A Path to Flourishing:
The Role of Emotion Regulation in Adolescent Wellbeing and Positive Education

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Abstract

Emotion regulation (ER) is a widely recognized contributor to adaptive psychological functioning, and an important developmental task of adolescence. Positive education programs (PEPs) are school-based interventions that seek to enhance wellbeing and protect young people against the development of psychological distress and dysfunction. To date, the role and relevance of ER to PEPs remains unknown. The central objective of this thesis was to evaluate the relationship of ER with the full spectrum of mental health in an adolescent sample, and to determine the relevance of ER to outcomes of a best-practice PEP. A literature review explored methodological and conceptual considerations in the examination of ER in adolescent wellbeing. A second, targeted review of the literature (Publication 1) synthesized two fields of research, ER and positive psychology interventions, to reveal that processes of ER are meaningfully related to domains of wellbeing, including positive emotions, engagement, relationships, meaning, and health (i.e., the PERMA model). An exploratory study of 101 adolescents (age 14 -16; 36% female) was then conducted to assess the degree of covariance between change in physiological (i.e., heart rate variability; HRV) and self-report measures of ER (i.e., the Difficulties in Emotion Regulation Scale; DERS) over the school year, to determine if including both measures in subsequent analyses provides a more comprehensive measure of ER than using one alone. Small, significant relationships were found between HRV and DERS total score, indicating that HRV and self-report represent related but largely distinct processes contributing to the ER construct. A second study of 119 adolescents (age 14-17; 50% female) then evaluated the cross-sectional relationship between multiple ER measures and domains of positive and negative psychological functioning. As predicted, after controlling for covariates (i.e., age and school), hierarchical regression analyses revealed that self-reported ER predicted resilience, perseverance, connectedness, and happiness; and fewer depression and anxiety symptoms. Higher HRV also predicted resilience and perseverance. Effect sizes were small to moderate. To explore the longitudinal relationship between ER and wellbeing, and to determine the role of ER in PEP outcomes, a third empirical study was conducted. This study examined the relationship between two self-report measures of ER and changes in wellbeing scores of 44 Year 10 adolescents (50% female, *m* age = 15.07) following a year-long PEP compared to a treatment-as-usual control condition (*n* = 36; *m* age = 15.11; 18.8% female,). Results of linear mixed modelling revealed that ER meaningfully predicted wellbeing over time. A time-by-group-by-ER interaction

revealed that adolescents with low ER capacity enrolled in PEP reported improvements in happiness and social connection following PEP exposure, and benefits were sustained at least 6-months post treatment. Irrespective of treatment group, greater ER capacity was associated with higher wellbeing and resilience, and fewer symptoms of depression and anxiety over time. PEP did not improve students' ER capacity. Overall, this thesis underscores the importance of ER capacity to the full spectrum of adolescent mental health, and indicates that PEP interventions may be extended and enhanced by conceptualizing them within a broader, theoretical ER framework. Finally, results provide preliminary support for the value of ER in differentiating students who are more likely to benefit from PEP participation, and suggest that current PEP models might benefit from the inclusion of explicit ER training and interventions.

Declaration

This declaration is to certify that:

- Material included in this thesis has not been accepted for any other degree in any university;
- This thesis comprises only my original work towards the PhD and, to the best of my knowledge, this thesis contains no material previously published or written by any other person, except where due reference is given in the text;
- No third-party editorial services were used in the preparation of this thesis;
- Due acknowledgement has been made in the text to all other material used;
- This thesis is less than 100,000 words in length, exclusive of tables, figures, references and appendices.

Preface

This thesis includes two original papers published in peer reviewed journals and two unpublished manuscripts that are described, below. The ideas, development and production of these manuscripts were the principal responsibility of myself, the candidate, working within the Centre for Positive Psychology, Melbourne Graduate School of Education. This work was conducted under the primary supervision of Professor Dianne Vella-Brodrick and secondary supervision of Adjunct Associate Professor Nikki Rickard and Dr. Tan Chyuan Chin. This research, including all manuscripts published, submitted, and prepared for publication, was conducted in collaboration with Geelong Grammar School and funded by the Australian Research Council, grant number LP130100357. Professor Vella-Brodrick was the Chief Investigator of the ARC grant under which this project was conducted.

Chapter Two (section 2) includes a manuscript published by Journal of Happiness Studies in June 2018:
Morrish, L., Rickard, N., Chin, T.C., & Vella-Brodrick, D. (2018). Emotion regulation in adolescent wellbeing and positive education. *Journal of Happiness Studies*, 1-22.
Approximately 70% of the ideas and development of this manuscript was undertaken by myself, the candidate. Professor Vella-Brodrick, Associate Professor Rickard, and Dr Chin contributed content knowledge and recommendations during the manuscript revision process, each contributing approximately 10% to the final work.

Chapter Three includes a manuscript submitted for publication to the International Journal of Education and Psychological Assessment in November 2018:
Morrish, L., Chin, T.C., Rickard, N., & Vella-Brodrick, D. (submitted). Multi-method assessment of emotion regulation: Longitudinal covariance of heart rate variability and self-report measures in an adolescent sample. *The International Journal of Educational and Psychological Assessment.*
As the primary author, the majority (70%) of the ideas and development of this manuscript were carried out by myself, the candidate. Professor Vella-Brodrick, Associate Professor Rickard, and Dr Chin contributed content knowledge and recommendations during the manuscript revision process, and each contributed approximately 10% this manuscript.

A third manuscript, presented in Chapter Four, was accepted for publication by International Journal of Wellbeing in November 2018:

Morrish, L., Rickard, N., Chin, T.C., Sigley-Taylor, P., & Vella-Brodrick, D. (in press). The role of physiological and subjective measures of emotion regulation in predicting adolescent student wellbeing**.** *International Journal of Wellbeing*.

The majority of the content and production of this manuscript (70%) was the original work of myself, the candidate. Professor Vella-Brodrick (10% contribution), Associate Professor Rickard (10% contribution) and Dr Chin (5% contribution) provided content knowledge and recommendations during the production of this manuscript. Ms Sigley-Taylor (5% contribution) participated in data collection and data preparation.

A final manuscript, submitted for publication to Journal of Happiness Studies in November 2018, is presented in Chapter Five:

Morrish, L., Chin, T.C., Rickard, N., & Vella-Brodrick, D. (submitted). The influence of emotion regulation on adolescents' happiness and social connection following a positive education intervention: A preliminary study. *Journal of Happiness Studies.*

Approximately 70% of this manuscript including the development of ideas and production was undertaken by myself, the candidate. Professor Vella-Brodrick, Associate Professor Rickard, and Dr Chin contributed content knowledge and recommendations during the manuscript revision process, and each contributed approximately 10% this manuscript.

Dedication

It is said that it takes a village to raise a child. I believe that the same may be said for completing a PhD! This thesis is dedicated to all of those who helped along the way. First and foremost, my husband, Dr Paul Badcock. Your patience, wisdom, love, and moral support throughout this process has been invaluable and will be remembered fondly. I would like to express my gratitude to Dr Jo Mitchell and Dr Michael Carr-Gregg, who provided me with the confidence to take on this project and continue to teach me what great psychologists look like. Thank you also to Gwen Morrish, my mother, ultimate teacher, and constant source of encouragement; to Jacqui, Jesus, Peta, and all of those at The Centre for Positive Psychology for your advice and camaraderie; and finally, to all the friends and family for tolerating my inconsistent presence over the past four years. What brilliant humans you are.

Acknowledgements

I wish to sincerely thank my supervisors, Professor Dianne Vella-Brodrick, Associate Professor Nikki Rickard and Dr Tan Chyuan Chin for their scholarship, guidance, expertise, and collegiality in the completion of this thesis, as well as for providing clear direction for the structure and design of this project. I would also like to acknowledge the contributions of Dr Peggy Kern, Professor Lindsay Oades, Dr Vicki McKenzie, Dr Sandy Clarke and Dr Paul Badcock for their input and recommendations in the execution of this thesis. I also extend my thanks to the staff at The University of Melbourne Graduate School of Education; to the students, parents, teachers, and staff of the participating schools; and finally, to the Australian Research Council (LP130100357 - Enhancing adolescent mental health through positive education), in partnership with Geelong Grammar School, who funded this research project.

List of Abbreviations

ACT	Acceptance and Commitment Therapy
ANS	Autonomic Nervous System
ARC	Australian Research Council
CBT	Cognitive Behavior Therapy
CD-RISC	Connor Davidson Resilience Scale
CERQ	Cognitive Emotion Regulation Scale
DERS	Difficulties in Emotion Regulation Scale
EPOCH	EPOCH Adolescent Measure of Wellbeing
ER	Emotion Regulation
ERQ	Emotion Regulation Questionnaire
ERQ-CA	Emotion Regulation Questionnaire Children's Version
ESM	Experience Sampling Method
GGS	Geelong Grammar School
HF HRV	High Frequency Heart Rate Variability
HRV	Heart Rate Variability
IBIs	Interbeat Intervals
LMM	Linear Mixed Modelling
MBCT	Mindfulness Based Cognitive Therapy
PERMA	PERMA Model of Wellbeing
PHQ-4	Patient Health Questionnaire Four Item Scale
Pnn50	Percentage of successive IBIs greater than 50 milliseconds
PEP	Positive Education Program
PER	Positive Emotion Regulation program
PPI	Positive Psychology Interventions
RMSSD	Root Mean Square of Successive Differences
SEL	Social Emotional Learning
SEM	Structural Equation Modelling

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Chapter 1: General Introduction

Emotion regulation (ER) represents an important developmental task of adolescence that contributes to improved health, economic, and civic outcomes in adulthood (Moffit et al., 2010). ER refers to the initiation, inhibition, and self-modulation of emotional experience and expression in order to flexibly adapt to environmental demands (Berking & Wupperman, 2012). Processes of ER are complex, and draw upon physiological, cognitive, expressive and behavioral processes associated with emotional experience (Cole, 2014; Scherer & Coutinho, 2013). Broadly, adaptive ER is defined as a set of emotional responses that are consistent with environmental conditions or personal goals, while deficits of ER are characterized by rigid or contextually inappropriate emotional responding that can contribute to psychological distress and dysfunction (Aldao, Nolen-Hoeksema, & Schweizerm 2010). Emerging evidence suggests that improving an individual's ER capacity not only reduces symptoms of psychological distress and disorder, but can augment positive psychological characteristics associated with wellbeing, such as social adjustment (Modecki, Zimmer-Gembeck, & Guerra, 2017), school-achievement (Boekaerts & Pekrun, 2016), and positive affect (Koval et al., 2013). The potential to both reduce negative affective states and promote the adaptive aspects of psychological functioning positions ER as particularly relevant to contemporary wellbeing frameworks, such as the Complete State Model of Mental Health (Keyes, 2005; 2007), which regards optimal psychological health as the presence of positive aspects of functioning in addition to the absence of mental ill-health.

Despite growing recognition of the importance of ER to adolescent development and its compatibility with contemporary perspectives of wellbeing, there remains a paucity of research examining ER in relation to the application of positive psychology interventions in young people. A popular example of an adolescent-oriented wellbeing intervention is positive education, a school-based intervention that combines a traditional academic curriculum with evidence-based strategies to increase positive affect and functioning (Seligman, Ernst, Gillham, Reivich, & Linkins, 2009). Positive education programs (PEPs) provide a school-based, multifaceted intervention that targets a range of competencies associated with wellbeing, many of which draw on ER processes, such as building positive emotions and nurturing positive relationships (Morrish, Rickard, Chin, & Vella-Brodrick, 2017). It is currently unknown, however, how ER relates to domains of wellbeing targeted by PEPs, to what extent ER processes are implicated in positive psychology interventions, and whether a

student's ER capacity influence PEP outcomes. The current thesis seeks to address these questions, which are described in further detail below.

