Toward a Theory of Behaviour Change in Social Marketing

Patricia Tavares de Lima David

Master of Marketing (Class 1. Hons.), Griffith University

Social Marketing @ Griffith

Department of Marketing

Griffith Business School

Griffith University

Submitted in fulfilment of the requirements of the degree of

Doctor of Philosophy

October 2018
Abstract

Contemporary societies all over the world face issues that have been characterised as “wicked problems”. Wicked problems are difficult to define and are ingrained in complex systems, with numerous stakeholders involved. Although the causes of such problems cannot be easily delineated, they commonly can be associated with the practice of preventable behaviours at the individual level. An example is sedentary behaviours, which combined with an unhealthful diet can lead to problems like obesity, diabetes type 2 and more (World Health Organization, 2015c). Obesity is considered to be one of the leading causes of mortality globally. In Australia, for example, almost two thirds of the population are considered to be overweight or obese (Australian Institute of Health and Welfare, 2016). A few examples of other important societal issues are harmful alcohol consumption, environmental degradation, and smoking, among others (Centers for Disease Control and Prevention, 2016). There is an urgent need for effective interventions that can achieve positive behaviour change to decrease the incidence of these issues.

Social marketing is a discipline that utilises the tools and techniques of commercial marketing to combat social issues delivering programs valued by citizens and communities (Gordon, 2011). The ultimate goal of social marketing is to change behaviours for the better of society, by influencing people to engage in the desired behaviour. Social marketing is considered to be an effective approach to tackle social issues, and it has been applied to a range of behaviours, the most common being health (Gordon, McDermott, Stead, & Angus, 2006). Social marketers developed a set of principles that can improve social marketing programs’ effectiveness, named the Social Marketing Benchmark Criteria (SMBC). There are eight elements, which combined, can generate behaviour change, namely: behaviour change, audience orientation, insight,
segmentation, exchange, marketing mix, theory, and competition. This research focusses on theory in social marketing, and the core criterion behaviour change.

Theory provides a structured framework that can serve as a guide to practitioners in the development and implementation of social marketing programs, as well as to researchers. Researchers argue that theory use is fundamental to achieve successful programs (Eagle et al., 2013; Lefebvre, 2001). However, evidence in the literature shows that theory use is scarce (Luca & Suggs, 2013; Truong, 2014; Truong & Dang, 2017) and the majority of theories applied in social marketing are borrowed from other fields. Furthermore, even when theory is reportedly used, it is unclear how theory is applied to the research (Pang, Kubacki, & Rundle-Thiele, 2017).

An examination of the most commonly used theories employed in the social marketing discipline show that they approach behaviour as a static phenomenon limiting research attention to behaviour and not behavioural change. Since social marketing’s core is behavioural change and theory should provide guidance on to how to achieve change, theories used in social marketing must be behaviour change, and not behaviour, theories.

The overarching aim of this thesis is to take a first step toward developing a theory of behaviour change in social marketing. This thesis starts by understanding the process of behaviour change, and empirically examines how behaviour change differs from behaviour. Additionally, this thesis empirically examines determinants of behavioural change, and applies different methodologies to assess change. More specifically, the purpose of this research is to; first, understand whether behaviour and behavioural change are conceptually and empirically distinct; second, explore the multifaceted characteristics of behaviour change, and empirically test what are the determinants of behaviour change; and third, test the potential of a dynamic
methodology to empirically examine change in social marketing. To achieve the aims of this project, three studies were conducted.

Study 1 involved a *conceptual and operational distinction of the concepts of behaviour and behavioural change*. This study aimed to illustrate with empirical evidence from one case study, that determinants of behaviour may not the same as determinants of behavioural change. The method chosen for statistical analysis in Study 1 was multiple linear regression using time point 2 for analysis of behavioural determinants, and change scores for dependent (DV) and independent variables (IV) to examine behavioural change and its determinants. Findings from this study demonstrate that the two concepts are distinct. Empirical evidence shows that when a static model was examined in the context of walking to and from school behaviour, determinants of the behaviour at time point 2 were intentions and barriers to walk to and from school. The dynamic model, analysing only changers and using change scores as IVs and DV, found that a change in injunctive norms was statistically significant in explaining change in walking to and from school.

Study 2 was an *empirical exploratory study that aimed at examining which determinants were associated with behaviour change, by looking at the different types of behaviour change*. Study 2 also applied multiple linear regression for statistical analysis. A series of tests were performed to examine the complexities and different forms of looking at behavioural change. To assess behavioural determinants in a physical activity context, a static model was first tested. Next, a series of tests to explore behaviour change were undertaken. First, a model testing explanation of change using static variables at time point 1 was conducted. The second model involved using change scores for dependent and independent variables to examine a completely dynamic behavioural change model. Lastly, due to change being dynamic and having different directions, two models testing the determinants of different types of behaviour change, namely
undesired (negative changers only) and desired (positive changes only) were conducted. Findings indicate that behaviour change should not be treated as one thing. The key outcome of this study is that care should be taken when assessing change, since determinants differ for the different types of change.

Study 3 aimed to investigate the potential of a dynamic methodology, the Hidden Markov Model, to simultaneously assess determinants of both behaviour and behavioural change for social marketing. Due to the complex nature of behaviour change, a methodology that can capture the dynamics of change, such as different behavioural states, change rates and directions of change is needed. Study 3 involved an empirical examination to explore the potential of using the Hidden Markov Model to assess behaviour change in social marketing.

This research contributes to the literature by advancing social marketing theoretical enquiry beyond static behavioural explanation and prediction, representing a move beyond dominant cross-sectional research designs evident in downstream social marketing studies. Thus, this research takes a first step toward the development of a Theory of Behaviour Change. A future program of work that aims to expand research focus towards the factors that can explain behaviour change aligns theory more closely to social marketing’s end game, namely behavioural change.
Acknowledgements

First, I would like to thank Professor Sharyn Rundle-Thiele. She took me into the world of academia a few years ago, and I have been very fortunate to be working with her since then. More than a PhD supervisor, Sharyn has been my greatest mentor, believing in me even when I failed to do so. My deepest gratitude and appreciation to you for your guidance and patience, for being so caring and for all opportunities granted. I feel honoured for the opportunity of working with you, and I hope this is just the beginning.

I would also like to thank Dr. Joy Parkinson, Dr Julia Carins, and Dr. Jason Pallant, for all the guidance and support as PhD supervisors. I appreciate all advice and help that Dr. Joy Parkinson has provided from the start of my PhD. I am grateful to have had Dr. Julia Carins by my side in this journey, challenging my thinking and guiding me to achieve the best results as a researcher as I could possibly, and being there when I most needed. I would like to thank Dr. Jason Pallant for introducing me to novel ideas, and guiding while we explored new paths.

Someone once told me that undertaking a PhD would be a lonely journey. Thankfully, I was extremely lucky to be surrounded by the most amazing people during my journey. They made every step of the way more enjoyable, celebrating every small win with me, and being by my side whenever I found myself lacking self-confidence, or finding it difficult to see beyond the challenges faced. I would like to thank everyone from the Social Marketing @ Griffith team for your friendship, support, morning coffees, and many laughs shared. It’s amazing to be part of this team, and you can always brighten my days. A special thank you to Haruka Fujihira, Cuong Pham, Bo Pang and Carina Roemer for your friendship, and for being by my side on this journey, supporting me along the way.

I would also like to thank my friends that even not understanding completely what I was doing, were always there to listen, giving me the support and strength I needed.
Most importantly, I cannot thank my family enough. My father and brother, Fleury and Alex, for being so understanding during my most stressful times, giving me love and encouragement, even from distance. To my beloved husband Fabrizio, you were the first to motivate me to start this journey. Thank you with all my heart for always believing in me, for your continuous support and patience, for being so caring and loving, and for giving me strength whenever I needed. I am not sure I would have got this far without your endless encouragement. And last, but not less important, I would not be here if it was not for my mother and grandmother’s love and efforts. They are my eternal inspiration, and my motivation to keep going and to be a better person. I hope I can always make them proud, wherever they are.
Statement of Originality

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

Date: 20th September 2018
PhD Specific Publications

Journal Papers currently in second review


Journal Papers currently in review


Conference Papers and Presentations


Prizes, Grants and Awards

02/2018 Griffith Graduate Research School (GGRS) and International Experience Incentive Scheme (IEIS) Conference Travel Grants – AUD 1500

12/2015 Doctoral Colloquium Contribution to Theory and Knowledge - ANZMAC Doctoral Colloquium 2015

2015 – 2018 Griffith University Postgraduate Research Scholarship, approximately AUD 25000 per annum
2015 – 2018 Griffith University International Postgraduate Research Scholarship, approximately AUD 25000 per annum
# Table of Contents

Abstract ................................................................................................................................................. ii

Acknowledgements ................................................................................................................................. vi

Statement of Originality ......................................................................................................................... viii

PhD Specific Publications ....................................................................................................................... ix

List of Figures ........................................................................................................................................ xvi

List of Tables ........................................................................................................................................... xvii

List of Abbreviations .............................................................................................................................. xix

Acknowledgment of Papers included in this Thesis .............................................................................. xxi

1  Chapter I: Introduction ....................................................................................................................... 22

   1.1  Background ......................................................................................................................................... 22

   1.2  Research rationale and questions ....................................................................................................... 27

   1.3  Research design ................................................................................................................................... 30

   1.4  Overview of contributions to theory and practice ............................................................................... 33

   1.5  Structure of thesis ............................................................................................................................... 33

   1.6  Conclusion ......................................................................................................................................... 36

2  Chapter II: Literature review ............................................................................................................... 37

   2.1  Social marketing ................................................................................................................................... 37

       2.1.1  Social marketing characteristics .................................................................................................. 39

   2.2  Behaviour change ................................................................................................................................ 44

   2.3  Theory .................................................................................................................................................. 46

   2.4  Behavioural theories and models in social marketing ........................................................................ 50

       2.4.1  Transtheoretical Model of Change ............................................................................................... 54

   2.5  Methods of assessing behaviour change ......................................................................................... 56

   2.6  Research questions ............................................................................................................................ 58

   2.7  Conclusion ......................................................................................................................................... 60

3  Chapter III: Research Design and Methodology ............................................................................... 61
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 Philosophical positioning</td>
<td>61</td>
</tr>
<tr>
<td>3.2 Research Design Overview</td>
<td>63</td>
</tr>
<tr>
<td>3.2.1 Study 1: Conceptual and empirical distinction between behaviour and behaviour change</td>
<td>66</td>
</tr>
<tr>
<td>3.2.2 Study 2: Empirical exploration of behaviour and behaviour change determinants</td>
<td>69</td>
</tr>
<tr>
<td>3.2.3 Study 3: Test of a dynamic methodology to assess behaviour change in social marketing</td>
<td>72</td>
</tr>
<tr>
<td>3.3 Conclusion</td>
<td>73</td>
</tr>
<tr>
<td>4 Chapter IV - Study 1: Rethinking behaviour change: a dynamic approach in social marketing</td>
<td>74</td>
</tr>
<tr>
<td>Abstract</td>
<td>75</td>
</tr>
<tr>
<td>Introduction</td>
<td>77</td>
</tr>
<tr>
<td>Social marketing’s core: Behaviour or behavioural change?</td>
<td>79</td>
</tr>
<tr>
<td>Behaviour</td>
<td>81</td>
</tr>
<tr>
<td>Refocussing to behavioural change</td>
<td>82</td>
</tr>
<tr>
<td>Empirical illustration</td>
<td>84</td>
</tr>
<tr>
<td>Method</td>
<td>84</td>
</tr>
<tr>
<td>Design</td>
<td>84</td>
</tr>
<tr>
<td>Participants</td>
<td>85</td>
</tr>
<tr>
<td>The Static Measures</td>
<td>85</td>
</tr>
<tr>
<td>Statistical Analyses</td>
<td>87</td>
</tr>
<tr>
<td>Creating dynamic measures</td>
<td>88</td>
</tr>
<tr>
<td>Results</td>
<td>88</td>
</tr>
<tr>
<td>Determinants of Behaviour</td>
<td>91</td>
</tr>
<tr>
<td>Determinants of Behaviour Change</td>
<td>93</td>
</tr>
<tr>
<td>Discussion</td>
<td>95</td>
</tr>
<tr>
<td>Managerial Implications</td>
<td>98</td>
</tr>
</tbody>
</table>
Limitations and Future Research ............................................................... 99

References ........................................................................................................ 102

5 Chapter V - Study 2: Is all change the same? Exploring the intricate nature of behaviour change ................................................................. 111

Abstract ........................................................................................................ 112

Background .................................................................................................... 113

Method ........................................................................................................... 116

Context ........................................................................................................... 116

Measures ....................................................................................................... 116

Results .......................................................................................................... 119

Analysis 1 ..................................................................................................... 121

Analysis 2 ..................................................................................................... 123

Analysis 3 ..................................................................................................... 125

Analysis 4 ..................................................................................................... 127

Analysis 5 ..................................................................................................... 129

Discussion ................................................................................................... 132

References ................................................................................................... 136

6 Chapter VI - Study 3: (Re)Focussing on behavioural change: An examination of the utility of Hidden Markov Modelling ................................................. 140

Abstract ..................................................................................................... 141

Background .................................................................................................. 143

Literature Review ......................................................................................... 145

Method ......................................................................................................... 147

Design .......................................................................................................... 147

Participants .................................................................................................. 148

Data Analysis .............................................................................................. 149

Results ......................................................................................................... 153

Hidden Markov Model .................................................................................. 154
List of Figures

Figure 1. Levels of social marketing approach ................................................................. 24
Figure 2. Research, gaps and questions and overview ....................................................... 31
Figure 3. The social marketing planning process ............................................................... 39
Figure 4. Stages of Change .............................................................................................. 55
Figure 5. Proposed Research Design .............................................................................. 64
Figure 6. Illustration of behaviour (number of times the child walked to and from school) ... 89
Figure 7. Illustration of behaviour change (change in number of times the child walked to and from school) ................................................................................................................. 89
Figure 8. Change in physical activity .................................................................................. 119
Figure 9. Analysis 1: Model testing determinants of behaviour ......................................... 122
Figure 10. Analysis 2: Model testing determinants of behaviour change (static IVs) ......... 124
Figure 11. Analysis 3: Model testing determinants of behaviour change ......................... 126
Figure 12. Analysis 4: Model testing determinants of negative behaviour change .......... 128
Figure 13. Analysis 5: Model testing determinants of positive behaviour change .......... 130
Figure 14. Summary of Hidden Markov Model results ..................................................... 161
Figure 15. Research Overview ......................................................................................... 178
Figure 16. Dynamic behaviour change model proposed .................................................. 186
List of Tables

Table 1. Objectives, change and audience of different social marketing levels .................. 25
Table 2. Thesis structure .................................................................................................. 34
Table 3. Social Marketing Benchmark Criteria ................................................................. 41
Table 4. Major issues social marketing can have an impact .............................................. 43
Table 5. Examples of Definitions of Theory ..................................................................... 47
Table 6. Behavioural theories in social marketing .............................................................. 51
Table 7. Study 2 analyses outline ..................................................................................... 70
Table 8. Psychographic Measures ..................................................................................... 86
Table 9. Psychographic Descriptive Statistics ................................................................ 90
Table 10. Correlation matrix – static data ...................................................................... 92
Table 11. Static Behaviour (n=146) .................................................................................. 92
Table 12. Correlation matrix – dynamic data ................................................................. 93
Table 13. Behavioural Change (n=132) ......................................................................... 94
Table 14. Research design ............................................................................................ 118
Table 15. Frequencies of behaviour at T1 and T2 (n=1110) ............................................ 120
Table 16. Behaviour Change frequencies ....................................................................... 121
Table 17. Correlation matrix – analysis 1 ..................................................................... 123
Table 18. Analysis 1 results .......................................................................................... 123
Table 19. Correlation matrix – analysis 2 ..................................................................... 124
Table 20. Analysis 2 results .......................................................................................... 125
Table 21. Correlation matrix – analysis 3 ..................................................................... 126
Table 22. Analysis 3 results .......................................................................................... 127
Table 23. Correlation matrix – analysis 4 ..................................................................... 128
Table 24. Analysis 4 results .......................................................................................... 129
Table 25. Correlation matrix – analysis 5 ..................................................................... 130
Table 26. Analysis 5 results .......................................................................................... 131
Table 27. Results summary ......................................................................................... 133
Table 28. Variables included in HMM ......................................................................... 152
Table 29. Descriptive analysis ...................................................................................... 153
Table 30. Model fit statistics ......................................................................................... 155
Table 31. State profiles

Table 32. Transition probabilities

Table 33. Impact of covariates on starting states

Table 34. Impact of covariates on transitions between states

Table 35. Analyses undertaken in Study 2
### List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASM</td>
<td>Australian Social Marketing Association</td>
</tr>
<tr>
<td>AIHW</td>
<td>Australian Institute of Health and Welfare</td>
</tr>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>ATT</td>
<td>Attitude</td>
</tr>
<tr>
<td>BIC</td>
<td>Bayesian Information Criterion</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>CATI</td>
<td>Computer-Assisted Telephone Interviewing</td>
</tr>
<tr>
<td>CDCP</td>
<td>Centers for Disease Control and Prevention</td>
</tr>
<tr>
<td>DN</td>
<td>Descriptive Norms</td>
</tr>
<tr>
<td>ELM</td>
<td>Elaboration Likelihood Model</td>
</tr>
<tr>
<td>FV</td>
<td>Fruit and Vegetable</td>
</tr>
<tr>
<td>HBM</td>
<td>Health Belief Model</td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome</td>
</tr>
<tr>
<td>HMM</td>
<td>Hidden Markov Model</td>
</tr>
<tr>
<td>IN</td>
<td>Injunctive Norms</td>
</tr>
<tr>
<td>INT</td>
<td>Intention</td>
</tr>
<tr>
<td>ISMA</td>
<td>International Social Marketing Association</td>
</tr>
<tr>
<td>LGM</td>
<td>Latent Growth Models</td>
</tr>
<tr>
<td>LL</td>
<td>Log-Likelihood</td>
</tr>
<tr>
<td>MANOVA</td>
<td>Multivariate Analysis Of Variance</td>
</tr>
<tr>
<td>NCDs</td>
<td>Non Communicable diseases</td>
</tr>
<tr>
<td>NGOs</td>
<td>Non-Governmental Organisations</td>
</tr>
<tr>
<td>NSMC</td>
<td>National Social Marketing Centre</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>PBC</td>
<td>Perceived Behavioural Control</td>
</tr>
<tr>
<td>RQ</td>
<td>Research Question</td>
</tr>
<tr>
<td>SCT</td>
<td>Social Cognitive Theory</td>
</tr>
<tr>
<td>SE</td>
<td>Self-Efficacy</td>
</tr>
<tr>
<td>SMBC</td>
<td>Social Marketing Benchmark Criteria</td>
</tr>
<tr>
<td>SN</td>
<td>Social Norms</td>
</tr>
<tr>
<td>SOC</td>
<td>Stages of Change</td>
</tr>
<tr>
<td>T1/T2</td>
<td>Time Point 1/Time Point 2</td>
</tr>
<tr>
<td>TPB</td>
<td>Theory of Planned Behaviour</td>
</tr>
<tr>
<td>TRA</td>
<td>Theory of Reasoned Action</td>
</tr>
<tr>
<td>TTM</td>
<td>Transtheoretical Model</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
</tr>
</tbody>
</table>
Acknowledgment of Papers included in this Thesis

ALL PAPERS INCLUDED ARE CO-AUTHORED

Section 9.1 of the Griffith University Code for the Responsible Conduct of Research (“Criteria for Authorship”), in accordance with Section 5 of the Australian Code for the Responsible Conduct of Research, states:

To be named as an author, a researcher must have made a substantial scholarly contribution to the creative or scholarly work that constitutes the research output, and be able to take public responsibility for at least that part of the work they contributed. Attribution of authorship depends to some extent on the discipline and publisher policies, but in all cases, authorship must be based on substantial contributions in a combination of one or more of:

- conception and design of the research project
- analysis and interpretation of research data
- drafting or making significant parts of the creative or scholarly work or critically revising it so as to contribute significantly to the final output.

Section 9.3 of the Griffith University Code (“Responsibilities of Researchers”), in accordance with Section 5 of the Australian Code, states:

Researchers are expected to:

- Offer authorship to all people, including research trainees, who meet the criteria for authorship listed above, but only those people.
- accept or decline offers of authorship promptly in writing.
- Include in the list of authors only those who have accepted authorship
• Appoint one author to be the executive author to record authorship and manage correspondence about the work with the publisher and other interested parties.

• Acknowledge all those who have contributed to the research, facilities or materials but who do not qualify as authors, such as research assistants, technical staff, and advisors on cultural or community knowledge. Obtain written consent to name individuals.

Included in this thesis are papers in Chapters IV, V and VI which are co-authored with other researchers. My contribution to each co-authored paper is outlined at the front of the relevant chapter. The bibliographic details (if published or accepted for publication)/status (if prepared or submitted for publication) for these papers including all authors, are:

Chapter IV: Revise and resubmit 20th November 2018

Chapter V: In review 10th October 2018

Chapter VI: Accepted 10th December 2018

Appropriate acknowledgements of those who contributed to the research but did not qualify as authors are included in each paper.

(Signed)  
20th September 2018  
Patricia Tavares de Lima David

(Countersigned)  
6th October 2018  
Supervisor: Professor Sharyn Rundle-Thiele
1 Chapter I: Introduction

This first chapter presents an overview of the thesis, including a background to the research in Section 1.1; the research rationale and questions in Section 1.2; and an outline of the research design in Section 1.3, providing a diagram summarising the research gaps, research questions and correspondent study addressing each of the questions. Section 1.4 gives an overview of anticipated contributions to theory and practice; a thesis structure is illustrated and a brief description of all chapters included in this thesis is provided in Section 1.5.

1.1 Background

Contemporary societies all over the world face issues that have been characterised as “wicked problems”. Wicked problems are difficult to define and are ingrained in complex systems, with numerous stakeholders involved (Kreuter, De Rosa, Howze, & Baldwin, 2004). Different from the exact sciences, such as mathematics, chemistry or engineering, where the problems can be clearly described and can usually be solved with an explicit solution, the social sciences involve a human element, and in turn, social and environmental interactions that often cannot be clearly delineated, have many inter-dependent factors, are socially complex and are considered the responsibility of many different stakeholders (Glanz, Rimer, & Viswanath, 2015; Kennedy & Parsons, 2012). Some examples of complex problems are obesity, environmental deterioration, alcohol and illicit substance abuse, tobacco-related harm, inequalities (for example, gender, economic, social), along with many more (Gordon, Russell-Bennett, & Lefebvre, 2016). Although the causes of such problems cannot be easily defined, they are commonly associated with the practice of preventable behaviours at the individual level. A clear example is the burden of non-communicable diseases (NCDs), where individual behaviours have a major influence on the development of NCDs.
NCDs are a major public health problem worldwide. According to an action plan created by the World Health Organization (WHO) in 2013, NCDs account for over 60% of global mortality (World Health Organization, 2013). The NCDs responsible for almost two thirds of all global deaths consist mainly of cardiovascular disease (48% of non-communicable diseases), cancer (21%), chronic respiratory disease (12%) and diabetes (3.5%) (World Health Organization, 2013). The four behavioural risk factors responsible for the most problematic NCDs cited above are: tobacco use, prejudicial use of alcohol, unhealthy eating, and lack of physical activity (World Health Organization, 2013). Most NCDs have a slow development, becoming evident only from the third decade of life, after years of exposure to risk factors, such as the ones mentioned previously (Demaião, Nielsen, Tersbøl, Kallestrup, & Meyrowitsch, 2014). NCDs are not only an issue at the individual level, but they have also a great impact on societies at large. NCDs are accountable for approximately 38 million deaths every year (World Health Organization, 2015b). Socioeconomic consequences of the rise of NCDs include high productivity losses and increased health care expenditure in both developed and developing countries (Centers for Disease Control and Prevention, 2016). Economic loss attributed to NCDs is projected to reach seven trillion dollars over the next 15 years in middle and low-income countries (Centers for Disease Control and Prevention, 2016).

Wicked problems such as NCDs and others are considered to be preventable. Continuing with the example of NCDs, a preventable behaviour is the consumption of unhealthy food. Unhealthy eating is characterised by the intake of foods that are high in saturated fat, sugar, and processed foods (Bell & Swinburn, 2004). There is a growing trend of increased consumption of energy-dense nutrient-poor snacks and reduced consumption of water in favour of fruit/cordial drinks with added sugars (Sanigorski, Bell, Kremer, & Swinburn, 2005). Of concern, a poor diet with few nutrients is directly associated with a high body mass index (BMI) (Grow et al., 2010). Hence, there is a pressing need for preventive actions to change this
scenario, such as a combination of a more nutritious diet and physical activity. For example, WHO estimates that approximately 1.7 million deaths could be prevented if people reduced salt to the recommended level of 5g per day (World Health Organization, 2015a). Achieving positive change in behaviour, both individually (downstream or micro) and population-wide (upstream) (Beaglehole et al., 2011; Kohl et al., 2012) is needed.

Social marketing can be applied to influence behaviours across four main levels. These levels are: society, community, local level and individual (see Figure 1).

**Figure 1. Levels of social marketing approach**

Adapted from Brennan, Binney, Parker, Aleti, and Nguyen (2014)
Upstream social marketing occurs when the focus of the social marketing program is directed towards influencing society, for example when the issue is one of public policy (Brennan et al., 2014). Mid-stream social marketing is applied when an issue in the community or local-level is identified, and local stakeholders are involved to help solve the problem (Brennan et al., 2014). Examples of stakeholders at the local level are schools or neighbourhoods. Downstream social marketing refers to the approach where individual behaviour change is the ultimate goal. Brennan et al. (2014) state that individual behaviour change is crucial for social marketing. While social marketing researchers have noted the need to move upstream (Donovan, 2011; Lefebvre, 2011), to encourage, allow or support individual behaviour change, a continued dominance of downstream interventions is evident (Almestahiri, Rundle-Thiele, Parkinson, & Arli, 2017; Wymer, 2011). As a result, this doctoral research focuses on individual behaviour change (downstream level). Future theory development is needed to understand change at the midstream and upstream levels but is beyond the scope of the current project.

Different types of objectives are pertinent for each intervention approach (see Table 1 for summary).

**Table 1. Objectives, change and audience of different social marketing levels**

<table>
<thead>
<tr>
<th>Level</th>
<th>Type</th>
<th>Approach</th>
<th>Objectives</th>
<th>Type of Change</th>
<th>Audience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-cultural</td>
<td>Macro</td>
<td>Upstream</td>
<td>Long-term social change</td>
<td>Economic, political, cultural</td>
<td>Government and NGOs</td>
</tr>
<tr>
<td>Community</td>
<td>Macro</td>
<td>Upstream or Mid-stream</td>
<td>Permission to act on the issue, establishment of legal framework</td>
<td>Organisation-level decision making</td>
<td>Businesses and local governments</td>
</tr>
</tbody>
</table>
Evidence shows that the majority of behaviour change programs in social marketing have a downstream focus, targeting efforts at individuals whose behaviour needs to change (Kennedy & Parsons, 2012) to deliver societal gains. A limitation of the downstream focus is the assumption that behaviour is predominantly voluntary and, hence, a matter of individual choice (Kriznik, Kinmonth, Ling, & Kelly, 2018). These assumptions imply that behaviours and any changes in behaviour are largely the individuals’ responsibility and therefore fail to reflect social and built environmental influences that simultaneously influence individuals. The continuing dominant focus of social marketing behaviour change programs on individual behaviour is known to lead to victim-blaming and stigmatisation (Brennan, Previte, & Fry, 2016), and this research is mindful of these adverse consequences. However, given downstream remains the dominant focus in social marketing (Almestahiri et al., 2017), a downstream approach was deemed the best focal point for this research enquiry.
1.2 Research rationale and questions

Social marketing is a discipline that utilises the tools and strategies of commercial marketing to address social issues (Andreasen, 2002; Kotler & Zaltman, 1971a; Lee & Kotler, 2011). The ultimate goal of social marketing is to change behaviour for the better, e.g. increase physical activity, decrease junk food consumption, alcohol drinking and/or smoking. It is important to note, however, that in a few cases, behavioural maintenance can be the final objective (for example, when an individual has quit smoking) or an adolescent has not yet initiated into alcohol drinking (see Rundle-Thiele et al., 2015). Social Marketing programs are guided by eight criteria, named the Social Marketing Benchmark Criteria (SMBC), which aim to serve as a guide to social marketers to achieve more effective interventions (French & Blair-Stevens, 2006). The eight benchmark criteria are: behaviour, customer orientation, theory, insight, exchange, competition, segmentation and methods mix. Theory, one of the SMBC, provides a guide to researchers and practitioners to direct intervention development (Brennan et al., 2014; Luca & Suggs, 2013). Theory is used to explain or predict the occurrence of an action or event (Kemp, Tenenbaum, Niyogi, & Griffiths, 2010). While the importance of theory use in interventions is known for social marketers, according to a review of the literature only 23% of the 143 articles examined explicitly mentioned theory in their research (Truong & Dang, 2017). The lack of theory use in the social marketing literature is not a new phenomenon (Lefebvre, 2001; Luca & Suggs, 2013; Truong, 2014). Research shows that even when theory is mentioned in social marketing studies, the application of theory and how it is related to the research is often unclear (Truong, 2014). Despite commonly being reported this way in the social marketing literature, it is not enough to state that theory has been used. Researchers must not only embed theory in their research, but also clearly and specifically state for what purpose and how theory was used.
It is important not to assume that behaviour and behaviour change are the same. Behaviour is defined as any activity undertaken by an individual, and behaviour can be a response to internal and/or external events (Sundel & Sundel, 2004). There are cases where a behaviour can be simple actions, such as raising a hand when a teacher asks a question, and others where a sequence of actions is necessary, such as making a sandwich (Sarafino, 1996). Nevertheless, behaviour is an action or a series of actions that occur at one point in time. Alternatively, behaviour change is the modification of behaviour over time (Sarafino, 1996; Sundel & Sundel, 2004). An example of behaviour modification is when a person exercising twice a week for a month increases the number of times that they exercise to five times per week in the following month. In this case, the behaviour was modified (increased exercise frequency) over time (from one month to the following month) in a desired direction (more exercise) benefitting the individual and society owing to the individuals health gains that would arise from sustained the desired behaviour over time. Another example can be seen when a person changes their alcohol consumption from five standard drinks per weekend to no drinking. These are examples of behaviour change, but importantly, it should be acknowledged that sustained behaviour change is a crucial aspect of behaviour change which warrants further investigation, since people can change their behaviour during an intervention, but not maintain the changed behaviour over time in the absence of interventional support. However, a first step is extending understanding of behaviour change and how to achieve it. Given there are differences between behaviour and behaviour change, we can expect that the determinants of behaviour at one point in time may not be associated with behaviour change, which is entirely distinct series of actions when contrasted to behaviour. The understanding that behaviour and behaviour change are different is supported by other streams of research enquiry. Consider, Michie et al. (2008) who states that interventions are more effective when they are aimed at causal determinants of both
behaviour and behaviour change. Since social marketing is concerned with changing behaviour, research is needed to understand what actually explains behaviour change.

