UTS UNIVERSITY OF TECHNOLOGY SYDNEY

An investigation into the factors that underlie expertise in esports

by Matthew Anthony Pluss

Thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy (Sport and Exercise)

under the supervision of Doctor Job Fransen, Doctor Andrew Novak, Doctor Derek Panchuk, and Distinguished Professor Aaron Coutts

University of Technology Sydney
Faculty of Health

2021

Certificate of Original Authorship

I, Matthew Pluss declare that this thesis, is submitted in fulfilment of the requirements for the award of PhD Thesis: Sport and Exercise Science, in the Faculty of Health at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

This research is supported by the Australian Government Research Training Program.

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31/01/2021

Matthew Anthony Pluss

Date Submitted

Acknowledgements

First and foremost, I wish to acknowledge and express my gratitude towards my lead supervisor Dr. Job Fransen. I thank you for the dedication, commitment, and time you have offered throughout the years. Without your assistance, a thesis of this kind would not only be possible yet be where it is today. I look forward to further build both a professional relationship and friendship with you in the future.

Thank you, Prof. Aaron Coutts, and Dr. Derek Panchuk, your expertise, and knowledge within the sport science field has been valuable in the development of this research. I am very appreciative of the insight you have provided throughout this time.

Thank you, Dr. Kyle Bennett, and Dr. Andrew Novak, I am grateful for your dedication throughout the years. Without your support, this research thesis would not have been able to be completed. Also, thank you for your commitment towards my development.

To my fellow Research Higher Degree Students - Adam Beavan, and Rhys Tribolet. It has been a pleasure to work with all of you over this time. The light-hearted environment and friendship I have with you all made the time in the office enjoyable and I hope to continue to work with you all in the future.

To the participants who made themselves available for the testing, I am very grateful for your willing participation and commitment towards this research study. Without your assistance, this research study would not have been able to be completed.

Lastly, a massive thank you to my Family - Mark, Georgina, Holly and Jacinta. You have always provided the support I need to never doubt myself throughout the years. It is without a doubt, your understanding and patience allowed me to successfully complete my thesis. Also, a special mention for Kaitlin Rudd, you were the light at the end of the tunnel over the last year.

List of Publications

Peer-Reviewed Journal Articles

Pluss, M.A., Bennett, K. J. M., Novak, A. R., Panchuk, D., Coutts, A., & Fransen, J. (2019). Esports: the chess of the 21st century. *Frontiers in Psychology*, *10*, 156.

Pluss, M. A., Novak, A. R., Bennett, K. J., Panchuk, D., Coutts, A. J., & Fransen, J. (2020). Perceptual-motor abilities underlying expertise in Esports. *Journal of Expertise, 3*(2).

Pluss, M.A., Novak, A. R., Bennett, K. J. M., Panchuk, D., Coutts, A., & Fransen, J. (Prepared for submission). Exploring fitts' law: the speed-accuracy trade-off in esports.

Pluss, M.A., Novak, A. R., Bennett, K. J. M., Panchuk, D., Coutts, A., & Fransen, J. (Prepared for submission). Assessing the reliability and validity of an esports skill assessment.

Pluss, M.A., Novak, A. R., Bennett, K. J. M., Panchuk, D., Coutts, A., & Fransen, J. (2020). The relationship between the quantity of practice and in-game performance during practice with tournament performance in esports: An eight-week prospective study. *Journal of Sport and Exercise Science*.

Pluss, M.A., Novak, A. R., Bennett, K. J. M., McBride, I., Panchuk, D., Coutts, A., & Fransen, J. (Prepared for submission). Examining the quantity of practice of professional and semi-professional esports player: A 52-week longitudinal study.

Conference Proceedings

Bennett, K. J. M., **Pluss, M.A.** Novak, A. R., Panchuk, D., Coutts, A., & Fransen, J. (2019). Domain-general, perceptual-motor abilities underlying expertise in esports. *Australasian Skill Acquisition Network Conference*. Waikato, New Zealand.

Pluss, M.A., Bennett, K. J. M., Novak, A. R., Panchuk, D., Coutts, A., & Fransen, J. (2018). Esports: the chess of the 21st century. *Australasian Skill Acquisition Network Conference*. Sydney, Australia.