Research Overview: Aims and Hypotheses

The overarching goal of this thesis was to integrate two relatively disparate research domains: ER in young people and the emerging field of positive education, and in doing so, to address the following question: *Does ER predict wellbeing in a normative adolescent sample, and what is its relationship with positive education program outcomes?*

The research process thus commenced with three main aims:

1. To examine whether ER capacity was meaningfully related to domains of positive functioning and mental ill-health in a normative, school-based sample of Australian adolescents.
2. To determine whether participation in a best-practice, integrated, year-long PEP improves ER capacity in youth, compared to a wellbeing-as-usual control condition. PEPs draw upon positive psychology and cognitive behavior therapy interventions, both of which aim to counter damaging negative cognitive patterns and to optimize positive affective experience (Seligman et al., 2009). Many of the strategies used to achieve these goals implicitly involve ER skills, for example, thinking about a situation in a more adaptive light (i.e., cognitive reappraisal), or focusing on positive aspects of a situation (i.e., positive refocusing). While the apparent overlap between positive psychology interventions and ER processes has only recently been acknowledged and examined in adults (Quiodbach et al., 2015), it has not yet been evaluated in relation to adolescent samples, nor in the context of positive education programs. Therefore, the current thesis aimed to address this clear gap in current knowledge.
3. The third and final aim was to explore whether a young person's capacity for ER at commencement of the PEP contributed to the prediction of wellbeing outcomes at follow-up.

   Given the involvement of ER processes in skills taught via positive education, it is likely that students' capacity for adaptive ER on entering the program will influence how much benefit it has. On the one hand, individuals more adept or practiced at implementing effective ER strategies may be better positioned to integrate the specific

skills taught by positive education compared to those with less proficient ER capabilities. Conversely, it is possible that students with well-developed ER capacity are better able to manage their own wellbeing, and are therefore less likely to benefit from positive education than students with less developed ER capacities. In this sense, students presenting with poorer ER have a greater capacity to improve, while those higher in ER capacity may experience a 'ceiling effect' in relation to wellbeing.

As the research process progressed, an important methodological issue emerged relating to the degree of correspondence between change in subjective and objective measures of ER over time. Although a number of physiological markers of ER have been documented (e.g., heart rate variability, skin conductance, cortisol assays; Appelhans & Leuken, 2006; Geisler, Vennewald, Kubiak, & Weber, 2010), few studies have evaluated the degree to which they correspond to self-report measures of ER. Thus, as a pre-requisite to addressing the key aims of this project, it was first necessary to examine the strength and direction of the relationship between the physiological (i.e., heart rate variability; HRV) and self-report measures (i.e., the Difficulties in Emotion Regulation Scale (DERS); Gratz & Roemer, 2004) used to assess ER.

In sum, to answer the three research questions outlined above, one literature review and three empirical studies were completed. This resulted in the submission of four manuscripts to peer reviewed journals (one published, two under review, and one awaiting review).

Thesis Overview

This thesis comprises six chapters, reflecting each of the key stages of this thesis. A summary of each stage is summarized below.

Literature Review

The literature review provides an overview of the theoretical framework and empirical literature underpinning the current research. By integrating contemporary research on ER and youth-oriented positive psychology interventions, this chapter will demonstrate the importance of examining ER in relation to adolescent wellbeing broadly, and positive education specifically. This chapter presents an overview of the ER construct, examines relevant issues relating to the measurement of adolescent ER in school-based settings, and reviews the relationship between ER and domains of wellbeing, resilience, and mental ill-

health. In addition, the importance of adolescent wellbeing interventions in addressing rising rates of mental ill-health is discussed, and an overview of school-based wellbeing programs including positive education is provided. The literature review has been organized into main sections: a broad overview of the topics detailed above; and a more narrowly focused review that examines the relationship between ER and wellbeing, as defined by Seligman's (2011) PERMA framework. This latter review was published in *The Journal of Happiness Studies* in 2017, and focused specifically on the relationship of wellbeing with cognitive processes of ER, which are defined as the ways individuals think about emotion-eliciting events in order to manage and modify their experience and responses to them (Garnefski & Kraaij, 2006). Notably, this review does not make reference to physiological processes of ER – the unconscious, 'bottom-up', automatic processes that underlie an individual's ER capacity (Slonim, 2014). Although earlier revisions of this manuscript included reference to physiological ER processes, these were removed in the final version on the suggestion of Professor Antonella Delle-Fave, the editor-in-chief of *The Journal of Happiness Studies*. Physiological processes of ER are instead described extensively in the first section of the literature review. Chapter Two contributes meaningfully to this thesis by providing support for the relevance of ER to domains of well-being outlined by the revised PERMA model, including positive emotions, engagement, relationships, meaning, and health (also referred to as PERMA+; Iasiello, Bartholomeaus, Jarden, & Kelly, 2017). In addition, results of this review indicate that a young person's ER capacity can influence the degree of benefit gained from PEP participation.

Study 1: Establishing a Methodology for the Measurement of Emotion Regulation in a Normative, Adolescent Sample

Chapter Three introduces the first empirical study, a longitudinal investigation of the relationship between change in two measures of ER – an objective, physiological index; and a self-report measure of cognitive ER capacity. The primary aim of this research was methodological in nature; namely, to assess the value of including a physiological measure of ER (i.e., HRV) in addition to self-report (i.e., the DERS; Garnefski & Kraaij, 2006). Given the considerable time and resources involved in capturing physiological data, the authors sought to assess how much additional and unique information this method would provide about change in adolescents' ER capacity over time. If strong correlations were observed between self-report and physiological data, this would suggest that the use of self-report alone would be sufficient to measure the ER construct. Alternatively, small-to-moderate

correlations would indicate that each measure provides complementary information about ER processes, and both should be retained. Finally, statistically non-significant findings would challenge the validity of incorporating HRV as a measure of adolescent ER, and would lead to a reconsideration of the physiological index included in subsequent analyses. Results of this study demonstrated that greater self-reported ER capacity was positively related to greater HRV, reflected by significant, small-to-moderate correlations. Based on these findings, it was concluded that physiological and self-report ER data each contribute unique information regarding the regulatory capacity of this adolescent sample, and should be included in subsequent analyses.

Study 2: Investigating the Relationship between Emotion Regulation and Domains of Wellbeing Targeted by Positive Education

Chapter Four presents the second empirical study, a multi-trait, multi-method research design that investigated whether ER was predictive of measures of wellbeing and mental ill-health in a normative sample of adolescents. The aims of this study were twofold. The first was to determine the relationship between ER and multiple measures of wellbeing thought to contribute to flourishing, or optimal psychological health, in adulthood. The second aim was to determine whether inverse relationships between ER and symptoms of mental ill-health found in international youth samples generalized to the current sample of Australian, community-based adolescents. To increase the generalizability of the study outcomes, the initial sample of adolescents from regional and metropolitan independent schools was augmented with an additional 119 Year 10 students sampled from one regional and one metropolitan state secondary school. As predicted, self-report ER predicted numerous measures of positive youth functioning, including domains of wellbeing and resilience. Higher HRV values, representative of greater physiological ER capacity, predicted perseverance and resilience. Effect sizes were small to moderate. With respect to measures of mental ill-health, poorer self-reported ER capacity (as measured by higher total scores on the DERS) was associated with symptoms of depression and anxiety. These findings support the relevance of ER to the study of wellbeing, positive functioning and mental ill-health in adolescents, particularly self-reported ER.

Study 3: The Role of Emotion Regulation in Predicting Wellbeing Outcomes Following a Positive Education Program

Having confirmed the value of measuring both physiological and self-reported ER processes (Chapter 3), and established the relevance of ER to measures of both positive and negative functioning in youth (Chapter 4), Chapter Five presents the third and final empirical study of this research project. This study examined ER in relation to a PEP to improve wellbeing in 101 Year 10 students. This study was undertaken as part of a broader project funded by the Australian Research Council evaluating the wellbeing outcomes of a year 10 PEP compared to a wellbeing-as-usual control condition. This study extends cross-sectional findings with adolescents (Study 2) by demonstrating the relationships of ER with measures of wellbeing over time. Study 3 had three key aims. The first was to determine whether ER capacity at the commencement of Year 10 predicted wellbeing over a 15-month follow-up period, regardless of group. The second aim was to determine whether PEP participants experienced improvements in ER post-intervention compared to the wellbeing-as-usual comparison participants. The third aim was to determine whether ER capacity at the commencement of Year 10 (i.e., at baseline) could differentiate students who benefitted from participation in the PEP from those who did not. Similar to the literature review, this study is presented in two components – the published article, and supplementary data presenting findings relating to HRV. To address suggestions from journal reviewers that the inclusion of HRV data contributed little to the manuscript, the version of this study submitted for publication examines self-reported ER only. The second, unsubmitted section presents the methodology, results, and discussion of HRV results relating to this study.

Study Three revealed that irrespective of treatment group, self-reported ER predicted wellbeing and mental ill-health over the two-year follow up period, in the hypothesized directions. Baseline ER capacity predicted all domains of positive psychological functioning, including wellbeing and resilience; and inversely predicted measures of mental ill-health, including depression and anxiety. Further, PEP led to improvements in wellbeing for students with poorer ER capacity, but not for those with more adaptive ER profiles. Specifically, adolescents with low self-reported ER capacity who participated in the PEP showed improvements in happiness and social connectedness compared to those in the control group, and these benefits were maintained for at least six-months post-treatment.

Further, Study Three emphasized the importance of ER to the full spectrum of mental health (Keyes, 2005). Its findings show that adaptive ER processes predict positive domains of psychological functioning, and extend past research with adult and clinical adolescent samples by demonstrating that an inverse relationship exists between ER and measures of mental ill-health in a normative adolescent group. Notably, study three provides a novel

contribution to the positive education literature by providing evidence that students' ER capacity contributes to person-activity fit; that is, which students are likely to benefit most from PEP participation.

General Discussion and Conclusions

This final chapter aims to draw together the key findings of each empirical study in relation to the overarching aims of this research project, and to discuss its practical and theoretical implications. Important directions for future research include greater consideration of the role and relevance of ER in models of positive education and optimal positive psychological functioning in youth. Developing and piloting a revised PEP that integrates explicit ER training into the curriculum is also recommended. Drawing upon the leading theoretical ER model, Gross' (1998) Process Model, may provide a useful framework for developing new interventions and refining existing ones. In relation to the assessment of wellbeing interventions, examining students' use of ER and positive psychology strategies under specific emotional challenges may provide greater understanding of when and under which conditions these strategies are used. Similarly, the use of ecological momentary assessment methods to capture real-time emotional experience and ER efforts in naturalistic settings is warranted, and may enhance data provided by retrospective self-report and physiological functioning in the absence of environmental stressors.

Rationale and Justification for the Research

This thesis contributes to the emerging field of positive education by underscoring the importance of ER to domains of positive psychological functioning targeted by positive education programs. To date, ER has remained largely unexplored in the field of positive education. Similarly, research on ER in relation to positive psychological functioning in normative adolescent groups has been relatively neglected, in favor of exploring its association with symptoms of mental ill-health in clinical and at-risk samples. The current research demonstrated that greater ER capacity predicted higher levels of wellbeing, while deficits in ER predicted symptoms of mental ill-health. Thus, this thesis illustrates the importance of ER across the full-spectrum of psychological health in an Australian adolescent sample.

Further, the current research positions positive psychological interventions within a broader model of ER. Specifically, this research suggests that positive psychology

interventions incorporated within PEPs represent a subset of ER strategies that predominantly operate by enhancing positive emotional experiences. The author proposes that an ER model provides a valuable theoretical framework from which to refine and further develop positive psychology interventions incorporated into PEPs. Examining PEP interventions in light of the dominant theoretical ER model, Gross' (1998) Process Model of Emotion Regulation, provides the scaffold from which to develop increasingly specific, targeted interventions for adolescents. This argument is further outlined in Chapter 2: Literature Review, as well as the published review article titled, Emotion Regulation and Adolescent Wellbeing and Positive Education: A Review.

Similarly, the results of this thesis provide an overview of the effectiveness of a best-practice PEP to improve adolescent psychological functioning over a two-year period, compared to a wellbeing-as-usual comparison condition. A strength of this research includes the comprehensive measurement of psychological functioning, which includes numerous indices of wellbeing and mental ill-health, including ER.

Finally, by demonstrating the predictive value of ER to markers of wellbeing and mental ill-health, the current research presents a compelling argument for the incorporation of explicit ER content into PEP programs. In relation to mental ill-health, complementing PEP positive psychology interventions with more traditional ER-oriented strategies to manage challenging emotional experiences and optimize pleasant emotional experiences appears warranted.

