.

Revisiting Julian Nagelsmann's initial quote, the NEO-FFI proves to be a reliable instrument for quantitatively validating subjective assessments of personality, allowing us to look deeper behind the “mask” of personality. As Nagelsmann accurately observes, there are periods during a high-performance sports season when both the time and the need arise to employ sports psychological diagnostic tools to generate deeper insights into the key figures in football. The interaction between personal expertise, subjective perception, and the use of scientific methods can facilitate the identification of talent, foster personality development, and serve as a foundation for systematic work in the field.

6 General References

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7 Appendix

7.1 A) Demographic Questionnaire

The presentation of the original questionnaire has been reformatted for the purpose of the dissertation.

1. Nennen Sie Ihr aktuelles Alter in Jahren (z.B. 21).

_____

2. Welchem Geschlecht fühlen Sie sich am meisten zugehörig?

- o männlich
- o weiblich
- o divers
- o Sonstiges: _____

3. Welche Staatsangehörigkeit/-en besitzen Sie?

- o Deutsch
- o Britisch
- o Französisch
- o Türkisch
- o Sonstiges: _____

4. Wie lautet Ihre Muttersprache?

- o Deutsch
- o Englisch
- o Französisch
- o Türkisch
- o Sonstiges: _____

5. Sind Sie aktuell sportlich aktiv?

- o ja (fahren Sie mit Frage 6 fort)
- o nein (gehen Sie direkt zum Ende der Seite)

6. Wenn ja, nennen Sie Ihre Hauptsportart (+evtl. Nebensportarten) in der Sie aktuell aktiv sind.

_____

7. Wenn es in Ihrer Hauptsportart Positionen gibt, welche bekleiden Sie überwiegend (z.B. Torwart, Verteidiger)?

_____

8. Sind Sie in Ihrer Hauptsportart jemals einem Verein zugehörig gewesen? Wenn ja, welcher Verein war dies zuletzt?

_____

9. Wenn ja, welcher Altersklasse sind Sie zugehörig (z.B. U19, Aktive, etc.)?

_____

10. Wenn ja, in welcher Liga/auf welchem Niveau sind oder waren Sie zuletzt aktiv? (z.B. 1.Bundesliga, A-Jugend Bundesliga, etc.)?

_____

11. Ist/war dies Ihr höchstes Niveau? Wenn nein, nennen Sie das Niveau und den Zeitraum Ihrer Zugehörigkeit (z.B. A-Jugend Bundesliga, 2017 - 2019).

_____

12. Waren Sie jemals Teil einer Nationalmannschaft, Nationalkaders, etc.? Wenn ja, nennen Sie das höchste Team + Land und den Zeitraum Ihrer Zugehörigkeit (z.B. U19 - Italien, 2017 - 2018).

_____

13. An wie vielen Tagen einer normalen Woche treiben Sie Sport?

- o 1
- o 2
- o 3
- o 4
- o 5
- o 6
- o 7

14. Wie viele Stunden Training sind das in einer normalen Woche (Stunden/Woche)?

_____

15. Wie stark strengen Sie sich bei Ihrer sportlichen Aktivität in der Regel an?

- o ohne Schwitzen/Kurzatmigkeit/Schnaufen
- o etwas Schwitzen/Kurzatmigkeit/Schnaufen
- o viel Schwitzen/Kurzatmigkeit/Schnaufen

16. Wie lange betreiben Sie die jeweilige/n Sportart/en schon aktiv (in Jahren)?

_____

17. Wenn Sie die sportliche Aktivität nicht das ganze Jahr ausüben, in welchen Monaten sind Sie aktiv (von:__ bis:__)?

_____

18. Notizen/Bemerkungen (optional)?

_____

7.2 B) Curriculum Vitae (German)

Persönliche Daten	
Name	Jan Spielmann
Adresse	Sitzbuchweg 4 69118 Heidelberg
Mobil	+49 157 54600413
E-Mail	JanSpielmann@T-Online.de
Geburtsdatum / -ort	30.01.1990 in Landau
Familienstand	Ledig

Studium/Weiterbildung	
Mai 2024	Curriculum „Experte Fußballpsychologie“ des Deutschen Fußball Bundes (DFB) DFB Zertifikat „Experte Fußballpsychologie“
Seit Okt. 2019	Promotionsstudent Sportwissenschaft Universität des Saarlandes, Saarbrücken Thema: „Exploring Personality Traits in Sport: An Analysis of Football Athletes Through Personality Assessments“
Juni 2019	Curriculum „Sportpsychologisches Training und Coaching im Leistungssport“ der Arbeitsgemeinschaft für Sportpsychologie Abschluss: Sportpsychologischer Experte (asp)
Okt. 2015	Abschluss: Master of Science Sportwissenschaft
Okt. 2013	Master-Studiengang Sportwissenschaft Universität des Saarlandes, Saarbrücken Zweifach-Spezialisierung: • Bewegungs- und Sporttherapie • Leistungssport
Okt. 2013	Abschluss: Bachelor of Arts Sportwissenschaft
Okt. 2010 - Sept. 2013	Bachelor-Studiengang Sportwissenschaft Karlsruher Institut für Technologie, Karlsruhe Studienfächer: • Sportwissenschaft • Fitness- und Gesundheitsmanagement
Okt. 2009 – Sept. 2010	Bachelor-Studiengang Geschichte Ruprecht-Karls-Universität, Heidelberg Studienfächer: • Geschichte • Soziologie