Much of the research in the social sciences focusses on explaining or predicting behaviour at a static point in time, rather than predicting the dynamic process of behaviour change (Ployhart & Vandenberg, 2010). In social marketing, in the limited cases where theories are used, few theories seek to explain behaviour change, limiting knowledge of the determinants of behaviour change. Behavioural theories are important to explain how a certain behaviour occurs, however, theories concerned with changing behaviour are able to explain how changes in behaviour occurs, and therefore build our understanding about the constructs that are associated with such change. Therefore, behaviour change theories are needed in social marketing to explain the phenomenon of change.

Although commonly found in the literature, a cross-sectional research design limits knowledge of change. In the cases where a repeated measures design is used aiming to investigate program effectiveness, the most commonly used tests are ANOVAs, multiple linear regressions and Structural Equation Modelling with static variables (see literature reviews in Evans et al., 2014; Parker et al., 2006). Due to the fundamental differences between behaviour and behaviour change, being that the first occurs at one point in time (static behaviour), while the second is a dynamic process which occurs over time (behaviour change), methods to assess the dynamic nature of behaviour change are essential.

Against this backdrop, the objectives of this research are first, to examine conceptual and empirical differences between behaviour and behaviour change. Second, drawing on available data this study seeks to investigate which determinants can be associated with behaviour change across social marketing studies. Finally, drawing on available data this study applies a dynamic methodology to determine whether it can be used to assess behaviour change in a social
marketing setting. To achieve these objectives, the following three research questions will be investigated:

Research Question 1 (RQ1): Are there conceptual and empirical differences between behaviour and behaviour change?

Research Question 2 (RQ2): Which determinants are associated with behaviour, behaviour change, undesired change and desired change?

Research Question 3 (RQ3): How can behaviour change be explained and predicted using dynamic methods?

1.3 Research design

Three studies were proposed to answer the research questions. RQ1 builds on findings from Chapter II (the Literature Review), where behaviour and behaviour change are identified as two different concepts. RQ2 investigates which determinants are associated with behaviour and behaviour change, and explores different directions of behaviour change (undesired and desired) in the context of physical activity. RQ3 examines the extent to which a dynamic methodology to assess behaviour change offers potential for social marketers. Figure 2 below presents a research overview, outlining research gaps, research questions and proposed studies.
The proposed research design will have three studies, each addressing one research question, as follows:

The first question (RQ1) aimed to examine whether there are conceptual and empirical differences between behaviour and behaviour change. This question is addressed in Study 1 by critically examining the concepts of behaviour and behaviour change, and by undertaking a case study using data from a social marketing program to empirically test whether the two concepts are different.

The second question (RQ2) aimed to investigate which determinants could be associated with behaviour and with behaviour change in a context of a physical activity. Most behavioural
theories and much of existing research are focussed on understanding what factors explain or predict behaviour at a single point in time, rather than seeking to empirically understand what changes explain behaviour change over time. The author of one of the most used theories in social marketing, namely the Theory of Planned Behaviour (TPB) explains that “the TPB is in fact not a theory of behaviour change” (Ajzen, 2015, p. 133). In fact, the TPB was developed to help researchers explain and predict people’s intentions and behaviour (Ajzen, 2015). The results of a meta-analysis of 185 studies demonstrated the theory’s effectiveness in predicting behaviour, accounting for 27% of the variance explained in behaviour at one point in time (Armitage & Conner, 2001). However, as previously noted, behaviour and behaviour change are conceptually different. Therefore, after Study 1 expanded the attention from behaviour to behaviour change, Study 2 addressed RQ2 by empirically exploring determinants of behaviour and behaviour change. RQ2 replicates analysis of Study 1, testing a static model and a dynamic model, and subsequently takes one step further by also examining directions of change and the determinants of different types of change, namely desired and undesired direction.

The third question (RQ3) aimed to understand the extent that a dynamic methodology could offer explanatory potential for behaviour change, and if so, sought to examine whether this methodology could be used for behavioural change assessment in social marketing. Studies 1 and 2 explored the dynamic nature of behaviour change, and established a need for methodologies that are able to assess change. Most methodologies used in social marketing do not account for transitions between change states or even the direction of change. Therefore, Study 3 addressed RQ3 and assessed whether Hidden Markov Modelling could offer potential to assess behaviour change in social marketing.
1.4 Overview of contributions to theory and practice

Theories are extremely valuable, providing important frameworks to guide managerial planning and decision making and to teach the next generation of practitioners, as well as inform and guide research. Even though the importance of theory use in the social marketing field has been widely discussed, reviews of the literature show limited theory use in research (Lefebvre, 2001; Luca & Suggs, 2013; Truong, 2014). Moreover, in the occasional cases where theory is used in social marketing there is limited or no evidence that the theory used can effectively achieve change since most theories only explain or predict behaviour (Michie, Johnston, et al., 2008) and not behaviour change. Moreover, cross sectional research designs are dominant, restricting understanding to explanation of static behaviour rather than dynamic behaviour (Kher & Serva, 2014; Kubacki & Rundle-Thiele, 2014; Ployhart & Vandenberg, 2010). This research contributes to the body of knowledge by advancing understanding beyond static behavioural explanation, providing an important step toward a Theory of Behaviour Change. This research has the potential to expand the focus from understanding the determinants of behaviour to knowledge of the determinants of behaviour change. By switching the focus to behaviour change, insight into what causes actual change can be attained by social marketers and more informed interventions can be developed.

1.5 Structure of thesis

This thesis is structured as a series of published and unpublished papers, comprising seven chapters, each with its own focus. Chapter II comprises of a review of the literature, Chapter III outlines the methodologies chosen for this research, and Chapters IV, V and VI present the three studies of this thesis in the appropriate publication format for relevant journals. Chapter VII synthesises the findings from all studies, discussing the implications, and future research needs. Table 2 below outlines the thesis structure.
Table 2. Thesis structure

<table>
<thead>
<tr>
<th>Chapter I: Introduction</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview of research context and rationale, research objectives, research questions and</td>
<td></td>
</tr>
<tr>
<td>research design summary</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Chapter II: Literature Review</td>
<td></td>
</tr>
<tr>
<td>Review and synthesis of the literature on social marketing, behaviour change and theory</td>
<td></td>
</tr>
<tr>
<td>use in social marketing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Chapter III: Research Design and Methodology</td>
<td></td>
</tr>
<tr>
<td>Explanation and justification of the research paradigm, research design and methodology</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Chapter IV: Static vs Dynamic Behaviour</td>
<td></td>
</tr>
<tr>
<td>David, P., Rundle-Thiele, S. (revise and resubmit 20th November 2018). Rethinking</td>
<td></td>
</tr>
<tr>
<td>behaviour change: a dynamic approach in social marketing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Chapter V: Empirical exploration of determinants of behaviour and behaviour change</td>
<td></td>
</tr>
<tr>
<td>the same? Exploring the intricate nature of behaviour change</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Chapter VI: Dynamic behaviour change assessment</td>
<td></td>
</tr>
<tr>
<td>David, P., Rundle-Thiele, S., Pallant, J.I. (accepted 10th December 2018). (Re)Focussing</td>
<td></td>
</tr>
<tr>
<td>on behavioural change: An examination of the utility of Hidden Markov Modelling.</td>
<td></td>
</tr>
<tr>
<td>Journal of Social Marketing.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Chapter VII: Discussion and Conclusion</td>
<td></td>
</tr>
<tr>
<td>Synthesis of findings, integration of the studies to address the thesis research questions,</td>
<td></td>
</tr>
<tr>
<td>theoretical and practical contributions of the research and future research directions</td>
<td></td>
</tr>
</tbody>
</table>


This first chapter, **Chapter I**, has provided an introduction to the thesis and research project, giving an overview of the background, research rationale, and research gaps. In addition, it introduces the Research Questions and the studies addressing them. **Chapter II** summarises and examines the most relevant literature underpinning this research project. Through this review, the terms of behaviour and behaviour change are discussed, and it is proposed that the terms might have not only conceptual differences, but also empirical differences. As a result, three research questions are outlined. **Chapter III** provides the research paradigm in which this research is located and details the methodologies selected for each of the studies to address the research questions. **Chapter IV** presents a paper that has been submitted for journal review. The aim of this paper was to test and demonstrate the difference between the concepts of behaviour and behaviour change using available empirical data, and to illustrate the use of change scores as a method for assessing change. As noted by Michie et al. (2008) it is important to extend beyond understanding static behaviour, to investigate what actually determines behaviour change. **Chapter V** comprises of a paper that explored empirically the determinants of behaviour, behaviour change, and the determinants for desired change and undesired change. Following procedures used in Study 1, this paper used change scores and multiple linear regression to examine behavioural change. Drawing from data from a weight management program, Study 2 also seeks to explore whether behavioural change determinants are the same when looking at change in different directions (undesired and desired change). **Chapter VI** presents a paper that is currently in second review following the minor revision decision after the first round of reviews. This paper examines the utility of the Hidden Markov Model as one dynamic method that can potentially be employed to assess change in social marketing programs. **Chapter VII** integrates findings from all studies, addressing each of the research questions. It also discusses the theoretical and practical implications of the present research.
Finally, the limitations of the research, and an agenda for future research is outlined to continue progression towards a theory of behaviour change.

1.6 Conclusion

This chapter has outlined key aspects related to the background of the present research. It also presented the research rationale, research gaps, and questions. Additionally, the chapter provided an overview of the three research studies, including the anticipated contribution to theory and practical implications that are anticipated to arise from this research. Last, an overview of the thesis structure is provided. The following chapter presents a synthesis of the most relevant literature from a number of disciplines. This chapter provides an overview of the knowledge underpinning the present research project.
Chapter II: Literature review

In this chapter, the existing literature is reviewed. First, social marketing is defined and literature from the field of social marketing is examined. The purpose of such examination is to ascertain what contemporary social marketing is and examine the significant features of social marketing. Furthermore, the importance of theory use, along with its application in the field of social marketing is discussed. Last, this chapter will consider current behavioural theories, current behavioural change assessment and introduce the importance of re-focussing on behaviour change.

2.1 Social marketing

In order to comprehend the essence of social marketing, one needs to understand the core underlying concept: marketing. A managerial definition of marketing is “Marketing (management) is the process of planning and executing the conception, pricing, promotion, and distribution of ideas, goods, and services to create exchanges that satisfy individual and organizational goals” (Kotler, 2000, p. 4). Furthermore, marketing revolves around the concept of exchange, which in product marketing terms occurs through the process of acquiring a desired product from someone by offering something in return (Hollensen, 2003; Kotler & Keller, 2012; Mullins & Walker, 2008). The marketing tools used to influence the occurrence of such exchange are called the marketing mix. The marketing mix was initially categorised into four main categories, referred to as the four Ps of marketing: product, price, place and promotion (Kotler, 2003). The field of marketing has evolved over time, and with the addition of ‘people’, ‘process’, and ‘physical evidence’, the marketing mix has been extended and a 7 P’s framework is evident (Elliott, Waller, & Rundle-Thiele, 2014).

A critical shift in marketing has transpired, with the concept of marketing evolving significantly. Over the years different marketing streams have developed, such as: commodity,
institutional, functional, managerial, and social (Kotler, 1972). Marketing with a social focus, termed social marketing, was defined for the first time by Kotler and Zaltman (1971b, p. 5) as “the design, implementation, and control of programs calculated to influence the acceptability of social ideas and involving considerations of product planning, pricing, communication, distribution, and marketing research”. The authors also emphasised the differences between social marketing and social advertising, explaining that social marketing goes beyond the promotional component of marketing, utilising marketing techniques as the means to translate the knowledge of social issues into socially useful actions (Kotler & Zaltman, 1971b).

The definition of social marketing has evolved throughout the years, and the most evident change is the shift from the promotion of ideas to a focus on behaviour change. From the early 1970s, when the first definition of social marketing was introduced, to the end of the 1980s, the interpretation and understanding of social marketing was around the “dissemination of ideas” (Fine, 1981) and “increasing the acceptability of a social idea” (Kotler & Roberto, 1989). From the 1990s, a deviation from this initial understanding of social marketing was noticeable, with authors starting to redirect the core concept of social marketing to the idea of influencing behaviour (for example, Albrecht, 1997; Andreasen, 1994). Andreasen (1994) contradicted Kotler and Zaltman (1971b)’s social marketing initial definition, claiming that most researchers believe social marketing goes beyond only ideas. Moreover, Andreasen argued the end goal of social marketing must be behaviour change (Andreasen, 1994). Most of the research from the 1990s until now continues to reiterate behaviour change as the core and ultimate goal of social marketing (for example, Albrecht, 1997; Andreasen, 1994; Dann, 2010; Donovan & Henley, 2010; French & Blair-Stevens, 2006; Lee & Kotler, 2011; Smith, 1998). In an attempt to reach consensus on the concept of social marketing, a formal definition was created by the International Social Marketing Association (ISMA) (AASM, 2016):
Social Marketing seeks to develop and integrate marketing concepts with other approaches to influence behaviours that benefit individuals and communities for the greater social good.

In summary, social marketing embraces the tools and techniques of commercial marketing such as the concepts of consumer orientation, exchange theory, audience segmentation, competition, a marketing mix, and continuous monitoring (Andreasen, 2002; Grier & Bryant, 2005), so that behaviour change can be achieved.

2.1.1 Social marketing characteristics

Social marketing should be thought of as a systematic and strategic process (Hastings, 2007; Lee & Kotler, 2011), with six steps, as illustrated in Figure 3 by the The National Social Marketing Centre (2011):

Figure 3. The social marketing planning process

Every step of the social marketing planning process is important. First, initial planning is made, when primary and secondary research are undertaken to understand best practice and gain consumer insight (The National Social Marketing Centre, 2011). Then, a specific program, intervention or campaign is developed and implemented. Next, evaluation of the program, intervention or campaign needs to be performed to understand strengths and weaknesses, for future improvement. Last, follow up with all stakeholders is carried out, to analyse the results of the evaluation.
Whilst the process above illustrates the sequence of social marketing program, the most noteworthy definition of the characteristics of social marketing have been identified by Andreasen (2002) when he proposed the original six social marketing benchmark criteria (SMBC):

1. **Behaviour change** is the core criterion on which interventions are based;

2. **Audience research** is used to understand target audience, pre-test and monitor interventions;

3. **Segmentation** of target audience to ensure utmost effectiveness and efficiency;

4. Attractive and motivational **exchange** is the central element of strategies;

5. Use of the full 4 P’s **marketing mix**, and not only the promotion component;

6. Consideration of the **competition** faced by the desired behaviour.

Andreasen (2002) explains that what sets social marketing apart are three factors: first, behaviour change is at the core; second, social marketing is customer-driven; and third, it creates attractive exchanges in order to encourage the desired behaviour. Building on the original six social marketing benchmark criteria, a review was undertaken by French and Blair-Stevens (2006) for the NSMC, to further develop the SMBC. A review of successful behaviour change programmes was made, in order to identify the common elements that contributed to their success (French & Blair-Stevens, 2006). Following the review, an expanded set of eight social marketing benchmark criteria were proposed by French and Blair-Stevens (2006) namely behaviour focus, customer orientation, theory, insight, exchange, competition, segmentation and methods mix. In order to achieve effective social marketing programmes, it is recommended that the eight criteria of the SMBC to be applied throughout the entire social marketing process (see Figure 3 for the social marketing process) (French & Blair-Stevens, 2006; The National Social Marketing Centre, 2011). The eight criteria are outlined in Table 3 below.
Table 3. Social Marketing Benchmark Criteria

<table>
<thead>
<tr>
<th>Social Marketing Benchmark Criteria</th>
<th>Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behaviour</td>
<td>Aims to change people’s actual behaviour</td>
</tr>
<tr>
<td>Customer Orientation</td>
<td>Focuses on the audience, by understanding their lives and their engagement in the behaviour</td>
</tr>
<tr>
<td>Theory</td>
<td>Uses behavioural theories as framework understand behaviour and guide to the intervention</td>
</tr>
<tr>
<td>Insight</td>
<td>Customer research identifies ‘actionable insights’, comprehending what motivates the target audience to act in a certain way</td>
</tr>
<tr>
<td>Exchange</td>
<td>Considers barriers and benefits of engaging and maintaining a new behaviour. Then, creates an attractive offer, by minimising the costs and maximising the advantages</td>
</tr>
<tr>
<td>Competition</td>
<td>Seeks to understand the internal and external factors that compete with the new behaviour and minimise them</td>
</tr>
<tr>
<td>Segmentation</td>
<td>Identifies segments of the target audience and personalise the interventions to augment their effect within the segment</td>
</tr>
<tr>
<td>Method Mix</td>
<td>Utilises a mix of methods to achieve successful interventions, such as utilising all four Ps (product, price, place, promotion) or primary intervention methods (inform and educate, support, design and control)</td>
</tr>
</tbody>
</table>

Adapted from: French and Blair-Stevens (2006)

The use of the social marketing benchmark criteria has received widespread support from researchers in the field (Carins & Rundle-Thiele, 2014; French, Farrell, & Gordon, 2012; McDermott, Stead, & Hastings, 2005; Stead, Gordon, Angus, & McDermott, 2007; Truss, French, Blair-Stevens, McVey, & Merritt, 2010). However, evidence from literature reviews in
social marketing demonstrate that more often than not social marketing programs do not apply all criteria (Fujihira, Kubacki, Ronto, Pang, & Rundle-Thiele, 2015; Kubacki, Ronto, Lahtinen, Pang, & Rundle-Thiele, 2017; Truong & Dang, 2017). One of the most important criteria is having behaviour as the aim of the programs, however, social marketing campaigns or interventions not stating a behavioural goal or measuring behaviour change can be found in the literature. For example, a literature review assessing human-trafficking campaigns found that out of the 16 programs investigated, none of them measured actual or perceived behaviour change as a result of their campaigns (Szablewska & Kubacki, 2018). A further issue examined in another review of 18 interventions in the context of active school travel investigated to what extent theory was used, if used at all (Pang, Kubacki, et al., 2017). Consistent with other reviews in social marketing, the authors found that less than half of the interventions assessed reported having used theory, and the level of theory application varied, with two interventions being informed by theory, two applying theory and three testing theory (Pang, Kubacki, et al., 2017). Evidence indicates that behaviour change is more likely when more of the benchmark criteria are applied (Carins & Rundle-Thiele, 2014; Xia, Deshpande, & Bonates, 2016), suggesting social marketers should apply the SMBC in order to deliver effective programs.

Application of social marketing

Social marketing can be utilised to address any socially significant individual behaviour for a specific target audience (Andreasen, 2002). This characterises social marketing as applicable to a broad range of areas. Systematic literature reviews conducted in social marketing show the application and effectiveness of the discipline in various areas (for example, Stead et al., 2007). Contexts where the effectiveness of social marketing has been indicated include physical activity (for example, Fujihira et al., 2015), healthy eating (for example, Carins & Rundle-Thiele, 2014), alcohol consumption (for example, Kubacki, Rundle-Thiele, Pang, & Buyucek,
Lee and Kotler (2016) have synthesised the major social issues in which social marketing can have an impact. Their synthesis utilised data from the United Stated (U.S.), but is considered representative of other regions, with the five main behavioural contexts being: health, injury prevention, environmental protection, community involvement and financial behaviour (Lee & Kotler, 2016). A summary of their analysis can be found in Table 4 below.

**Table 4. Major issues social marketing can have an impact**

<table>
<thead>
<tr>
<th>Behaviours Context</th>
<th>Major Issues Social Marketing can Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health</td>
<td>Tobacco use, Binge drinking, Fetal alcohol syndrome, Obesity, Teen pregnancy, HIV/AIDS, Fruit and vegetable intake, High cholesterol, Breastfeeding, Breast cancer, Prostate cancer, Colon cancer, Birth defects, Immunisations, Skin cancer, Oral health, Diabetes, Blood pressure, Eating disorders</td>
</tr>
<tr>
<td>Injury prevention</td>
<td>Drinking and driving, Texting or emailing while driving, Head injuries, Proper safety restraints for children in cars, Suicide, Domestic violence, Gun storage, School violence, Fires, Falls, Household poisons</td>
</tr>
<tr>
<td>Behaviours Context</td>
<td>Major Issues Social Marketing can Impact</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Environmental protection</td>
<td>Waste reduction, Wildlife habitat protection, Forest destruction, Toxic fertilisers and pesticides, Water conservation, Air pollution from automobiles, Air pollution from other sources, Composting garbage and yard waste, Unintentional fires, Litter, Watershed protection</td>
</tr>
<tr>
<td>Community involvement</td>
<td>Organ donation, Blood donation, Voting, Literacy, Animal Adoption</td>
</tr>
<tr>
<td>Financial</td>
<td>Identity Theft, Establishing bank accounts, Bankruptcy, Fraud</td>
</tr>
</tbody>
</table>

Adapted from: Lee and Kotler (2016)

Even though social marketing can be effective across a wide range of contexts and social issues, application of social marketing to health is a dominant focus (Andreasen, 2002).

### 2.2 Behaviour change

According to widely accepted definitions of social marketing, and the SMBC, a key criteria for successful social marketing programs is having behaviour change at its core. Therefore, this section will examine the concept of behaviour and behaviour change.

_Human behaviour is highly dynamic, multi-factorial in origin, and affected by interactions between individuals and contextual_
Behaviour change and its complexities has been a topic of interest and discussion among scholars and scientist in a diverse range of disciplines. Although the study of behaviour and behaviour change originated from psychology, understanding human behaviour and how to change such behaviour is a phenomenon of interest for a multitude of disciplines and consequently behavioural change is studied in several contexts including public health, behavioural economics, behavioural psychology, behavioural medicine, human resources, organisational sciences, marketing, social marketing (Davis, Campbell, Hildon, Hobbs, & Michie, 2015; Glanz et al., 2015; Hoek & Jones, 2011; Michie & Abraham, 2004) and more. However, different disciplines have different aims when changing behaviours. For example, commercial marketing is often concerned in selling more products or services to consumers (Kotler, 2003), hence they need to understand how consumers behave and what influences consumers to change their behaviour to increase their consumption. Another example can be drawn from management and the organisational sciences. Frequently, managers’ need to increase employee’s performance (Ployhart, Weekley, & Ramsey, 2009), hence understanding the motivators of change is extremely beneficial in this field. In health, individual behaviour change has been considered one of the most important means to prevent illnesses and mortality (Alwan, 2011). Some disciplines that focus on changing health behaviours are public health, behavioural medicine, and health psychology. Examples of health behaviours targeted for change are improving healthy eating, increasing physical activity, reducing substance abuse, taking medications, among others (Larsen et al., 2017). Social marketing focusses on changing
behaviours across a range of different social issues, at times overlapping with other disciplines’ aims.

Research investigating behaviour change is fundamental. However, behaviour change is multifaceted, and understanding the process of how change occurs requires appreciation of the multiple interactions and complexities involved in behaviour change. For example, change can occur in different directions (desired or undesired change), it can be linear, nonlinear, or discontinuous, and cyclical change patterns can occur for some constructs (Mitchell & James, 2001; Ployhart & Vandenberg, 2010; Stritch, 2017).

2.3 Theory

Theory is one of the eight SMBC, and it is known to help guide researchers and practitioners to explain a phenomenon, which in turn can be used to implement more effective interventions (French & Blair-Stevens, 2006). In social marketing, theories can be used to investigate what determines the phenomenon of behaviour change. Prior to any discussion on theory and its use, it is important to understand how theory is defined, as this is the first step toward making theoretical contributions in any field of science and to understand what constitutes theoretical development. Theories have been defined in different ways by several authors, and a few examples of definitions can be found in Table 5 below.
Table 5. Examples of Definitions of Theory

<table>
<thead>
<tr>
<th>Theory definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>A systematic explanation for the observed facts and laws that relate</td>
<td>Babbie (1989, p. 46)</td>
</tr>
<tr>
<td>to a particular aspect of life</td>
<td></td>
</tr>
<tr>
<td>A set of interrelated constructs (concepts), definitions, and</td>
<td>Kerlinger (1986, p. 9)</td>
</tr>
<tr>
<td>propositions that presents a systematic view of phenomena by</td>
<td></td>
</tr>
<tr>
<td>specifying relations among variables, with the purpose of explaining</td>
<td></td>
</tr>
<tr>
<td>and predicting phenomena.</td>
<td></td>
</tr>
<tr>
<td>A set of relatively abstract and general statements which collectively</td>
<td>Chafetz (1978, p. 2)</td>
</tr>
<tr>
<td>purport to explain some aspect of the empirical world</td>
<td></td>
</tr>
<tr>
<td>An abstract, symbolic representation of what is conceived to be</td>
<td>Zimbardo, Ebbesen, and Maslach (1977, p. 53)</td>
</tr>
<tr>
<td>reality – a set of abstract statements designed to fit some portion of</td>
<td></td>
</tr>
<tr>
<td>the real world</td>
<td></td>
</tr>
</tbody>
</table>

For the purpose of this research, a consensus definition will be considered as follows: theory is a structured system of relationships between concepts (Brennan et al., 2014; Field, 1977; Kemp et al., 2010), which aligns with previous theory definitions. According to this definition, concepts play a crucial role in the development of theories. Therefore, it is important to comprehend the meaning of such concepts and that their meaning are given by their role within their containing system (Field, 1977; Rapaport, 2002). The system of concepts (theory) is used to explain an existing set of observations or future observations (Brennan et al., 2014).
According to Brennan et al. (2014), in some cases concepts are not necessarily directly observed, as other forms of observation are carried out, such as self-report surveys, for instance. The “hypothetical concepts not directly observable” are called constructs (Morgeson & Hofmann, 1999). They operate as heuristic factors for understanding observables, creating a network map with other constructs to explain an observed variable (Nunnally & Bernstein, 1994).

Theories are extremely useful as they build a central body of knowledge, helping to explain relationships between phenomena and delineate boundaries between disciplines (Koh, 2013). Kemp et al. (2010) explain that theories establish relationships between concepts which are often, but not always, causal. Non causal theories are usually found in sciences such as physics and biology and commonly describe physical relationships, such as, the periodic table in chemistry, or development stages, such as theories of the human development (Pruitt, 1995). For example, the Theory of Mind Development describes the development of children’s mentalistic understanding (Flavell, 2004), hence simply describing a development sequence and not causal relationships (Pruitt, 1995). Theories are commonly used across a broad range of disciplines, such as marketing (Lee & Kotler, 2016), psychology, philosophy and computer science (Kemp et al., 2010). Koh (2013) points out that development of theory is essential in all disciplines, and hence, “the progress of any discipline can be measured by the scope and quality of its theories and the extent to which its scholarly community is engaged in theory use and development”. In fact, Kerlinger and Lee (2000) claim that theory represents the core aim of science, as theory allows understanding, representation and prediction of phenomena.