Chapter 2: Literature Review

Preamble

The second chapter of this thesis provides a comprehensive overview of the theoretical and historical background informing the choice of methodology used in the empirical studies, presented in chapters three to five. This chapter is divided into two sections. Section One introduces the key topics and constructs relevant to the thesis broadly, including the importance of adolescent wellbeing interventions, an introduction to the theoretical underpinnings and rationale for positive education, an overview of ER and its aims and applications to adolescent research, and suggestions for the examination of ER in the context of adolescent wellbeing interventions, including positive education.

Section Two, a manuscript published in the *Journal of Happiness Studies*, focuses specifically on the relationship between self-reported ER and the PERMA+ domains of wellbeing targeted by PEPs. This manuscript builds upon the themes outlined in Section One, while also providing a more targeted, nuanced argument for exploring the role of ER in positive education.

Section Two also outlines the compatibility of positive psychology interventions and the dominant model of ER, Gross' (1998) *Process Model*; examines the relationship of ER with PERMA+ domains of wellbeing; and finally, builds a persuasive argument for examining positive education from an ER perspective. In sum, the aim of this chapter is to orient the reader to the respective fields of research central to this thesis – ER and positive education. Furthermore, this chapter illustrates why synthesizing these domains provides a valuable opportunity to further refine and enhance adolescent-focused positive psychology interventions and programs.

Section One: A Path to Flourishing: Investigating the Role of Emotion Regulation in Adolescent Wellbeing & Mental Health Interventions

The last decade has witnessed increased recognition of the need to promote wellbeing and psychological health in adolescent populations, and the subsequent emergence of services seeking to achieve this goal. Within Australia, adolescents spend approximately 10,700 hours per year at school, positioning it as a relevant and popular setting for wellbeing interventions targeting youth (Hamilton & Hamilton, 2009). School-based programs are delivered in a diverse array of formats that aim to teach social-emotional competency skills, including problem-solving, decision-making, emotional literacy, and strategies to promote prosociality and positive affect (Domitrovich, Durlak, Staley, & Weissberg, 2017). Broadly referred to as social emotional learning programs (SELs), these programs are effective in enhancing numerous domains of wellbeing, such as resilience and social adjustment, and in reducing symptoms of mental ill-health, including depression and anxiety (Weare & Nind, 2011).

PEPs are a subset of school-based wellbeing programs that have arisen from the field of positive psychology and combine a traditional academic curriculum with evidence-based skills to enhance wellbeing (Seligman, Ernst, Gillham, Reivich, & Linkins, 2009). Primarily, PEPs seek to optimize positive affective experiences in order to cultivate resilience and buffer young people against the detrimental effects of stress. While PEPs contribute to positive psychological functioning (Shoshani & Steinmetz, 2014), less is known about the mechanisms underlying their effectiveness. Despite being a foundational skill in cultivating social-emotional competence (Liew, 2012), a potentially important candidate that has received relatively scant attention in the positive education literature is ER.

ER refers to one's ability to identify, manage, and modify emotional experiences in order to meet environmental demands and personal goals (Thompson, 1994). ER involves a constellation of cognitive and physiological processes that gain increasing relevance during adolescence, positioning it as a key developmental skill contributing to adolescent wellbeing (Sawyer et al., 2012). Whereas a greater capacity for ER plays a critical role in the maintenance of positive psychological functioning, ER deficits contribute to the development of psychological distress and dysfunction (Adrian, Zeman, & Veits, 2011; Aldao, Nolen-Hoeksema, & Schweizer, 2010). For example, greater ER capacity is associated with

resilience, predicts increases in positive affect and social adjustment, and can protect against the development of depression and anxiety symptoms and syndromes (Curtis & Cicchetti, 2007; Gardner, Dishion, & Connell, 2008; Tortella-Feliu, Balle, & Sesé, 2010).

The capacity for ER can be enhanced in young people through both group and school-based interventions that share a number of characteristics with PEPs (Horn, Pössel, & Hautzinger, 2011; McCraty, Atkinson, Tomasino, Goelitz, & Mayrovitz, 1999; Sawyer et al., 2012). Targeting ER via focused interventions increases numerous wellbeing domains, including greater social adjustment (Bradley et al., 2010; McCraty, Atkinson, Tomasino, & Bradley, 2009), and lower stress and negative affect (Horn et al., 2011; McCraty et al., 1999). ER-specific interventions are emerging as stand-alone treatments and are being increasingly incorporated into existing therapeutic models for mental ill-health (see Compare et al., 2014, for a review). ER is also implicated in contemporary models of positive psychology, which aim to enhance positive affect and functioning in individuals, communities, and organizations (Gable & Haidt, 2005; Quoidbach, Mikolajczak, & Gross, 2015). Positive psychology interventions that promote gratitude, savoring, and positive cognitive styles have been conceptualized as ER strategies that specifically focus on enhancing positive emotion in response to challenging events (Quoidbach et al., 2015). As will be seen, a growing body of research suggests that ER has a meaningful role in positive psychology interventions, and represents a likely mechanism through which PEPs may lead to improvements in wellbeing.

This review aims to present and synthesize literature that has investigated the relationship between ER, adolescent wellbeing, and the outcomes of positive education and similar programs. Definitions and a brief overview of wellbeing and mental ill-health will be provided, followed by a discussion of their relevance to adolescent populations. Conceptual and methodological issues relevant to the application of ER to research with adolescents will then be explored. Next, the importance of ER to adolescent wellbeing will be outlined, and the relevance of ER to evaluations of wellbeing interventions broadly, and positive education specifically, will be illustrated. Finally, this section will conclude with a summary of key findings and suggestions for further research.

Enhancing Adolescent Wellbeing Through School-Based Programs: Why is it Important and How is it Achieved?

1.1 The impact of mental ill-health on adolescent functioning

Occurring between the ages of 12 and 25, adolescence is a period of profound development associated with extensive changes across psychological, social, academic, and vocational domains (Sawyer et al., 2012). It is a period of both opportunity and risk, as young people develop skills and resources to navigate an increasingly complex environment. Current international trends suggest that young people of the 21st century will be faced with an array of vocational, psychosocial, environmental, and economic challenges that can adversely influence psychological health (Wallace, Holloway, Woods, Malloy, & Rose, 2011; Waters, 2011).

Mental disorders comprise the single greatest burden of disease for adolescents worldwide, with suicide representing the leading cause of mortality in 10 to 19 year olds globally (World Health Organization, 2016). In Australia, approximately one in four people aged 16-24 years experience mental ill-health in a 12-month period (Ivancic, Perrens, Fildes, Perry, & Christensen, 2014; Pieris-Caldwell, Hotstone, & Eldridge, 2007), with almost one in seven (13.9%) of four to 17 year-olds meeting criteria for a mental disorder in the past 12 months (Lawrence et al., 2015). Mental disorders commonly experienced by young people include anxiety (14%) depression (6%), and substance abuse (5%; Kitchener & Jorm, 2009). High or very high levels of psychological distress, which involves sub-clinical emotional symptoms and functional impairments, affects 20% of young Australians over a 12-month period (Lawrence et al., 2015). Unsurprisingly, mental health has also been identified by young people as the most significant national concern facing Australia today (Bullot, Cave, Fildes, Hall, & Plummer, 2017).

The presence of mental ill-health during adolescence can create a significant and long-lasting impact on wellbeing and quality of life across the lifespan (McGorry & van Os, 2013; Patton et al., 2016). Mental ill-health is predicted to be at least equal to cardiovascular disease as the primary threat to gross domestic product over the next 20 years (Bloom et al., 2011), a finding that reflects the impact of psychological disorders and distress on a young person's capacity to contribute economically and socially. In light of these pressures, there is increasing need for the development of early intervention and prevention programs to help young people adaptively navigate psychosocial challenges (Patton et al., 2016).

1.2 Adolescent wellbeing: Beyond the absence of psychological ill-health.

The importance of addressing the high prevalence of mental ill-health among adolescents is unequivocal. However, contemporary perspectives on wellbeing suggest that a narrow focus on the symptoms of mental ill-health is not sufficient to promote successful adaptation in

young people, a perspective that is informed by an evolving understanding of psychological wellbeing (Wallace et al., 2011; Waters, 2011). Contemporary definitions of psychological wellbeing involve two components: 1) the subjective experience of life satisfaction and positive affect (i.e., happiness), referred to as *hedonia*; and 2) positive psychological functioning, positive relationships with other people, and self-realization, referred to as *eudaimonia* (Stewart-Brown & Janmohamed, 2008; Vella-Brodrick, 2013). Wellbeing, therefore, is a multidimensional concept involving both positive subjective states and adaptive functioning in numerous life domains, defined as "the combination of feeling good and functioning well" (Huppert & Johnson, 2010, p.264). More specifically, Keyes (2002, 2005) proposes that wellbeing comprises emotional, social, and psychological factors, based on Ryff's (1995) understanding of wellbeing that includes domains such as positive relations with others, psychological growth, environmental mastery, life purpose, autonomy, and self-acceptance. Seligman's (2011) revised wellbeing model, known as PERMA+, reflects a similar range of psychosocial domains, including experiencing positive emotions, engagement with valued activities, fostering positive relationships with other people, cultivating a higher purpose or meaning in life, pursuing and reflecting on accomplishments and success, and cultivating positive health (Norrish, 2015). Taken together, these theoretical perspectives regard wellbeing as comprising a high level of adaptive success across a range of psychosocial dimensions, not simply an absence of dysfunction or deficit. This conceptual distinction – the *presence* of psychological wellbeing and not just the *absence* of psychological ill-health - challenges the assumption that targeting and ameliorating constellations of negative symptoms is sufficient to create conditions for optimal functioning. As Keyes (2007, p.95) asserts: "[c]uring or eradicating mental illness will not guarantee a mentally healthy population…focusing solely on mental illness can, at best, reduce mental illness but not promote mental health".

1.2.1 The Complete State Model of health

The Complete State Model of health (Keyes 2002; 2005) postulates that mental wellbeing and mental ill-health comprise two separate but related continua rather than occupying opposite ends of a single wellbeing spectrum. According to this framework, interventions and policies seeking to ameliorate mental ill-health will not necessarily result in a psychologically healthy population, as they overlook the second arm of complete health – mental wellbeing. Mental wellbeing exists along a spectrum from *flourishing*, defined as the presence of positive emotion as well as functioning well in psychological and social domains, to

languishing, defined as emptiness, stagnation, or a 'life of quiet despair' (Keyes, 2002, 2005). According to this perspective, improving adolescent wellbeing is as paramount as reducing mental ill-health (Huppert, 2009; Keyes, 2006).

Support exists for the application of the dual continuum model to wellbeing initiatives targeting young people (Keyes, 2006). In their synthesis of 23 meta-analyses of universal and early intervention programs for school-aged children, Browne et al. (2004) concluded that universal early intervention mental health programs promote wellbeing by developing skills and competencies relating to specific functional domains, which in turn protect young people against the development of mental ill-health. Notably, it was also found that programs aiming to *increase* a young person's skills and abilities, such as coping and positive social interactions, were found to be generally more effective in increasing wellbeing than those that aim to *reduce* negative behaviors, a finding since replicated (for a review, see Wallace et al., 2011). In summary, prevention programs that develop conditions for flourishing complement traditional mental health interventions, and provide an effective strategy to increase wellbeing and protect against mental ill-health in young people.

1.3 School-based interventions to promote adolescent wellbeing

The school setting is among the most influential developmental contexts for adolescents, and as such, it is ideally placed to address their mental health needs (Patton et al., 2016). Schools provide a common setting for 95.9% of Australians aged 17 and younger (Lawrence et al., 2015), can focus on early intervention and prevention, and are cost effective compared to clinical services (Burns, Davenport, Durkin, Luscombe, & Hickie, 2010). Over 80% of 13 to 17 year olds report needing assistance with emotional or behavioral problems in the previous 12 months, yet just 17% of young people aged 17 years and below had sought help from either school or external mental health services (Lawrence et al., 2015). As the majority of young people who experience mental ill-health and associated problems are reluctant to seek help from a mental health professional, school-based programs that target all students provide a valuable opportunity for intervention (Gulliver, Griffiths, & Christensen, 2010; Ivancic et al., 2014). School-based wellbeing programs comprise a heterogeneous group of interventions delivered in the school setting, which can be broadly defined as structured interventions that provide children and adolescents with psychological, emotional, and social skills necessary for "feeling good and functioning well", while also building resilience, which buffers young people against the development of mental ill-health (Domitrovich et al., 2017; McGorry & van Os, 2013; Olsson, Bond, Burns, Vella-Brodrick, & Sawyer, 2003; Wallace et

al., 2011). These programs may also address specific social-emotional difficulties facing young people, for example, problems with the control or expression of emotion (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011).

