The Role of Human Safety Interventions on Co-Workers' Safety Outcomes in Construction Projects

Emmanuel Bannor Boateng

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Environmental and Occupational Health at the University of Newcastle

2021

STATEMENT OF ORIGINALITY

I hereby certify that the work embodied in the thesis is my own work, conducted under normal supervision. The thesis contains no material which has been accepted, or is being examined, for the award of any degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository, subject to the provisions of the Copyright Act 1968 and any approved embargo.

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I hereby certify that the work embodied in this thesis contains published paper/s/scholarly work of which I am a joint author. I have included as part of the thesis a written declaration endorsed in writing by my supervisor, attesting to my contribution to the joint publication/s/scholarly work

By signing below I confirm that Emmanuel Bannor Boateng contributed conceptualisation, methodology, formal analysis and writing to the publications entitled below

Boateng, E.B., Pillay, M. & Davis, P. 2019, 'Predicting the Level of Safety Performance Using an Artificial Neural Network', in T. Ahram, W. Karwowski & R. Taiar (eds), Human Systems Engineering and Design, Springer International Publishing, Cham, pp. 705-10.

Boateng, E.B., Davis, P. & Pillay, M. 2019, 'Predictors of Safety Behaviour in the Construction Industry: A Systematic Review', paper presented to the CIB World Building Congress 2019, Hong Kong SAR, China, 17 – 21 June 2019.

Boateng, E.B., Davis, P. & Pillay, M. 2020, 'Role of Human Safety Intervention on the Impact of Safety Climate on Workers Safety Behaviours in Construction Projects: A Conceptual Model', in P.M. Arezes (ed.), Advances in Safety Management and Human Factors, vol. 969, Springer, pp. 190-200.

Boateng, E.B., Pillay, M., Gajendran, T. & Davis, P. 2020, 'Development of the Human Safety Intervention Questionnaire on Construction Projects', paper presented to the Joint CIB W099 & TG59 Annual Conference, Glasgow, Scotland, 9 – 11 September 2020.

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Dr Manikam Pillay

ACKNOWLEDGEMENTS

This thesis could not have been completed without the guidance and friendship I have received over the last three and a half years from numerous people, some of whom I mention below. These words of acknowledgement only bring out a small fraction of the heartfelt gratitude I feel for them. First, I am grateful to the Almighty God for giving me the strength, ability, and knowledge to complete this work. I would also like to acknowledge the full scholarship I received from the University of Newcastle. Without this funding, I would not have been in a position to undertake this research.

I would like to thank my supervisors, Dr Manikam Pillay, Professor Peter Davis, and Associate Professor Thayaparan Gajendran for their guidance and support, and for the amount of time they have dedicated to supervising me throughout my PhD. In particular, thanks to Mani, my principal supervisor, for all his help, patience, and neverfailing optimism! Mani has been a source of support and nurtured me to expand the scope and reach of my thinking through his insightful observations and constructive criticisms. This thesis has benefited greatly from his depth of knowledge, in the areas of, amongst many others, construction and safety. I am thankful for the opportunities he has provided me and for his guidance through this journey.

I am hugely grateful to my co-supervisor, Peter, who has left an indelible mark on me, both personally and professionally. Peter has been patient, enthusiastic and understanding, and he has been extremely generous with his time, not least in reading and correcting the work produced in this thesis. His unique explanations and brilliant understanding gave me new insights into my research findings. I am also thankful to Thayaparan, my co-supervisor, I feel privileged to have had the opportunity to learn from him not only about the science of my study area but also about the art of scientific research itself. He has been a connector-of-dots and I have terrific admiration for his capacity to regard a question, no matter how blurry, and snap a picture-in-focus of the deep problems at hand.

Thank you to Professor Carole James and her family, for sharing their Christmas evenings and dinners with me and my colleagues. I also appreciate the critical feedback she provided on my pilot survey which has been invaluable to my research. My profound gratitude also goes to Dr Mohammad Tanvi Newaz, Dr Matthew Abunyewah, and Dr Joanna Bohatko-Naismith who have been a rich source of support and inspiration. They generously offered their time, knowledge, and shared information relevant to my thesis. My sincere thanks also go to Mr Patrick McAllister for his genuine curiosity and excitement about my work. His support has been instrumental in gathering all the data I needed for my study. I would like to thank my colleague and friend, Dr Andrew Enya, who have made the past years very enjoyable. Thanks to Andrew for all his inspiring conversations with me.

As always, I am indebted to my parents, Patrick and Mercy, and my four sisters, Margaret, Lydia, Priscilla and Ama, for they have always gone the extra mile for me and their love and support have been unwavering. I owe everything to them, and no words are sufficient to describe the importance of their unbounded love and support, not just through my PhD, but throughout my life. Finally, I would like to echo the motto of UON. *I look ahead*.