There are different types of theories which serve a range of purposes. Glanz and Bishop (2010) explain that theories can be explanatory, often called a “theory of problem”, or change theories, also called “theories of action”. Explanatory theories describe and explain why a problem exists. Theories classified as explanatory can also predict behaviours, under defined conditions.
(Glanz & Bishop, 2010). Change theories guide provide explicit assumptions of why and how a program should be implemented, helping guide intervention planning and evaluation (Glanz & Bishop, 2010).

In this research, theory is examined from within the field of social marketing. The main goal of social marketing is to change behaviour for the better (Andreasen, 1994). According to Andreasen (2002), theory is one of the elements that can significantly improve intervention effectiveness, but theory was not included in the initial social marketing benchmark. The importance of theory use to generate effective programs, interventions or campaigns is evident in the literature (Lefebvre, 2001; The National Social Marketing Centre, 2011). However, many authors point to the lack of theory use in social marketing (e.g. Brennan et al., 2014; Lefebvre, 2001; Luca & Suggs, 2013; Truong, 2014). Brennan et al. (2014) explain that this is a result of the fact that social marketing is a relatively new discipline, starting at some point in time between the 1960s and 1970s, and as such social marketing is still in the development stage.

According to a review conducted by Truong in 2014, where published articles from 1998 to 2012 in the social marketing field were investigated, only 18.5% of the 867 articles explicitly mentioned theory in their research (Truong, 2014). In Truong’s most recent systematic literature review examining social marketing journal articles from 2000 to 2015, only 23% of the 143 articles investigated explicitly mentioned theory in their research (Truong & Dang, 2017). A modest increase in the percentage of articles that have applied theory in social marketing interventions is seen from the review made in 2014 to the most recent one in 2016. However, nearly 80% of social marketing programs do not apply theory or report doing so, demonstrating that utilisation of theory is still extremely limited. Moreover, this is not a new phenomenon, as seen by Lefebvre (2001) and Luca and Suggs (2013), where authors have also acknowledged the lack of theory use in the social marketing literature. In addition, Truong (2014) noted that even when theory was used, often authors did not state how the theory was related to the
research. Furthermore, prior research suggests that a number of social marketing campaigns are often undertaken on the basis of assumptions, without reference to theory, or evidence-based approaches (Luca & Suggs, 2013; Truong & Dang, 2017). It is essential that researchers not only embed theory in their research, but also clearly state for what purpose and how theory was used. Theory can be applied to research in different forms, such as: to guide interventions development and implementation; to evaluate programs by assessing the underlying factors; or to test, refine, or develop the original theory (Koh, 2013; Pang, Kubacki, et al., 2017).

2.4 Behavioural theories and models in social marketing

There is a broad agreement that theories should explain or predict certain phenomenon (Kemp et al., 2010). Hence, most behavioural focussed theories explain or predict behaviour at a single point in time, therefore describing a static behavioural act or action, and the determinants of behaviour at that time point. However, as behaviour change is the end goal of social marketing, the process of behaviour change is the phenomenon that needs to be explained or predicted. Thus, for one to understand behaviour change, it is critical to differentiate between the terms static and dynamic. Static is referred to as a unit of observation at one point in time (behaviour), while dynamic is attributed to units of observation measured repeatedly over time (behaviour change) (Ployhart & Vandenberg, 2010). Explaining static behaviour is not the same as explaining dynamic behaviour, as static variables cannot explain change over time (Ployhart & Vandenberg, 2010). However, most research in social sciences utilises a cross-sectional design, looking at static behaviour, which does not provide enough insight into how behaviour change over time can be achieved (Pitariu & Ployhart, 2010).

An investigation of the most commonly used behavioural theories in social marketing and behaviour change fields was undertaken to understand to what extent behaviour change was the outcome variable of theories. A summary is presented in Table 6 below.
<table>
<thead>
<tr>
<th>Theory / Model</th>
<th>Static Behaviour</th>
<th>Dynamic Behaviour</th>
<th>Theoretical Constructs / Stages of Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Cognitive Theory (SCT) (Bandura, 1986)</td>
<td>Personal and environmental factors are determinants of behaviour. Outcome variable: behaviour</td>
<td>-</td>
<td>Self-efficacy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Outcome expectations</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Facilitators of change</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Impediments of change</td>
</tr>
<tr>
<td>Theory of Reasoned Action (TRA) (Fishbein &amp; Ajzen, 1977)</td>
<td>Attitudes and subjective norms determine intentions, which then can influence behaviour. Outcome variable: behaviour</td>
<td>-</td>
<td>Attitudes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Subjective Norms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Intentions</td>
</tr>
<tr>
<td>Theory of Planned Behaviour (TPB) (Ajzen, 1991)</td>
<td>Attitudes and subjective norms determine intentions, which influences behaviour. Perceived behavioural control (PBC) can influence behaviour through intentions or directly. Outcome variable: behaviour</td>
<td>-</td>
<td>Attitudes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Subjective Norms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Intentions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PBC</td>
</tr>
<tr>
<td>Health Belief Model (HBM) (Rosenstock, 1974)</td>
<td>Expectancies for the behaviour such as benefits, barriers and beliefs (severity and vulnerability) are the key elements that influence behaviour.</td>
<td>-</td>
<td>Benefits</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Barriers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cues to action</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Severity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Vulnerability</td>
</tr>
<tr>
<td>Theory / Model</td>
<td>Static Behaviour</td>
<td>Dynamic Behaviour</td>
<td>Theoretical Constructs / Stages of Model</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------</td>
<td>------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Transtheoretical Model / Stages of Change Model (TTM/SOC) (Prochaska et al., 1994)</td>
<td>Outcome variable: behaviour</td>
<td>Understanding of the behaviour change stages and how to determine which stage a person is at and therefore readiness to change. Intermediate outcome: pros and cons and self-efficacy</td>
<td>Stages of change Decisional balance Self-efficacy Processes of change</td>
</tr>
<tr>
<td>Diffusion of innovation theory (Rogers, 2010)</td>
<td>Diffusion of an idea (behaviour) is influenced by communication channels, time and social system. Outcome variable: behaviour</td>
<td>-</td>
<td>Innovation Communication channels Time Social system</td>
</tr>
<tr>
<td>Elaboration Likelihood Model (ELM) (Petty &amp; Cacioppo, 1986)</td>
<td>Cognitive processing of message, assumes that attitudes will lead to intentions and/or behaviour. Outcome variable: attitudes</td>
<td>-</td>
<td>Motivation to process Ability to process Nature of cognitive process</td>
</tr>
</tbody>
</table>
The behavioural theories depicted in Table 6 above were drawn from systematic literature reviews and books in the social marketing and behavioural change literature such as Stead et al. (2007), Luca and Suggs (2013), Truong (2014), Truong and Dang (2017), Brennan et al. (2014), Glanz and Bishop (2010). Examination of the theories demonstrates that most theories used in the field of social marketing have static behaviour as the main outcome. Despite the stated aim of many of these theories being change in behaviour, the outcome variable of the model or theory is behaviour. Most of these theories aim to explain or predict behaviour at one point in time. Of crucial importance, researchers should not assume behaviour and behaviour change are the same, since they are conceptually different. However, there is evidence in the literature showing use of behavioural theories as behavioural change theories (for examples see Corace et al., 2016; Richens et al., 2018), suggesting that behaviour change and behaviour are often treated as being the same. Due to the fundamental differences between behaviour and behaviour change, and the end goal of social marketing being behaviour change, the utilisation of theories focusing on behaviour change as a dynamic process rather than behaviour are therefore of the utmost importance.

According to Michie, Johnston, et al. (2008), interventions are more effective when they are aimed at causal determinants of not only behaviour but behaviour change. However, in the limited cases where theories are used for the development, implementation and evaluation of interventions (Brennan et al., 2014; Lefebvre, 2001; Truong & Dang, 2017), few theories seek to explain or predict behaviour change. Since social marketing is concerned with changing behaviour, research is needed to understand what actually causes people to change.

Theories can only be considered to be effectively theories of behaviour change when behaviour change is regarded dynamically as a process, and acknowledging that time is part of such process (George & Jones, 2000). As outlined in Table 6 above, only one of the theories
identified in social marketing could be described as behaviour change theory, and this theory will be discussed below.

### 2.4.1 Transtheoretical Model of Change

A commonly used theory in public health interventions and considered to be a behaviour change theory is the Transtheoretical Model (TTM). The TTM is a model that conceptualises the process of intentional behaviour change (Prochaska & DiClemente, 1986). Different from other theories, the TTM acknowledges that change is a process and can only unfold over time. In an article illustrating the theory’s applications, the authors state that “this [change] aspect was largely ignored by alternatives theories of change” (Velicer, Prochaska, Fava, Norman, & Redding, 1998). In other theories, behaviour change is defined as an event, rather than a series of observations over time. Although time is considered to be a central aspect to change, most theories do not contain any temporal representation or construct (George & Jones, 2000; Prochaska & Velicer, 1997).

Stages of Change is considered to be the temporal dimension of the TTM, and it consists of the following stages: pre-contemplation, contemplation, preparation, action and maintenance (Prochaska & DiClemente, 1986). The Stages of Change, as proposed by the TTM is depicted in Figure 4 below.
The model also proposes decisional balance (analysing the pros and cons) and self-efficacy (level of confidence in maintaining behaviour change when facing situations that trigger relapse) as core constructs of the TTM (Pro-Change Behavior Systems, 2018; Prochaska & DiClemente, 1986). Additionally, the TTM suggests 10 factors that influence people to change from one stage to the next stage. These are theoretical constructs drawn from other theories which, in the model, are called processes of change: consciousness raising (raising awareness), dramatic relief (feelings), environmental re-evaluation (noticing your effect on others), self-re-evaluation (creating a new self-image), social liberation (noticing public support), self-liberation (making a commitment), helping relationship (getting support), counterconditioning (using rewards), and stimulus control (managing environment) (Pro-Change Behavior Systems, 2018; Prochaska, 2013).

The TTM is widely accepted and used by researchers and practitioners, especially in the context of public health (Bridle et al., 2005). Although evidence can be found for the model’s effectiveness as a basis for smoking cessation interventions (Spencer, Adams, Malone, Roy, & Yost, 2006), inconsistencies have been found (Bridle et al., 2005). There is substantial debate
on whether a stages-approach is applicable to other behaviours (Nigg et al., 2011; Povey, Conner, Sparks, James, & Shepherd, 1999). For example, problems have been found in implementing a stages-based model to complex behaviours. One issue raised with the TTM is the validity of staging algorithms to categorise people into the correct stages of change, which can lead to implementing a series of strategies to people that have been incorrectly segmented into a particular stage that does not transpire their true stage (Adams & White, 2004). Another criticism of the TTM is that it separates behaviour change into a series of distinct stages, instead of treating behaviour change as a continuum (Armitage, 2009; Lippke, Wiedemann, Ziegelmann, Reuter, & Schwarzer, 2009). In fact, Bandura (1997) argued that “the subdivision of behavioural continuance at six months [maintenance stage] into different stages is arbitrary rather than grounded in personal transformational change”.

### 2.5 Methods of assessing behaviour change

Reviews of research design methods and statistics in social sciences demonstrate that, although important progress has been made over the past two decades, cross-sectional, correlational and descriptive studies remain dominant in the literature (Evans et al., 2014; Merrill, Lindsay, Shields, & Stoddard, 2007; Noar & Zimmerman, 2005; Painter, Borba, Hynes, Mays, & Glanz, 2008). Ideally, a minimum of three waves of data using a repeated-measures design is needed, allowing true change to be assessed (Singer & Willett, 2003). However, in some circumstances, it is not possible to collect data across three time points, due to limitations in resources, time constrains, contextual issues, or the nature of the study (Finch & Shim, 2018). In the absence of three data points, a repeated-measures pre-post design with two waves of data is recognised as being the most appropriate way for change assessments to be undertaken (see examples in
Cox, Burke, Beilin, & Phillips, 2017; Mullender-Wijnsma et al., 2015), due to the complexities involved in collecting multiple waves of data to capture psychological predispositions.

Calls for more sophisticated and appropriated methodologies for treating change data are not new (Allison, 1990; Banks et al., 2014; Chan, 1998). However, limiting methodologies that examine only the associations between independent and outcome variables at a single point in time to explain behaviour change remain prominent in the literature. A review of papers in the context of water safety showed that 18 studies of 31 used ANOVAs or regression tests to assess intervention effectiveness (Evans et al., 2014). A closer examination of these studies showed that the variables used are items measured at one point in time. For example, Baker et al. (2010) evaluated a targeted theory-driven intervention using leaflets to increase healthful eating behaviour. The authors used MANOVAs to assess intervention effectiveness, examining between group differences, and testing intentions at pre-test as a covariate to eating healthily. Although methods such as this are useful in many instances, they are limited to stationary data. An example of another method considered more appropriate to assess behaviour change, which regards time as being an aspect of the change analysis is the Latent Growth Model (LGM). However, LGM requires minimum criteria to be met. A minimum sample size of at least 200 cases in each time point is required (Boomsma & Hoogland, 2001). Moreover, when the focus of the LGM model is on individual changes, data must be acquired over at least three points in time (Byrne, 2013), which is not always possible.

Change score, also named difference score, has been acknowledged in the literature to be a measure of change over time (Allison, 1990; Borenstein, Hedges, Higgins, & Rothstein, 2009). Change score (T2-T1) can be used as a dependent variable in regression analysis, which allows assessing of actual change in behaviour. There is some debate in the literature regarding reliability issues in using change scores as a dependent variable in regression analyses (Kessler, 1977; Rogosa & Willett, 1983) and whether this is the best way to assess change. However,
change scores capture actual change, and using change score variables rather than static behavioural variables allows better understanding of determinants of behavioural change given changes are analysed (see examples in Dalecki & Willits, 1991; Fu & Holmer, 2016; Sassenberg, Muller, & Klauer, 2014)

The dynamic nature of behaviour change requires a method that captures the fluidity of the movement, as well as rates of change, and possible different directions of change. As methodologies that suit these criteria appeared to be lacking in social marketing, other disciplines were investigated to find a suitable dynamic methodology. One method considered to be of a dynamic nature is the Hidden Markov Model (HMM), also known as Latent Transition Analysis in health research (J. K. Vermunt, 2004). HMM is a form of segmenting people examining longitudinal data. This method allows identification of behavioural states, rates and direction of transition between the identified states (Visser, 2011). Importantly, HMM also identifies factors that influence people to transition from one behavioural state to another. There is no evidence of HMM’s application to social marketing. However, utilisation of this method can be commonly found in technology sciences (Sathyanarayana, Boyraz, & Hansen, 2008), ecology (Patterson, Basson, Bravington, & Gunn, 2009) and in commercial marketing (Netzer, Lattin, & Srinivasan, 2008).

2.6 Research questions

The ultimate goal of social marketing is to change behaviours for the better (Andreasen, 2002). However, most social marketing studies investigate the determinants of static behaviour (for example, Gardner, de Bruijn, & Lally, 2012; Grønhøj, Bech-Larsen, Chan, & Tsang, 2012). This means that these studies focussed on change are in fact assessing determinants of behaviour, rather than determinants of behaviour change. This finding raised the question of whether behaviour was conceptually different from behaviour change, and if determinants of
behaviour were the same as determinants of behaviour change. This led to the first research question:

*RQ1: Are there conceptual and empirical differences between behaviour and behaviour change?*

Theories in social marketing have mainly focussed on explaining or predicting behaviour. Even though the aim of social marketing is to achieve behaviour change, several studies, in fact, only investigate static behaviour at one point in time (cross-sectional studies) (for example, Armitage, 2005; Huchting, Lac, & LaBrie, 2008). In addition, studies that examine change in behaviour over time are usually concerned with assessing whether behaviour change has effectively occurred (for example, Metcalf, Henley, & Wilkin, 2012; O'Loughlin, Paradis, Gray-Donald, & Renaud, 1999) and do not investigate the underlying determinants of such change. This indicates a gap in what is known of the determinants of behaviour change. On this basis, a research question was formulated:

*RQ2: Which determinants are associated with behaviour, behaviour change, undesired change and desired change?*

Taking into consideration findings that behaviour may be different from behaviour change, and the complex and dynamic nature of behaviour change, a need for better methodologies that allow consideration of the dynamics of change such as states of change and movement in different directions, a gap in the social marketing literature was found. Thus, the following research question is proposed:

*RQ3: How can behaviour change be explained and predicted using dynamic methods?*
While it seems obvious that research concerning behaviour change interventions should aim to investigate the determinants of behavioural change and methods that can be used to test such determinants, often this is not done (Nielsen et al., 2018). This research contributes to the social marketing body of knowledge: first, by expanding the theoretical aim from behaviour to behaviour change by conceptually and empirically distinguishing between the two terms. Second, by deflecting attention from behaviour to behaviour change, it may be possible to understand the determinants of behavioural change – a proposition this study aims to assess empirically. Third, by introducing a dynamic assessment of behaviour change in social marketing. Armed with the understanding of the determinants of behavioural change and how to better assess behavioural change, precision in decision making can be attained and effective social marketing programs can be designed.

2.7 Conclusion

This chapter has reviewed the existing literature relating to the research proposed in this thesis. First, the development and evolution of the concept of social marketing was discussed. The characteristics of social marketing were outlined; social marketing application and utilisation of theory in the discipline were then examined. Next, main behavioural theories in the field of social marketing were described. Subsequently, research questions were presented. The following chapter discusses the research design of this thesis, and outlines the methodology for each of the studies undertaken.
3 Chapter III: Research Design and Methodology

The ultimate goal of social marketing is to change behaviours for the better. However, as identified in the last chapter, often behaviour is used as a proxy for behaviour change, and therefore much of the existing body of work is operating under untested assumptions that determinants of behaviour are the same of determinants of behaviour change. At times, the two terms are used interchangeably, suggesting there may be confusion between the two concepts, which are conceptually and operationally different. This led to the three research questions introduced in the previous chapter.

This chapter outlines and justifies the methodology selected for the research project to address the research questions. First, the research paradigm and philosophical positioning that guides this study is presented. Then, the methodologies applied in this research to address the research questions are described. The three studies undertaken are outlined and justification for the research methods is provided.

3.1 Philosophical positioning

An important part of any research project is understanding the philosophical positioning in which the research is situated. A research paradigm is a series of associated assumptions, providing a conceptual and philosophical framework, which is shared by scientists investigating the world (Deshpande, 1983). Moreover, a research paradigm is a belief system or a world view that provides the framework which guides how the research is conducted (Denzin & Lincoln, 1994). This enables researchers to comprehend the methodological choices with regards to ontological and epistemological assumptions. Ontology is concerned with the nature of reality, and several ontological positions reflect different prescriptions of what constitutes reality and what does not (Willis, Jost, & Nilakanta, 2007). Epistemology reflects how one perceives knowledge to be created. There are five main philosophical approaches to social science,
according to Brennan, Voros, and Brady (2011). These are positivism, post-positivism, criticalism, constructivism and participatory. Drawing upon Reason and Torbert (2001), these approaches can be classified in three main categories: positivistic (positivism and post-positivism), interpretivistic (criticalism and constructivism), and action/participatory. The positivistic paradigms involve experimental manipulation of the exterior objective world conducive to investigation of the causal dependencies of the various factors under examination (Brennan et al., 2011). As a result, the positivism approach uses mostly quantitative methods. The post-positivistic approach moves from the positivism view of “true” findings to “probably true” findings, and also admits a more critical realism, whilst the first applied a naive realism (Heron & Reason, 1997). Post-positivism moves from mostly quantitative methods to the possibility of including some qualitative methods. In the other three philosophical approaches (criticalism, constructivism and participatory), a shift from objectivity to subjectivity in the researcher’s point of view is clear (Guba & Lincoln, 1994). These positions assume that knowledge is primarily a function of mind and knowledge claims are expressed as propositions (Heron & Reason, 1997).

Studies with a positivistic approach seek to be objective, have exact measures and cautiously conduct statistical analysis (Collis & Hussey, 2013). Accordingly, quantitative methods are an objective form of measurement when compared to other methods such as unstructured observations relying on researcher field notes, focus groups and interviews. Data collected in quantitative studies are in the form of numbers in an attempt to approximate reality (Creswell, 2013). While there is discussion about whether quantitative or qualitative methods are superior to each other (e.g. Achenbaum, 2001; May, 2005), both have their advantages and disadvantages. Hence, it is fundamental to understand the differences and to use the method based on the purpose of the research. Qualitative research concentrates more on an interpretive approach, focusing on understanding, while quantitative research aims to test hypotheses and
measure information with numbers (Zikmund, Babin, Carr, & Griffin, 2012) permitting replication in different contexts.

This research is guided by the positivistic philosophical approach, which is considered one of the main paradigms associated with social research (Neuman, 2006; Wisker, 2007), and aligns with the worldview most reflective of the researcher. Positivism is commonly related with a structural, logical and rational perspective (Collis & Hussey, 2013; Neuman, 2006). The belief that the world is “describable and provable, measurable and deductive” is the foundation of the positivistic paradigm (Wisker, 2007). As such the current study tests a set of hypotheses using quantitative methods, and therefore, enables the research to be replicated. Furthermore, an objectivist view is undertaken in this study, in regards to epistemology, due to the nature of this research. In the present research, determinants of behaviour change are being investigated from a quantitative perspective. The aim is to undertake this research as objectively as possible with the data analysed.

3.2 Research Design Overview

This section introduces the research design undertaken in this research project, which includes three studies (see Figure 5). The specific research design and justification for each of the studies are presented in turn.
Findings from the literature review undertaken in this thesis and synthesised in Chapter II underpin the research design utilised in the present study. Study 1 examines the concepts of behaviour and behaviour change, and empirically tests whether the two are different within the same dataset. Empirical testing involves comparing and contrasting determinants of static behaviour, using multiple linear regression with dependent and independent variables at time point 2, and dynamic behaviour, using change scores as the dependent and independent variables in a multiple linear regression. Study 2 consists of an empirical exploration using an existing dataset to investigate which determinants of behaviour change have been observed in a social marketing study conducted within a physical activity context. Multiple linear regression
was chosen for this study. Study 3 applies a dynamic method, namely Hidden Markov Modelling (HMM) to examine whether HMM can be used to assess behaviour change for social marketers.

All studies have used secondary data, drawn from Social Marketing @ Griffith studies. Secondary data is defined as data that has been previously collected and recorded by someone else and for purposes other than the current project (Zikmund, Ward, Lowe, Winzar, & Babin, 2011). According to Babin and Zikmund (2015), the primary advantage of using secondary data comes from availability. Disadvantages of secondary data use also have to be acknowledged. The main disadvantages of using secondary data come from inadequacy of its use in regards to the purpose of the research (Zikmund et al., 2011). Since the data was not designed specifically to meet the researcher’s needs, the researcher can face issues such as not having measured all the desired variables (Babin & Zikmund, 2015). For example, in this research, the existing data drawn from the studies have applied extended versions of the TPB. However, it is important to note that the approach of the present research was not to use the TPB as a theory or model as such. Instead, the studies investigated whether the theoretical constructs were significantly associated with behaviour change, when testing for dynamic models. Testing of such constructs can provide important insights for behavioural change models. In addition to being part of the TPB, these constructs can be found in the consensus work undertaken by Fishbein et al. (2001) and Michie et al. (2005), where they attempted to simplify and summarise potential behavioural change determinants from over 30 theories.

However, such as any method choice in research, the decision to use secondary data has to take the adequacy of the method to into consideration, and the reliability of the data source. Obtaining secondary data is generally faster and less expensive than acquiring primary data (Bernard & Bernard, 2012). Therefore, secondary data is recommended when access to data comes from a reliable source, and data collected is relevant and adequate for the aim of the
study. In this research, all studies investigated were drawn from social marketing contexts, and all of them utilised existing and validated scales adapted from the literature. Hence, access and utilisation of secondary data from numerous longitudinal studies undertaken within the context of social marketing was a requirement, and utilisation of secondary data was considered to be beneficial in the present study. Each study will now be detailed in turn.

3.2.1 Study 1: Conceptual and empirical distinction between behaviour and behaviour change

Prior to investigating what are the determinants of behaviour change, one must understand the differences between static and dynamic behaviour, as well the distinction between cross-sectional and longitudinal designs in research. As previously mentioned in Chapter II, behaviour is an event, or a series of events that transpire at one point in time (Sundel & Sundel, 2004). Therefore, behaviour can be described as being static. Distinctly, behaviour change is characterised as the modification of behaviour over time (Sarafino, 1996; Sundel & Sundel, 2004). Hence behaviour modification, or behaviour change, can be considered to be dynamic. The main distinction between static and dynamic behaviour is the temporal component (Ployhart & Vandenberg, 2010). Most of the research undertaken in the social sciences is characterised by the utilisation of cross-sectional design, where static behaviour is explained at one time point (Pitariu & Ployhart, 2010). It is crucial to note that despite the advantages of utilising cross-sectional design in some types of research, descriptive research utilising cross-sectional design cannot explain change, due to its static form. For one to be able to identify and explain the cause of the change process with predictor variables, it is necessary to employ a longitudinal design (also known as repeated-measures design) (Ployhart & Vandenberg, 2010). For behaviour change to be assessed over time, the exact same variables have to be consistently measured at different time points, to ensure reliability (Kher & Serva, 2014). Moreover,
Ployhart and Vandenberg (2010) state that studies examining change over time need to use the dynamic form of behaviour (changes observed/self-reported over time) as the variable to be studied. A study in the organisational sciences tested how human capital was related to unit effectiveness over time, and determined that a change in the human capital unit predicted changes in unit effectiveness over time (Ployhart et al., 2009). It is important to note that this study also tested the same relationship cross-sectionally, and found that human capital was weakly and non-significantly related to unit effectiveness at a single point in time (Ployhart & Vandenberg, 2010; Ployhart et al., 2009). Some authors claim that the development of theories of dynamic relationships (for example, a change in the predictor will contribute to change in the outcome variable) represent one of the next evolutions in the literature (Mitchell & James, 2001; Ployhart & Vandenberg, 2010).

Study 1 aimed to: first, empirically illustrate the distinction between behaviour and behaviour change; and second, illustrate the use of change scores as a method to assess change. Statistical analyses were undertaken to empirically examine variables explaining static behaviour and dynamic behaviour change. Data used in Study 1 was drawn from an available longitudinal study in the context of active travel (walking to and from school), a behaviour that benefits child health through physical activity. The online survey was completed by 2,001 participants at baseline. The survey contained demographic, psychographic and behavioural questions. Statistical analyses were performed using software IBM SPSS Statistics version 25. Prior to data analysis, data was cleaned and coded. To examine the relationship between the variables in each study, Cronbach’s alpha tests were performed on items capturing the same measure, so that psychographic constructs could be created for all variables exceeding reliability thresholds. Cronbach's alpha is a widely used coefficient for internal consistency and the reliability cut off score used in this research was $\alpha > 0.7$ (Bernardi, 1994; Cronbach, 1951).
Statistical analyses conducted were multiple linear regression. Regression analysis is one of the most commonly utilised statistical methods, due to its explanatory and predictive characteristics (Selvanathan, Selvanathan, & Keller, 2011). This statistical technique is used to explain the relationship between two or more variables, or to predict a variable outcome. The variables used as the basis for prediction are called independent variables (IV) and the variable to be explained or predicted is termed the dependent variable (DV). There are two main approaches to regression analysis; bivariate regression analysis and multiple regression analysis. Bivariate regression analysis only uses one independent variable to explain or predict the dependent variable (Hair & Lukas, 2014). Multiple regression analysis is an extension of bivariate regression, with the inclusion of multiple independent variables as a basis to explain or predict the dependent variable (Hair, Wolfinbarger, Ortinau, & Bush, 2008; Selvanathan et al., 2011). Regression analysis will always assume an associative relationship between the variables (Huizingh, 2007). In regression, it is possible to measure the extent of this relationship.

Two statistical tests were undertaken. One with static measures and a subsequent test with dynamic measures. Static measures included psychographic variables such as intentions, affective and instrumental attitudes, descriptive and injunctive norms, perceived behavioural control and barriers measures at Time point 2 and behaviour in Time point 2. For change to be investigated, a new variable called ‘change score’ (Allison, 1990; Kessler, 1977) was created by calculating the difference between behaviour at follow-up and baseline, expressed as the excess of the follow-up over the baseline level. Next, all cases where no change in behaviour was observed were removed from the dataset, so that only people that reported behaviour change would be assessed, restricting the analysis to cases where dynamic behaviour (behaviour change) was observed (Ployhart & Kim, 2013). Then, change variables (difference between the dependent variable at follow-up and baseline, expressed as the excess of the follow-up over the baseline level) were created for all psychographic variables. This step was necessary to
understand whether a change in psychographic variables could explain change in self-reported behaviour. Dynamic measures included change scores (T2 – T1) for all variables tested (psychographic and behavioural). Multiple linear regressions were performed, for both static behaviour and dynamic behaviour, to test whether determinants of behaviour were different from determinants of behaviour change. Further detail and illustration of measures can be found in Chapter IV, in the format of a journal article.

As a result, findings of Study 1 addressed Research Question 1.