A number of high-quality evaluations demonstrate the effectiveness of school-based wellbeing programs in improving the mental health of young people. For example, in an evaluation of 52 meta-analyses and systematic reviews examining mental health interventions in schools, Weare and Nind (2011) found that school-based wellbeing programs provide important mental-health benefits, including reductions in depression and anxiety symptoms (small to large effect sizes; Cohen's *d*: 0.10-1.70), and improvements on measures of positive mental health such as emotional and social skills and general wellbeing (small to large effect sizes; Cohen's *d*: 0.15 – 1.49). Although the effect sizes of most interventions were statistically small to moderate, these effects translated into significant real-world benefits to student wellbeing (Weare & Nind, 2011). Similarly, in a meta-analysis of 213 studies of school-based social emotional learning (SEL) programs conducted with a total of 270,000 kindergarten to high-school students, Durlak et al. (2011) found that compared to controls, the intervention group showed significant improvements in social-emotional skills, including emotion recognition, stress management, behavioral adjustment, and positive social behavior. Notably, these benefits were maintained for a minimum of 6 months after program completion. Similar findings have been reported in a recent meta-analysis of 82 school-based SEL interventions involving over 97,000 kindergarten to high-school students: SEL program participation led to significant improvements in social-emotional skills and wellbeing indicators compared to controls; regardless of student's ethnicity, socioeconomic background, or school location (Taylor, Durlak, Oberle, & Weissberg, 2017).

School-based wellbeing interventions have been applied in a variety of formats, from focused and time-limited programs that operate on specific skills, to comprehensive, school-wide approaches. Results of meta-analyses and systematic reviews indicate that the most effective programs incorporate: a) wellbeing promotion rather than an exclusive focus on deficit; b) interactive delivery of relatable and practical content; c) a school-wide approach that facilitates the development of a positive school culture and environment; d) long-term interventions of 12 months or more; and e) follow-up sessions to consolidate learning (Durlak et al., 2011; Wallace et al., 2011; Waters, 2011; Weare & Nind, 2011).

1.4 Positive education programs

Positive psychology is a burgeoning but relatively young discipline that conducts scientific investigation into the factors that promote flourishing amongst individuals, communities and organizations (Gable & Haidt, 2005). Positive education has been defined as positive psychology applied in education (Green et al., 2011), and more specifically, an approach to education that incorporates both traditional academic skill development as well as skills for wellbeing and mental health (Seligman et al., 2009). Positive education provides a useful framework for early intervention and prevention services, and is an example of a school-based wellbeing program that is gaining increasing popularity in educational settings, particularly within Australia (Norrish et al., 2013). Comprehensive PEPs typically incorporate elements of positive psychology and cognitive behavior therapy (CBT) approaches. CBT seeks to build resilience and improve the capacity to identify and manage emotional experiences, including thinking flexibly and accurately, emotional awareness and understanding, problem-solving and decision-making (Dobson, 2010). CBT-based skills such as goal setting, problem-solving, and interpersonal skills all contribute to wellbeing and positive social functioning in young people when taught via school-based programs (Bird & Markle, 2012). The Penn Resiliency Program (Penn; Gillham, Jaycox, Reivich, Seligman, & Silver, 1990) is an example of a best-practice, CBT-based school wellbeing program on which a number of Australian school-based PEPs have been modelled (e.g., KidsMatter, MindMatters, Optimistic Kids). This program has been shown to provide an effective framework for addressing mental ill-health in children and adolescents. A meta-analysis of 21 evaluations, involving over 3,000 young people aged between 8 and 22 years, found that Penn programs were effective in reducing depression, anxiety and behavioral problems up to 12 months post program compared to controls (Brunwasser, Gillham, & Kim, 2009).

Positive interventions are specific strategies that are thought to enhance wellbeing by increasing the duration and frequency of positive emotions, a process of 'up-regulating' positive affect (Quoidbach, Berry, Hansenne, & Mikolajczak, 2010). PEPs extend the CBT-based approach adopted by Penn by incorporating evidence-based wellbeing interventions devised from positive psychology, including developing pro-social behaviors, mindfulness (i.e., awareness of present-moment experiences), character strengths (i.e., positive traits reflected in thoughts, feelings, and behaviors), and active-constructive responding (i.e., responding to others in a positive, engaged, validating manner; Peterson & Seligman, 2004; Sin & Lyubomirsky, 2009). Positive interventions aim to increase pleasure, engagement and meaning, all of which have been shown to predict wellbeing (Vella-Brodrick, Park, & Peterson, 2009), while developing character strengths to help young people build and utilize

positive resources to flexibly adapt to a wide range of life experiences (Quinlan, Swain, & Vella-Brodrick, 2012). Strengths-based approaches can provide benefits beyond those conveyed by CBT and problem-solving interventions alone (Fava et al., 2005; Moeenizadeh & Kumar, 2010). A meta-analysis of 51 positive interventions demonstrated their efficacy in improving wellbeing and reducing depression (Sin & Lyubomirsky, 2009), which suggest that strength-based approaches might supplement traditional therapeutic strategies aimed at reducing mental ill-health by augmenting wellbeing (Padesky & Mooney, 2012).

The implementation and assessment of school-based PEPs are relatively recent phenomena, and the underlying mechanisms by which PEPs lead to positive wellbeing outcomes remain unclear. One promising avenue for exploration is examining the underlying social and emotional competencies developed CBT and positive psychology interventions. CBT-based skills are applied in order to enhance resilience and interpersonal functioning, develop a flexible cognitive style, increase emotional awareness and understanding, and promote adaptive problem-solving and decision-making (Padesky & Mooney, 2012). Positive interventions provide strategies to increase wellbeing and resilience by optimizing positive emotion and building positive psychosocial resources (Fredrickson, Tugade, Waugh, & Larkin, 2003). Aims common to both approaches include fostering emotional competencies by building cognitive resources (e.g., identifying the link between thoughts and emotions, focusing on positive aspects of a situation, planning positive activities), or by enhancing protective emotional states (e.g. up-regulating positive emotion). These emotion-focused skills constitute processes collectively known as ER (Gratz & Gunderson, 2006; Quoidbach et al., 2010; Quoidbach et al., 2015; Weytens, Luminet, Verhofstadt, & Mikolajczak, 2014).

Emotion Regulation: Conceptual and Methodological Considerations for Adolescent Research

2.1 Emotion regulation: Definition and conceptual foundations.

Emotions are complex processes that involve coordinated changes in central and peripheral physiology, behavioral tendencies, and cognitive processes (Appelhans & Luecken, 2006; Koole, 2009). Emotions influence our decision-making, our response to challenges, and our ability to navigate social interactions (Adolphs, 2003). Emotions that are expressed in a manner appropriate to the situational context, both in terms of their magnitude and timing, generally promote adaptive responses (Appelhans & Leucken, 2006). As noted, ER refers to the processes by which individuals respond to, manage, and modify emotional experiences to

achieve personal goals and adapt to environmental demands (Gross & Thompson, 2007; Thompson, 1994). It is a multidimensional construct, with the appropriate regulation of emotion occurring via numerous physiological mechanisms and psychological strategies (Scherer & Coutinho, 2013; Thompson, Lewis, & Calkins, 2008). Compare et al. (2014) describe ER as involving the initiation, inhibition, or modulation of emotional functioning across four domains, including internal emotional states (e.g., the subjective experience of emotion); emotion-related cognitions (e.g., perceptions of, and thoughts about, emotional states); emotion-related physiological processes (e.g., autonomic arousal); and emotion-related behaviors (e.g., actions in response to emotional experience).

ER involves both conscious and unconscious processes that are implemented by the individual to influence the magnitude and/or the nature of experiences of emotion, thus the vast majority of research examining ER in adolescent and adult samples has focused on the *self*-regulation of emotion (Davidson, 1998; Gyurak, Gross, & Etkin, 2011; Koole & Rothermund, 2011). Some definitions of ER also consider emotional awareness to be a core component of ER (e.g. Gratz & Roemer, 2004). This involves the ability to identify and label emotions and to understand the causes and consequences of emotional experiences, and these skills are frequently regarded as a prerequisite for modifying emotional reactions adaptively (Suveg, Hoffman, Zeman, & Thomassin, 2009). For example, Gratz and Roemer (2004) conceptualize ER as a process involving: a) an awareness and understanding of emotional experience; b) acceptance of one's emotional experience; c) the ability to control impulsive behaviors and behave in accordance with desired goals when experiencing negative emotions; and d) the ability to apply contextually appropriate ER strategies to flexibly modulate emotional responses in order to meet individual goals and situational demands.

While debate surrounds the issue of whether ER can be examined independently of processes of emotion generation, a person's capacity for ER is distinct from their level of emotional intensity/reactivity to emotional stimuli (Thompson et al., 2008). Gratz and Roemer's (2004) definition of ER is helpful, because it emphasizes the adaptiveness of an individual's response to emotional experience, rather than their emotional control *per se* (Gratz & Tull, 2014). This is significant, given that the process of ER applies to the regulation of all emotional experiences, both pleasant and unpleasant (Gross, 2001). Affective states can be reduced or increased in intensity via ER processes referred to as down-regulation and up-regulation, respectively. While the majority of ER research has focused on the regulation of unpleasant emotional states (Gross & Thompson, 2007), the regulation of pleasant emotion is gaining increasing attention. Preliminary findings indicate

that the tendency to down-regulate positive affect contributes to the development of mental ill-health, while the ability to up-regulate positive affect plays an important role in maintaining psychological wellbeing (Carl, Soskin, Kerns, & Barlow, 2013; Gruber, Kogan, Quoidbach, & Mauss, 2013; Quoidbach et al., 2010; Tugade & Fredrickson, 2004).

2.2 Measurement of emotion regulation.

2.2.1 *Self-reported emotion regulation.*

Self-reported ER mechanisms comprise those conscious, cognitive strategies implemented by the individual to regulate affective and behavioral responses to emotion-eliciting events (Garnefski, Kraaij, & Spinhoven, 2001; Gratz & Roemer, 2004). Over 92% of studies conducted between 1975 and 2010 that evaluated ER in child and adolescent samples used a self-report method, positioning it as the most common method to capture ER processes in this demographic (Adrian et al., 2011). The popularity of this format is due to a number of advantages, including the superior capacity of self-report to access more sophisticated emotion regulatory processes and internal states that are not detectable using observational methods, for example, via parent or teacher reports (Adrian et al., 2011). Self-report methods also tend to be time and cost efficient, and the large body of ER research that has utilized self-report measures allows between-study comparisons to be made. Consequently, research on ER in adolescent and adult populations has chiefly focused on the conscious, cognitive strategies individuals use in response to emotional experiences (Garnefski, Kraaij, & Spinhoven, 2001; Gratz & Roemer, 2004).

Notably, there is considerable variation in the number and type of regulatory strategies that are considered a component of ER (Cole, Martin, & Dennis, 2004), and reflecting this is a range of self-report measures of ER. Among the more psychometrically established measures that are commonly used with adolescent samples are: Gross and John's (2003) Emotion Regulation Questionnaire (ERQ); Garnefski and Kraaij's (2001) Children's Emotion Regulation Questionnaire Short Version (CERQ-short); and Gratz and Roemer's (2004) Difficulties in Emotion Regulation Scale (DERS). These will now be considered in turn.

The Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA) (Gullone, Hughes, King, & Tonge, 2010) is a self-report questionnaire that measures the habitual use of two ER strategies, emotional suppression and cognitive reappraisal, in 10 to 18 year-olds. It is based on the adult ERQ (Gross & John, 2003), and derived from a well-established theoretical framework (Gross, 2013). It includes 10 items evaluated with a 5-

point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), and has good psychometric properties (e.g., Cronbach's *a* = .83 (reappraisal) and .75 (suppression)) (Gullone et al., 2010). Emotional suppression refers to attempts to conceal the expression of emotional reactions, and is generally considered a maladaptive ER strategy due to its associations with negative physical, social, and cognitive outcomes (Gross, 2002). Cognitive reappraisal refers to the process of changing the meaning of an emotional event in order to modify its emotional significance (Gross & Thompson, 2007). Cognitive reappraisal is generally considered to be adaptive, and its use is associated with favorable interpersonal, emotional, and cognitive outcomes compared to emotional suppression (Buhle et al., 2014; Gross, 2003).