Schulbildung

17. März 2009	Abitur Johann-Wolfgang-Goethe-Gymnasium, Germersheim

Berufliche Tätigkeiten

Seit Dez. 2023	Leiter Psychologie & Consulting Koordination Technologie TSG 1899 Hoffenheim Spielbetriebs GmbH, Zuzenhausen
Seit Juni 2021	Geschäftsführer TSG ResearchLab gGmbH, Zuzenhausen
Seit Jan. 2020	Freier Mitarbeiter Sportpsychologie Coaching Competence Cooperation Rhein Neckar, Schwetzingen
Sept. 2019 – Juni 2021	Koordinator Sportpsychologie & Wissenschaft TSG ResearchLab gGmbH, Zuzenhausen
Seit Jan. 2019	Sportpsychologisches Training und Coaching Leistungssport u.a. Athlet*innen, Trainer*innen, Teams u.a. aus den Sportarten Fußball, Eishockey, Sportklettern, Ringen.
Jan. 2017 – Sept. 2019	Leistungsdiagnostiker Sportpsychologie TSG 1899 Hoffenheim Spielbetriebs GmbH, Zuzenhausen
Seit Okt. 2015	Freie Referenten- und Dozententätigkeit (u.a.) -Universität des Saarlandes, -Universität Heidelberg, -SRH Hochschule Heidelberg (SRH), -Curriculum asp-Ausbildung Sportpsychologie (asp), -Hochschule Fresenius Heidelberg, -Duale Hochschule Baden-Württemberg Mosbach (DHBW), -Deutscher Ringer-Bund e.V. (DRB) -Deutscher Fußball Bund (DFB), -Nachwuchs und Jugend Basketball Bundesligen gGmbH (NBBL), -Deutscher Alpenverein Sektion Heidelberg e.V. (DAV), -Friedrich-Naumann-Stiftung, -Stadt Heidelberg
Okt. 2015 – Dez. 2016	Leistungsdiagnostiker Sportpsychologie Cavorit Consulting GmbH, Berlin Einsatzort: TSG 1899 Hoffenheim Spielbetriebs GmbH, Zuzenhausen

Preise, Auszeichnungen

Nov. 2019	Förderpreisträger „Seelische Gesundheit im Nachwuchsleistungssport“, Robert-Enke-Stiftung Für die TSG 1899 Hoffenheim
März 2009	Abiturpreis Sport, Land Rheinland-Pfalz Pierre de Coubertin-Medaille

Publikationsliste

Jahr	Referenz
In Submission	Spielmann, J., Altmann, S., Steindorf, L., Herr, C. & Mayer, J. Inside the Minds of Football Athletes: Examination of Age, Expertise, and Gender Disparities in Personality Traits. Manuscript submitted for publication in *European Journal of Personality.*
	Weiler, H., Russell, S., Spielmann, J., & Englert, C. Mental Fatigue: Is It Real?–Perceptions from Semi-Structured Inter-views with Athletes, Coaches, and Sports Psychologists.
2024	Bangert, Y., Jaber, A., Trefzer, R., Zietzschmann, S., Koch, K. A., Kern, R., Spielmann, J., Renkawitz, T. & Weishorn, J. (2024). The Impact of Injury on Career Progression in Elite Youth Football—Findings at 10 Years. *Journal of clinical medicine*, *13*(7), 1915.
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Spielmann, J., Beavan, A., & Mayer, J. (2023). The relationship of personality and executive functions in high-level soccer athletes: expertise-and gender-specific differences. *Frontiers in Sports and Active Living*, *5*, 1130759.

Weishorn, J., Jaber, A., Trefzer, R., Zietzschmann, S., Kern, R., Spielmann, J., ... & Bangert, Y. (2023). How Does Age Affect Injury Characteristics in Young Elite Footballers?—A Prospective Cohort Study of a German Youth Academy. *Journal of clinical medicine*, *12*(21), 6938.

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Werner, C., Hezel, N., Dongus, F., Spielmann, J., Mayer, J., Becker, C., & Bauer, J. M. (2023). Validity and reliability of the Apple Health app on iPhone for measuring gait parameters in children, adults, and seniors. *Scientific Reports*, *13*(1), 5350.

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Beavan, A., Spielmann, J., Ehmann, P., & Mayer, J. (2022). The Development of Executive Functions in High-Level Female Soccer Players. *Perceptual and Motor Skills*, 00315125221096989.

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2018	Spielmann, J. (2018). Die Bedeutung von Normen im Profifußball. In R. Lanwehr & J. Mayer (Hrsg.), *People Analytics im Profifußball*. Implikationen für die Wirtschaft (S. 117-130). Heidelberg: Springer Gabler.
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