**RQ1: Are there conceptual and empirical differences between behaviour and behaviour change?**

### 3.2.2 Study 2: Empirical exploration of behaviour and behaviour change determinants

Building on from Study 1, where behaviour and behaviour change were investigated conceptually and empirically, Study 2 commenced with a replication of Study 1. Study 2 then offered an extension, moving focus to exploring the multidirectional nature of behaviour change. The overall aim of Study 2 was to empirically explore the determinants of behaviour and behaviour change, testing static and dynamic variables in the context of physical activity. To achieve the aims of this study, data from a weight management program was utilised, focussing on the understanding the determinants of behaviour and behaviour change in physical activity.

In order to explore what determinants are associated with behaviour and behaviour change following participation in a 12-week weight management program, an empirical examination was undertaken using the software IBM SPSS Statistics version 25. Prior to statistical analysis,
data cleaning and preparation was executed. Cronbach’s alpha tests were executed ($\alpha > 0.7$), so that psychographic constructs could be created for all variables exceeding reliability thresholds.

In Study 2, five statistical analyses were conducted to explore different ways one can investigate the determinants of behaviour and behaviour change, as well as taking into consideration the different directions of behaviour change. The five analyses are outlined in Table 7 below.

### Table 7. Study 2 analyses outline

<table>
<thead>
<tr>
<th>Research question</th>
<th>Analysis</th>
<th>Independent Variables</th>
<th>Dependent Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Explaining static behaviour</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do psychographic variables at Time point 1 predict behaviour at Time point 2?</td>
<td>Analysis 1</td>
<td>Psychographic variables at T1</td>
<td>Physical activity frequency at T2</td>
</tr>
<tr>
<td><strong>Explaining dynamic behaviour change</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do psychographic variables at Time point 1 predict behaviour change?</td>
<td>Analysis 2</td>
<td>Psychographic variables at T1</td>
<td>Change in physical activity frequency (T2-T1)</td>
</tr>
<tr>
<td>Does a change in psychographic variables predict behaviour change?</td>
<td>Analysis 3</td>
<td>Psychographic variables (T2-T1)</td>
<td>Change in physical activity frequency (T2-T1)</td>
</tr>
<tr>
<td><strong>Explaining directions of dynamic behaviour change</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Are predictors of undesired behaviour change different from predictors of negative behaviour change?

Analysis 4 followed the same procedures used in the static model of Study 1 of this doctoral research. Static variables were used, investigating what are the determinants of behaviour at T2.

Analyses 2 and 3 explored the determinants of dynamic behaviour (namely, behaviour change). The first model tested whether static variables could explain dynamic behaviour, and the second model tested a completely dynamic model, replicating the test undertaken in Study 1 of this doctoral research.

To account for the multifaceted nature of behaviour change, Analyses 4 and 5 involved testing determinants of negative and positive behaviour change. Both statistical tests consisted of full dynamic models, with Analysis 4 testing determinants of negative change, and Analysis 5 looking at what determines positive change.

Findings from Study 2 will allow Research Question 2 to be answered:
RQ2: Which determinants are associated with behaviour, behaviour change, undesired change and desired change?

3.2.3 Study 3: Test of a dynamic methodology to assess behaviour change in social marketing

As demonstrated in Study 1, and also emerging from Study 2, behaviour is different from behaviour change. Hence, behaviour change should be examined from not only a longitudinal perspective, but the dynamic nature of change should be considered when using analytical methodologies to assess change. Study 3 introduces a novel methodology to social marketing to assess behaviour change using a dynamic approach. Hidden Markov Modelling (HMM) (also known as Latent Transition Analysis) is a method for longitudinal segmentation (Collins & Lanza, 2010). HMM segments individuals into appropriate groups, at different time points. The dynamic nature of the model allows understanding of how individuals move between groups over time. An individual may belong to a group at one point in time, but then may belong to a different group at another point in time (Collins & Lanza, 2010). HMM is therefore positioned well to examine how individuals may be grouped behaviourally (into groups exhibiting different behaviour or behaviour states) along with delivering insights to understand how individuals move between these groups, and identifying factors or influences that explain these movements.

This study once again used secondary data drawn from the Social Marketing @ Griffith research centre in the context of food waste that involved a telephone survey collected from 244 participants. Self-efficacy in reusing leftovers (Waste and Resources Action Programme, 2007, 2010), attitudes (Fishbein & Ajzen, 2011), social norms (Perugini & Conner, 2000; Rhodes & Courneya, 2003) and self-reported fruit and vegetable waste were measured pre and post program. Once data was cleaned and coded, HMM was executed. A more in-depth
description of HMM and the data analysed can be found in Chapter VI, in the format of a journal article.

This study will address RQ3:

\[ RQ3: \textit{How can behaviour change be explained and predicted using dynamic methods?} \]

3.3 Conclusion

This chapter has outlined the research design. The philosophical positioning that framed this research was explained. Description and justification for the research methodology was also provided. Study 1 aimed to distinguish behaviour and behaviour change conceptually, and empirically. Study 2 was comprised of an empirical exploration of behaviour change determinants in social marketing. Study 3 tested the potential of a dynamic methodology to assess behaviour change for social marketers. The following three chapters present the three studies in detail, each in the format for the journal targeted for publication at time of thesis submission.
Chapter IV - Study 1: Rethinking behaviour change: a dynamic approach in social marketing

STATEMENT OF CONTRIBUTION TO CO-AUTHORED PUBLISHED PAPER

This chapter includes a co-authored paper. The status of the co-authored paper, including all authors, are:

Revise and resubmit received from Journal of Social Marketing on 20th November 2018

Patricia David, Sharyn Rundle-Thiele

All authors were included in the research design. Patricia David was involved in the literature review, data analysis and contributed to the development of the first manuscript. Sharyn Rundle-Thiele revised the first version, and all authors contributed to subsequent versions of the manuscript. All authors agreed to the publication of this manuscript.

(Signed) (Countersigned)
20th September 2018 6th October 2018

Corresponding author of paper: Patricia Tavares de Lima David
Supervisor: Professor Sharyn Rundle-Thiele
Abstract

**Purpose** - While awareness of social, health and environmental consequences of our collective action are growing; additional efforts are required to deliver the changes needed to affect the greater good. A review of the literature indicates that research efforts may be misdirected. Drawing from empirical data where a total of 161 caregivers reported changes in their child’s walking behaviour following a month long social marketing program, this paper illustrates differences between behaviour and behaviour change.

**Design/methodology/approach** - Data analyses involved use of multiple linear regression on static followed by dynamic measures of behaviour and behavioural change and their respective determinants. The static model used variables reported by caregivers after program participation, while the dynamic measures used change scores for all variables reported (T2 – T1).

**Findings** - Results from the static model showed that only intentions and barriers explained behaviour at Time point 2. In contrast, findings from the dynamic data analysis indicated that a change in injunctive norms (important others’ approval of the child walking to school) explained a change in walking to and from school behaviour. Taken together, the results of the current study suggest research attention needs to be directed towards dynamic methodologies to re-centre research attention on behavioural change and not behaviour, which dominates current practice.

**Originality/value** - This paper offers a foundational step to support the research community to expand research efforts from understanding behaviour to focussing research design and
theoretical development on behavioural change. Theories of behaviour change are needed to affect the greater good.

**Keywords:** Behaviour, Behaviour change, Static, Dynamic, Theory

The Victorian Health Promotion Foundation (VicHealth) funded and supported this research. The funders played no role in study design, collection, analysis, interpretation of data, or in the decision to submit the paper for publication. They accept no responsibility for contents.
Introduction

There is no doubt that economic development has delivered advantages across our planet improving quality of life. However, we cannot ignore that many are left behind, and a sole focus on material wellbeing and development agendas that are focussed on economic growth, employment and financial gain are deeply flawed, given few are experiencing gains at the expense of many. While awareness of social, health and environmental consequences of our collective action are growing; additional efforts are required to deliver the changes needed to affect the greater good. A key step forward was the introduction of 17 sustainable development goals (SDGs) on the 1st January in 2016, which were adopted by global leaders in a United Nations summit (United Nations, 2016). The SDGs aim to align and mobilize effort to end all forms of poverty, address inequalities, tackle climate change, and more. As noted by Spotswood (2016), a desire to change behaviour - getting people to change eating or minimise food waste, approach child discipline differently, or even just take the bus instead of driving a car - is at the root of a lot of social and social welfare programs, yet these efforts are failing to stem growing divides. The question of how we can bring about effective, lasting changes in behaviour to affect the greater good is a complicated one, drawing together a range of academic disciplines, fields of social research and ethical debate concerning what constitutes the greater good. Delivering change requires efforts at all levels from individuals whose behaviours need to change, to the social and built environments they operate within (Hoek & Jones, 2011; Wymer, 2011).

This paper acknowledges a systems perspective is imperative to deliver built and social environments that support individual’s whose behaviour needs to change to affect greater good (Domegan et al., 2016). In line with Domegan et al. (2016) this paper contends that wider
systems focussed efforts will augment conventional behaviour change approaches such as social marketing where downstream, micro or individually focussed practices dominate (see Almestahiri et al., 2017; Truong, 2014; Truong & Dang, 2017). Systems perspectives deliver strategic and critical reinforcement rather than replacement of behavioural change campaigns. Social marketing is the application of marketing thinking to benefit society and reviews of social marketing demonstrate the ability of this discipline to deliver behaviour change (Fujihira et al., 2015; Kubacki et al., 2017; Kubacki et al., 2015). It is important to note that social marketing represents an extension of marketing’s notion of mutuality beyond corporate or institutional interests (e.g. profit, funds raised or votes). In contrast to all other forms of marketing, social marketing serves exclusively to further societies’ interests. Operating within complex systems, social marketers seek to create new kinds of value between diverse actors within a socio-material configuration (Kimbell, 2011; Meroni & Sangiorgi, 2011). Social marketing’s core principle of exchange overcomes victim blaming and stigmatisation criticisms (see Brennan et al., 2016) offering governments a community centred and positive approach that can be applied to deliver social, health and environmental change affecting the greater good.

From its first conception to the present day, social marketing has and will continue to evolve. In the first two decades, social marketing was largely based on the application of promotion to influence change (see examples in Lock & Kaner, 2000; Maibach, 1993; Samuels, 1993; Van Rossem & Meekers, 2000). In the following years, a shift from initial social marketing conceptualisation was evident, with a behaviour focus gaining prominence in the field (for example, Albrecht, 1997; Andreasen, 1994). Importantly, Andreasen (1994) argued the end goal of social marketing must be behavioural change and this view is widely supported by social marketing practitioners today (for example, Albrecht, 1997; Almestahiri et al., 2017;
The first consensus definition of social marketing was reached in 2014 (AASM, 2016) and it reflects the dominant research and practical focus in the field, namely behaviour. Further to this, Michie, Johnston, et al. (2008) state that interventions are more effective when they are aimed at causal determinants of both behaviour and behaviour change. Michie, Johnston, et al. (2008)’s work acknowledges existence of two key concepts, each of which may differ conceptually and importantly methodologically. In line with the call to extend research enquiry to understanding more complex relational and dynamic factors (Kriznik et al., 2018), the current study, which draws from a social marketing study theoretically grounded in Theory of Planned Behaviour (reference withheld to ensure anonymity during review), aims to 1) conceptually and 2) methodologically distinguish behaviour from behavioural change. This paper offers a foundational step to support the research community to move from understanding behaviour to focussing theoretical development on behavioural change, which is needed to affect the greater good.

Social marketing’s core: Behaviour or behavioural change?

Over time social marketing benchmark criteria (SMBC) or principles emerged (Andreasen, 1994) serving as features to distinguish social marketing from other behavioural change focussed disciplines such as public policy, education and public health and guides for social marketing practitioners. SMBC were first introduced by Andreasen (1994), who proposed six social marketing principles, namely; behaviour is the core criterion on which interventions are
based; *audience research* is used to understand target audience, pre-test and monitor interventions; *segmentation* of target audience to ensure utmost effectiveness and efficiency; attractive and motivational *exchange* is the central element of strategies; use of the full 4 P’s *marketing mix*, and not only the promotion component; and consideration of the *competition* faced by the desired behaviour. SMBC have been used to determine the extent that social marketing has been applied within interventions (Carins & Rundle-Thiele, 2014; French et al., 2012; McDermott et al., 2005; Stead et al., 2007; Truss et al., 2010). More recently, research has emerged indicating that when more of the social marketing benchmark criteria are applied behavioural change is more likely (Carins & Rundle-Thiele, 2014; Xia et al., 2016). Hence, social marketers advocate the application of the SMBC in order to achieve behavioural change.

As part of the broadly adopted SMBC, behaviour is a core principle that is considered to be the bottom line for social marketing programs (Andreasen, 1994). While the aim to influence behaviour was acknowledged in the creation of the SMBC, a lack of distinction between the concepts of behaviour and behavioural change is clearly evident from literature reviewed. Lack of conceptual and operational definitions may result in confusion between constructs. Examples of social marketing programs focussing on behaviour can be widely found in the literature (for example, Holdershaw, Gendall, & Wright, 2011; Mainsbridge, Cooley, Fraser, & Pedersen, 2016). There are also cases of studies that, despite having a behaviour change focus, use cross-sectional data or static behaviour (see example in Umeh & Sharps, 2012).

Taken together, a review of social marketing literature indicates that behaviour, rather than behavioural change has dominated social marketing research and practice to date. The two conceptually and operationally distinct concepts will now be outlined in turn.
Despite agreement that behavioural change should be at the heart of social marketing programs, and an understanding that behavioural change affecting the greater social good are the ultimate goal, a focus on behaviour is evident in the literature. For example, the dominant social marketing theoretical focus centres attention on behaviour (for example, Manning, 2009; Plotnikoff, Lippke, Courneya, Birkett, & Sigal, 2010) and the dominant methodological approaches employ linear and time-invariant predictors or explanatory variables (Ployhart & Kim, 2013). Consider the Theory of Planned Behaviour (TPB) (Ajzen, 1991) - an extensively used theory in social marketing (Truong & Dang, 2017), and behaviour change interventions more broadly (see Hardeman et al., 2002’s review for example). The TPB states that together attitudes, subjective norms and perceived behavioural control are related to intentions which, in turn, explain behaviour (Ajzen, 1991). A review of the literature indicates that many studies applying the TPB stop at intentions, using intentions as a proxy for behaviour (for example, Arvola et al., 2008; Forward, 2009). Moreover, models extending research focus beyond intentions, predict or explain behaviour, and not behaviour change (Skår, Sniehotta, Araújo-Soares, & Molloy, 2008). TPB authors acknowledge that although TPB can be helpful as an intervention framework, it is not a theory of behaviour change (Ajzen, 2015). The TPB was developed to explain and predict intentions and behaviour at a single point in time (Ajzen, 2015). Given the dominant theoretical focus directs attention at understanding behaviour we contend research effort is needed directing conceptual and methodological focus towards understanding behavioural change. To examine change, theoretical and methodological approaches need to examine what happens between two time points. Hence, theories of behaviour change should be at the focal point of research effort and this is now discussed.
Refocussing to behavioural change

According to Michie, Johnston, et al. (2008) to achieve more effective interventions researchers should direct research attention towards understanding the causal determinants of both behaviour and behaviour change. As noted previously, confusion between the two terms can be seen in social marketing. Moving forwards it is crucial that researchers differentiate between theories that focus on explaining behaviour and theories of behaviour change. Critically, researchers must understand that behaviour and behaviour change are conceptually different.

For one to understand the difference between the concepts, it is necessary to discern between static and dynamic. Static is referred to as a unit of observation at one point in time (behaviour), while dynamic is attributed to units of observation measured repeatedly over time (behaviour change) (Ployhart & Vandenberg, 2010). More specifically, behaviour change is characterised as the modification of the target behaviour over time (Sarafino, 1996; Sundel & Sundel, 2004). The main distinction between static and dynamic behaviour is the temporal component (Ployhart & Vandenberg, 2010). Most of the research in social sciences utilises a cross-sectional design, looking at static behaviour, which does not provide enough insight into how behaviour change over time can be achieved (Pitariu & Ployhart, 2010). Using time-invariant approaches involves examinations of causal relationships between predictors, usually suggesting that X causes Y, for example. In these models, time is neglected, with determinant changes as well as changes in behaviour ignored.

The need for longitudinal studies to investigate change is emphasised by Singer and Willett (2003) who state that “cross-sectional data - so easy to collect and so widely available - will not
suffice”. In addition, even when a longitudinal design is applied, it is common to see researchers assess change by using independent variables captured at the first point in time regressed on a dependent variable (e.g. behaviour) measured in the second point in time. As explained by Kher and Serva (2014), this cannot be considered a longitudinal design, since this method uses variables observed only once, and not longitudinal changes within the same variable across time.

Dynamic theories operationalise constructs examining within variable changes for X and Y over time (Mitchell & James, 2001) to then assess interrelationships between the constructs. In these cases, relationships between variables are much more complex, since change can occur in different directions (e.g. incremental, discontinuous, positively and negatively). Further, this paper acknowledges that not all individuals change. The concept of change and how (or even if) it can be assessed has been widely discussed over time (see Bereiter, 1962; Chan, 1998; Cronbach & Furby, 1970; Kher & Serva, 2014; Ployhart & Vandenberg, 2010; Rogosa, Brandt, & Zimowski, 1982). A simple form of assessing change involves the calculation of a change (or difference) score. A change score is an estimate of true change, calculated by the difference (T2 – T1) between time point 1 (T1) and time point 2 (T2). The use of a change score has been discussed and some researchers criticise its use citing reliability and validity issues (see Cronbach & Furby, 1970; Linn & Slinde, 1977). However, other researchers have found such claims to be unfounded (Allison, 1990; Chan, 1998; Finch & Shim, 2018; Fu & Holmer, 2016; Rogosa et al., 1982), delivering evidence suggesting that a change score is a simple and unbiased measure of change. Dalecki and Willits (1991) compared three change methods employing regression analyses, finding that difference scores as a dependent variable is preferable.
Due to the conceptual distinctions between behaviour and behaviour change, one cannot assume that explaining static behaviour is the same as explaining dynamic behaviour (Ployhart & Vandenberg, 2010). Hence, determinants of behaviour at a single point in time may not be the same as determinants of behaviour change. The aims of this study are twofold: first, to test and demonstrate the difference between the concepts of behaviour and behaviour change using empirical data for carers who report changes affecting the greater social good; second, to illustrate the use of change scores as a method for assessing change.

**Empirical illustration**

**Method**

Statistical analyses were conducted to empirically examine factors explaining static behaviour and dynamic behavioural change drawing on data from a longitudinal study conducted by [name withheld to ensure anonymity during peer review] in the context of increasing physical activity for children.

**Design**

Program X is a state wide program conducted annually in [to be added following peer review]. Program X’s objective is to increase the number of times children walk to and from school each week. The maximum number of times a child can walk to and from school is 10 times within a one week period. The intervention occurred across a one month duration and participation in the program was completely voluntary. Parents and carers were asked to answer an online
survey at baseline (T1) prior to program commencement, and a follow-up survey (T2) was completed one month following the program to examine program effects. At baseline the survey was distributed via email to a mailing list of people who had agreed to be contacted for research purposes, and was also promoted through social media platforms such as Facebook and Twitter. Mailing lists were provided by the partnering organisation, [name withheld to ensure anonymity during peer review].

Participants

The online survey was completed by 2,001 people at baseline (T1), and a total of 375 carers whose children had participated in Program X participated in program evaluation at T2. Therefore, examination of both static and dynamic data was restricted to n=375. The questionnaire was answered by parents or carers of the children, and gender and age were reported for both the children and parents or carers at baseline. Child’s gender was reportedly 50% female and 50% male. Parent or carer’s gender was 85% female and 15% male. The mode age for children in the study was 6 years old. The majority of parents or carers were between 40 to 44 years old. Income and education level were also reported. Most of the parents and carers stated receiving a yearly wage of $104,000 and over, and having a University degree indicating the sample were highly educated and their wages were above the average.

The Static Measures

The social marketing program evaluation was theoretically guided and measures of reliability and validity were evaluated and both were assured [reference to be inserted following blinded peer review]. The survey contained demographic, psychographic and behavioural questions.
Psychographic measures utilised in this study included intentions, affective and instrumental attitudes, descriptive and injunctive norms, perceived behavioural control and barriers. An illustration of the static measures and their origins in the literature are shown in Table 8 below.

Table 8. Psychographic Measures.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Example measure</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention</td>
<td>I intend to increase the number of times the child walks to/from school during the next week. [Extremely unlikely</td>
<td>Rundle-Thiele, Russell-Bennett, Leo, and Dietrich (2013)</td>
</tr>
<tr>
<td></td>
<td>Extremely likely]</td>
<td></td>
</tr>
<tr>
<td>Affective attitudes</td>
<td>Walking to/from school is: [Unpleasant</td>
<td>Scott, Eves, French, and Hoppé (2007)</td>
</tr>
<tr>
<td></td>
<td>Pleasant]</td>
<td></td>
</tr>
<tr>
<td>Instrumental</td>
<td>Walking to/from school is: [Harmful</td>
<td>Scott et al. (2007)</td>
</tr>
<tr>
<td>attitudes</td>
<td>Beneficial]</td>
<td></td>
</tr>
<tr>
<td>Descriptive norms</td>
<td>Many of my friends' children walk to/from school. [Strongly disagree</td>
<td>Perugini and Conner (2000)</td>
</tr>
<tr>
<td></td>
<td>Strongly agree]</td>
<td></td>
</tr>
<tr>
<td>Injunctive norms</td>
<td>People who are important to me think the child should/should not walk to/from school. [Should not</td>
<td>Rhodes and Courneya (2003)</td>
</tr>
<tr>
<td></td>
<td>Should]</td>
<td></td>
</tr>
<tr>
<td>Variables</td>
<td>Example measure</td>
<td>Source</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Perceived</td>
<td>Whether or not the child walks to/from school in the next week is entirely up to me. [Strongly disagree</td>
<td>Rhodes and Courneya (2003)</td>
</tr>
<tr>
<td>behavioural control</td>
<td>Strongly agree]</td>
<td></td>
</tr>
<tr>
<td>Barriers</td>
<td>Streets are dangerous to cross along the route to/from school. [Strongly disagree</td>
<td>Napier, Brown, Werner, and Gallimore (2011)</td>
</tr>
<tr>
<td></td>
<td>Strongly agree]</td>
<td></td>
</tr>
</tbody>
</table>

For the static behavioural measure, participants were asked to indicate how many times their children walked to (zero to five mornings per week) and from (zero to five afternoons per week) school during the previous week. The two measures were combined into one scale, in which 0 was the lowest and 10 was the highest value.

**Statistical Analyses**

Prior to undertaking statistical analyses, data was cleaned, coded and participants that responded to surveys in both T1 and T2 were matched (n=325), using SPSS v.25. Next, reliability analyses were conducted using Cronbach’s alpha to ensure validity of measures (all measures had a Cronbach’s alpha > 0.7). Next, individual psychographic items were computed into scales. For statistical analysis of static behaviour, all carers reporting no behaviour change (n=164) were removed from the data set to ensure the same individuals were being compared
both statically and dynamically (n=161). The final step was undertaking a multiple linear regression.

*Creating dynamic measures*

In order to test dynamic behaviour change, change scores (Allison, 1990) were created for behaviour and all psychographic measures. Given that behavioural change is the conceptual focus for the present study, respondents reporting no change in their child’s walking to and from school behaviour were removed from analysis to focus on understanding change. This resulted in 164 cases being removed from the dataset limiting analysis to people that reported changes in walking behaviour; both desired and undesired change (n=161) (see Figure 7). Once change variables (T2-T1) were created for behaviour and all psychographic variables, multiple linear regressions were performed following the same procedure applied on static measures.

*Results*

Descriptive analyses of behaviour and behaviour change were performed prior to multiple linear regression to visualise operational differences between the two constructs (see Figure 6 and Figure 7).
Figure 6. Illustration of behaviour (number of times the child walked to and from school)

Figure 7. Illustration of behaviour change (change in number of times the child walked to and from school)
As seen in the illustrations above, behaviour and behavioural change are operationally distinct. Figure 6 illustrates that walking to and from school in the past week directs attention to the number of times a child has walked to school over the past week (one period of time). Figure 7 involves use of change data that has subtracted the number of times a carer reports that their child walked to school after the intervention from the number of times their child walked to school in a week prior to the intervention. Changes reported by carers can be positive or negative indicating change in the desired and undesired directions, respectively. Means and standard deviations for psychographic measures in the study are reported in Table 9 for static and dynamic data treatments.

Table 9. Psychographic Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>Static Mean (SD)</th>
<th>Dynamic Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention</td>
<td>3.4 (2.0)</td>
<td>0.3 (1.7)</td>
</tr>
<tr>
<td>Affective attitudes</td>
<td>5.6 (1.5)</td>
<td>0.0 (1.6)</td>
</tr>
<tr>
<td>Instrumental attitudes</td>
<td>5.9 (1.7)</td>
<td>0.0 (1.6)</td>
</tr>
<tr>
<td>Descriptive norms</td>
<td>4.4 (1.6)</td>
<td>0.1 (1.2)</td>
</tr>
<tr>
<td>Injunctive norms</td>
<td>4.8 (1.7)</td>
<td>0.2 (1.5)</td>
</tr>
<tr>
<td>Perceived control</td>
<td>5.4 (1.7)</td>
<td>0.0 (1.5)</td>
</tr>
</tbody>
</table>
Barriers

<table>
<thead>
<tr>
<th></th>
<th>Static Mean (SD)</th>
<th>Dynamic Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barriers</td>
<td>3.8 (1.7)</td>
<td>-0.1 (1.2)</td>
</tr>
</tbody>
</table>

Behaviour change is extremely complex, and there are multiple factors that go beyond the dynamic nature of behaviour that need to be considered, such as the direction of change (Kher & Serva, 2014) and the magnitude of change. Examination of static data indicates that attitudes (affective and instrumental) are high, social norms were neutral and intentions to increase walking to and from school were low for carers reporting changes in walking to and from school. Examination of dynamic psychographic data indicates that few changes in Theory of Planned Behaviour constructs such as attitudes and perceived behaviour control occurred. This is to be expected given the Theory of Planned Behaviour was not used to guide intervention design or implementation. Earlier research had indicated that social norms changed as a result of program participation (result withheld to ensure anonymity during review). Further examination of dynamic data indicates that on average perceived barriers to walking to and from school were lowered, while injunctive norms and carers intentions to walk to and from school increased as a result of participation in the social marketing program.

**Determinants of Behaviour**

Prior to data analysis, correlations analyses were performed to understand the association between all variables (see results in Table 10). A multiple linear regression of static behaviour assessed the extent that intention, affective attitude, instrumental attitude, descriptive norm, injunctive norm, PBC and barriers (all measured at T2) could explain walking to and from school in T2 (see Table 11).
Table 10. Correlation matrix – static data

<table>
<thead>
<tr>
<th>Variables</th>
<th>Walk to and from school</th>
<th>Intention</th>
<th>Affective attitudes</th>
<th>Instrumental attitudes</th>
<th>Descriptive norms</th>
<th>Injunctive norms</th>
<th>PBC</th>
<th>Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk to and from school</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affective Attitudes</td>
<td>.254***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrumental attitudes</td>
<td>.196***</td>
<td>.057</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Descriptive norms</td>
<td>.231***</td>
<td>.011</td>
<td>.830***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injunctive norms</td>
<td>.347***</td>
<td>.299***</td>
<td>0.070</td>
<td>.073</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBC</td>
<td>.252***</td>
<td>.206***</td>
<td>.005</td>
<td>-.010</td>
<td>.134*</td>
<td>.263***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barriers</td>
<td>-.524***</td>
<td>-.270***</td>
<td>-.077</td>
<td>-.148**</td>
<td>-.279***</td>
<td>-.466***</td>
<td>.193***</td>
<td></td>
</tr>
</tbody>
</table>

All tests are two tailed. * = p < 0.05; ** = p < 0.01; *** = p < 0.001 (Note: Sample size differed in the variables).

Table 11. Static Behaviour (n=146)

<table>
<thead>
<tr>
<th>Walking to and from school behaviour</th>
<th>β</th>
<th>sr²</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention T2**</td>
<td>-0.214</td>
<td>0.041</td>
<td>0.010</td>
</tr>
<tr>
<td>Affective attitudes T2</td>
<td>-0.206</td>
<td>0.008</td>
<td>0.263</td>
</tr>
<tr>
<td>Instrumental attitudes T2</td>
<td>0.305</td>
<td>0.017</td>
<td>0.094</td>
</tr>
<tr>
<td>Descriptive norms T2</td>
<td>0.030</td>
<td>0.001</td>
<td>0.719</td>
</tr>
<tr>
<td>Injunctive norms T2</td>
<td>0.161</td>
<td>0.020</td>
<td>0.069</td>
</tr>
<tr>
<td>Perceived behavioural control T2</td>
<td>0.139</td>
<td>0.013</td>
<td>0.139</td>
</tr>
<tr>
<td>Barriers T2*</td>
<td>-0.165</td>
<td>0.024</td>
<td>0.045</td>
</tr>
</tbody>
</table>
The model showed statistical significance (Adj. $R^2 = .131$, $F(7, 138) = 31.598$, $p < .001$). Barriers to walking to and from school were statistically significant factors explaining static behaviour at T2 ($B = -.165$, $p = .045$). Intention ($B = -0.214$, $p < .01$) was also a statistically significant factor explaining walking to and from school at T2.