Given that the ERQ-CA only captures emotional suppression and cognitive reappraisal, it does not provide a comprehensive account of the ER strategies potentially used in response to emotional experiences, nor does it assess emotional awareness, which is regarded as a necessary contributor to ER (Gratz & Roemer, 2004; Rieffe, Oosterveld, Miers, Terwogt, & Ly, 2008). This is problematic, given the growing evidence base to show that individuals use a diverse range of ER strategies, for example, acceptance and problem-solving, which are regarded as putatively adaptive, and rumination and avoidance, which are generally considered maladaptive (Aldao & Nolen-Hoeksema, 2010, 2012; Heiy & Cheavens, 2014; but for a discussion of the importance of context in ER success, see Aldao, 2013; Aldao & Nolen-Hoeksema, 2012). As a result, the ERQ-CA is limited in its capacity to identify subtle changes in the way individuals' process emotional information following, for example, psychological interventions or school-based wellbeing programs.

The Children's Emotion Regulation Questionnaire Short Version (CERQ-short; Garnefski & Kraaij, 2006) is an 18-item self-report questionnaire consisting of nine conceptually distinct subscales that assess cognitive approaches to managing emotional arousal in response to difficult life events. These include putatively maladaptive ER strategies (e.g. rumination, self-blame, catastrophizing) (Garnefski, Legerstee, Kraaij, Van Den Kommer, & Teerds, 2002) and adaptive ER strategies (e.g. acceptance, positive reappraisal, positive refocusing; Heiy & Cheavens, 2014; North, Pai, Hixon, & Holahan, 2011). CERQ-short items are measured on a 5-point Likert scale ranging from 1 ((almost) never) to 5 ((almost) always), and are suitable for people aged 12 and above (Adrian et al., 2011; Garnefski & Kraaij, 2006a).

The CERQ-short has reasonable psychometric properties (e.g., Cronbach's *a* ranging from .51 to .83; Garnefski et al., 2001), and provides a comprehensive assessment of ER

strategies used by young people in response to difficult life events. Due to its inclusion of a broad range of ER strategies, the CERQ-short can provide detailed information about changes in cognitive ER over time. This is particularly useful when applied to longitudinal assessments of wellbeing interventions, which seek to increase and reduce the use of adaptive and maladaptive ER strategies, respectively. A growing body of research indicates that having access to a greater range of cognitive ER strategies is associated with wellbeing, while the rigid use of few strategies is associated with mental ill-health and contributes to the development and maintenance of emotional disorders in adolescents (Garnefski & Kraaij, 2014; Lougheed & Hollenstein, 2012) and adults (Aldao, 2012; Aldao et al., 2010; Gratz & Roemer, 2004). A recent study employing the experience sampling method (ESM) to record the use of 40 ER strategies over 10 consecutive days found that adult participants used, on average, 15 different ER strategies in response to negative emotions, and 16 strategies in response to positive emotions (Heiy & Cheavens, 2014). Therefore, a key advantage of the CERQ-short is its capacity to assess a broader repertoire of cognitive ER strategies compared to the ERQ and DERS, including both adaptive and maladaptive strategies. The CERQ-short does not, however, include subscale scores for adaptive and maladaptive ER strategies, and the reliability of scales vary considerably (Garnefski & Kraaij, 2006). These factors complicate the interpretation of results and may limit the generalizability of findings.

Finally, the *Difficulties in Emotion Regulation Scale (DERS*; Neumann, van Lier, Gratz, & Koot, 2009) is a 36-item self-report questionnaire used to assess clinically relevant difficulties in ER relating to: a) awareness and understanding; b) acceptance of emotions; c) the ability to engage in goal-directed behavior when experiencing negative emotions; and d) access to effective ER strategies. It includes six sub-scales representing specific problems with ER, including lack of emotional awareness; lack of emotional clarity; difficulties controlling impulsive behaviors when distressed; non-acceptance of emotional responses; and limited access to effective ER strategies. Items are scored on a five-point Likert scale ranging from 1 (almost never) to 5 (almost always), with higher scores reflecting greater problems with ER. The DERS has been validated for use in adolescent samples aged 12 to 17, and has good psychometric properties, including internal consistency for each scale (Cronbach's $a >$ .80) (Gratz & Roemer, 2004). The DERS captures a broad range of deficits in ER, as well as providing a total score that can be used to measure patterns of change in ER over time. However, the DERS does not measure the use of adaptive ER strategies, which is a potential limitation when evaluating wellbeing interventions that encourage the use of a number of adaptive ER strategies to up-regulate positive affect.

A comparison of the different ER self-report questionnaires targeting youth reveals substantial variation in approaches to measuring ER. Whereas the ERQ-CA and CERQ examine the use of specific ER strategies, both adaptive and maladaptive, the DERS examines a broader range of ER capabilities but does not examine specific adaptive ER strategies. Although the ERQ-CA examines the use of just two ER techniques, the CERQ and DERS examine a broader range of strategies and skills. Finally, although the CERQ does not facilitate calculation of aggregate ER scores, this is possible using the ERQ-CA and DERS. The appropriate choice of measure should, therefore, be guided by the particular research aims at hand; for example, whether the researcher seeks to: a) identify a wide range of specific ER strategies; b) identify specific areas of difficulty in ER processes (e.g., emotion identification or access to ER strategies); c) examine adaptive ER strategies used in response to challenges; or d) to compare aggregate ER scores (e.g., general ER ability; general use of adaptive or maladaptive ER strategies).

A parallel methodological consideration concerns the use of ER measures beyond self-report. The following section will discuss the advantages of adopting a multi-method approach to the evaluation of ER in youth, before outlining the benefits of physiological assessments of ER as well as the methods through which this is commonly applied in research with young people.

2.3 Physiological measures of emotion regulation.

The physiological regulation of emotions facilitates flexible adaptation to environmental demands (Thompson, 1994). For instance, activation of biological systems and the subsequent 'fight-or-flight' response in reaction to perceived threat is adaptive from an evolutionary perspective because it promotes survival (LeDoux, 1996). This 'default mode' of sympathetic, hormonal, and cortical activation protects against genuine threat (e.g., proximity of a predator) but is commonly triggered by unfamiliar experiences that do not pose an actual risk to the individual (e.g., a job interview or first date; Davidson, 2000). The capacity to modify this default reaction by regulating emotional responses is beneficial as it provides the individual with a broader repertoire of behavioral responses, which can facilitate flexible adaptation to environmental conditions and conserve energy for when it is genuinely required (Rickard & Vella-Brodrick, 2014).

The Neurovisceral Integration Model (Thayer & Lane, 2000) proposes that physiological ER capacity results from structural and functional interconnections between the brain, heart, and branches of the autonomic nervous system. Prefrontal cognitive functions

influence the capacity to engage in adaptive ER processes while inhibiting less functional ER responses (Thayer & Brosschot, 2005). Broadly, it is thought that pre-frontal regions of the brain associated with executive control influence emotional responses by modulating activity in brain regions implicated in the generation of emotion, such as the amygdala (involved in evaluation of arousal/threat value of stimuli) and ventral striatum (involved in memory/encoding of the value of stimuli; Ochsner, Silvers, & Buhle, 2012).

Further contributing to physiological ER capacity is the influence of a dynamic and flexible autonomic nervous system (ANS) that ensures that energy expenditure is matched to environmental demands (Thayer, Ahs, Fredrickson, Sollers, & Wager, 2012). Accordingly, physiological markers provide insight into the physiological processes supporting ER that are not accessible via self-report data alone (Ochsner & Gross, 2008). A number of physiological systems and processes have been examined in the context of ER research, including neuroimaging techniques, hormonal stress response markers, and heart rate variability. Research involving each of these methodologies will be considered in turn.

2.3.1 *Neuroimaging techniques.*

Electroencephalogram and neuroimaging techniques have been utilized to better understand how cortico-limbic circuitry is involved in emotional processing and regulation. Such work contributes to knowledge of ER processes by providing insight into the neurobiological processes supporting ER that are not accessible via psychological or observational data alone (Ochsner & Gross, 2008; Ochsner, Silvers, & Buhle, 2012). As noted, it is broadly thought that pre-frontal regions of the brain associated with executive control influence emotional responses by modulating activity in brain regions implicated in the generation of emotion, such as the amygdala and ventral striatum (Ochsner et al., 2012). In a 2012 review of 42 fMRI studies of ER, predominantly conducted with healthy young adult samples (18 – 30 years), Ochsner and colleagues (2012) reported that the activity of affective systems of the brain can be effectively modulated following the use of adaptive ER strategies (e.g., cognitive reappraisal), including the amygdala (involved in evaluation of arousal/threat value of stimuli) and ventral striatum (involved in memory/encoding of the value of stimuli). Although further research is required to establish that comparable relationships exist in younger age groups, these findings suggest that changes in brain activity in regions associated with executive control and affect generation contribute to ER capacity. While neuroimaging techniques provide valuable information about the brain regions implicated in the conscious, cognitive regulation of emotion, this methodology also requires specialist

training, expensive equipment, and cumbersome, time-intensive procedures, thereby limiting its practical utility in numerous research settings, such as large, school-based studies.

2.3.2 *Hormonal stress response markers.*

The hypothalamus-pituitary-adrenocortical (HPA) axis is a slow-acting stress response system that is typically activated by exposure to psychosocial and physical stressors (Dickerson & Kemeny, 2004), and responds by releasing the glucocorticoid cortisol from the adrenal glands. This is part of the process commonly referred to as the "stress response". Cortisol stress response patterns have been proposed as a neuroendocrinological mechanism that may differentiate individuals with effective and ineffective ER capacity (Quirin, Kuhl, & Düsing, 2011). Individual differences in the ability to regulate emotions following stress exposure is thought to contribute to between-person variation in cortisol stress response patterns (Kudielka, Hellhammer, & Wüst, 2009), and individuals with poor ER ability have been found to display excessively high cortisol levels in the evening after being presented with aversive visual images (Urry, 2006). In children, the implementation of adaptive ER strategies, such as personal control, seeking social support, and self-soothing, has been associated with lowered cortisol release following exposure to stress (for a review, see Stansbury, 1994). Similarly, in a sample of 36 healthy male university students (*M* age = 24.8), Quirin and colleagues (2011) found that participants low in self-reported ER demonstrated significantly higher cortisol reactivity in preparation for, and at least 45 minutes following, a stress-inducing task, compared to a group reporting high ER. Cortisol assays to investigate the impact of disruptions to the HPA axis on ER and measures of wellbeing can be collected via non-invasive methods such as salivary cortisol and hair samples, making it a viable methodology for research purposes (Inder, Dimeski, & Russell, 2012; Stalder & Kirschbaum, 2012). Together, these findings indicate that cortisol reactivity correlates with self-reported ER, and thus may be a useful physiological index of ER.

2.3.3 *Heart rate variability.*

Heart rate variability (HRV) is a measure of beat-to-beat intervals in heart rate, and is widely considered to be a downstream, peripheral index of the effect of the ANS on the heart (Thayer et al., 2012). Resting HRV provides a measure of homeostasis or general ER capacity; that is, the overall degree of flexibility of the cardiovascular and cortico-subcortical neurocircuits to respond to emotional input and meet changing environmental demands (Thayer & Brosschot, 2005). In the context of ER, a flexible nervous system facilitates the

appropriate expression or modification of emotional reactions in response to environmental stress or emotionally salient experiences. Conversely, autonomic rigidity reduces the capacity to generate or flexibly moderate physiological and emotional responses to satisfy environmental demands (Appelhans & Leucken, 2006). Whereas higher resting HRV represents a greater ER capacity, individuals with a low resting HRV are thought to have more difficulty inhibiting impulsive emotional reactions and deliberately engaging in adaptive ER strategies (Beauchaine, Gatzke-Kopp, & Mead, 2007; Thayer & Lane 2009). Under conditions of chronic stress or worry, autonomic balance can become disrupted as a result of insufficient top-down modulation of the ANS from the pre-frontal cortex, leading to lower resting HRV and greater homeostatic inefficiency (Thayer and Brosschot, 2005). This pattern of dysregulation impairs adaptation to stress (Juster, McEwen, & Lupien, 2010), while autonomic imbalance – as indexed by low HRV – is implicated in poorer adolescent wellbeing and is considered a transdiagnostic marker for the development of mental ill-health (Beauchaine, 2015b).