Pluss, M.A., Novak, A. R., Bennett, K. J. M., Panchuk, D., Coutts, A., & Fransen, J. (2018). Practice activities explain individual performance in a major esports tournament. *Exercise and Sport Science Australia – Research to Practice*. Brisbane, Australia.

Pluss, M.A., Novak, A. R., Bennett, K. J. M., Panchuk, D., Coutts, A., & Fransen, J. (2017). An investigation into the factors that underlie expertise in esports. *Australasian Skill Acquisition Network Conference*. Brisbane, Australia.

Invited Presentations

Pluss, M.A., Bennett, K. J. M., Novak, A. R., Panchuk, D., Coutts, A., & Fransen, J. (2018). Expertise in esports. *Pint of Science Festival*. Central Coast, Australia.

Pluss, M.A., Bennett, K. J. M., Novak, A. R., Panchuk, D., Coutts, A., & Fransen, J. (2017). Esports: the chess of the 21st century. *Australian Esports Masterclass*. Sydney, Australia.

Statement of Candidate Contribution

The valuable contribution of each author to the studies submitted as part of this thesis (Table I).

Table I. The contribution (%) of each author to study 1 to 2.

	Study 1						**Study 2**					
	Matthew Pluss	Kyle Bennett	Andrew Novak	Derek Panchuk	Aaron Coutts	Job Fransen	Matthew Pluss	Andrew Novak	Kyle Bennett	Derek Panchuk	Aaron Coutts	Job Fransen
Research design	70					30	50					50
Ethics application							80					20
Subject recruitment							100					
Data collection							100					
Data analysis							80					20
Statistical analysis												100
Manuscript preparation	100						100					
Manuscript revisions		10	10	10	10	50		10	10	10	10	50

Table I (cont'd). The contribution (%) of each author to study 3 and 4.

	Study 3						Study 4					
	Matthew Pluss	Andrew Novak	Kyle Bennett	Derek Panchuk	Aaron Coutts	Job Fransen	Matthew Pluss	Andrew Novak	Kyle Bennett	Derek Panchuk	Aaron Coutts	Job Fransen
Research design	50					50	50					50
Ethics application	80					20	80					20
Subject recruitment	100						100					
Data collection	100						100					
Data analysis	80					20	80					20
Statistical analysis						100		50				50
Manuscript preparation	100						100					
Manuscript revisions		10	10	10	10	50		10	10	10	10	50

Table I (cont'd). The contribution (%) of each author to study 5 and 6.

	Study 5						Study 6						
	Matthew Pluss	Andrew Novak	Kyle Bennett	Derek Panchuk	Aaron Coutts	Job Fransen	Matthew Pluss	Andrew Novak	Kyle Bennett	Ignatius McBride	Derek Panchuk	Aaron Coutts	Job Fransen
Research design	50					50	50						50
Ethics application	80					20	80						20
Subject recruitment	100						100						
Data collection	100						100						
Data analysis	80					20	80						20
Statistical analysis						100				50			50
Manuscript preparation	100						100						
Manuscript revisions		10	10	10	10	50		10	10		10	50	50

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List of Abbreviations

×	By
Δ	Change in
=	Equals
<	Less than
>	Greater than
%	Percentage
±	Plus-minus sign
cm	Centimetres
e.g.	For example
ES	Effect size
F	F statistic
h	Hours
ICC	Intraclass correlation coefficient
i.e.	That is
MANOVA	Multivariate analysis of variance
n	Number
p	P value
η^2_p	Partial eta squared effect size
RM-MANOVA	Repeated measure multivariate analysis of variance
s	Seconds
SD	Standard deviation
v	Versus
y	Year

Abstract

For many decades, researchers have explored the limits of human achievement in a variety of domains (e.g. music, science, sport, technology, and academia). Despite a plethora of research into how human expertise is achieved, several recurring complications persist when assessing the characteristics of an expert and studying the development of expertise. The first is the bias associated with using retrospective recall to examine an individual's developmental activities in the pursuit of excellence. Second, developing tasks that allow participants to accurately reproduce the behaviours observed in a performance environment in a laboratory setting remains difficult. Lastly, as the attainment of expertise often occurs over a long time span, there are factors (e.g. systematic training environments) that can confound the development of expertise. Despite providing insights into how expertise is attained, expanding on these findings in different domains may further improve our understanding about expertise. Therefore, the current thesis investigated the extent to which electronic sports (esports) may present an opportunity to add to the existing knowledge of expertise through six research studies.