**Determinants of Behavioural Change**

Analyses of correlations were conducted to comprehend the association between all variables (see results in Table 12). Following the same multiple linear regression approach employed for static variables a second multiple linear regression was performed using dynamic data (change scores) to understand whether intention change, affective attitude change, instrumental attitude change, descriptive norm change, injunctive norm change, PBC change and barrier change could explain behavioural change. Behavioural change was operationalised as the carers reported change in their child’s walking to and from school (see descriptive statistics in Table 9 and results of dynamic data analysis in Table 13).

**Table 12. Correlation matrix – dynamic data**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Walk to and from school change change</th>
<th>Intention change</th>
<th>Affective Attitudes change change</th>
<th>Instrumental attitudes change change</th>
<th>Descriptive norms change change</th>
<th>Injunctive norms change change</th>
<th>PBC change change</th>
<th>Barriers change change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk to and from school change change</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Intention change change</td>
<td>-.121</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Affective Attitudes change change</td>
<td>-.121</td>
<td>.021</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Attitude Type</td>
<td>Intention Change</td>
<td>Affective Attitudes Change</td>
<td>Instrumental Attitudes Change</td>
<td>Descriptive Norms Change</td>
<td>Injunctive Norms Change</td>
<td>PBC Change</td>
<td>Barriers Change</td>
<td></td>
</tr>
<tr>
<td>----------------------------</td>
<td>------------------</td>
<td>---------------------------</td>
<td>-----------------------------</td>
<td>-------------------------</td>
<td>-------------------------</td>
<td>------------</td>
<td>-----------------</td>
<td></td>
</tr>
<tr>
<td>Instrumental attitudes</td>
<td>-.050</td>
<td>.053</td>
<td>.768***</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Descriptive norms change</td>
<td>.136</td>
<td>.201***</td>
<td>.136*</td>
<td>.151**</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Injunctive norms change</td>
<td>.277**</td>
<td>.077</td>
<td>.129*</td>
<td>.138*</td>
<td>.301***</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>PBC change</td>
<td>.084</td>
<td>.083</td>
<td>.035</td>
<td>.067</td>
<td>.045</td>
<td>.000</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Barriers change</td>
<td>-.110</td>
<td>-.038</td>
<td>.071</td>
<td>.044</td>
<td>-.158**</td>
<td>-.118*</td>
<td>-.009</td>
<td></td>
</tr>
</tbody>
</table>

All tests are two tailed. * = p < 0.05; ** = p < 0.01; *** = p < 0.001 (Note: Sample size differed in the variables).

Table 13. Behavioural Change (n=132)

<table>
<thead>
<tr>
<th>Behavioural Change</th>
<th>β</th>
<th>sr²</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking to and from school</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>behaviour change</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention change</td>
<td>-0.105</td>
<td>0.010</td>
<td>0.221</td>
</tr>
<tr>
<td>Affective attitudes change</td>
<td>-0.181</td>
<td>0.013</td>
<td>0.170</td>
</tr>
<tr>
<td>Instrumental attitudes change</td>
<td>0.019</td>
<td>0.000</td>
<td>0.888</td>
</tr>
<tr>
<td>Descriptive norms change</td>
<td>0.094</td>
<td>0.007</td>
<td>0.314</td>
</tr>
<tr>
<td>Injunctive norms change**</td>
<td>0.259</td>
<td>0.058</td>
<td>0.005</td>
</tr>
<tr>
<td>Perceived behavioural control change</td>
<td>0.053</td>
<td>0.003</td>
<td>0.529</td>
</tr>
<tr>
<td>Barriers change</td>
<td>-0.077</td>
<td>0.005</td>
<td>0.378</td>
</tr>
</tbody>
</table>
A dynamic modelling method also yielded a statistically significant model (Adj. $R^2 = .097$, $F(7, 124) = 3.000$, $p < .01$). With a weaker variance explained in this model, the only variable found to be statistically significant in explaining changes in walking to and from school was a change in injunctive norms ($B = .259$, $p < .01$). A dynamic modelling approach indicates a focus on achieving a change in behaviour would require efforts to be focussed on increasing injunctive norms.

**Discussion**

According to Michie, Johnston, et al. (2008) interventions are more effective when they are aimed at causal determinants of both behaviour and behaviour change; which indicates an understanding that these concepts are theoretically and methodologically different. In line with the call to extend research enquiry to understanding more complex relational and dynamic factors (Kriznik et al., 2018) the current study aimed to 1) conceptually and 2) methodologically distinguish behaviour from behavioural change to understand if research attention should be expanded towards understanding behavioural change.

Systematic literature reviews across different disciplines (e.g. social marketing, public health, psychology) that focus on behaviour change have been demonstrating lack of theory use in behavioural change programs (see Keogh, Tully, Matthews, & Hurley, 2015; Luca & Suggs, 2013; Prestwich et al., 2014; Truong & Dang, 2017; Truong & Hall, 2013). These reviews show that the most commonly applied theories in behaviour change interventions (for example, the Theory of Planned Behaviour) are behavioural theories, with dominant data treatments drawing on static measures. A behaviour focus dominates social marketing research enquiry, which is
surprising given the conceptual and operational differences between behaviour and behavioural change. While other social sciences (e.g. organisational science) acknowledge dynamic and static treatment of data (see Pitariu & Ployhart, 2010; Ployhart & Vandenberg, 2010), limited consideration had been directed towards understanding the determinants of behavioural change in social marketing to date.

In an article calling for better theory for behaviour change across different disciplines such as organisational sciences, sociology and psychology, Mitchell and James (2001) emphasise the importance of considering time and behaviour as dynamic, when building models and theories. The authors state that “[…] most of our research involves causal hypotheses and designs presumed to support causal inferences. Yet, very few papers specifically address, from a theoretical perspective, the time elements involved in X causing Y” (Mitchell & James, 2001). Several years later, behavioural researchers continue to call for theories of change, and for research methodologies that go beyond cross-sectional design, and look at change as a dynamic process (e.g. Jebb, Tay, Wang, & Huang, 2015; Pitariu & Ployhart, 2010; Ployhart & Vandenberg, 2010; Stritch, 2017; Wang et al., 2017). Since change is a complex process, and confusion between the concepts of behaviour and behaviour change is evident in the literature, this paper has taken an important step, demonstrating that conceptual and operational definitions for behaviour and behavioural change are different. Moreover, the results of this study point to the need for research attention to expand to understanding of behavioural change. Theory serves as a roadmap to direct effort and a theories of behaviour change need to be developed by the research community to deliver a framework that practitioners can use.
Drawing on empirical data and utilising the same constructs, this study examined both static and dynamic data to empirically examine whether the determinants of behavioural change were the same as behaviour. Differences in explanatory variables and the extent of variance explained were observed between static and dynamic data treatments providing further evidence that behaviour and behavioural change are conceptually and operationally distinct. When comparing results from the static and dynamic models, the static model showed that only intentions and barriers explained behaviour at Time point 2. However, statistical analysis utilising dynamic data treatment found that a change in injunctive norms (important others’ approval of the child walking to school) explained a change in walking to and from school behaviour. Importantly, results show a positive relationship, suggesting that an increase in injunctive norms leads to an increase in walking to and from school behaviour.

Interpretation of the data from the separate analyses conducted for this study indicates that although walking to and from school could be explained by barriers (for example, distance to school), and whether the parents intended to walk to school or not, to change this behaviour, one cannot assume that changing intentions or perceived barriers would lead to a change in walking to school behaviour. This study provided initial evidence that behaviour and the factors explaining behaviour may not the same as the factors that explain behavioural change. Moving forward researchers must expand their focus to understanding how and why people change their behaviour. In this study, a program that aimed to encourage more children to walk to school delivered changes in social norms, which in turn explained increases in walking to school behaviour. These results provide important theoretical implications, since most widely used theories in social marketing are behavioural, and not behavioural change, theories. While behavioural theories are important, we cannot assume they are capturing factors that bring about actual change. Taken together, the results of the current study suggest research attention needs
to be directed towards dynamic methodologies to re-centre research attention on behavioural change and not behaviour, which dominates current practice.

A final contribution of this paper is methodological. Specifically this paper illustrates one possible method that may be used to assess behavioural change. Change scores were captured for both dependent and independent variables (for examples of change score use see Allison, 1990; Castro-Schilo & Grimm, 2018; van Breukelen, 2013) ensuring all data collected longitudinally (pre and post intervention) was treated dynamically and not statically as commonly occurs in social marketing practice (for examples of static data treatment see Holdershaw et al., 2011; Mainsbridge et al., 2016).

Managerial Implications

This study demonstrated the importance of distinguishing between behaviour and behaviour change, identifying that determinants of one may not be the same as the other. Application of theories focussing attention on behaviour and not behavioural change in program design may lead social marketing practitioners to misallocate resources if the end goal is behavioural change. By expanding the theoretical lens and methodological practice from behaviour to also behaviour change, insight into behavioural change determinants can be gained, which can then be used to inform strategic decision making to guide behaviour change program investment and implementation.

In the context of Program X, for example, it would be recommended that strategies to increase injunctive norms should be put in place. Injunctive norms, as previously defined, are
perceptions of how important others think it is for you to engage in the behaviour. In the walking to school context, a strategy to increase injunctive norms could be to have walking to school groups. Posters communicating approval of important others (e.g. teachers, Principals, grandparents and other parents) of children who walk to and from school would also assist to increase injunctive norms.

It is crucial that behaviour change programs have a longitudinal research design. Longitudinal assessments are essential to advance knowledge of behaviour change ensuring optimisation of resources. Evaluative methods need to go beyond prediction of behaviour to identification of behaviour change determinants. This is only possible when researchers treat data dynamically.

**Limitations and Future Research**

As with any research, there are limitations that need to be acknowledged in the present study. Although, change scores are acknowledged in the literature as one measure of change over time (Allison, 1990; Borenstein et al., 2009), some discussion regarding reliability issues and whether or not calculation of change scores is the best method for explaining change over time (Kessler, 1977; Rogosa & Willett, 1983). Some authors have suggested a stronger method for explaining change over time is the latent growth curve model (LGM) (Pitariu & Ployhart, 2010; Ployhart & Kim, 2013; Rogosa et al., 1982). However, minimum criteria for utilising LGC have to be met. For example, a minimum sample size of at least 200 cases in each time point is required (Boomsma & Hoogland, 2001). Moreover, when the focus of the LGM is on individual changes, data must be acquired over at least three points in time (Byrne, 2013), which may exceed budget capabilities for many behavioural change programs.
Other methods that are able to assess dynamic behaviour need to be explored. An example of a method that allows for longitudinal assessment of change in a dynamic form is the Hidden Markov Model (HMM), also referred to as Latent Transition Analysis. It is recommended that HMM be applied to assess its capacity to model behaviour and behavioural change determinants. Consideration of a range of dynamic evaluative methods would advance understanding of the methods that can be applied reliably and cost-effectively to examine and develop understanding of behavioural change. Such consideration would determine whether simpler evaluation methodologies are capable of delivering equivalent diagnostic information to complex modelling alternatives. The product of which would be evaluation methods that produce high quality diagnostic information by collecting only necessary data (and no more) creating the most user friendly and cost-effective approach.

This study used secondary data to illustrate the utility of using change scores to assess behavioural change. However, use of existing data limits understanding of change determinants to the variables that were initially measured in the study. In the case of the current study change data is limited to psychographic and behavioural variables and self-report data. The data that formed the basis for this paper was individual level data and additional research is recommended to widen focus beyond individuals to capture changes in the environment (e.g. infrastructure changes that would support sustained behaviour change, such as walking paths and school crossings) and objective behaviour measures. For future research, it is recommended that environmental and social factors are collected and included in dynamic change assessments.
In light of limitations, it is recommended that the model tested in this study is repeated across a range of conditions before it can be fully accepted as a potential Walk to School Behaviour Change Theory. More data and testing is needed prior to drawing absolute conclusions or proposing effective solutions. Replication across the walking to school context is necessary. Similarly, to broaden beyond the current context, testing of studies in other behavioural contexts is needed. The final limitation of the present study is removal of carers reporting no change from the data set and the simultaneous consideration of both negative and positive change. Future research is also recommended to empirically examine the carers who report no change to determine if drivers for a lack of change can be identified and to direct research attention at understanding if the drivers of desired and undesired change vary.
References


Ajzen, I. 2015. The theory of planned behaviour is alive and well, and not ready to retire: a commentary on Sniehotta, Presseau, and Araújo-Soares. Health Psychology Review, 9, 131-137.


Byrne, B. M. 2013. *Structural equation modeling with AMOS: Basic concepts, applications, and programming*, Routledge.


Chan, D. 1998. The conceptualization and analysis of change over time: An integrative approach incorporating longitudinal mean and covariance structures analysis (LMACS) and multiple indicator latent growth modeling (MLGM). *Organizational Research Methods*, 1, 421-483.


Kher, H. V. & Serva, M. A. 2014. Changing the way we study change: Advocating longitudinal research in MIS. *ACM SIGMIS Database*, 45, 45-60.


Chapter V - Study 2: Is all change the same? Exploring the intricate nature of behaviour change

STATEMENT OF CONTRIBUTION TO CO-AUTHORED PUBLISHED PAPER

This chapter includes a co-authored paper. The status of the co-authored paper, including all authors, are:

Submitted to Social Marketing Quarterly on 09th October 2018

Patricia David, Joy Parkinson, Sharyn Rundle-Thiele, Julia Carins, Jason Pallant

Patricia David, Sharyn Rundle-Thiele and Julia Carins were involved in the research design. Joy Parkinson provided the data set for this analysis. Patricia David conducted the literature review, data analyses and worked on the first manuscript. All authors were involved in subsequent versions of the paper, and agreed to the publication of this manuscript.

(Signed)  
20th September 2018  
Corresponding author of paper: Patricia Tavares de Lima David  

(Countersigned)  
8th October 2018  
Supervisor: Dr. Julia Carins

(Countersigned)  
09th October 2018  
Supervisor: Dr. Joy Parkinson  

(Countersigned)  
6th October 2018  
Supervisor: Professor Sharyn Rundle-Thiele
Abstract

Research shows that insufficient physical activity is one of the main causes of non-communicable Diseases (NCDs). Implementing effective behaviour change programs can change sedentary behaviours. However, intervention assessments often treat behaviour change and behaviour as the same, leading to misallocation of resources. Drawing from data collected for a commercial 12-week weight management program this research empirically explores the determinants of behaviour and behavioural change. Determinants of behaviour and behavioural change were investigated in statistical analyses using behaviour at Time point 2 (T2) as static behaviour, and change scores (T2-T1) for dynamic behaviour. Five statistical analyses were undertaken using multiple linear regressions. Results of the analyses showed that behaviour is empirically different from behaviour change, determinants of behaviour are different from determinants of behaviour change and determinants of desired behaviour change are different from determinants of undesired change. Findings suggest that to achieve desired behaviour change resources should be focussed on changing the target audience’s self-efficacy, as well as their descriptive norms. Implications for practice demonstrate that while current evaluation practice in social marketing focuses efforts on determinants of static behaviour, these are not the same as behaviour change determinants. Moreover, consideration of behaviour change requires simultaneous examination of desired and undesired behaviour change. Together, this study indicates evaluation practice needs to change given operational differences between behaviour and behaviour change constructs. Re-aligning evaluation to the primary outcome, namely behaviour change (desired and undesired change) is needed to align resource investment to the desired outcome.
Background

A WHO report (2010) shows that an insufficient amount of physical activity is responsible for 3.2 million deaths globally every year (World Health Organization, 2010). Furthermore, physically inactive people are more likely to have long-term health conditions (Bonomi & Westerterp, 2012). Research also indicates that an increase in physical activity can reduce health conditions such as high blood pressure, high cholesterol, high blood glucose and obesity (Bull & Bauman, 2011).

The combination of increased consumption of unhealthy food with the increasingly sedentary lifestyle has produced levels of obesity higher than ever before. In the last 30 years, the prevalence of obesity has more than doubled (World Health Organization, 2015c). World Health Organization (2015c) statistics show that in 2014, 39% of adults worldwide were overweight and 13% were obese. Common health consequences related to obesity are the reduction of life expectancy, development of type 2 diabetes, cardiovascular diseases and cancer amongst others (Australian Bureau of Statistics, 2013; Centers for Disease Control and Prevention, 2014; Ezzati & Riboli, 2013; Fock & Khoo, 2013). Research shows that life expectancy can decrease by 8 years for an adult obese person (Grover et al., 2015).

As noted in previous research, 80% of all cases of cardiovascular disease or type-2 diabetes, and cancer are considered to be preventable (Beaglehole et al., 2011; Demaio et al., 2014; Lopez, Mathers, Ezzati, Jamison, & Murray, 2006; World Health Organization, 2013). Hence, actions to prevent non communicable diseases (NCDs) are necessary, such as achieving positive change in behaviour, both individually (downstream) and population-wide (upstream) (Beaglehole et al., 2011; Kohl et al., 2012). Effective interventions are critical (Unwin & Alberti, 2006), so that a change in known risk behaviours can be achieved.
Over the years researchers across a multitude of disciplines have studied human behaviour in an attempt to understand why people behave as they do, as well as to uncover how to bring about behaviour change, with the most discernible being psychology. Originally, human behaviour and behavioural change were areas of interest and study for psychology scientists, who tried to understand the human mind, chasing explanations underlying individual’s behaviours (Larsen et al., 2017). However, human behaviour is central to all aspects of life, which caused scientists beyond the context of psychology to become interested in human behaviour and considerable research effort across a diverse range of disciplines evolved to understand how to influence people to change their behaviour. Some of these contexts include public health, behavioural medicine, human resources and organisational sciences, marketing, social marketing (Davis et al., 2015; Glanz et al., 2015; Hoek & Jones, 2011; Michie & Abraham, 2004).

Learning what changes human behaviour is paramount in a range of different contexts. However, the underlying reasons and goals are distinct for each of them. Health researchers and practitioners, for example, are concerned with influencing patients to take their medication (Zwikker et al., 2014), or change their unhealthy food habits (Samdal, Eide, Barth, Williams, & Meland, 2017). In an organisational managerial context, understanding how employers change their motivation to work, or increase their productivity is important (Deschamps, Rinfret, Lagacé, & Privé, 2016). In marketing, understanding how to influence consumers to increase their consumption of product and service sales is extremely valuable (Kotler, 2003). In social marketing, the end goal is to influence behaviours for the betterment of society (Andreasen, 2002). This discipline encompasses changing behaviours across a range of different contexts, such as health (for example, increasing exercise frequency) and the environment (for example, increasing recycling behaviour), which may overlap with other disciplines.
Although a core focus of social marketing is to change behaviours for the better (Gordon et al., 2016), intervention assessments often treat behaviour change and behaviour as the same. However, it is important to make a clear distinction between the two terms. Behaviour can be conceptualised as a unit of observation at one point in time (namely, static behaviour), while behaviour change is considered to be units of observation across multiple points in time (namely, dynamic behaviour). Frequently, when programs explicitly claim that they aim to change behaviour, assessments use behavioural variables to determine what the determinants of such change were (for example, Baker et al., 2010), limiting knowledge to understanding of behavioural determinants, rather than determinants of behaviour change. While an understanding of the determinants of behaviour is important (Michie, Hardeman, et al., 2008), knowledge of the determinants of behaviour change is essential to achieve behavioural change, and they may not necessarily be the same.

In addition, the behavioural change process is complex, and most of the research in social marketing does not consider the intricate nature of behaviour change. Behaviour change can occur in different directions (desired or undesired change), it can be linear, nonlinear, or discontinuous, and cyclical change patterns can occur for some constructs (Mitchell & James, 2001; Ployhart & Vandenberg, 2010; Stritch, 2017). Therefore, research that appreciates behaviour change is a process, and takes into consideration its complexities and multifaceted nature is crucial. Due to the complex nature of behaviour change, this research aimed to empirically explore the determinants of behaviour and behavioural change, testing static and dynamic variables in the context of physical activity.
Method

Context

The data used in this study was drawn from a commercial 12-week weight management program. The program provides a set of different personal support and behaviour management tools, such as online recipes, exercise plans, and demonstration videos (Parkinson, David, & Rundle-Thiele, 2017). Online surveys were used to collect data from participants of the program. Participants were invited to take part in the survey via email from the commercial weight management organisation at the commencement of a 12-week program using a convenience sampling method. Participants who completed the first survey were invited to participate in a follow-up survey at the end of the 12-week program, with reminders sent one week later. The program encouraged participants to engage in physical activity and healthful eating, and this study will focus on the physical activity element of the program. Respondents (n=1,124) were mostly female (97.6%), with a mean age of 43 years. Most respondents could be classified as having a high socio-economic status, having a salary of $120,000 per year and 64.1% having completed a University degree.

Measures

Seven psychographic variables collected during the survey were applicable to this investigation of behaviour change in the context of physical activity. Intentions to perform the behaviour were measured using 3 unipolar scales from 1 to 7 (Perugini & Bagozzi, 2001). Attitudes were measured with 11 seven-point bipolar scales, where respondents had to choose from opposite adjectives such as “Unpleasant-Pleasant” (Perugini & Bagozzi, 2001). Subjective norms (2 injunctive and 3 descriptive norms items) and 3 items of perceived behavioural control (PBC) were measured using seven-point unipolar scales (Rhodes & Courneya, 2003). Self-efficacy measured the participants’ confidence and perceived ability to engage in physical activity, using 3 seven-point Likert-scales (Rhodes & Courneya, 2003). Desire to perform physical activity
was also measured using 6 seven-point unipolar scales (Perugini & Bagozzi, 2001). The behavioural measure used was the frequency of participating in physical activity in the month prior to the survey (“How often did you do physical exercise in the past month in order to achieve/maintain your weight goal?”, where 0 was Never and 7 was Always).

Due to the longitudinal nature of this study, only respondents that have responded to surveys at baseline (T1) and follow-up 12 weeks later (T2) whose data could be matched across time were considered for inclusion in the statistical analysis (n=1110). First, a comparison of means was conducted to determine if a mean change in physical activity was evident. Then, change score variables were created (Allison, 1990) for behaviour by calculating the difference between behaviour in Time 2 and behaviour in Time 1 (T2-T1). Respondents with no change in behaviour (Behaviour change = 0) were removed from the analysis (n=391), restricting the analysis to people that reported change in behaviour (n=719) in either a positive direction or a negative direction. Sequentially, behavioural determinant change variables (T2-T1) were created for all psychographic variables (intentions, attitudes, injunctive norms, descriptive norms, PBC, self-efficacy, desires). Statistical analyses involved multiple linear regressions using SPSS version 25.

Determinants of behaviour and behavioural change were investigated in five statistical analyses, as described in Table 14 below, which allowed the exploration of determinants of static behaviour, dynamic behaviour change, undesired change, and desired change.
<table>
<thead>
<tr>
<th>Research question</th>
<th>Analysis</th>
<th>Independent Variables</th>
<th>Dependent Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Explaining static behaviour</strong></td>
<td>Do psychographic variables at Time point 1 predict behaviour at Time point 2?</td>
<td>Analysis 1</td>
<td>Psychographic variables at T1</td>
</tr>
<tr>
<td><strong>Explaining dynamic behaviour change</strong></td>
<td>Do psychographic variables at Time point 1 predict behavioural change?</td>
<td>Analysis 2</td>
<td>Psychographic variables at T1</td>
</tr>
<tr>
<td></td>
<td>Does a change in psychographic variables predict behavioural change?</td>
<td>Analysis 3</td>
<td>Change in psychographic variables (T2-T1)</td>
</tr>
<tr>
<td><strong>Explaining directions of dynamic behaviour change</strong></td>
<td>Are predictors of positive behavioural change different from predictors of negative behavioural change?</td>
<td>Analysis 4</td>
<td>Change in psychographic variables (T2-T1)</td>
</tr>
<tr>
<td>Research question</td>
<td>Analysis</td>
<td>Independent Variables</td>
<td>Dependent Variables</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------</td>
<td>-----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Are predictors of positive behavioural change different from predictors of negative behavioural change?</td>
<td>Analysis 5</td>
<td>Change in psychographic variables (T2-T1)</td>
<td>Positive change in physical activity frequency (T2-T1)</td>
</tr>
</tbody>
</table>

**Results**

Prior to statistical analyses, data cleaning and coding was executed and reliability tests of the items using Cronbach’s alpha was performed to ensure validity. All Cronbach’s alpha exceeded 0.7 (Cronbach, 1951). Analysis of mean change in physical activity behaviour was performed using a paired t-test to understand whether there was an overall positive or negative change in behaviour from T1 to T2. Results showed a statistically significant mean increase in physical activity (PA) behaviour as illustrated in Figure 8 below.

**Figure 8. Change in physical activity**

![Physical Activity*** (N=1110)](image)

***p < .001
Behaviour at the different time points was then examined to gain more insight into the respondents’ physical activity behaviour. Table 15 shows respondents’ exercise frequencies ("at T1 and T2, where 0 was Never and 7 was Always.

Table 15. Frequencies of behaviour at T1 and T2 (n=1110)

<table>
<thead>
<tr>
<th>Physical activity levels</th>
<th>T1</th>
<th>T2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>0</td>
<td>74</td>
<td>6.7%</td>
</tr>
<tr>
<td>1</td>
<td>43</td>
<td>3.9%</td>
</tr>
<tr>
<td>2</td>
<td>125</td>
<td>11.3%</td>
</tr>
<tr>
<td>3</td>
<td>139</td>
<td>12.5%</td>
</tr>
<tr>
<td>4</td>
<td>330</td>
<td>29.7%</td>
</tr>
<tr>
<td>5</td>
<td>242</td>
<td>21.8%</td>
</tr>
<tr>
<td>6</td>
<td>118</td>
<td>10.6%</td>
</tr>
<tr>
<td>7</td>
<td>39</td>
<td>3.5%</td>
</tr>
<tr>
<td>Total</td>
<td>1110</td>
<td>100%</td>
</tr>
</tbody>
</table>

Then, a behaviour change variable was created, using the change score from time point 1 to time point 2 (T2-T1). The frequencies of change were analysed to understand not only whether respondents had effectively changed or not, but also how respondents changed their behaviour (negatively or positively). See Table 16 illustrated change scores for behaviour (behaviour change).
Table 16. Behaviour Change frequencies

<table>
<thead>
<tr>
<th>Physical activity change (T2-T1)</th>
<th>(N=1110)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-6</td>
<td>1</td>
</tr>
<tr>
<td>-5</td>
<td>3</td>
</tr>
<tr>
<td>-4</td>
<td>14</td>
</tr>
<tr>
<td><strong>Negative change</strong></td>
<td></td>
</tr>
<tr>
<td>-3</td>
<td>25</td>
</tr>
<tr>
<td>-2</td>
<td>68</td>
</tr>
<tr>
<td>-1</td>
<td>178</td>
</tr>
<tr>
<td><strong>No change</strong></td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>209</td>
</tr>
<tr>
<td>2</td>
<td>116</td>
</tr>
<tr>
<td>3</td>
<td>65</td>
</tr>
<tr>
<td><strong>Positive change</strong></td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1110</td>
</tr>
</tbody>
</table>

In the following section results of the statistical analysis outlined in Table 14 above are reported.

**Analysis 1**

The first analysis aimed to replicate what is commonly found in intervention assessments to understand whether psychographic variables at T1 predicted behaviour at T2. Static
psychographic variables at T1 were used as independent variables and static behaviour at T2 was used as the dependent variable (see Figure 9).