In adolescent samples, HRV is positively correlated with subjective levels of stress (Oldehinkel et al., 2011), individual differences in the capacity for cognitive control (Chapman, Woltering, Lamm, & Lewis, 2010), and self-reported ER during a negative affect-eliciting task (Cui, Morris, Harrist, Larzelere, & Criss, 2015). In a three-year longitudinal study, Vasilev et al. (2009) found that increasing HRV across development was associated with fewer self-reported ER difficulties at year three of the study, indicating that adolescents whose physiological capacity for ER improves over time also report a greater ability to manage and respond to difficult emotional experiences.

HRV is regarded as a relatively stable index of ER that is slow to reflect change (Tarkiainen et al., 2005), therefore the use of HRV to measure change in ER may be better suited to research designs incorporating longer follow-up periods. Despite this potential limitation, HRV is a commonly cited physiological method for assessing ER capacity in adolescent and adult samples and confers additional benefits as it is non-invasive and relatively time- and cost-efficient. Thus, the following review will focus predominantly on research using HRV as a physiological index of ER (Adrian et al., 2011; Appelhans & Luecken, 2006; Graziano & Derefinko, 2013).

2.3.4 *Summary.*

Reflective of the array of physiological processes associated with the generation, processing, and regulation of emotion, numerous methods for assessing physiological components of ER

have been developed, including neuroimaging techniques, hormonal stress response markers (e.g., cortisol), and vagal influence on the heart (e.g. HRV). While all approaches capture an important ER process contributing to an individual's capacity to flexibly and adaptively respond to environmental demands, each differs in regards to its practical application for adolescent samples and particularly school-based research. For example, neuroimaging techniques require prohibitively expensive and cumbersome equipment for many school-based research designs, while the transportable, efficient, and relatively cost-efficient methods of cortisol assays and HRV readily lend themselves to research in these settings. Nonetheless, cortisol and HRV are also subject to limitations, including a reliance on the rigorous standardization of collection methods, careful storage, and specialized analyses in the case of cortisol (Inder et al., 2012); and the need for research designs that accommodate a slow rate of change in the case of baseline HRV (Tarkiainen et al., 2005). Similar to self-report, then, physiological measures of ER are subject to limitations that may jeopardize their robustness as stand-alone measures of ER. To address these potential disadvantages whilst harnessing the strengths of these respective measures, incorporating both self-report and physiological ER measures into wellbeing and school-based research is recommended (Adrian et al., 2011; Rickard & Vella-Brodrick, 2014).

The third and final section of this review builds upon previous sections that have, firstly, introduced the importance of school-based interventions to enhance the psychological wellbeing of youth, and secondly, introduced conceptual and methodological issues relating to the examination of ER. Section Three will synthesize these lines of evidence and present empirical support for the importance of ER to adolescent wellbeing, before exploring whether targeting ER can enhance wellbeing in youth. It will examine ER in the context of school-based wellbeing programs including PEPs, before concluding with recommendations for further research in this field.

The Relevance of Emotion Regulation to the Assessment of Adolescent Wellbeing and Positive Education

3.1 Emotion regulation and adolescent wellbeing.

The ability to appropriately regulate emotions becomes increasingly important during adolescence, and successfully mastering this developmental task can facilitate adaptive psychosocial functioning across the lifespan (Horn et al., 2011; Sawyer et al., 2012). Neurobiological (e.g., development of the frontal lobes), psychological (e.g., understanding

of emotional processes), and interpersonal (e.g., navigating increasingly complex social relationships) changes during late childhood and adolescence increase a young person's capacity for ER (Brenner & Salovey, 1997; Gross & Thompson, 2007; Sawyer et al., 2012). Simultaneously, during mid-adolescence, disparity in maturation between the limbic system (involved in the generation of basic emotions) and prefrontal cortex (involved in the interpretation and regulation of emotions) is at its peak, leading to an increase in impulsive and reward-driven behavior over rational decision-making (Casey, Jones, & Hare, 2008; Sawyer et al., 2012). The formation of peer relationships gains importance, as does a greater self-reliance in navigating life demands (Sawyer et al., 2012). The capacity to engage in ER plays a vital role in successfully managing these developmental challenges, and is thus regarded as an essential component of positive adolescent development (Blair, 2010; Durlak et al., 2011; Graziano & Derefinko, 2013). ER is associated with numerous aspects of adolescent wellbeing, including resilience, satisfaction with life, positive affect, and social adjustment (Kim & Cicchetti, 2010; Mak, Ng, & Wong, 2011; Quoidbach et al., 2015; Shiota, 2006). While the examination of specific ER strategies associated with positive psychological functioning is a relatively recent phenomenon, preliminary data suggests that the use of cognitive strategies such as refocusing on planning and positive reappraisal are linked with both subjective and psychological wellbeing (Balzarotti, Biassoni, Villani, Prunas, & Velotti, 2014; Shiota, 2006).

3.1.1 *Emotion regulation and resilience.*

Resilience has been described as the ability to recover following adversity, to achieve normal development under difficult conditions, and as patterns of functional behavior despite risk (Olsson et al., 2003). Resilience contributes to wellbeing by protecting against the development of mental ill-health (Min, Yu, Lee, & Chae, 2013). ER has been conceptualized as a protective factor contributing to resilience following stress, or conversely, a trait that builds resources to cope in the face of adversity (Cohn et al., 2009). Adaptive ER is considered an important marker of resilience in adults, and ER skills may also bolster a young person's capacity for resilience (Garnefski et al., 2002; Mak et al., 2011). In a study of psychological factors associated with resilience in low-income school-aged youths, Buckner and Mezzcappa (2003) found that after controlling for negative life events and chronic stressors, resilient youths possessed significantly greater ER ability than non-resilient youths, as measured by two interviewer-assessed self-regulation inventories. The authors suggested that adaptive ER strategies might help children cope with potential stressors before they

evoke negative emotion, and allow effective management of negative emotions when experiencing stress. Curtis and Cicchetti (2007) used an observational assessment of ER to examine how differences in ER might promote resilience in a 12-month longitudinal study of 87 maltreated and non-maltreated children aged 6 to 12. It was found that for both groups, a greater capacity to modulate the expression of negative emotions significantly contributed to resilience one year later. Similar research with children has found that ER mediated the relationship between the presence of multiple psychosocial risk factors and basal cortisol level, a physiological measure of stress (Kliewer, Reid-Quiñones, Shields, & Foutz, 2009). Conversely, in a prospective study of 1065 non-clinical adolescents, McLaughlin and Hatzenbuehler (2009) found that emotion dysregulation mediated the relationship between stressful life events and internalizing symptoms over time. Together, these studies indicate that deficits in ER limit the ability to function well in the face of adversity, a defining characteristic of resilience.

3.1.2 *Emotion regulation and positive affect.*

It is thought that ER can also improve resilience via the up-regulation of positive affect; that is, by increasing positive emotion through the use of specific strategies such as positive reappraisal (Tugade & Fredrickson, 2004), savoring (Quidbach et al., 2010), and gratitude (Fredrickson et al., 2003). This argument is informed by Fredrickson's (2001) Broaden and Build theory, which posits that experiencing positive emotions has two complementary functions: to broaden and to build. 'Broadening' refers to increasing an individual's thought-action repertoires, which in turn serves to 'build' their intellectual, physical, social and psychological capacities to cope with adversity. By emphasizing the importance of building protective resources to better cope with stress, Fredrickson's model is complementary to theoretical approaches that regard resilience as a product of developing social and psychological competencies associated with wellbeing (Cohn, Fredrickson, Brown, Mikels, & Conway, 2009; Olsson et al., 2003). In a study of 1,418 university students, Mak and colleagues (Mak et al., 2011) used structural equation modelling (SEM) to demonstrate that resilience was significantly associated with positive cognitions about oneself, the world, and the future. In addition, resilient students reported significantly more positive cognitions and higher satisfaction with life than non-resilient counterparts, leading researchers to conclude that the ability to cultivate a "positive cognitive triad", that is, positive thoughts about the self, the world, and the future, provides a mechanism through which resilience can enhance wellbeing. The process of cultivating or increasing these positive thoughts represents an

adaptive ER strategy (i.e., positive reappraisal; Tugade & Fredrickson, 2007). Consistent with this assumption, the use of positive reappraisal is associated with higher subjective wellbeing in university undergraduates (Shiota, 2006), while self-reported ER has been found to mediate the relationship between HRV, a physiological marker of ER, and satisfaction with life in first- and second-year university students (Geisler, Vennewald, Kubiak, & Weber, 2010). Similarly, higher baseline HRV has been found to predict higher levels of positive affect in adult samples after wellbeing interventions of nine (Kok & Fredrickson, 2010), and 16 weeks duration (Lü, Wang, & Liu, 2013). However, as the majority of this research has involved adult samples, further research is required to confirm whether similar relationships are observed in adolescents.

3.2 Emotion regulation and mental ill-health.

Although the adaptive and flexible use of ER strategies can be an important factor in the maintenance of wellbeing, the limited availability of adaptive strategies and use of maladaptive strategies can also lead to the development of psychological distress and disorder. Emotional dysregulation occurs when an individual's response to emotional arousal becomes rigid, loses flexibility, or is unresponsive to contextual demands (Cole et al., 2004). Once a dysregulatory pattern becomes a characteristic aspect of a young person's emotional repertoire, this pattern becomes maladaptive and may function to sustain or become a symptom of psychological ill-health (Cole et al., 2004).

Deficits of ER have been described as a putative transdiagnostic factor implicated in the development, maintenance, and treatment of a variety of mental disorders (Berking et al., 2012). A considerable body of research supports this assertion by demonstrating the role of ER in the development of psychological ill-health in adolescents and adult samples, ranging from affective disorders such as depression and anxiety, substance misuse, self-harm, impulse-control difficulties such as eating disorders, interpersonal aggression and conduct disorders, through to more entrenched problems such as borderline personality disorder (see meta-analytic reviews by Aldao et al., 2010; Graziano & Derefinko, 2013). Specific ER deficits linked to poorer psychological health include the use of maladaptive cognitive strategies such as rumination, catastrophizing, self-blame, and avoidance (Aldao & Nolen-Hoeksema, 2010; Balzarotti et al., 2014), as well as impaired emotional awareness (Saxena, Dubey, & Pandey, 2011; Vine & Aldao, 2014).

Many studies have examined how participants regulate unpleasant emotions when distressed, but the regulation of positive emotions has received less attention. In a recent

theoretical review, Carl and colleagues argue that deficits in the regulation of positive emotions constitute an overarching feature of emotional disorders, including depression and anxiety (Carl et al., 2013). While consistent with existing accounts of the relationship between emotion dysregulation and mental ill-health, this review extends previous conceptualizations by drawing attention to the importance of enhancing positive affect rather than focusing solely on the regulation of negative emotional states. Failing to address deficits in positive ER may overlook the protective role of positive emotions in resilience, symptom reduction, and recovery from mental ill-health (Ehrenreich, Fairholme, Buzzella, Ellard, & Barlow, 2007). It therefore warrants further empirical investigation.

Given the high prevalence of anxiety and depression in community samples of adolescents (Bullot et al., 2017; Kitchener & Jorm, 2009), the following review will be limited to studies that have examined depression and anxiety symptoms or syndromes in adolescent populations.