Study 1 framed esports (competitive video gaming) as a contemporary window into human expertise that can address some of these limitations associated with current methodologies used in expertise research. Examining expertise through an esports lens has the following advantages: (i) developmental activities are objectively tracked and automatically logged online, thus limiting the reliance on retrospective recall when attempting to map participation histories, (ii) esports performance is conducted in a relatively controlled environment, which offers researchers a unique opportunity to conduct investigations that sufficiently represent real-world performance, and (iii) esports expertise has emerged with limited influence of guided systematic training environments (e.g. talent development programs and structured coaching). Therefore, Study 1 argues

that esports provides an opportunity to complement the current understanding about expertise.

Study 2 investigated the extent to which esports expertise can be detected using a battery of perceptual-motor assessments using an expert/nonexpert paradigm. Study 2 findings indicated that professional esports players were better able to maintain their accuracy whilst producing shorter movement times when compared with recreational esports players and a control group. Furthermore, professional esports players demonstrated faster two-choice response times and were better at using or ignoring congruent or incongruent information preceding a stimulus to inform subsequent action when compared with the control group.

Study 3 explored Fitts' law, a law that describes the relationship between movement speed and accuracy which governs the control of voluntary movement in humans, in manual aiming tasks using an expert/non-expert paradigm and a targeted subset of the data collected for Study 2. Overall, professional esports players produced shorter movement times and adapted their movement time to changes in task difficulty with imposed accuracy demands when compared with recreational esports players and a control group.

Study 4 investigated the test-retest reliability and construct validity of a commonly used and practically relevant esports perceptual-motor skill assessment (Mobalytics Proving Ground Test). In terms of the main performance characteristics, the esports group demonstrated superior performance in total score and mechanics compared with the control group, however background processing and map awareness did not distinguish between groups. When analysing the variables related to each aspect of the performance characteristics, most variables associated with mechanics and background processing significantly differed between groups. Overall, the esports perceptual-motor skill

assessment used in the current study can to some extent distinguish between an esports player from a control group.

Study 5 examined the influence of the quantity of practice and the in-game performance during practice of professional esports players over an eight-week period immediately prior to a major esports tournament. Overall, the quantity of practice and in-game performance during practice explained a small proportion of the variance in tournament performance. More specifically, measures of in-game performance (i.e. kill/death ratio and score) were most associated with better tournament performance during practice, rather than the quantity of practice during the lead up to competition.

Study 6 examined the practice activities (i.e. time spent in-game and time spent in competition) of professional and semi-professional esports players over a 52-week period. Study 6 reported that professional esports players on average accumulate more practice over a one-year period than semi-professional players, of which a large part involves competitive play. While this finding may appear to be logical, it demonstrates that even at considerable levels of expertise, practice time appears to distinguish intermediate from expert performers.

Overall, the current thesis provided new insights into assessing the characteristics of experts and studying the development of expertise in a relatively new domain known as esports. In terms of assessing the characteristics of experts in esports, perceptual-motor abilities may underlie expertise in esports, yet their ability to distinguish between professional and recreational esports players is limited when assessments are not able to replicate the perception and action demands of competitive performance. Furthermore, computerised speed-accuracy trade-off tasks provide a task-representative measure of domain-specific expertise. However, esports perceptual-motor skills remain difficult to quantify and further research is needed to develop and assess the validity and reliability

of these representative assessments. Whereas when studying the development of expertise in esports, the quantity of practice had a limited acute association with better tournament performance in a homogeneous sample of expert esports players. However, over longer time scales, practice time appears to distinguish professional from semi-professional esports players.

Keywords: electronic sports, expert performance, excellence, skilled performance, video games, gaming