**Figure 9. Analysis 1: Model testing determinants of behaviour**

Analysis of multiple linear regression tested whether intentions, attitudes, injunctive norms, descriptive norms, PBC, self-efficacy and desire could explain change in physical activity. The model showed statistical significance (Adj. $R^2 = 0.374$, $F(7, 1110) = 96.397$, $p < .001$). Self-efficacy ($\beta = 0.531$, $p < .001$), perceived behavioural control ($\beta = 0.121$, $p < .01$) and desires ($\beta = 0.156$, $p < .01$) at T1 were statistically significant determinants explaining physical activity frequency at T2. Examination of the Beta weightings demonstrated that self-efficacy was the variable with the strongest effect on how much people exercise at T2, showing that a 1-point increase in self-efficacy was associated with an increase of 0.5 of a level in physical activity frequency at T2. Correlations between variables are shown in Table 17. Results can be seen in Table 15 below.
Table 17. Correlation matrix – analysis 1

<table>
<thead>
<tr>
<th>Variables</th>
<th>Physical Activity</th>
<th>Intention</th>
<th>Attitudes</th>
<th>Injunctive norms</th>
<th>Descriptive norms</th>
<th>Self-Efficacy</th>
<th>PBC</th>
<th>Desires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Activity</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention</td>
<td>.315***</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitudes</td>
<td>.253***</td>
<td>.278***</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injunctive norms</td>
<td>.168***</td>
<td>.255***</td>
<td>.206***</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Descriptive norms</td>
<td>.146***</td>
<td>.126***</td>
<td>.104***</td>
<td>.386***</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>.582***</td>
<td>.469***</td>
<td>.361***</td>
<td>.297***</td>
<td>.201***</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBC</td>
<td>.430***</td>
<td>.306***</td>
<td>.304***</td>
<td>.249***</td>
<td>.143***</td>
<td>.714***</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Desires</td>
<td>.445***</td>
<td>.517***</td>
<td>.349***</td>
<td>.258***</td>
<td>.101**</td>
<td>.555***</td>
<td>.366***</td>
<td></td>
</tr>
</tbody>
</table>

Table 18. Analysis 1 results

<table>
<thead>
<tr>
<th>Physical activity T2 (All changers n=1118)</th>
<th>β</th>
<th>sr²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention T1</td>
<td>0.072</td>
<td>0.002</td>
<td>0.083</td>
</tr>
<tr>
<td>Attitudes T1</td>
<td>0.023</td>
<td>0.000</td>
<td>0.463</td>
</tr>
<tr>
<td>Injunctive T1</td>
<td>-0.021</td>
<td>0.000</td>
<td>0.567</td>
</tr>
<tr>
<td>Descriptive norms T1</td>
<td>-0.034</td>
<td>0.001</td>
<td>0.341</td>
</tr>
<tr>
<td><strong>Self-efficacy T1</strong>*</td>
<td>0.531</td>
<td>0.072</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Perceived behavioural control T1</strong>*</td>
<td>0.121</td>
<td>0.005</td>
<td>0.003</td>
</tr>
<tr>
<td><strong>Desires T1</strong>*</td>
<td>0.156</td>
<td>0.005</td>
<td>0.003</td>
</tr>
</tbody>
</table>

***p < .001

Analysis 2

In Analysis 2, the model tested whether static independent variables at T1 were able to explain dynamic behaviour (behaviour change = T2-T1). Figure 10 illustrates the model tested.
The model was not statistically significant (Adj. R² = -0.003, p = .640), meaning the static psychographic variables at T1 did not explain change in behaviour. Additionally, none of the individual coefficients were significant (see Table 19 and Table 20).

Table 19. Correlation matrix – analysis 2

<table>
<thead>
<tr>
<th>Variables</th>
<th>Physical Activity change</th>
<th>Intention</th>
<th>Attitudes</th>
<th>Injunctive norms</th>
<th>Descriptive norms</th>
<th>Self-Efficacy</th>
<th>PBC</th>
<th>Desires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Activity change</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention</td>
<td>-0.051</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitudes</td>
<td>-0.009</td>
<td>.278***</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injunctive norms</td>
<td>-0.027</td>
<td>.255***</td>
<td>.206***</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Descriptive norms</td>
<td>-0.040</td>
<td>.126***</td>
<td>.104***</td>
<td>.386***</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>-0.069</td>
<td>.469***</td>
<td>.361***</td>
<td>.297***</td>
<td>.201***</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBC</td>
<td>-0.030</td>
<td>.306***</td>
<td>.304***</td>
<td>.249***</td>
<td>.143***</td>
<td>.714***</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Desires</td>
<td>-0.054</td>
<td>.517***</td>
<td>.349***</td>
<td>.258***</td>
<td>.101**</td>
<td>.555***</td>
<td>.366***</td>
<td></td>
</tr>
</tbody>
</table>
Table 20. Analysis 2 results

<table>
<thead>
<tr>
<th>Physical activity change</th>
<th>β</th>
<th>sr²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(All changers n=719)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention T1</td>
<td>-0.031</td>
<td>0.000</td>
<td>0.691</td>
</tr>
<tr>
<td>Attitudes T1</td>
<td>0.022</td>
<td>0.000</td>
<td>0.687</td>
</tr>
<tr>
<td>Injunctive T1</td>
<td>0.009</td>
<td>0.000</td>
<td>0.899</td>
</tr>
<tr>
<td>Descriptive norms T1</td>
<td>-0.047</td>
<td>0.001</td>
<td>0.480</td>
</tr>
<tr>
<td>Self-efficacy T1</td>
<td>-0.112</td>
<td>0.002</td>
<td>0.206</td>
</tr>
<tr>
<td>Perceived behavioural control T1</td>
<td>0.056</td>
<td>0.001</td>
<td>0.478</td>
</tr>
<tr>
<td>Desires T1</td>
<td>-0.047</td>
<td>0.000</td>
<td>0.636</td>
</tr>
</tbody>
</table>

Analysis 3

Analysis 3 investigated the explanatory potential of a completely dynamic model. Change scores for psychographic variables were used as independent variables and behaviour change was used as the dependent variable. Illustration of the model is found in Figure 11 below.
The model showed statistical significance (Adj. $R^2 = .143$, $F(7, 711) = 18.131$, $p < .001$). The only variable found to be a statistically significant determinant of behaviour change was change in self-efficacy ($\beta = .499$, $p < .001$). The Beta coefficient indicates that a 1 unit increase in self-efficacy change is associated with a 0.5 unit increase in physical activity frequency change. This means that a higher degree of change in self-efficacy is associated with a higher degree of change in behaviour. More details are shown in Table 21 and Table 22 below.

Table 21. Correlation matrix – analysis 3

<table>
<thead>
<tr>
<th>Variables</th>
<th>Physical Activity change</th>
<th>Intention change</th>
<th>Attitudes change</th>
<th>Injunctive norms change</th>
<th>Descriptive norms change</th>
<th>Self-Efficacy change</th>
<th>PBC change</th>
<th>Desires change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Activity change</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention change</td>
<td>.219***</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitudes change</td>
<td>.098**</td>
<td>.167***</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injunctive norms change</td>
<td>.093*</td>
<td>.144***</td>
<td>.063*</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Descriptive norms change</td>
<td>0.029</td>
<td>0.049</td>
<td>0.022</td>
<td>.334***</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-Efficacy change</td>
<td>.382***</td>
<td>.388***</td>
<td>.205***</td>
<td>.189***</td>
<td>.119***</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBC change</td>
<td>.241***</td>
<td>.219***</td>
<td>.083**</td>
<td>.132***</td>
<td>.101**</td>
<td>.549***</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>
Table 22. Analysis 3 results

<table>
<thead>
<tr>
<th>Physical activity change</th>
<th>β</th>
<th>sr²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(All changers n=719)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention change</td>
<td>0.079</td>
<td>0.002</td>
<td>0.192</td>
</tr>
<tr>
<td>Attitudes change</td>
<td>0.021</td>
<td>0.000</td>
<td>0.612</td>
</tr>
<tr>
<td>Injunctive norms change</td>
<td>0.026</td>
<td>0.000</td>
<td>0.660</td>
</tr>
<tr>
<td>Descriptive norms change</td>
<td>-0.060</td>
<td>0.001</td>
<td>0.386</td>
</tr>
<tr>
<td>Self-efficacy change</td>
<td>0.499</td>
<td>0.053</td>
<td>0.000</td>
</tr>
<tr>
<td>Perceived behavioural control change</td>
<td>0.057</td>
<td>0.001</td>
<td>0.426</td>
</tr>
<tr>
<td>Desires change</td>
<td>0.069</td>
<td>0.001</td>
<td>0.430</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01, ***p < .001

Analysis 4

Similar to Analysis 3, this analysis examined a completely dynamic model, however, the direction of change was taken into consideration here. Due to the fact that there were both positive and negative changers in the sample (see Table 16 for more detail), Analyses 4 and 5 investigated the determinants of negative change and determinants of positive change respectively. These tests allow exploration of whether different determinants explain positive behaviour change versus negative behaviour change. Statistical analysis followed the same procedure as the previous test, selecting only the respondents that had a negative change score (T2-T1) (see Figure 12).
Figure 12. Analysis 4: Model testing determinants of negative behaviour change

Results showed that change in intentions (β = .176, p < .001) and change in attitudes (β = .073, p < .05) were statistically significant in explaining negative change in physical activity (Adj. R² = .074, F(7, 281) = 4.306, p < .001). The Beta coefficients show that a positive association between behaviour change and both intentions change and attitude change, with intentions change having the strongest effect on behaviour change. The positive relationship can be interpreted that a large decrease in physical activity frequency is associated with a large decrease in attitude change and a large decrease in intention change. See Table 23 for correlations between variables, and Table 24 for results.

Table 23. Correlation matrix – analysis 4

<table>
<thead>
<tr>
<th>Variables</th>
<th>Physical Activity change</th>
<th>Intention change</th>
<th>Attitudes change</th>
<th>Injunctive norms change</th>
<th>Descriptive norms change</th>
<th>Self-Efficacy change</th>
<th>PBC change</th>
<th>Desires change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Activity change</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Intention change</td>
<td>-</td>
<td>.270***</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Attitudes change</td>
<td>-</td>
<td>.172**</td>
<td>.167***</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Injunctive norms change</td>
<td>0.092</td>
<td>.144***</td>
<td>.063*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Descriptive norms change</td>
<td>0.061</td>
<td>0.049</td>
<td>0.022</td>
<td>.334***</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 24. Analysis 4 results

<table>
<thead>
<tr>
<th>Physical activity change</th>
<th>β</th>
<th>sr²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Negative changers n=289)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention change***</td>
<td>0.176</td>
<td>0.048</td>
<td>0.000</td>
</tr>
<tr>
<td>Attitudes change*</td>
<td>0.073</td>
<td>0.015</td>
<td>0.030</td>
</tr>
<tr>
<td>Injunctive norms change</td>
<td>-0.003</td>
<td>0.000</td>
<td>0.939</td>
</tr>
<tr>
<td>Descriptive norms change</td>
<td>0.036</td>
<td>0.001</td>
<td>0.508</td>
</tr>
<tr>
<td>Self-efficacy change</td>
<td>-0.063</td>
<td>0.004</td>
<td>0.296</td>
</tr>
<tr>
<td>Perceived behavioural control change</td>
<td>0.074</td>
<td>0.007</td>
<td>0.152</td>
</tr>
<tr>
<td>Desires change</td>
<td>-0.016</td>
<td>0.000</td>
<td>0.813</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01, ***p < .001

Analysis 5

Following the previous approaches, Analysis 5 investigated determinants of positive behaviour change selecting only the respondents that had a positive change score (T2-T1) (See Figure 13).
The model showed statistical significance (Adj. $R^2 = .039$, $F(7, 422) = 2.477$, $p < .05$). Findings from statistical analysis indicated that the determinants of positive behaviour change in this context were descriptive norms change ($\beta = - .129$, $p < .05$) and self-efficacy change ($\beta = .135$, $p < .05$). Beta analyses demonstrate that both variables have a similar effect size. Descriptive norms change was negatively associated with a change in physical activity frequency. A large increase in physical activity was associated with a small change in descriptive norms. Self-efficacy change was positively associated with an increase in physical activity frequency, meaning a large increase in self-efficacy was associated with a large increase in physical activity change. See Table 25 for correlations between variables and Table 26 for results.

**Table 25. Correlation matrix – analysis 5**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Physical Activity</th>
<th>Intention</th>
<th>Attitudes</th>
<th>Injunctive norms</th>
<th>Descriptive norms</th>
<th>Self-Efficacy</th>
<th>PBC</th>
<th>Desires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Activity</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention</td>
<td>.028</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitudes</td>
<td>.064</td>
<td>.167***</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injunctive norms</td>
<td>.050</td>
<td>.144***</td>
<td>.063*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Descriptive norms</td>
<td>-.078</td>
<td>.049</td>
<td>.022</td>
<td>.334***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>.142**</td>
<td>.388***</td>
<td>.205***</td>
<td>.189***</td>
<td>.119***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBC</td>
<td>.096*</td>
<td>.219***</td>
<td>.083**</td>
<td>.132***</td>
<td>.101**</td>
<td>.549***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desires</td>
<td>.040</td>
<td>.375***</td>
<td>.161***</td>
<td>.113***</td>
<td>.053</td>
<td>.401***</td>
<td>.182***</td>
<td></td>
</tr>
</tbody>
</table>
Table 26. Analysis 5 results

<table>
<thead>
<tr>
<th>Physical activity change</th>
<th>β</th>
<th>sr²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Positive changers n=430)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention change</td>
<td>-0.021</td>
<td>0.000</td>
<td>0.655</td>
</tr>
<tr>
<td>Attitudes change</td>
<td>0.027</td>
<td>0.002</td>
<td>0.374</td>
</tr>
<tr>
<td>Injunctive norms change</td>
<td>0.073</td>
<td>0.005</td>
<td>0.130</td>
</tr>
<tr>
<td><strong>Descriptive norms change</strong></td>
<td>-0.129</td>
<td>0.014</td>
<td>0.013</td>
</tr>
<tr>
<td><strong>Self-efficacy change</strong></td>
<td>0.135</td>
<td>0.012</td>
<td>0.023</td>
</tr>
<tr>
<td>Perceived behavioural control change</td>
<td>0.054</td>
<td>0.002</td>
<td>0.357</td>
</tr>
<tr>
<td>Desires change</td>
<td>-0.032</td>
<td>0.001</td>
<td>0.629</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01, ***p < .001

These analyses demonstrated that behaviour and behavioural change are different, hence, one cannot assess behaviour at time point 2 and assume that it is the same as behaviour change. Understanding of behavioural determinants is important, however, these cannot be used as a proxy for behavioural change determinants, as these analyses show they are different. In this research, both static and dynamic determinants were tested to explain behaviour change, and only dynamic variables were found to explain change in behaviour. In addition, even when examining a full dynamic model, it is important to consider that change is complex and multifaceted. Second, behaviour change can occur in different forms. This research segmented behaviour change into desired and undesired change and explored the determinants of each.
Findings indicated change direction cannot be neglected. Results of the determinants of undesired behaviour change were different from determinants of desired behaviour change.

**Discussion**

The current study extends the idea of examining the determinants of behaviour change, expanding the focus from understanding the determinants of behaviour in one point in time to behaviour change over time. As social marketers seek behaviour change, it is critical that they develop an understanding of what drives *behaviour change*, conceptualised as dynamic movement between behaviour states, rather than what contributes to *behaviour*, deemed to be a static state at a single point in time.

In this study, analysis 1 tested a full static model, with findings demonstrating that self-efficacy, PBC and desires at T1 were statistically significant in explaining behaviour at T2. Although understanding determinants of behaviour is important, understanding of behaviour change determinants is essential to achieve effective interventions. Analyses 2 to 5 investigated the determinants of behaviour change by examining change in different ways. Analysis 2 tested whether static variables at T1 could explain behaviour change, and results showed a non-significant model. Next, a full dynamic model was tested with all people that changed their behaviour and both dependent and independent variables were represented by change scores. Findings of this model showed that a change in self-efficacy is associated with a change in physical activity frequency. Further, different directions of change were assessed to understand if determinants of change in the desired direction were the same as determinants of change in the undesired direction. Results found that change in intentions and in attitudes were associated with undesired behaviour change, while change in descriptive norms and self-efficacy were associated with change in the desired direction. Table 27 outlines results of each analysis.
Table 27. Results summary

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Analysis 1</th>
<th>Analysis 2</th>
<th>Analysis 3</th>
<th>Analysis 4</th>
<th>Analysis 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Physical activity frequency at T2</td>
<td>Change in physical activity frequency (T2-T1)</td>
<td>Change in physical activity frequency (T2-T1)</td>
<td>Undesired change in physical activity frequency (T2-T1)</td>
<td>Desired change in physical activity frequency (T2-T1)</td>
</tr>
<tr>
<td>Intentions T1</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitudes T1</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injunctive Norms T1</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Descriptive Norms T1</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBC T1</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy T1</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desires T1</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In addition to different variables being identified as statistically significant in each of the models, it is important to note the difference in explanatory power in each of the models.

Although the results demonstrated that the models are indeed different, and behavioural data should be treated differently from behaviour change, the more traditional approach using behavioural data showed a stronger explanatory power compared to the behaviour change models. A reason for such difference may be the fact that this research took an individualistic approach.
viewpoint, and as behaviour change is a complex process, factors beyond the individual may have been more successful in explaining change in behaviour. This aligns with social marketing calls for approaches that take a wider view than aiming only at the individual which can lead to “victim blaming” and consumer myopia (Brennan et al., 2016). For example, Pang, Rundle-Thiele, and Kubacki (2017) demonstrated that by testing environmental factors such as distance to school to explain active school travel, their model showed a higher explanatory power (53% of variance explained), when compares to individual-focussed theories such as the Theory of Planned Behaviour (36% of variance explained) (Pang, Rundle-Thiele, & Kubacki, 2018).

This research contributed to practice by demonstrating that while current evaluation practice in social marketing focuses efforts on determinants of static behaviour, they may not be the same as determinants of behaviour change which can lead to misallocation of resources when developing and implementing behaviour change programs. Further, the multidirectional nature of behaviour change needs to be taken into consideration for analytical approaches such as regression when examining the determinants of behaviour change to ensure correct guidance for strategic decisions on which determinants to focus effort when planning for programs. For example, results of this study showed that when assessing determinants of all changers, change in self-efficacy alone was associated with change in physical activity frequency, which indicates that from all of the variables tested this should be the only variable practitioners should focus on when developing programs. However, the analysis of the people that changed behaviour in the desired direction showed that in addition to self-efficacy change, descriptive norms change was also significant in explaining desired behavioural change. These findings suggest that resources should be focussed on changing the target audience’s confidence in performing the behaviour (self-efficacy), as well as their perception that important others also perform the behaviour (descriptive norms).
Results of this study need to be considered in light of limitations. Limitations of this study include the use of change scores in multiple linear regressions, as a methodology to assess dynamic behaviour. Change scores have been extensively debated by researchers to whether it is the optimum methodology to assess behaviour change, due to possible reliability and validity issues (Borenstein et al., 2009; Rogosa & Willett, 1983). However, change scores are still considered to be appropriate to assess true change, and its determinants (Fu & Holmer, 2016; Sassenberg, Muller, & Klauer, 2014). Another important limitation is the use of secondary data, which limits the theoretical constructs tested in this research. Future research should test different methodologies that are capable of assessing behaviour change in a more dynamic manner, as well as rates of change. A methodology suggested for future research is Hidden Markov Model (HMM), also referred to as Latent Transition Analysis. In addition, other theoretical constructs should be tested, as well as consideration of factors that go beyond the individual level.

By moving beyond understanding of static behaviour, knowledge of determinants of behaviour change can be obtained, resulting in important insights for social marketers and change agents aiming to change behaviours. Moreover, this research acknowledges that change is multidirectional, and tests were conducted to understand the determinants of change in different directions.
References


6 Chapter VI - Study 3: (Re)Focussing on behavioural change: An examination of the utility of Hidden Markov Modelling

STATEMENT OF CONTRIBUTION TO CO-AUTHORED PUBLISHED PAPER

This chapter includes a co-authored paper. The bibliographic details of the co-authored paper, including all authors, are:


All authors were included in the research design. All authors contributed to the development of the first manuscript, with Patricia David conducting most of the literature review and Jason Pallant conducting most of the data analysis. All authors contributed to subsequent versions of the manuscript, and agreed to the publication of this manuscript.

(Signed)  
20th September 2018

(Countersigned)  
8th October 2018

Corresponding author of paper: Patricia Tavares de Lima David  
Supervisor: Dr. Jason Pallant

(Countersigned)  
6th October 2018  
Supervisor: Professor Sharyn Rundle-Thiele
Abstract

**Purpose** – Behavioural change practice has focussed attention on understanding behaviour; failing to apply dynamic approaches that capture the underlying determinants of behavioural change. Following recommendations to direct analytical focus towards understanding both the causal factors of behaviour and behavioural change to enhance intervention practice, this paper applied a Hidden Markov Model (HMM) approach to understand why people transition from one state to another (e.g. reporting changes from wasting food to not wasting food or vice versa).

**Design/methodology/approach** – Data was drawn from a 2017 food waste program that aimed to reduce waste of fruit and vegetables by increasing self-efficacy through a 2-week pilot, featuring recipes and in-store cooking demonstrations. A repeated measure longitudinal research design was used. 314 households completed a phone survey prior to the two-week pilot and 244 completed the survey in the weeks following the intervention (77% retention in the evaluation study).

**Findings** – Two behavioural states were identified, namely fruit and vegetable (FV) wasters and non FV-wasters. Age was identified as a causal factor for FV food wasting prior to the campaign (45-54 years were most likely to waste FV). Following the intervention, a total of 43.8% transitioned away from FV wasters to non-wasters, and attitudes and self-efficacy were indicated as potential causal factors of this change in FV waste behaviour.

**Originality/value** – Through this application, we demonstrate how a HMM can identify behavioural states, rates of behaviour change and importantly how HMM can identify both causal determinants of behaviour and behavioural change. Implications, limitations and future research directions are outlined.
Keywords Behaviour, behaviour change, social marketing, Hidden Markov Modelling, food waste

Paper type Research paper
Background

As noted by Kriznik et al. (2018, p. 1) “the dominant epistemic assumption (i.e. the assumption about what constitutes admissible evidence to guide action) underpinning the implementation of public health and other behavioural change programmes is that human behaviour is a major determinant of health, and that behaviour is largely a matter of individual choice; individuals are therefore responsible for their own health and for making health-related behaviour changes”. Evolving from commercial marketing, social marketing first emerged as a discipline within health which aimed at changing individual behaviours to benefit both the individual and the society in which they live (Andreasen, 2002). In line with other behavioural change and public health practice recent social marketing reviews highlight the continued dominant focus of intervention efforts on the individual (for example see Almestahiri et al., 2017), a focus that may overlook social and environmental behavioural determinants. We acknowledge an individual focus is frequently stigmatising and can lead to victim-blaming (Brennan et al., 2016).

In an individually (also referred to as downstream or micro) focussed program, social marketing uses the tools and techniques of commercial marketing to influence the individual whose behaviour needs to change to benefit society more broadly. Andreasen explains that what sets social marketing apart from other behaviour change fields are three factors: first, behaviour (and not awareness raising) is at the core; second, social marketing is customer-driven; and perhaps most notably, social marketing creates attractive programs into which individuals will willingly enter into exchange to achieve the desired behaviour (Andreasen, 2002). Social marketing’s core principle of exchange overcomes victim blaming and stigmatisation criticisms directed at behavioural change programs, particularly when monetary exchange occurs and people willingly purchase a program of their own volition.
Typically in social marketing, behavioural change is the desired ultimate goal. We acknowledge there are some settings where behaviour maintenance, and not behavioural change are required (for example see Rundle-Thiele et al., 2015 who sought to maintain the non-alcohol drinkers while attempting to moderate binge drinkers). Measurement indicating that behavioural change has occurred following implementation would indicate to program evaluators that the social marketing program was a success. This suggests that in many cases behaviour change is the variable of interest for social marketers, and not simply behaviour.

Although behaviour change is the end goal of social marketing dominant use of cross-sectional designs is noted in a review of the literature (for example, Armitage, 2005; Huchting et al., 2008), which focuses understanding on behaviour and not behavioural change. Use of longitudinal approaches are less evident (for example, Leatherdale et al., 2014; Mihrshahi, Dobson, & Mishra, 2015; Shefferly, Scharf, & DeBoer, 2016) and therefore focus on behavioural change remains limited within social marketing. Further, theoretical perspectives are largely behaviour and not behavioural change focussed (Brennan et al., 2014). Consistent with prevailing theoretical views; when longitudinal approaches are used, research focus remains centred on identifying the causal determinants of behaviour rather than examining the determinants of behavioural change. Researchers contends that interventions are more effective when they are aimed at causal determinants of both behaviour and behaviour change (Davis et al., 2015; Michie, Johnston, et al., 2008). As behaviour change is the end goal of social marketing, there is a need for greater understanding of the causal determinants of behaviour change.

In addition to a lack of focus on behavioural change, prevailing practice relies on analysis methods that are static in nature. For example, Repeated Measure ANOVAs are frequently employed in outcome evaluations in social marketing (for an example see Schuster, Kubacki, & Rundle-Thiele, 2016a). A shift towards dynamic evaluation methods is needed to centre
research attention on the proportion of the target audience who change (or not) and understanding which factors support positive change outcomes along with the factors contributing to undesired change. Responding to calls to direct efforts to understanding more complex relational and dynamic factors (Kriznik et al., 2018), this paper employs one dynamic analytical method drawing on available data from a social marketing food waste pilot program.

Food waste is a global problem. It is estimated that one third of all food supplied for human consumption is wasted (Stancu, Haugaard, & Lähteenmäki, 2016), hence, there is an urgent need for effective interventions focussed on changing food wasting behaviour to be put in place.

The aims of this paper are twofold. First, this paper seeks to explore the utility of employing Hidden Markov Modelling to understand transition states, which involves understanding why people transition from one state to another (e.g. wasting food to not wasting food or vice versa). Second, consistent with dominant research practices this study aims to extend our understanding of the causal determinants of food waste behaviour.

**Literature Review**

The most commonly used behavioural theories reported in social marketing research are Social Cognitive Theory (Bandura, 1986), Theory of Planned Behaviour (Ajzen, 1991), Health Belief Model (Rosenstock, 1974) and Stages of Change Model (Prochaska et al., 1994) (see Truong & Dang, 2017). Close inspection of the theories applied within social marketing indicates the main focus of these commonly adopted theories is the explanation and description of behaviour at one point in time or an individual’s readiness for change as measured at a point in time (static). For example, commonly used theories such as the Theory of Planned Behaviour aim to explain or predict behaviour at one single point in time. For example, the author of the Theory of Planned Behaviour (TPB) acknowledges that “the TPB is in fact not a theory of behaviour
change” (Ajzen, 2015, p. 133). Instead, TPB was developed to help researchers explain and predict people’s (current) intentions and behaviour (Ajzen, 2015).

One model known for its focus on behavioural change is the Stages of Change Model (also referred to as the Transtheoretical Model) (Prochaska et al., 1994). Stages of Change focuses research attention on identifying different states. Specifically, Stages of Change centres on identifying a person’s readiness for change. Although the model is change focussed, its application frequently captures readiness at a single point in time providing an understanding of the proportion of individuals at each stage of change. However, the model does not clearly identify which factors may cause a person to transition (change) from one readiness state to another in a single diagnostic model. Advances in methodologies using longitudinal data permit transitions between states to be modelled. Crucially, dynamic models can explain and predict how individuals change (or not), while also identifying the determinants of positive change, negative change, or lack of change. Given behaviour change is the end goal of social marketing, behavioural change (a dynamic process) and not behaviour (a static phenomenon) should be the analytical focus. For behavioural change to be assessed, variables have to be consistently measured at different time points, in exactly the same way, to ensure reliability (Kher & Serva, 2014) and evaluation methodologies need to be dynamic, capturing changes over time (Ployhart & Vandenberg, 2010), which occurs in repeated measure longitudinal research designs.

Commonly used behavioural theories such as the Theory of Planned Behaviour aggregate (average) past behaviour overlooking individual variation. Yet individual behaviour change is a dynamic process, where ongoing changes both internally and externally can lead to growth, regression, or stagnation. Research focused on explaining or predicting phenomena at a single point in time is not able to capture these dynamic effects. An example is the study undertaken by Gardner et al. (2012), where despite having measured all items across two time points (T1 and T2) use of change data (calculation of difference scores) was overlooked, ignoring the
potential for a dynamic approach to be taken. Gardner et al. (2012) used behaviour at time point 2 as the dependent variable and independent variables at time point 1 (past behaviour, intention, attitudes, subjective norms, PBC, self-identity and habit). This approach is typical of the predominant research practice in behavioural change science, and it fails to recognise that behaviour change is a dynamic process (Jebb et al., 2015; Ployhart & Vandenberg, 2010; Wang et al., 2017). As noted above, interventions are more effective when they are aimed at causal determinants of not only behaviour but also behaviour change. Achieving this aim requires consideration of behaviour change as a dynamic, and somewhat individual, process. Taken together, a review of the social marketing literature indicates the need for theoretical and methodological development to examine behaviour change as a dynamic process. Against this background, this paper examines the utility of the Hidden Markov Model as one dynamic method that can potentially be employed to evaluate the effectiveness of a two-week pilot food waste program.

**Method**

**Design**

A convenience sample of 314 local council area residents were allocated into either the program (n = 110) or control groups (n = 204). The program group received an intervention pack which consisted of a shopping bag, chopping board, 16 new leftover reuse recipe cards, invitation flyer, and a shopping list. Further, residents had access to a 2-week interactive shopping centre display between the pre and post-survey period. This display was delivered to engage the local community to trial developed recipes. The interactive shopping centre display consisted of daily food demonstrations delivered by a chef, interaction with volunteers and a display fridge, culminating in a Cook-Off event delivered by two local Chefs.
A controlled, repeated measure design was used to assess social marketing pilot program outcomes. A telephone survey was conducted in March (before the campaign) and April 2017 (two weeks after the campaign) following ethical and local government approval. The survey was conducted using Computer-Assisted Telephone Interviewing (CATI) equipment. Personal information including postcode and address were essential for distribution of campaign materials and were used to send the household intervention package to the program group. Self-efficacy in reusing leftovers (Waste and Resources Action Programme, 2007, 2010), attitudes (Fishbein & Ajzen, 2011), social norms (Perugini & Conner, 2000; Rhodes & Courneya, 2003), and self-reported fruit and vegetable waste were measured pre and post program. Self-efficacy items captured a range of behaviours linked to food waste including planning meals, storing food correctly, planning food shopping, buying the right amount of food, measuring portion size, transforming leftovers, reusing leftovers and storing leftovers correctly. The proportion of fruit and vegetable waste was measured on a five-point scale, where 1 was hardly any, 2 was less than 10 per cent and 5 was more than half. Demographic information including age, gender and private garden was collected at baseline only. Reported exposure to the intervention was also recorded, to ensure that the program group had successfully received the intervention materials.