3.2.1 *Emotion regulation and depression.*

Deficits of ER represent a risk factor for the development of depression (Beauchaine, 2015). For example, impaired ER has been found to mediate the development of depression in children and adolescents exposed to a range of stressors, including the experience of negative affect (Tortella-Feliu et al., 2010), stressful life events (McLaughlin, Hatzenbuehler, & Hilt, 2009), interpersonal stress (Moriya & Takahashi, 2013), childhood maltreatment (Kim & Cicchetti, 2010), sexual minority status (Hatzenbuehler, McLaughlin, & Nolen-Hoeksema, 2008), and the experience of bullying (Garnefski & Kraaij, 2014) and cyber-bullying (Feinstein, Bhatia, & Davila, 2014). Controlled studies also demonstrate that self-reported ER difficulties are associated with higher levels of depressive symptoms in children and adolescents following an induced emotional task (Gentzler, Santucci, Kovacs, & Fox, 2009; Reijntjes, Stegge, Terwogt, & Hurkens, 2007). Notably, it is claimed that difficulties in regulating emotion, rather than experiencing high levels of negative affect *per se*, puts young people at risk for depression (Reijntjes, Dekovic, Vermande, & Telch, 2009).

A number of studies have examined the relationship between the use of specific maladaptive ER strategies and risk for developing depression (Betts, Gullone, & Allen, 2009; Garnefski & Kraaij, 2006b; Gentzler et al., 2009; Hughes & Gullone, 2011; Larsen et al., 2012; Moriya & Takahashi, 2013; Saxena et al., 2011). For example, in a study of 288 participants aged 16 to 38 years, Saxena, Dubey and Pandey (2011) found that specific ER deficits (as measured by the DERS; Neumann et al., 2009) – including difficulties in

identifying feelings, lack of emotional clarity, and limited access to ER strategies – predicted poorer psychological wellbeing compared to other emotional difficulties. Similarly, Moriya and Takahashi (2013) found that lack of emotional clarity and limited access to ER strategies, as measured by the DERS, mediated the relationship between interpersonal stress and the development of depression in a sample of 152 university undergraduates.

Fewer studies have investigated the regulation of positive emotion in the context of youth depression. In a study investigating the regulation of positive affect in 112 undergraduate students, Werner-Seidler, Banks, Dunn, and Moulds (2013) found that the down-regulation of positive affect (i.e., greater dampening and reduced amplification of positive emotion) was associated with greater self-reported depressive symptoms. In two follow-up studies outlined in the same paper, the researchers also found that never-depressed participants could be distinguished from recovered depressed and currently depressed participants by their responses to positive affect, with the latter groups both displaying greater use of maladaptive down-regulatory strategies (Werner-Seidler et al., 2013). Similar findings in adult samples have been reported, with individuals with depressive symptoms showing greater dampening of positive emotions (Feldman, Joormann, & Johnson, 2008). However, a notable limitation of this study is that participants' mental health history was established via the self-report of past mental health symptoms, which may be subject to recall bias (Hunt, Auriemma, & Cashaw, 2003). Using a longitudinal methodology in which depression symptoms are reported at numerous time points may reduce reliance on participants' memory of past depressive symptoms, and reduce the potential influence of recall bias. The incorporation of physiological measures of ER such as HRV may also supplement self-report, given the consistent associations found between low resting HRV and depression in adult (Di Simplico et al., 2012) and adolescent (Gentzler et al., 2012; Gentzler et al., 2009; Kovacs & Yaroslavsky, 2014) samples. Finally, experimental studies examining the relationship between depression and the regulation of positive emotion are needed to further clarify these relationships.

3.2.2 *Emotion regulation and anxiety.*

Like depressed individuals, anxious young people have greater difficulty regulating emotions compared to non-anxious counterparts, as measured by physiological (e.g., HRV) and self-report measures (Balle, Tortella-Feliu, & Bornas, 2013; Bender et al., 2012; Blom, Olsson, Serlachius, Ericson, & Ingvar, 2010; Greaves-Lord et al., 2010; Tan et al., 2012). Consistently, lower resting HRV has been associated with greater symptoms of anxiety (Balle

et al., 2013; Bosch, Riese, Ormel, Verhulst, & Oldehinkel, 2009; Dietrich et al., 2007; Schmitz, Tuschen-Caffier, Wilhelm, & Blechert, 2013), and deficits in ER have been found to mediate the relationship between the presence of psychosocial stressors and anxiety in young people, including negative affect (Tortella-Feliu, 2010), stressful life events (McLaughlin & Hatzenbuehler, 2009), exposure to a greater number of psychosocial risk factors (Kliewer et al., 2009), and sexual minority status (Hatzenbuehler, 2008).

A small number of studies have also examined the use of specific cognitive ER strategies in relation to anxiety levels in young people. For example, Tan et al. (2012) have found that strategies such as avoidance, distraction and problem-solving were associated with fewer negative emotions in a sample of 65 adolescents diagnosed with an anxiety disorder. While this seems at odds with the notion that distraction and avoidance are maladaptive (Garnefski et al., 2002; Neumann et al., 2009), it may be that these strategies are recruited to reduce short-term distress (e.g. by not engaging with difficult emotions in the case of avoidance or distraction), but lead to maladaptive patterns that perpetuate anxiety disorders in the long-term (Sheppes & Gross, 2011). Consistent with this hypothesis, it has been shown that using a wider repertoire of cognitive ER strategies may combat the development of anxiety disorders in young people (Lougheed & Hollenstein, 2012), suggesting that learning and applying more adaptive regulatory strategies may reduce reliance on maladaptive strategies such as avoidance or distraction. These ideas are speculative, however, requiring further research into longitudinal associations between strategy use and anxiety symptoms in non-clinical samples.

Taken together, these findings indicate that difficulties regulating emotional experiences are a pathway through which negative life experiences can lead to mental ill-health, with a small collection of studies also suggesting that adaptive ER strategies protect young people against the development of depression and anxiety.

3.3. Emotion regulation interventions to enhance mental health.

Over the past decade, ER has gained increasing attention and relevance in etiological models of mental health (see reviews by Aldao et al., 2010; Berking & Wupperman, 2012; Compare et al., 2014; Tianqiang et al., 2014). Deficits in ER are widely recognized as an underlying mechanism contributing to the development and maintenance of numerous mental ill-health problems (see reviews by Aldao et al., 2010; Beauchaine, 2015; Berking & Wupperman, 2012; Carl et al., 2013), while improving ER ability has been proposed as an active component of a number of validated treatments and interventions (see Gratz & Gunderson,

2006 for a review). Subsequently, ER is attracting increasing recognition as an important treatment target, as reflected by the development of a number of ER-based frameworks. Notable examples include Emotion Focused Therapy (Greenberg, 2002), which aims to increase emotional awareness and assist clients to modify emotions and cognitions that trigger emotional responses; and Mindfulness-Based Cognitive Therapy (MBCT) (Teasdale, Segal, & Williams, 2000), which seeks to facilitate ER by increasing awareness and acceptance of cognitive-affective and sensory experience via mindfulness practice. Similarly, Emotion Regulation Therapy (ERT) (Mennin, Heimberg, Turk, & Fresco, 2006) is a specialized treatment for generalized anxiety disorder (GAD), which regards GAD as arising from ER deficits and thus aims to increase knowledge, acceptance, use, and management of emotions. These treatment models seek to address core deficits in ER relating to the identification, management, and modification of emotional experiences; for example, by improving emotional awareness and acceptance of emotion, developing adaptive ER strategies, and identifying and reducing reliance on maladaptive ER strategies.

Incorporating ER-focused treatment components into established, well-validated, therapeutic frameworks such as CBT has also been proposed as a method to improve treatment efficacy in youth with anxiety disorders (Hannesdottir & Ollendick, 2007; Trosper, Buzzella, Bennett, & Ehrenreich, 2009). Moreover, introducing ER-specific skills to CBT treatment programs has been found to augment wellbeing outcomes when compared to non-ER supplemented programs in children with anxiety (Suveg, Sood, Comer, & Kendall, 2009), adults with depression (Berking, Ebert, Cuijpers, & Hofmann, 2013), police officers (Berking, Meier, & Wupperman, 2010), and adult psychiatric inpatients (Berking et al., 2008). Although such findings provide further evidence for the importance of addressing ER as a treatment target in both child and adult populations, further research is required to establish whether treating ER can enhance wellbeing in non-clinical populations, and specifically, non-clinical adolescent populations. These issues will be explored next.

3.3.1 *Emotion regulation interventions: Impact on adolescent wellbeing.*

Programs that specifically target ER in adolescent populations provide evidence that enhancing the capacity for ER can lead to improvements in wellbeing. Prospective research in adolescent samples sheds light on the question of whether enhancing the capacity for ER can lead to improvements in wellbeing. Preliminary findings suggest that adaptive cognitive ER strategies can be taught via formats similar to PEPs, including group training (Hammond, Westhues, & Hanbidge, 2009; Suveg, Hoffman, et al., 2009), and school-based intervention

programs (Bradley et al., 2010; Ghahremani et al., 2013; Horn et al., 2011; McCraty et al., 1999). For example, McCraty and colleagues (1999) evaluated a sample of 30 Year 7 students enrolled in a 2-week (16 hour) program and 60 Year 6 to 8 students enrolled in a 12-month emotional self-management program. Both programs involved a series of strategies to neutralize or change negative emotional reactions, reduce stress, and improve communication and relationships. Post-treatment results showed significant improvements in wellbeing, including better stress and anger management; improved relationships with peers, teachers, and family; improvements in work management and focus; and reductions in risky behavior. Significant improvements in baseline HRV and the speed of HRV recovery following a stressful task were also found (McCraty et al., 1999). These findings suggest that ER interventions that seek to improve cognitive ER also benefit physiological ER, leading to a beneficial state of physiological and psychological alignment known as *physiological coherence* (McCraty, 2006).

Horn et al. (2011) compared a random stratified sample of high-school students allocated to either a control condition or a 10-week ER program, which involved training in emotion recognition, the need for stress-coping balance, the physiological effects of suppressing thoughts and emotion, and an expressive writing component. It was found that the ER condition led to significant reductions in negative affect at 6-months post-treatment relative to controls. In another study involving a randomly stratified sample of Year 10 students, participants of a one-day ER workshop were encouraged to cultivate positive emotions such as love, compassion, and appreciation while monitoring their heart function using bio-feedback software (see Bradley et al., 2010). Post-treatment improvements were found both in HRV at rest and during a stress-inducing task. These effects were greater for students with high test anxiety at baseline, indicating that those in greater need of ER skills benefited most. Notably, this study included a multifaceted intervention including a HRV bio-feedback component as well as training in cognitive ER skills, thus targeting both physiological and cognitive components of ER. Importantly, results of this particular intervention demonstrate that even brief interventions can lead to improvements in both cognitive and physiological markers of ER.

3.3.2 *Emotion regulation and positive psychology interventions.*

More recently, interventions that seek to enhance wellbeing via the regulation of positive affect have gained recognition, with a number of authors arguing that positive psychology interventions represent a specific type of ER intervention that involves building skills to up-

regulate, or increase, positive emotions (Quoidbach et al., 2010; Quoidbach et al., 2015; Weytens et al., 2014). In an examination of eight savoring (i.e., to increase or maintain positive affect) and eight dampening (i.e., to decrease positive affect) strategies, Quoidbach and colleagues (2010) found that focusing attention on the present moment (i.e., mindful attention) and vividly recalling or anticipating positive events promoted positive affect, while sharing positive experiences with others promoted satisfaction with life. This study indicates that ER strategies that actively encourage focusing on positive (past, present or future) events or sharing positive experiences with others can both augment wellbeing. Furthermore, Weytens et al. (2014) developed a 6-week program targeting the regulation of positive emotion (positive emotion regulation program; PER), which involved education about emotions and ER strategies; positive interventions to increase positive affect (e.g. savoring, gratitude, enjoyable physical activity, expressing positive emotions to others, planning positive activities); and strategies to increase positive cognitions. In a pilot trial involving 113 young adults (*M* age = 22.3), PER was compared against a 6-week loving-kindness meditation (LKM) program and a wait-list control group. Compared to controls, the PER group showed a significant increase in subjective wellbeing and satisfaction with life, and a significant decrease in symptoms of depression and somatic complaints. Although both the LKM and PER groups demonstrated positive changes in wellbeing post-treatment, the participant drop-out rate was significantly lower in the PER group compared to the LKM group, indicating that PER may be more acceptable or accessible to the majority of individuals (Weytens et al., 2014). These ER strategies, which focus on positive aspects of a situation and positive interactions with others (Quiodbach et al., 2010) or enhancing positive affect and cognition with use of positive interventions (Weytens et al., 2014), comprise key components of school-based PEPs. Moreover, the lower drop-out rate associated with PER treatment may be particularly important when targeting adolescent groups, who are commonly difficult to engage and retain in mental health treatment (Patton et al., 2016).