DEDICATION

And for whom, anyway, do I do the things that lead to a PhD

if not for my mother, Mercy

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LIST OF ABBREVIATIONS

ARS	Audience Response System
AWHSS	Australian Work Health and Safety Strategy
AVE	Average Variance Extracted
BBS	Behaviour-Based Safety
R ²	Coefficient of Determination
CFI	Comparative Fit Index
CR	Composite Reliability
CFA	Confirmatory Factor Analysis
CB-SEM	Covariance-Based Structural Equation Modelling
rho_A	DiJkstra-Henseler's rho
EFA	Exploratory Factor Analysis
НТМТ	Heterotrait-Monotrait Ratio
HREC	Human Research Ethics Committee
HSI	Human Safety Interventions
КМО	Kaiser-Meyer-Olkin
MLE	Maximum Likelihood Estimation
MaxR(H)	Maximum Reliability(H)
MSV	Maximum Shared Variance
MICE	Multivariate Imputation by Chained Equations
OHS	Occupational Health and Safety
PClose	p of close fit
PLS-SEM	Partial Least Squares-Structural Equation Modelling
PPE	Personal Protective Equipment
RMSEA	Root Mean Squared Error of Approximation
SRMR	Standardised Root Mean Squared Residual
SEM	Structural Equation Modelling
VB-SEM	Variance-Based Structural Equation Modelling

ABSTRACT

Globally, the construction industry is known to have a high rate of recorded accidents, fatalities, or injuries. Historically, the behaviour of workers concerning safety matters was recognised as a significant factor leading to poor safety outcomes. Recently, insights from assessing workers' safety climate have been used to improve workers' safety. These insights often tend to focus on a worker's perception about the leadership and/or self rather than the workgroup within which one operates. Considering the physical and social proximity of construction activities, the lack of attention on social and team practices, which are vital to construction activities, has resulted in challenges to accident reduction rates. Despite this, there is a limited body of knowledge on factors that influence workers' perceptions, especially in the workgroup among co-workers. Owing to this, safety interventions have been suggested as possible antecedents that improve safety climate. Hence, this research aims to investigate how human safety interventions (HSIs) affect workgroup safety climate and co-workers' safety behaviour.

A quantitative approach employing a strategy using a cross-sectional survey collected data from 317 trade workers within five large commercial construction projects in New South Wales, Australia. Exploratory factor analysis, reliability analysis, descriptive statistics, and covariance-based structural equation modelling were used to develop and validate the HSI constructs. Following this, variance-based structural equation modelling was used to validate the theoretical model by evaluating thirteen proposed hypotheses. Due to the complexity of the model, another model was further developed to examine how co-workers' safety outcomes influence workers' perceptions about safety priority.

Results from validating the HSI construct revealed two factors: psychological safety interventions and sociological safety interventions. An intersection was found between the two factors suggesting that they should be regarded as reflective-reflective higher-order constructs. Because the two factors tap into the same underlying concept. Thirteen out of the fourteen hypotheses were supported. The results suggest that HSIs do not directly influence co-workers' safety behaviour. Instead, an increase in HSIs strengthens the relationship between how workers' perceived the value of safety and co-workers' safety behaviour. The study shows that, through social exchanges, the provision

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of HSIs positively improves workgroup safety climate. The relationship between supervisory environment and workgroup safety climate was strengthened by HSIs. A partial mediation was revealed, as the supervisory environment influences the workgroup safety climate through HSIs. An increase in safety outcomes was found to decrease the workgroup safety climate. The study also identified a route to reducing the number of accidents and near-misses on construction sites.

The implication of the research is that it identifies supervisory environment, coworkers' safety outcomes and HSIs as factors influencing the perceptions workers' form about the priority of safety in their organisation. These outcomes contribute to the expansion of the safety climate theory in construction. The study confirms the role HSIs play in reducing risks and uncertainties while improving workers' safety knowledge and reasoning. The implementation of HSIs by construction managers or safety professionals offers a fertile ground for the formation of workgroup safety climate. The study also stresses the need for a focus on co-workers as they are important agents of change in the development of safety perceptions by other workers. In addition, the research contributes to the development and validation of the HSI construct in construction. The validated HSI scale may be used to identify potential weaknesses within existing construction safety regimes. The scale has the potential, alongside other established safety constructs to function as a modifying factor in cultivating desired behaviours. The research also contributes to the categorisation of safety climate dimensions at various levels of climate analysis. Finally, the study provides implications for practice and recommendations for further study.