Participants

Some attrition (33 per cent) was observed for the post-campaign survey. Thus, there were 244 (77 per cent retention) participants that completed both pre and post surveys. Of those, 91 were from the program group (82.7 per cent retention) who received a household intervention pack and/or saw the shopping centre display and 153 were from the control group who did not receive the intervention pack and who were not exposed to the local shopping centre display (75 per cent retention). Retention rates were high relative to typical social research. One issue with
Longitudinal studies is the loss of participants over time. In order to avoid high attrition rates, incentives to participate in the surveys (pre and post) were offered. For the control group, a chance to participate in a draw to win a $50 gift voucher was offered, and the intervention group received a free program pack valued at $100. Respondents were asked a series of questions to provide a profile of the sample obtained in the survey. Over 73% of the sample were female. The majority of the participants belonged to the 34 to 49 year old age group, and described their households as a family (only adults) and having a private garden.

Data Analysis

A Hidden Markov Model (HMM), was used to examine the effectiveness of the food waste campaign. Hidden Markov Models, which are often referred to as Latent Transition Analysis in health research, can be summarised as a form of longitudinal segmentation (Collins & Lanza, 2010). That is, the HMM categorises individuals into groups at different points in time. Importantly, these groups are dynamic meaning that any given individual may be a member of a certain group at one point in time, but then may belong to a different group at a different point in time (Collins & Lanza, 2010). Importantly, this means the HMM not only reveals groups (i.e. segments) within a population, but also examines the way individuals move between these groups.

HMMs have been successfully applied in a broad range of settings involving individual behaviour. Netzer et al. (2008) apply a HMM to alumni-university interactions, finding three behaviour groups ranging from Dormant, to Occasional, to Active donors. Importantly, they demonstrated that individuals may move between these groups, and that this is affected by factors such as attendance at reunion events, and volunteering. Singh, Tan, and Youn (2011) utilised HMM to investigate learning dynamics in the context of open source software projects.
Their model revealed three learning groups (low, medium, and high) which represented different learning patterns. They also find that learners may move between these groups based on the learning activities they engage with. Finally, in a health-setting, H. Chung, Park, and Lanza (2005) applied HMM (labelled as Latent Transition Analysis) to investigate the dynamics of substance use behaviour among adolescent females. They found five groups based on substance use, ranging from no use, to alcohol or cigarette use in isolation, to a combination of substances. Their model shows that the likelihood of progressing to more advanced substance use depends on stage of puberty, and the age when substance use began. These examples serve to highlight the utility of HMM in uncovering 1) behavioural groups, 2) the rates of change between groups, and most importantly 3) the determinants of change. Detailed discussion including practical applications and examples of HMM are available in Visser (2011) and Collins and Lanza (2010).

The HMM makes a number of assumptions to examine the way individuals evolve over time in a dynamic way. First, consistent with Factor Analysis and Structural Equation Modelling, variation among observed variables is assumed to be caused by differences within a latent (unobserved) variable (Collins & Lanza, 2010). However, HMM is distinct from these methods as the second assumption is that this latent variable is assumed to be categorical, rather than continuous (Collins & Lanza, 2010). Hence, a HMM proposes that there are sub-groups (or segments) of individuals which differ in ways that cause differences to occur in observed variables. To illustrate this, consider the example of H. Chung et al. (2005) discussed above. In their case, the HMM assumes that there are sub-groups of adolescent females regarding substance abuse behaviours. However, these groups are not known or observed. Instead, membership in these groups is inferred based on observed behaviour. That is, through the data individuals are observed to use cigarettes at a given point in time. From this observed behaviour,
it can then be inferred that this particular individual is in a state of “substance user” at that point in time.

This example also helps lead to the final assumption of the HMM, which is that the latent groups are dynamic. This means individuals may change groups over time (Langeheine & Van de Pol, 2002). Following the substance use example, an individual who is observed to be a “substance user” may be found at a later date to no longer use cigarettes. That is, they have changed from a group of substance use, to a group of non-substance use. To signify the dynamic nature, the sub-groups in a HMM are referred to as “latent states”, and “transitions” refer to the movement from one state to another over time (Langeheine & Van de Pol, 2002; J. K. Vermunt, 2004). These assumptions make HMM an appropriate method for our study. Given our context, the HMM assumes that there are dynamic subgroups of individuals in relation to food waste behaviour, and investigates movement between these groups (i.e. behaviour change).

As discussed above, observed variables, are used to describe the latent states in a HMM. These are known as “indicator variables” (Collins & Lanza, 2010). Changes in individual scores on these variables are also used to infer transitions between latent states. In our study, a single indicator variable Proportion of Fruit and Vegetable (FV) Wasted, which measured the proportion of fruit and vegetables that a family wasted in the past week as a categorical variable. This variable had three categories; hardly any, less than 10%, and 10% or more. Repeated measurement occurred pre and post intervention. Hence the proportion of FV Waste at two time points was included; prior to the intervention, and after the intervention. This variable was measured at an individual level, allowing us to track changes (transitions) over time.

HMM can also incorporate variables to test the causal factors of the latent states individuals belong to, and the way they transition between states. These variables are referred to as “covariates” (H. Chung et al., 2005; Collins & Lanza, 2010). The impact of covariates is tested
in a similar way to logistic regression, where the covariate may have a positive or negative impact on the likelihood of an individual being in a given latent state, and/or transitioning between states (H. Chung et al., 2005; Collins & Lanza, 2010; J. K. Vermunt, 2004). In this study, we examine evolving FV food waste behaviour while testing the effectiveness of a social marketing campaign. Hence, our covariates include exposure to the campaign as well as other variables which may impact changes to food waste behaviour. A full list of variables included in our model is displayed in Table 28.

**Table 28. Variables included in HMM**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indicators</strong></td>
<td></td>
</tr>
<tr>
<td>Proportion of FV wasted</td>
<td>The proportion of food a family wasted in the past week; Hardly any, less than 10%, or 10% or more</td>
</tr>
<tr>
<td><strong>Covariates</strong></td>
<td></td>
</tr>
<tr>
<td>Exposure</td>
<td>Binary indicator of whether an individual was exposed to the campaign</td>
</tr>
<tr>
<td>Age</td>
<td>The age of the respondent (categorical)</td>
</tr>
<tr>
<td>Gender</td>
<td>The gender of the respondent (dichotomous)</td>
</tr>
<tr>
<td>PrivateGarden</td>
<td>Binary indicator of whether the respondent had access to a private garden</td>
</tr>
<tr>
<td>Attitude</td>
<td>Rating of attitudes towards food waste, measured pre and post campaign</td>
</tr>
<tr>
<td>SelfEfficacy</td>
<td>Rating of self-efficacy towards food waste, measured pre and post campaign</td>
</tr>
<tr>
<td>SocialNorm</td>
<td>Rating of social norms towards food waste, measured pre and post campaign</td>
</tr>
</tbody>
</table>
Results

Descriptive Analysis

Descriptive statistics for key variables pre and post campaign were analysed across our entire sample, and are displayed in Table 29.

Table 29. Descriptive analysis

<table>
<thead>
<tr>
<th></th>
<th>Pre Campaign</th>
<th>Post Campaign</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=244</td>
<td>N=244</td>
</tr>
<tr>
<td>Proportion of FV wasted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardly any</td>
<td>45.1%</td>
<td>55.7%</td>
</tr>
<tr>
<td>Less than 10%</td>
<td>38.5%</td>
<td>31.1%</td>
</tr>
<tr>
<td>10% or more</td>
<td>16.4%</td>
<td>13.1%</td>
</tr>
<tr>
<td>Attitudes</td>
<td>2.3</td>
<td>2.2</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>5.7</td>
<td>5.7</td>
</tr>
<tr>
<td>Social Norms</td>
<td>5.6</td>
<td>5.6</td>
</tr>
</tbody>
</table>

Across our sample, we observe that the proportion of individuals who reported wasting “hardly any” food or vegetables prior to the campaign (45.1%) increased after the campaign (55.7%). Additionally, the proportion who wasted 10% or more decreased from 16.4% to 13.1%. Hence, at an overall level positive changes in the amount of fruit and vegetables wasted after the campaign were observed, which indicates “model-free” evidence of changes to behaviour over time. Notably, there is a 10% increase in the proportion of households reporting they waste hardly any food after the campaign. Interestingly, we notice that the average scores on the
Attitudes, Self-Efficacy, and Social Norms scales are relatively consistent prior to and post the campaign.

*Hidden Markov Model*

The “Hidden” aspect of the HMM refers to the fact that the underlying states of behaviour in the model are not known prior to analysis (Visser, 2011). Importantly, this extends not only to the profile or nature of the states, but also the number of states. That is, it is not known how many states there are, or what each state entails. To rectify this, models with varying numbers of states, as well as different state profiles, are estimated. A likelihood function is then used to determine the number and profile of states that best fits the observed data (Visser, 2011). In other words, the preferred solution is the one that creates the highest likelihood that the observed data would have occurred (Collins & Lanza, 2010).

To generate our solution, we estimated Hidden Markov Models with ranging numbers of states using LatentGold Version 5 (Vermunt & Magidson, 2013). Full details regarding how LatentGold estimates a Hidden Markov Model can be found in the technical guide provided by Vermunt and Magidson (2013). For each possible number of states (i.e. models with 1-state, models with 2-states etc.) we started the model with 100 different random sets of parameters (i.e. different cluster profiles). Following best practice, we then used a combination of Expectation-Maximisation and Newton-Raphson algorithms to estimate the best possible parameters (state profiles) based on each set of starting values (McCutcheon, 2002). Estimating the model based on multiple sets of starting parameters provides a way of ensuring the model converges on the true best (or “global”) solution, rather than a sub-optimal (or “local) solution based on the starting point used.

We then compare the solutions ranging from 1-5 states using The Bayesian Information Criterion (BIC). The BIC compares the fit of the generated solution with the observed data,
while also imposing a penalty for more complex models (Masyn, 2013). The model with the lowest BIC value is generally preferred, as lower numbers represent a better model fit while accounting for model complexity (Masyn, 2013). Table 30 displays the BIC statistic for models ranging from 1 state to 5 states, as well as the Log-Likelihood (LL) value on which the BIC is based.

Table 30. Model fit statistics

<table>
<thead>
<tr>
<th>Model</th>
<th>LL</th>
<th>BIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-state</td>
<td>-485.6</td>
<td>1015.1</td>
</tr>
<tr>
<td>2-states</td>
<td>-419.7</td>
<td>998.7</td>
</tr>
<tr>
<td>3-states</td>
<td>-379.8</td>
<td>1144.3</td>
</tr>
<tr>
<td>4-states</td>
<td>-345.5</td>
<td>1411.1</td>
</tr>
<tr>
<td>5-states</td>
<td>-325.8</td>
<td>1816.9</td>
</tr>
</tbody>
</table>

The data indicated that the BIC was lowest with two states, which suggests that two states of behaviour provided the best combination of model fit and model complexity. Hence, this is the first important outcome of our HMM; there are two states of behaviour related to food waste.

The next crucial step is to consider what these two behavioural states are. The answer to this comes by examining the profile of each state on the indicator variables included in the model (Collins & Lanza, 2010). Table 31 displays the profile of the two revealed states on our indicator variable (Proportion of FV wasted). As our indicator variable is categorical, the profile displays the proportion of members of each state that are expected to be in each category. The state profiles are estimated through a density function of responses to the included indicator variables, conditional on membership in the various latent states (Vermunt & Magidson, 2013). A separate probability is estimated for state membership, which can be used to identify the relative size of each state.
Table 31. State profiles

<table>
<thead>
<tr>
<th></th>
<th>State 1 – Non-Wasters</th>
<th>State 2 – Wasters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>68.5%</td>
<td>31.5%</td>
</tr>
<tr>
<td>Proportion of FV wasted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardly any</td>
<td>0.73</td>
<td>0.04</td>
</tr>
<tr>
<td>Less than 10%</td>
<td>0.26</td>
<td>0.52</td>
</tr>
<tr>
<td>11%+</td>
<td>0.01</td>
<td>0.44</td>
</tr>
</tbody>
</table>

State 1 equates to 68.5% of our sample and almost two-thirds of this state waste “hardly any” food, while the remainder waste “less than 10%”. Hence, state 1 refers to respondents with low self-reported fruit and vegetable wastage behaviour. As a result, this state was labelled “non-wasters”. State 2 is a smaller state, at only 31.5% and in contrast to state 1, only a small proportion (4%) of state 2 waste “hardly any food”. Instead, almost half (44%) respondents in this group report wasting more than 10% of their food. Hence, this state was labelled “wasters”. Therefore, a key outcome of our HMM is the identification of two states of behaviour (wasters and non-wasters), as well as the approximate sizes of these two groups.

The next outcome of a HMM is the transition probabilities; which estimate the probability of individuals moving between states, compared to the probability of individuals not changing their behaviour (Collins & Lanza, 2010). In other words, the rates of change between the behaviour states are revealed by the model, and are therefore a key result. Transition probabilities are generated by estimating the probability of state membership at a given time period \( t \) as dependent on state membership in the previous time period \( t-1 \) (Vermunt & Magidson, 2013). This is the “Markov” component of a Hidden Markov Model (Visser, 2011). Recall that our HMM revealed two states of behaviour; waster, and non-waster. Also recall that our model includes two time periods; prior to the intervention, and after the intervention. As a result, the transition probabilities in our model are relatively simple. They represent the
probability of individuals who were wasters prior to the campaign becoming non-wasters (relative to no change in behaviour), and vice versa. The transition probabilities estimated by the model are displayed next.

**Table 32. Transition probabilities**

<table>
<thead>
<tr>
<th>State before campaign (t-1)</th>
<th>Non-waster</th>
<th>Waster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-waster</td>
<td>0.947</td>
<td>0.053</td>
</tr>
<tr>
<td>Waster</td>
<td>0.438</td>
<td>0.562</td>
</tr>
</tbody>
</table>

In Table 32, the rows represent the possible states of behaviour prior to the campaign. The first row represents individuals who were non-wasters prior to the intervention campaign, while the second row includes wasters. The columns represent the possible states of behaviour after the intervention campaign. The cells on the diagonals therefore represent the likelihood of individuals remaining in the same state over time, while the non-diagonals represent the probability of transitions between states (behaviour change).

To interpret the transition probabilities, it is easiest to read across the rows, as they sum to 100%. By considering the first row, we identify that the probability of individuals who were non-wasters prior to the intervention remaining non-wasters after the campaign (i.e. staying in the same state) is 94.7% (see Table 32). There is only a 5.3% probability that these individuals will transition to the wasters state after the campaign. That is, it is highly likely that non-wasters will remain non-wasters. In contrast, by considering the second row (and the second column) the probability of wasters remaining wasters is substantially lower (56.2%). In contrast, the probability of this state transitioning (changing behaviour from waster to non-waster) is
relatively high (43.8%). Hence, these transition probabilities highlight an overall trend of positive behavioural change post intervention.

Next, the factors that influenced individual transition states were examined by considering model covariates. Covariates may have two different impacts in a HMM; influencing an individual’s starting state (behaviour prior to the intervention), or influencing transitions between states (change in behaviour over time). In each case, they are tested through a form of logit model as part of the Hidden Markov Model (Collins & Lanza, 2010). Table 33 depicts results of the covariates we tested in relation to each individual’s starting state. As our model includes only two states, these results display the probability of belonging to State 2 (waster), as opposed to belonging to State 1 (non-waster) as a result of each covariate.

Table 33. Impact of covariates on starting states

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Impact on probability of starting state = waster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>18-44</td>
<td>0.47 (0.36)</td>
</tr>
<tr>
<td>45-54</td>
<td>0.92 (0.34)**</td>
</tr>
<tr>
<td>55-64</td>
<td>-0.17 (0.32)</td>
</tr>
<tr>
<td>65+</td>
<td>-1.22 (0.32)*****</td>
</tr>
<tr>
<td>Gender (Female)</td>
<td>-0.53 (0.21)*</td>
</tr>
<tr>
<td>Private Garden (No private garden)</td>
<td>0.19 (0.33)</td>
</tr>
</tbody>
</table>

Displayed as Coefficient (Standard Error), ^p≤0.1, *p≤0.05, **p≤0.01, ***p≤0.001

Results indicate that individuals aged 45-54 are relatively more likely than other age groups to be wasters prior to the campaign, while those aged 65+ are relatively less likely. The significant negative coefficient for females indicates that females are less likely to start as wasters than males. Hence, both age and gender influence the likelihood that an individual will be a food waster prior to the campaign. No significant effect for Private Garden was observed, which
means respondents with access to a private garden are just as likely to start as wasters (or non-wasters) as those with no access.

The impact of covariates on transitions between states, relative to the probability of staying in the same state was examined (see Table 34). In the context of the current study this equates to testing which factors may increase or decrease the likelihood of wasters becoming non-wasters, or vice versa.

Table 34. Impact of covariates on transitions between states

<table>
<thead>
<tr>
<th>Covariate</th>
<th>State (Pre)</th>
<th>State (Post)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Waster</td>
<td>Waster</td>
</tr>
<tr>
<td>Age (18-44)</td>
<td>Non-Waster</td>
<td>-2.14 (5.25)</td>
</tr>
<tr>
<td></td>
<td>Waster</td>
<td>-8.54 (5.08)^</td>
</tr>
<tr>
<td>Age (45-54)</td>
<td>Non-Waster</td>
<td>3.66 (4.48)</td>
</tr>
<tr>
<td></td>
<td>Waster</td>
<td>-3.66 (4.48)</td>
</tr>
<tr>
<td>Age (55-64)</td>
<td>Non-Waster</td>
<td>-3.19 (8.97)</td>
</tr>
<tr>
<td></td>
<td>Waster</td>
<td>2.88 (1.76)^</td>
</tr>
<tr>
<td>Age (65+)</td>
<td>Non-Waster</td>
<td>1.68 (3.94)</td>
</tr>
<tr>
<td></td>
<td>Waster</td>
<td>4.52 (2.86)</td>
</tr>
<tr>
<td>Gender (Female)</td>
<td>Non-Waster</td>
<td>-2.74 (2.76)</td>
</tr>
<tr>
<td></td>
<td>Waster</td>
<td>1.80 (1.80)</td>
</tr>
<tr>
<td>PrivateGarden (No)</td>
<td>Non-Waster</td>
<td>5.26 (3.11)^</td>
</tr>
<tr>
<td></td>
<td>Waster</td>
<td>7.18 (4.21)^</td>
</tr>
<tr>
<td>Exposure</td>
<td>Non-Waster</td>
<td>-0.56 (1.50)</td>
</tr>
<tr>
<td></td>
<td>Waster</td>
<td>-0.46 (0.85)</td>
</tr>
<tr>
<td>Attitudes</td>
<td>Non-Waster</td>
<td>1.10 (1.27)</td>
</tr>
<tr>
<td></td>
<td>Waster</td>
<td>2.31 (1.35)^</td>
</tr>
<tr>
<td>SelfEfficacy</td>
<td>Non-Waster</td>
<td>-1.27 (1.09)</td>
</tr>
<tr>
<td></td>
<td>Waster</td>
<td>7.18 (4.07)^</td>
</tr>
<tr>
<td>SocialNorms</td>
<td>Non-Waster</td>
<td>0.18 (1.75)</td>
</tr>
<tr>
<td></td>
<td>Waster</td>
<td>-1.08 (1.42)</td>
</tr>
</tbody>
</table>

Displayed as Coefficient (Standard Error), ^p≤0.1, *p≤0.05, **p≤0.01, ***p≤0.001
Results were not significant at the 0.05 probability level, which may be a result of the relatively low sample size. Many results had p-values around 0.06 or 0.07, which given the sample size was considered to near traditional significance levels. Hence, results discussed are significant at the 0.1 level. The first notable results are that transitions from waster to non-waster are more likely among 55-64 year olds (based on the significant positive coefficient), but less likely among 18-44 year olds. That is, older individuals are more likely to improve their FV wastage compared to younger individuals.

Individuals with private gardens were likely to transition between states, from both non-wasters to wasters and vice versa. Significant results were observed for two of the three psychographic variables. Specifically, transitioning from waster to non-waster is positively associated with both attitudes and self-efficacy. In contrast, social norms had no impact on the likelihood of behavioural change. A summary of the Hidden Markov Model results is presented in Figure 14. This figure serves to graphically summarise the results presented in the tables above. The ovals represent the two latent states, including their respective sizes as reflected in Table 31. The curved arrows represent possible transitions between the states, including the possibility of remaining in the same state. The percentages attached to these arrows represent the transition probabilities, or rates of change, associated with each possible transition as reflected in Table 32. Finally, significant covariates (at the 0.1 level) highlighted in Table 34 are displayed next to each transition, with an upwards arrow demonstrating a positive impact, and a downwards arrow demonstrating a negative impact.
Discussion

This paper contributes to the literature in two ways. First, this paper applied Hidden Markov Modelling to explore the utility of this method, as an example of a dynamic model, to examine the causal determinants of positive and negative behavioural change. Application of Hidden Markov Modelling permitted an understanding of transition between states to be observed. A second contribution of this paper arises in the analytical insights gained. This study contributes to our understanding of food waste reduction behaviour identifying causal determinants of positive behavioural change (an increase in food waste reduction behaviour). Each contribution is discussed in turn in light of the literature.

Behavioural states

The dominant theoretical focus (see Brennan et al., 2014; Truong & Dang, 2017) centres research attention on identifying factors associated with behaviours typically drawing from
cross-sectional data (for example, Armitage, 2005; Huchting et al., 2008). This research approach assists us to understand which conditions may need to exist for a behaviour to occur but they do not identify causal determinants of change. In response to calls to expand the research focus (see Michie & Prestwich, 2010) this paper drew on available data and applied HMM to examine changes in food waste behaviour following a two week pilot program directing analytical attention towards understanding the causal determinants of both behaviour and behavioural change. First, HMM identified two behavioural states and termed these FV wasters and non-FV wasters. A higher likelihood that non-wasters will remain non-wasters (after the program) was noted suggesting many individuals did not change, nor did they need to change given low FV waste behaviours reported by the majority in the sample prior to pilot program implementation. Next, the factors influencing the food waste behavioural state were examined. Analysis indicated a major causal factor for FV food wasting was age. Specifically, results indicated that individuals aged 45-54 were more likely to be food wasters than other age groups while females and individuals aged 65+ were less likely to be wasters. Theoretically derived psychographic measures (attitudes, self-efficacy and social norms) for the commonly used Theory of Planned Behaviour (Ajzen, 1991) did not explain FV waste group membership. Directing analytical focus to the behavioural states provides information that can guide program planning directing resources at those individual profiles most likely to be wasting food and results indicate that behaviour causal factors in this context were not psychographic determinants as suggested by Theory of Planned Behaviour.

Transition and rates of behavioural change

As stated previously, directing analytical focus at understanding the causal factors of behavioural change is recommended (see Michie & Prestwich, 2010 for a detailed explanation).
In line with this recommendation HMM was applied to understand how, and why, people transition from one state to another (e.g. wasting food to not wasting food or vice versa). The transition probabilities estimated by the model identify the rates of change that occurred throughout the promotional period. We observe a notably high probability of positive behavioural change. However, we also observe that the probability of individuals remaining in the same state (performing the same behaviour) is higher in both states than the probability of transitioning (behavioural change). This highlights a consistent challenge in social marketing of encouraging behavioural change within individuals. Importantly, through the HMM our study is able to examine causal determinants of behavioural change relative to stagnant behaviour. In the present study attitudes and self-efficacy were indicated as potential causal factors of FV waste change. Attitudes and perceived behavioural control explained why individuals transitioned from food wasting to non-food wasting, which was in line with the core program objective of leftover re-use (self-efficacy) through attractive and tasty recipes provided to the program group (attitudes). Importantly, these factors were significant for behavioural change, but not static behaviour as stated above. Hence, applying a dynamic model provides deeper insights into the role different variables have in behaviour compared to behaviour change.

Adoption of dynamic analytical approaches such as HMM extend understanding beyond dominant forms of outcome evaluation which deliver aggregate information. The strength of dynamic models such as HMM is identification of behavioural states as well as data on transitions between states, assisting program evaluators to understand the extent of behavioural change that can be expected and the factors causing behavioural change. This is especially relevant to the social marketing discipline, which has a dominant focus on cross-sectional designs, and even when a longitudinal design is employed, the most commonly used methodologies are static (such as ANOVA, for example). This paper makes an important
contribution to the field applying a novel approach to assess behaviour change. An enhanced understanding of the causal determinants of change provides important data to inform dollar spend. In the current study investment focus on the factors causing non desired change could be avoided with funds directed towards factors causing desired behavioural change (FV wasters transitioning to non FV wasters). Identifying groups based on the behaviour of interest meets the segmentation principle recommended for social marketing, delivering a more nuanced means to direct strategy and investment, and theoretically an increased chance of achieving behavioural change (Carins & Rundle-Thiele, 2014; Xia et al., 2016).

**Implications for policy and practice**

The results of the current study indicate that FV food waste reduction can be changed through a focus on attitudes and beliefs about their own abilities. Therefore, based on this results of this study, social marketers seeking to reduce FV food waste should focus programs on self-efficacy and attitudes, although care should be taken prior to generalisation of these results and more tests within the same context are needed. In this pilot program recipe cards were developed by leading regional chefs to provide recipes focussed on using contents that would already be in the household fridge. Daily cooking demonstrations were delivered during the 2-week pilot program demonstrating how easy the recipes were to make and food samples were provided allowing individuals to trial the recipe. This pilot program provides one example of assisting to promote self-efficacy – one’s confidence to re-use the items already available in the fridge. Additional efforts that could be considered in future food waste programs to further enhance self-efficacy include offering a cook book or cooking classes for purchase to ensure the program offers an essential exchange mechanism to avoid stigmatising or victimisation (Brennan & Fry, 2016).
The results of this study indicate potential utility of application of a dynamic approach to direct research and in turn practitioner focus to behaviour change and its determinants. The results of the current study suggest that social marketing definitions need to be revised from a focus on behaviour to an emphasis on behavioural change. By redirecting focus from behaviour to behavioural change, definitions and core focus will be altered ensuring that longitudinal designs are employed on all occasions to evaluate behavioural change. Dynamic modelling approaches such as HMM need to become mainstream practice in line with recommendations by Michie and Prestwich (2010) and Kriznik et al. (2018). Extending the evidence base to understand the causal determinants of change will enhance practice overall and ensure that monies invested in behavioural change programs are appropriately invested.

Understanding how to theorise, predict, measure and evaluate behaviour change is a hugely relevant issue. Various social marketing campaigns have been highly successful in the past but there is still limited understanding about why some campaigns work and why, despite repeated efforts other campaigns do not. By understanding the causal determinants of change, more effective behavioural change initiatives can be implemented across a broad spectrum of public health and environmental issues, from overweight and obesity, to mental health, problem gambling, greater equality for marginalised and vulnerable groups, sustainable use of resources and so on. Further, while the personal and social benefits of these changes are obvious effective delivery of change can deliver significant economic benefit.

Limitations and future research directions

The results of this study must be viewed in light of limitations. The sample size in this study was small particularly when we consider that more than two-thirds of the sample were non-wasters prior to program implementation with low likelihoods of becoming food wasters, which
we would desire. As a result, a significance level of 0.1 was adopted in the present study based on the small sample size to illustrate the potential application of HMM to evaluate behavioural change. Therefore, the results must be treated with caution until larger sample sizes can be obtained. Future research drawing from larger sample sizes is recommended to draw definitive conclusions of HMM’s potential to evaluate behavioural change. This study took a first step at looking at behaviour change from a dynamic perspective, however, it is recommended for future studies to also examine probabilities of long-term behaviour change and maintenance of behaviour. Expanding on this, future research is recommended to test the relevance and usefulness of alternative models of behaviour change, such as Latent Growth Curve Modelling.

In the current study, causal determinants of behaviour (initial food waste) were different from the causal determinants of behavioural change (transitions). Recall that psychographic constructs such as attitudes and self-efficacy did not initially explain FV food waste behaviour. Initial FV food waste behaviour was influenced by age and gender. In contrast to behaviour, causal determinants of behavioural change were increases in attitudes and self-efficacy suggesting the role these variables have to play in FV food waste reduction. This has important theoretical implications. Future research involving replication across contexts is recommended to develop a Theory of Behavioural Change. Additionally, the individual effects of each causal determinant were considered in this study. Future research may seek to examine whether there are important interactions between these factors.

This study was undertaken in the context of food waste and was focussed on changing individual behaviour. Extensions beyond the FV waste context are recommended for future research to examine the utility of HMM across a range of behavioural range contexts. Additionally, future research is recommended to include social and environmental behavioural change determinants into analysis to extend our understanding beyond individuals as recommended by Kriznik et al. (2018) and many other researchers.
The present study drew on available data to explore the utility of HMM for evaluating behaviour and behavioural change. Available data involved a repeated measure design and self-report data. Self-report data for contexts such as food waste can be biased, given known biases such as socially desirable responding (Devaux & Sassi, 2015). Future research should obtain objective behavioural data in order to draw more definitive conclusions. A further limitation may arise from the combined use of the control and program use sample within a single HMM given that the control group is not expected to transition in the absence of an intervention. Additional research is recommended to understand the utility of including a control sample, or not, in transition modelling.

A related limitation based on available data is in the use of a single categorical variable to measure the behaviour of interest; food waste. Hidden Markov Models can include multiple indicator variables from various scale types (J. K. Vermunt, 2004). Further research should examine how results vary if multiple variables are used as indicators of the behaviour of interest.

A final limitation of this study was that known biases such as socially desirable responding were not measured and this is recommended for future studies. The results of the current study indicated that almost half of individuals who were not exposed to the campaign still improved their food waste behaviour, which may be explained through a combination of the Hawthorne effect and social desirability bias (J. Chung & Monroe, 2003). Involvement in the study may have encouraged some participants to improve their FV food waste behaviour, while other respondents may have reported food waste reductions due to social desirability. Future research can determine the presence and absence of socially desirable responding and the Hawthorne effect through measurement of SDR and experimental designs.

This paper has demonstrated the role that HMM can play in delivering an assessment of a social marketing campaign to identify rates of positive (and negative) change and importantly to
understand the factors predicting changes observed. Extending analytical focus to behavioural change ensures that resources can be directed to the causal determinants of behavioural change.
References


Kher, H. V. & Serva, M. A. 2014. Changing the way we study change: Advocating longitudinal research in MIS. *ACM SIGMIS Database, 45*, 45-60.


7 Discussion

7.1 Introduction

Overall, the research undertaken in this thesis aimed to take a first step toward developing a theory of behaviour change in social marketing. The studies directed efforts to understanding the process of behaviour change, examining how behaviour change differs from behaviour, exploring the determinants of behavioural change, and examining a dynamic methodology to assess change. More specifically, the purpose of this research was to; first, understand whether behaviour and behavioural change are conceptually and empirically distinct; second, explore the multifaceted characteristics of behaviour change, and empirically test what are the determinants of behaviour change; and third, test the potential of a dynamic methodology to empirically examine change in social marketing. To achieve the aims of this project, three studies were conducted.

Although the literature examined in this thesis touched on psychology, and other behavioural research, the lens used for this research is from a social marketing perspective. Social marketing research has shown a lack of theory use over the years (Pang, Kubacki, et al., 2017; Truong & Dang, 2017), and a closer inspection shows that when theory is used behavioural theories rather than behaviour change theories dominate (examples can be found in Brennan et al., 2014).

In this final chapter, a brief summary of the research aims and an outline of the research design is given in the first section (section 7.2). Next, findings from each study and an understanding of how they address each correspondent research question is synthesised in section 7.3. The theoretical and practical contributions and implications of this research are presented in sections 7.4 and 7.5. Then, section 7.6 outlines the limitations of this research, and section 7.7 describes
avenues for future research. Finally, an overall conclusion is made in the last section (section 7.8).

7.2 Restating the research purpose and design

Social marketing’s core focus is changing behaviours for the betterment of society. One of the SMBC known to help guide researchers and practitioners to achieve more effective social marketing programs is theory. However, despite the demonstrated benefits of applying theory (Lefebvre, 2001; The National Social Marketing Centre, 2011), the use of theory to inform interventions in social marketing, and more broadly behavioural change is low, and in cases where theory use is reported application is poor (David & Rundle-Thiele, 2018). Evidence indicates that less than half of intervention studies report theory use (Luca & Suggs, 2013; Pang, Kubacki, et al., 2017). For example, Pang, Kubacki, et al. (2017) found less than a third of active school interventions applied or tested theories. This is supported by Prestwich et al. (2014); Prestwich, Webb, and Conner (2015), who state 36% to 89% of interventions are not explicitly based on theory and while theory may often be mentioned, often the application of theory is not extensive. In the rare cases where theories are consistently reported across studies, consistent measures are not used. For example, items are removed from constructs to obtain model fit, item wording is adjusted between studies and the constructs used frequently differ across study contexts (David & Rundle-Thiele, 2018), which prevents any comparisons from occurring.

In addition, most of the theories used in the field of social marketing are behavioural theories describing static behaviour. Theories which have static behaviour as the outcome can only explain or predict behaviour at a single point in time. The author of one of the most commonly used theories in social marketing and behaviour change more broadly, namely the Theory of Planned Behaviour (TPB) acknowledges that “the TPB is in fact not a theory of behaviour
change” (Ajzen, 2015, p. 133). TPB was developed to help researchers explain and predict people’s (current) intentions and behaviour (Ajzen, 2015). While understanding static behaviour and behavioural determinants is important (Michie, Hardeman, et al., 2008), it is essential that researchers discern that static behavioural theories and behavioural determinants are not the same as dynamic behaviour change theories and determinants of change (Davis et al., 2015; Ployhart & Vandenberg, 2010).

Although longitudinal designs are essential to examine behaviour change, most of the research in social marketing and the social sciences in general are predominantly utilising cross-sectional research designs (see examples in Dietrich, Rundle-Thiele, Schuster, & Connor, 2016; Truong & Dang, 2017). While advantages of utilising cross-sectional design for some types of research are clear; descriptive research utilising cross-sectional design does not provide enough insight into how behaviour change over time can be achieved, due to its static form (Pitariu & Ployhart, 2010). Hence, it is crucial that researchers and practitioners looking to assess change over time use research designs and methodologies that allow examining beyond a static point in time. Advances in methodologies using longitudinal data permit transitions between states to be modelled. Crucially, dynamic models can explain and predict how individuals change (or not), while also identifying the determinants of positive change, negative change, or lack of change.

Summarising the above, the social marketing literature shows a need for more theory use; for the development of theory that explains behaviour change rather than behaviour at a single point in time; and methodologies that measure whether individuals exhibit behaviour change, and that can identify the determinants of dynamic behaviour change. To address these gaps, three Research Questions were developed for this thesis. These are outlined below:
Research Question 1 (RQ1): Are there conceptual and empirical differences between behaviour and behaviour change?

Research Question 2 (RQ2): Which determinants are associated with behaviour, behaviour change, undesired change and desired change?

Research Question 3 (RQ3): How can behaviour change be explained and predicted using dynamic methods?

Three studies were undertaken in an attempt to answer these RQs (see Figure 15). Drawing from the literature review, Study 1 aimed to make a clear distinction between the concepts of behaviour and behaviour change, while testing whether there were empirical differences between the concepts. Study 2 investigated the complexities of behaviour change and explored behaviour change determinants using empirical data from a social marketing evaluation for a 12 week weight loss program. Study 3 tested the extent that a dynamic methodology (Hidden Markov Modelling) could be used to examine change in social marketing.
A more detailed analysis of findings can be found within the respective chapters: Chapter IV – Study 1: Rethinking behaviour change: a dynamic approach in social marketing; Chapter V – Study 2: An empirical exploration of the determinants of behaviour and behaviour change; and Chapter VI – Study 3: (Re)Focussing on behavioural change: An examination of the utility of Hidden Markov Modelling. Next, each of the Research Questions will be addressed and a synthesis of all findings will be provided.

7.3 Addressing the Research Questions

7.3.1 Research Question 1

The first research question (RQ1) asked: *Are there conceptual and empirical differences between behaviour and behaviour change?*. Study 1 was undertaken to answer RQ1. This study aimed to conceptualise the differences between behaviour and behaviour change, and empirically demonstrate these differences. In addition, the use of change score as a method to assess behaviour change was illustrated in this study. The study used data from a social
marketing campaign in the context of walking to and from school behaviour, to empirically test whether determinants of behaviour were the same as determinants of behaviour change. Statistical analysis of behaviour involved multiple linear regression, using static variables at only one point in time (T2). In contrast, analysis of behaviour change involved using change scores for the behavioural measures (T2-T1), as well as change scores for all other variables. In summary, this study examined both static and dynamic data to empirically examine whether the determinants of behavioural change were the same as the determinants of behaviour at a single point in time.

This study described the differences between the concepts of behaviour and behaviour change, noting that the former is static and the latter dynamic, and that the determinants of dynamic change may not be the same as those for static behaviour. Data analysis of the walking to and from school study demonstrated differences in explanatory variables, and the extent of variance explained observed between a static (behaviour) model and a dynamic (behaviour change) model. Under a dynamic model, a change in injunctive norms (important others approval of the child walking to school) led to a change in walking to and from school behaviour. Importantly, results show a positive relationship, that an increase in injunctive norms leads to an increase in walking to and from school behaviour. Findings from modelling of static behaviour show that four factors can statistically explain behaviour, namely, barriers, injunctive norms, descriptive norms and PBC. Although explaining static behaviour has its value, it is crucial that researchers do not assume that by focussing effort on changing variables that explain behaviour, change will occur. Of the four factors that explained static behaviour, only one (injunctive norms) explained changes in walking to and from school behaviour. Therefore, social marketing programs with the goal of changing walking to and from school behaviour should solely focus attention on changing injunctive norms, rather than focussing on the other three factors identified in the static model. In summary, this study established that static behaviour, and
dynamic behaviour change are different, and dynamic research methods and longitudinal and not cross sectional data are needed in social marketing to build an evidence base to better understand the predictors of behavioural change.

7.3.2 Research Question 2

The second research question (RQ2) asked: Which determinants are associated with behaviour, behaviour change, undesired change and desired change?. Study 2 was conducted to answer RQ2. Due to the complex nature of change, this research aimed to empirically explore the determinants of behaviour and behavioural change, testing static and dynamic variables in the context of physical activity.

The data used in Study 2 was drawn from a commercial 12-week weight management program. Following the procedures of Study 1, statistical analysis of behaviour involved multiple linear regression using static dependent and independent variables, while dynamic behaviour was tested using change scores for both dependent (behaviour change) and independent variables. The behaviour measure was represented by physical activity frequency, and psychographic variables tested were intention, attitudes, injunctive norms, descriptive norms, self-efficacy, perceived behavioural control, and desires. Five analyses were undertaken as outlined in Table 35.

Table 35. Analyses undertaken in Study 2

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Explaining static behaviour</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analysis 1</td>
<td>Psychographic variables at T1</td>
<td>Physical activity frequency at T2</td>
<td>Self-efficacy at T1 PBC at T1 Desires at T1</td>
</tr>
<tr>
<td></td>
<td><strong>Explaining dynamic behaviour change</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Findings from the static model showed that self-efficacy, PBC and desires at T1 were statistically significant in explaining behaviour at T2. Then, a model testing whether static independent variables could explain dynamic behaviour showed no statistical significance. Next, a full dynamic model showed that a change in self-efficacy is associated with a change in physical activity frequency. Finally, different directions of change were assessed to understand if determinants of change in the desired direction were the same of determinants of change in the undesired direction. Results found that change in intentions and in attitudes were associated with undesired behaviour change, while change in descriptive norms and self-efficacy were associated with changes in physical activity in the desired direction.

Building on from the previous study, in which behaviour and behavioural change were shown to be two different concepts, Study 2 served as a replication of Study 1 examining the determinants of static behaviour and the determinants of behaviour change. This study extended beyond Study 1 undertaking additional analyses to examine the different types of behaviour change (desired and undesired) to examine whether the determinants of behaviour change were different from determinants of desired and undesired change. Given behaviour change is dynamic, which means not all people move in the same direction, this is an important step...
toward gaining insight into what makes people change, but more so, what determines changes in different types of behaviours, namely desired and undesired behavioural change. In summary, Study 2 acknowledged the multidirectional nature of behaviour change, and conducted tests to understand whether the determinants of change differed for different behavioural change types.

7.3.3 Research Question 3

The third Research Question (RQ3) asked: *How can behaviour change be explained and predicted using dynamic methods?*. Building on the findings from the previous studies, Study 3 aimed to address this question by examining the utility of a dynamic methodology to assess behaviour change. Social marketing outcome evaluations are dominated by research methods that assess the behaviour of different groups at different time points (cross sectional series design) or track individual behaviour over time points using repeated measures focusing understanding on the behaviour at each time point for the individuals participating in the evaluation (for example, Rundle-Thiele et al., 2015; Schuster, Kubacki, & Rundle-Thiele, 2016b). These approaches limit understanding to group comparisons of behaviour at different time points and a focus on explanation and/or prediction of behaviour. Given social marketing’s core aim is behavioural change, methods to assess behaviour change are needed.

Drawing on data from a food waste social marketing intervention Study 3 tested a dynamic modelling approach, namely the Hidden Markov Model (HMM), to assess behaviour change. The Hidden Markov Model (HMM) permits change to be examined empirically. Repeated measure data (pre and post intervention) was used to identify different states of behaviour and determinants of change from one state to another. The Hidden Markov Model was applied to examine behaviour states, and then using longitudinal data, transition between the identified
behavioural states was examined (desired change, no change and undesired change). Finally, HMM identified factors associated with the changes.

Findings of the HMM identified that there were two dynamic states of behaviour; non-wasters (less than 10% of fruit and veg wasted) and wasters (more than 10% of fruit and veg wasted). One third of wasters became non-wasters after the campaign, a change that was positively associated with an increase in self-efficacy. Results indicated behavioural change is higher among females and those with no private garden. These results suggest that Hidden Markov Modelling (HMM) can be used to identify behavioural states and determinants of behavioural change in social marketing. Application of HMM extends social marketing understanding beyond behaviour to behaviour change, taking into consideration the dynamic nature of behaviour, identifying behavioural states and change directions. A shift towards dynamic evaluation methods is needed to centre research attention on the proportion of the target audience who change (or not) and on understanding the determinants of change. This study demonstrates one method of achieving this, through the use of Hidden Markov Modelling (HMM), in a social marketing context.

7.4 Implications for theory

Theoretical contribution is central to any scientific research. It consists of contributions based on science which advance knowledge and move the discipline’s thinking forward (Corley & Gioia, 2011). This can be achieved by providing new relationships to existing concepts, for example, or by the development of new ideas, concepts, or theories in the field. This section presents the overarching contribution to theory made by this research project, which was designed with a strong theoretical purpose.
Theory is a set of relationships between constructs that provide a framework to guide researchers and practitioners. Theory also helps understand a phenomenon. Davis and colleagues explain that theory represents “the accumulated knowledge of the mechanisms of action (mediators) and moderators of change as well as the a priori assumptions that can deliver this understanding” (Davis et al., 2015). The significance of theory has been widely recognised across different disciplines within the social sciences (Brennan et al., 2014; David & Rundle-Thiele, 2018; Dubin, 1978; Lucas, 2003; Michie, Johnston, et al., 2008; Pitariu & Ployhart, 2010; Rimer & Glanz, 2005; Wacker, 1998). In social marketing, theory use is one of the eight principles that can help deliver more effective social marketing programs (French & Blair-Stevens, 2006). However, reviews in the social marketing literature show that theory application is still scarce. In the active school travel context, for example, Pang, Kubacki, et al. (2017) found that less than a third of school-based interventions have in fact applied theory. Calls for more theory use in social marketing have been made for years (Gordon et al., 2016; Luca & Suggs, 2013; Prestwich et al., 2014; Truong, 2014; Truong & Dang, 2017). This doctoral research contributes to knowledge by investigating theory use (or lack thereof) in social marketing at a deeper level, looking at theory types, as well as theory purpose.

The social marketing field incorporates marketing techniques to change behaviour for the better. Hence, it is fair to say that social marketing’s ultimate goal is behaviour change. Behaviour change is a complex field of study, raising interest across different disciplines throughout the years (Spotswood, 2016). While many disciplines are centred on understanding what drives change (Michie et al., 2008; Ployhart & Vandenberg, 2010) many methodological and theoretical perspectives are not behaviour change centred, rather they are behaviour focussed. Importantly, this research distinguished between the concepts of behaviour and behaviour change. Behaviour is one unit of observation measured at a single time point, while behaviour change can only be observed through a series of observations, measured repeatedly
over time. Understanding behaviour is very important, but in fields of research that are focussed on delivering behavioural change, it is insufficient to examine behaviour alone. Behavioural change researchers, such as social marketers, have to look beyond behaviour to investigate what drives behaviour change. This research expands theory focus from explanation and prediction of behaviour at a single point in time, towards understanding the process of behaviour change through identification of the determinants of behavioural change.

This research moves beyond static theoretical perspectives to a dynamic perspective, ensuring an understanding of behaviour change can be attained. Undertaking a behavioural change perspective in research allows identification of immediate determinants of behaviour change (Schwarzer, Lippke, & Luszczynska, 2011).

Finally, this research expands the focus to the development of theories that explain behavioural change, which is needed in social marketing. A review of the literature shows that there are many theories to choose from, however, often the purpose of the theories and how to apply them remains unclear (Chatterton & Wilson, 2014; Davis et al., 2015). The number of models and theories that focus on explanation and prediction of behaviour are estimated to be somewhere between 60 and 83 (Chatterton & Wilson, 2014; Davis et al., 2015; Gainforth, West, & Michie, 2015). However, often only a few of the same theories are repeatedly utilised, such as the Theory of Planned Behaviour (TPB; Ajzen, 1991) and Social Cognitive Theory (SCT; Bandura, 1986). While these theories’ importance in explaining behaviour should be recognised, more often than not, the TPB gets confused with a theory of behaviour change. Importantly, even the authors acknowledge that it is not a theory of behaviour change (Ajzen, 2015). Hence, although there are a number of behavioural theories available, a lack of behaviour change focussed theories is evident. Social marketing has been borrowing theories from other disciplines such as psychology since its beginning and this research indicates this practice has to stop as it is limiting progress in the field.
This research project takes a much needed first step towards understanding the determinants of change. The findings of this PhD thesis are not sufficient to propose a new theory of behavioural change. Further investigation including replication, inclusion of additional influences of behavioural change and utilisation of dynamic methodologies are needed to deliver a theory of behavioural change. The program of research reported in this thesis have taken the first step and a dynamic behavioural change model has been identified (see illustration of model in Figure 16).

**Figure 16. Dynamic behaviour change model proposed**

![Dynamic behaviour change model](image)

### 7.5 Implications for practice

There are a number of practical implications that arise from this research. First, this research puts forward a clear point for practitioners to assess change and change determinants in behaviour change programs. As previously stated, a cross-sectional research design is still dominant in social marketing (Evans et al., 2014; Merrill et al., 2007; Noar & Zimmerman, 2005; Painter et al., 2008; Truong & Dang, 2017), and even when a longitudinal design is
utilised, static approaches are commonly used to assess behaviour change (see Evans et al., 2014; Parker et al., 2006), limiting knowledge of behaviour change determinants.

Second, this research makes a clear conceptual and empirical distinction between the concepts of behaviour and behaviour change. This distinction may provide possible explanations for why some behaviour change programs that focus efforts on previously identified behavioural determinants may not be achieving successful outcomes. Due to the dominant focus of social marketing on behaviour, rather than behaviour change, social marketers may be allocating resources into developing programs focussing on factors that do not lead to behaviour change. This research demonstrates that an expansion from understanding the determinants of behaviour to also examining determinants of behaviour change is essential when aiming to implement effective behaviour change programs.

Last, this research demonstrated that the theories that are most commonly used in social marketing programs are behavioural in nature, which means that they are effective in explaining behaviour, but not behaviour change. The use of explanatory theories such as Theory of Planned Behaviour (TPB) may lead social marketing practitioners to misallocate resources in the belief that factors such as intentions, for example, need to be targeted to effect behavioural change. By redirecting the theoretical lens from behaviour to behaviour change, insight into behaviour change determinants can be gained which can then be used to inform strategic decision making delivering more effective behaviour change programs.

7.6 Limitations

Any contribution and conclusions drawn from research need to be examined in light of limitations. The limitations that are specific to each of the three studies conducted in this
This section discusses the key limitations of the overall research project.

First, this doctorate research used secondary data for all studies. Secondary data is defined as data that has been previously collected and recorded by someone else and for purposes other than the current project (Zikmund et al., 2011). According to Babin and Zikmund (2015), the primary advantage of using secondary data comes from availability. Disadvantages of secondary data use also have to be acknowledged. The main disadvantages of using secondary data come from inadequacy of its use in regards to the purpose of the research (Zikmund et al., 2011). Since the data was not designed specifically to meet the researcher’s needs, the researcher can face issues such as not having measured all the desired variables (Babin & Zikmund, 2015). Additional issues that arise from using secondary data include having different sample sizes across the different studies (Study 1, 2 and 3), hence the reason why Study 3 had a significantly smaller sample size when compared to Study 1 and Study 2. However, such as any method choice in research, the decision to use secondary data has to take the adequacy of the method into consideration, and the reliability of the data source. Obtaining secondary data is generally faster and less expensive than acquiring primary data (Bernard & Bernard, 2012). Therefore, if access to secondary data comes from a reliable source, and it is relevant and adequate to the aim of the study, it can be a beneficial method. Using secondary data in the present research enabled access to more than one data set, with large sample sizes, and longitudinal research designs. This was necessary to permit a robust examination of the difference between behaviour and behaviour change across a number of different contexts.

Due to the use of existing data, this research was limited to the individual level and psychographic constructs only. The purpose of this research was to test theoretical constructs, hence psychographic variables were crucial. However, this research was limited to the available psychographic items already measured during data collection, which may not have included all
of the important behaviour change determinants. Additionally, behaviour change is a complex process, and to fully understand what influences change, it would be important to measure other variables that had the potential to explain behaviour change, such as social or environmental factors. Due to the nature of the research method chosen, this was not possible, and, hence, any conclusions drawn from this research should be examined in light of such limitations.

Second, data collection was conducted using self-report questionnaires. Self-report survey data is a widely used method in social research, the main reason being that self-report surveys are considered to be very cost-effective (Bauhoff, 2011). Reviews of the social marketing literature show that most studies in the field do not extend beyond self-report research methods (see Carins & Rundle-Thiele, 2014; Kubacki et al., 2015; Pang, Kubacki, et al., 2017). Despite its dominance in social marketing, and indeed the social sciences, limitations of the method have been acknowledged in the literature, such as self-report response bias. Self-report response bias is the inaccuracy of measurement due to respondents’ imperfect recall of events, or providing misleading answers (social desirability bias) (Bauhoff, 2011). Respondents may underreport certain activities considered to be socially undesirable (especially with sensitive topics, such as use of illegal substances, for example), or over report socially desirable ones, such as healthy eating (Krumpal, 2013). In alignment with calls made for more innovative methods to measure behaviour (Dodd-McCue & Tartaglia, 2010), it is recommended that objective data be used in future research. In addition to the limitation of self-report surveys generally, online survey samples can be biased, due to the “skewness of characteristics of the internet population” (Evans & Mathur, 2005). Considerable debate is evident with some scholars questioning the ability of an internet sample to be representative of the general population (Wilson & Laskey, 2003). Two of the three samples were online; therefore, the inherent biases associated with online surveys have to be taken into account when examining the results for this PhD study.
Third, the present study used data with a repeated-measures design containing only two time points. It is widely known from the literature that to measure and examine change, longitudinal designs are a requirement. Longitudinal methods permit individual change to be observed and are requisite to understanding behavioural change and the drivers of change. Despite longitudinal designs being crucial for researchers focusing on behaviour change, it is evident the predominant use of cross-sectional designs in the social sciences remains dominant (see examples in Dietrich et al., 2016; Truong & Dang, 2017). However, as stated by Singer and Willett (2003, p. 2), “Cross-sectional data - so easy to collect and so widely available - will not suffice”. Cross-sectional designs limit understanding of a phenomena, since it does not capture what happens between time points to build an evidence base that explains change. The current doctorate research takes a step beyond use of cross-sectional data, to assess change between two time points. However, much of the research in the behavioural change discipline claims that one can only measure true change with a minimum of three time points (Ployhart & Vandenberg, 2010). Hence, although this research takes an important step into measurement of behaviour change, future research should include three time points.

Fourth, there are also limitations in using change scores as a dependent variable in regression analysis. Change scores, or difference scores, have been acknowledged in the literature to be a measure of change over time (Allison, 1990; Borenstein et al., 2009), and there is some discussion in the literature regarding the variable’s reliability and whether or not it is the best method for explaining change over time (Kessler, 1977; Rogosa & Willett, 1983). Some authors have suggested a stronger method for explaining change over time is the latent growth curve (LGM) model (Pitariu & Ployhart, 2010; Ployhart & Kim, 2013; Rogosa et al., 1982). However, minimum criteria for utilising LGM have to be met. A minimum sample size of at least 200 cases in each time point is required (Boomsma & Hoogland, 2001). Moreover, when the focus of the LGM model is on individual changes, data must be acquired over at least three points in
time (Byrne, 2013). These issues present limitations for Study 1 and Study 2, however, Study 3 explores a methodology to assess behaviour change that overcomes the limitations described. Finally, this research is bound to the contexts in which the studies were located. As stated by Hekler et al. (2016, p. 825), a “theory is useful because it provides explanations and predictions that support the generalization of findings from past work into future areas of inquiry and use”. Moreover, differently from the exact sciences, where a hypothesis is tested within the constraints of a laboratory, and it is influenced by external variables, the social sciences can be contextual and situational. Therefore, replication within the same context and across contexts are crucial before any definitive conclusions can be drawn.

7.7 Future research

Theory and behaviour change are two very complex areas, involving a multitude of factors of influence and further research should be undertaken prior to drawing definitive conclusions.

HMM was found to be successful in assessment of change in behaviour in Study 3, however, prior to drawing conclusions further testing of the method is recommended. For example, HMM should be replicated in a number of studies within the same context, as well as across social marketing contexts. Future research should also explore use of other statistical analyses that allow consideration of the dynamics of change. To test additional methods that could be useful for examining behaviour change, such as Latent Growth Models (Finch & Shim, 2018), it is suggested that research with big data is pursued, as this would address some of the criteria necessary for using more sophisticated methods, such as more time points, and larger sample sizes.

In addition, future research where data analysis may be challenging, due to a large amount of the sample not changing their behaviour, methodologies such as zero-inflated models may be
used to solve this issue. Importantly, investigation of what influences people to change, and simultaneous understanding of the factors influencing people to not change should be conducted. This is highlighted by Rundle-Thiele et al. (in press), where ten social marketing theory development goals (SMTDGs) are proposed. The seventh goal proposed by the authors is based on the fact that not all people targeted to change will actually change behaviour, therefore, social marketers should focus efforts in building theories explaining why people do not change in addition to extending effort to understand how and why people do change their behaviour in both desired and undesired directions (Rundle-Thiele et al., in press).

In addition, to overcome issues with self-reported bias, future research should use objective behaviour measures. Self-reported bias encompasses both social desirability (the inclination individuals have to show themselves the same as their perceived norms) and social approval (wish to gain positive response from others) (Adams et al., 2005). In the context of physical activity, for example, wearable technology or digital monitoring could deliver objective behavioural data overcoming limitations associated with self-reported behavioural data.

Precise application of theoretical constructs and items is also recommended (David & Rundle-Thiele, 2018) as is replication across a variety of different contexts to understand which determinants of change are consistent. Further, testing of additional theoretical constructs drawing from different behavioural theories is suggested, including social and environmental factors. As mentioned earlier in this thesis, behaviour change is a complex process, and while looking at what determines individual behaviour change is essential, a downstream focus may not be enough to understand behaviour change (Brennan et al., 2016). Environmental and structural aspects are very important, especially for some contexts. Consider, active school travel, where children can live far from their school, creating a additional barriers (see Pang, Rundle-Thiele, et al., 2017). Hence, environmental changes offer an important avenue for future research, and should be further investigated. Together, this offers a rich area for future research
to deliver an evidence base to extend our understanding of how to achieve behaviour changes to benefit both individuals and society.

7.8 Conclusion

Studies should focus attention on identifying determinants of behavioural change before accepting the static theoretical perspectives that dominate behavioural change research practice. Insights into behaviour change determinants needs to be gained, which can then in turn be used to inform strategic decision making delivering more effective behaviour change programs.
8 References


Bell, A., & Swinburn, B. (2004). What are the key food groups to target for preventing obesity and improving nutrition in schools? European journal of clinical nutrition, 58(2), 258-263.


Chan, D. (1998). The conceptualization and analysis of change over time: An integrative approach incorporating longitudinal mean and covariance structures analysis (LMACS)


Kher, H. V., & Serva, M. A. (2014). Changing the way we study change: Advocating longitudinal research in MIS. *ACM SIGMIS Database, 45*(2), 45-60.


202


207


208


World Health Organization. (2015c). Obesity and overweight (Fact Sheet No. 311). Retrieved from [www.who.int](http://www.who.int)