A small number of short-term, prospective studies have examined the impact of wellbeing interventions on HRV in adults. In one study, a randomly-selected group of 16 university students with low trait positive affect completed a 16-week positive psychotherapy group intervention based on Seligman et al.'s (2006) positive psychotherapy protocol. This program involved weekly, two hour sessions incorporating five positive psychology interventions – three good things, character strengths, savoring, the gratitude visit, and active-constructive responding (see Lü et al., 2013). Compared to matched controls, participants showed improvements in trait positive affect and resting HRV, which occurred independently

of decreases in trait negative affect (Lü et al., 2013). Increases in baseline HRV were also noted in a community sample of 73 adults following a 9-week self-monitoring exercise in which participants rated their levels of positive affect and social connection in a daily journal (Kok & Fredrickson, 2010). Notably, Kok and Fredrickson (2010) demonstrated that HRV can be improved without complex or time-consuming interventions – simply self-monitoring aspects of one's daily wellbeing was sufficient. Furthermore, researchers found that improvements in HRV and wellbeing reciprocally and prospectively predicted each other, suggesting that improvements in HRV and wellbeing create an 'upward spiral' of mental health. Both Kok and Fredrickson (2010) and Lü and colleagues (2013) demonstrated that positive interventions can enhance ER and measures of wellbeing. However, neither of these studies included follow-up data, therefore, the sustainability of these improvements is unknown.

3.3.3 *Emotion regulation and positive education programs.*

Although not framed as ER interventions per se, it is reasonable to expect that PEPs are capable of enhancing students' capacity for adaptive ER. Many of the skills taught within PEPs overlap with ER-specific interventions; for example, enhancing the understanding and recognition of emotions, or enhancing ER capacity via the up-regulation of positive affect with the use of savoring or gratitude (Morrish et al., 2017). In a 12-month prospective investigation of the efficacy of an Australian best-practice PEP with 119 Year 9 students, Vella-Brodrick et al. (2014) found that students whose wellbeing (life satisfaction) increased over the year could be distinguished from those whose wellbeing was stable or declined according to their use of coping strategies (Vella-Brodrick, Rickard, & Chin, 2014). Students with higher wellbeing used more adaptive strategies (e.g., savoring the moment) in response to positive events and fewer maladaptive strategies (e.g., avoiding the situation) in response to negative events, when compared with students whose wellbeing decreased or remained stable. Students who displayed this adaptive ER pattern were also able to increase their wellbeing compared to students who did not. These findings suggest that wellbeing is influenced by the ER strategies young people use to respond to both positive and negative emotional events in their lives: although the use of maladaptive ER strategies following negative events lowers wellbeing, the use of positive ER strategies can increase it. With this in mind, ER might be a factor that contributes to PEP effectiveness.

Summary and Future Directions.

Deficits in ER provide a transdiagnostic risk-factor for the development and maintenance of a number of mental health problems common in adolescence (Beauchaine, 2015). Conversely, adaptive ER constitutes a protective factor that promotes psychological flexibility, resilience and wellbeing in youth (Graziano & Derefinko, 2013). PEPs are school-based wellbeing interventions that have arisen from a positive psychology tradition, and are entrenched in the ethos that psychological wellbeing involves the presence of positive affect and functioning as well as the absence of mental ill-health (Huppert & Johnson, 2010; Seligman et al., 2009). They seek to increase psychological wellbeing and reduce mental ill-health by building positive affect and psychosocial resources (Fredrickson, 2001). Given convincing evidence that ER capacity in adolescents influences the development and maintenance of both psychological wellbeing and mental ill-health, exploring its role in PEPs and associated changes in wellbeing is an important step forward. A review of the literature surrounding wellbeing, ER, and positive education provides promising evidence that ER can be enhanced through structured training to develop specific regulatory skills, be that via ER-specific interventions or as a component of broader therapeutic models such as CBT. Second, the literature also suggests that many positive psychology interventions can be regarded as a specialized sub-type of ER training that focuses on the up-regulation of positive affect. Third, preliminary, longitudinal evaluations of PEPs suggest that ER capacity at baseline may predict wellbeing post-treatment (Vella-Brodrick et al., 2014). Notably, though, there is a relative paucity of research examining ER in the context of PEPs, and literature that amalgamates ER concepts and positive psychology traditions has only just begun to emerge (see Quidbach et al., 2015 for a review). Taken together, these findings build a compelling argument for further exploring the role of ER in adolescent wellbeing generally, and in evaluations of PEP outcomes specifically. An enhanced understanding of the role of ER in school-based interventions would provide insight into the degree to which ER capacity influences, and is implicated in, the process of positive changes in student wellbeing. Such research would also provide insight into whether PEPs enhance the capacity for ER in young people, and the ways in which current PEPs might be enhanced by incorporating ER into theory and practice. This knowledge may then be used to further promote the psychological wellbeing, or flourishing, of adolescents.

Section Two: Emotion Regulation in Adolescent Wellbeing and Positive Education Program Outcomes: A Review

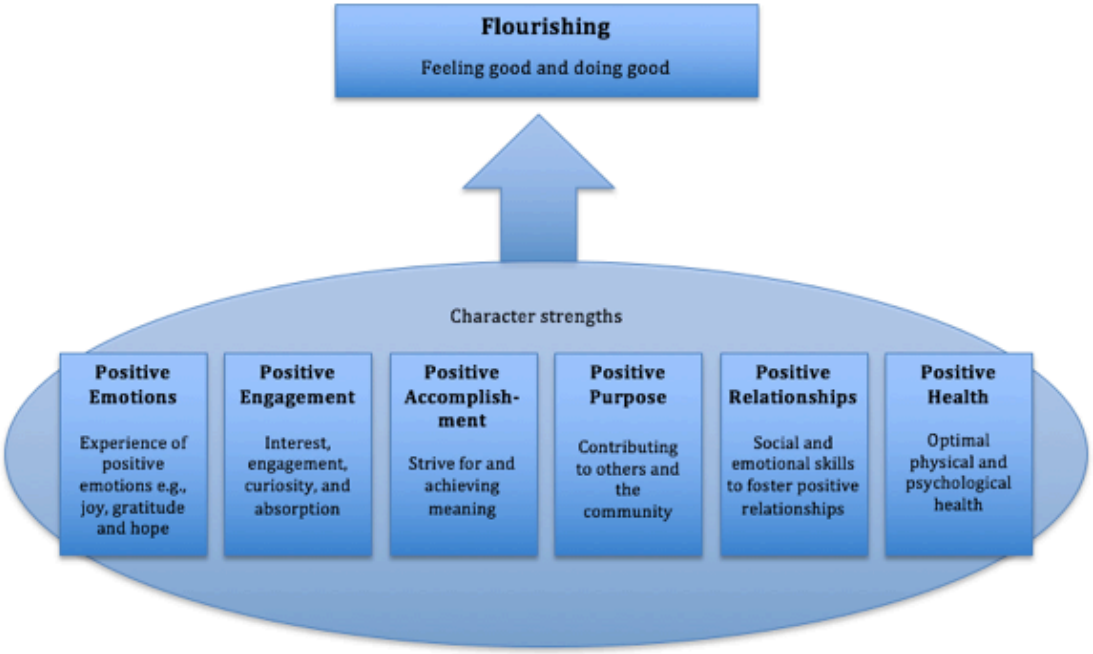
Morrish, L., Rickard, N., Chin, T.C., & Vella-Brodrick, D. (2018). Emotion regulation in adolescent wellbeing and positive education. Journal of Happiness Studies, 1-22.

Abstract

Emotion regulation (ER) becomes increasingly important across adolescent development, and promotes psychological flexibility, resilience and well-being in youth. Positive education programs (PEPs) combine academic training with positive psychology interventions (PPIs) to increase well-being and reduce mental ill-health. Despite considerable overlap between PPIs and ER models, the role and relevance of ER to PEPs remains unclear. This review aimed to evaluate the relationship of ER to PEPs targeting adolescents. First, to evaluate the relationship of ER to domains of well-being targeted by school-based PPIs. Second, to examine whether school-based PPIs can improve adolescents' ER capacity. Third, to evaluate the role of ER in well-being outcomes of PEPs. Results support the relevance of ER to domains of well-being outlined by the revised PERMA model, including positive emotions, engagement, relationships, meaning, and health. ER can influence the degree to which students benefit from PEP participation. It remains to be determined whether ER capacity is improved as a result of exposure to positive education programs. Findings are limited by the small and heterogeneous group of interventions examined, and the use of various ER measures. Further research of the role of ER in positive education may improve understanding of the mechanisms underlying their effectiveness and further promote the psychological well-being of adolescents.

Adolescence is a phase of profound development that involves extensive changes across psychological, social, academic, and vocational domains (Sawyer et al., 2012). Difficulties meeting these developmental challenges can have a significant and long-lasting impact on wellbeing, with approximately 75% of mental disorders first presenting before the age of 25 years (Burns, Morey, Lagelée, Mackenzie, & Nicholas, 2007; McGorry & van Os, 2013). In light of such risks, promoting positive adolescent functioning across multiple psychosocial domains represents a key goal of both educational and psychological services (Waters, 2011; Keyes, 2007; McGorry, Purcell, Hickie, & Jorm, 2007). Schools represent a common setting for the majority of young people, can focus on early intervention and prevention, and provide a cost effective setting compared to clinical services (Burns, Davenport, Durkin, Luscombe, & Hickie, 2010). School-based interventions, therefore, are a popular platform to promote psychological wellbeing in adolescents. Positive education programs are a popular subset of school-based wellbeing interventions that combine a traditional academic curriculum with evidence-based skills to enhance wellbeing, known as positive psychology interventions (PPIs; Seligman, Ernst, Gillham, Reivich, & Linkins, 2009). Typically, positive education programs adopt the PERMA framework of positive functioning, which understands wellbeing to involve a high level of functioning across a range of psychosocial domains including positive emotion (P), engagement with valued activities (E), fostering positive relationships (R), cultivating life purpose and meaning (M), and pursuing valued accomplishments (Seligman, 2011). Further development of this model has led to the incorporation of a sixth facet: positive health and resilience (Norrish et al., 2013). This PERMA+ model (Iasiello, et al., 2017) is presented in Figure 1, and is described in detail elsewhere (Norrish & Seligman, 2015). PPIs effectively enhance wellbeing and increase positive affect, with a subset of these interventions (e.g., cognitive restructuring, behavioral activation, mindfulness) also found to reduce negative affect (Bolier et al., 2013; Carl et al., 2013; Chambers et al., 2009; Hoffman et al., 2012; Sin & Lyubirmirski, 2009, Quoidback, Mikolajczak, & Gross, 2015). There is growing evidence to suggest that when incorporated into school-based programs, PPIs can improve wellbeing and reduce mental ill-health in adolescent samples (Brunwasser, Gillham, & Kim, 2009; Shoshani & Steinmetz, 2014). These findings are promising, yet to date, the underlying mechanisms that contribute to these positive psychological outcomes remain unclear (Sin & Lyubomirsky, 2009). One candidate, which has remained largely unexamined in the field of positive psychology, is emotion regulation.

Figure 1. The Geelong Grammar School Positive Education Model (simplified). Adapted from Norrish, Williams, O'Connor, & Robinson (2013).



Emotion Regulation and Adolescent Wellbeing

Emotion regulation (ER) refers to the processes by which individuals respond to, manage, and modify emotional experiences in order to achieve individual goals and meet environmental demands (Thompson, 1994). More specifically, ER includes the conscious, cognitive strategies implemented by the individual to regulate affective and behavioral responses to emotion-eliciting events (Adrian et al., 2011; Gratz & Roemer, 2004). The ability to successfully self-regulate emotional impulses and behaviors becomes increasingly important across adolescent development, and can facilitate adaptive psychosocial functioning across the lifespan (Sawyer et al., 2012). Consequentially, ER is regarded as an essential component of positive adolescent development (Blair, 2010; Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011). Affective states can be either reduced or increased in intensity via processes of ER, and individuals typically use a wide variety of strategies to regulate emotional experiences (Aldao & Nolan-Hoeksema, 2013). Although exceptions are

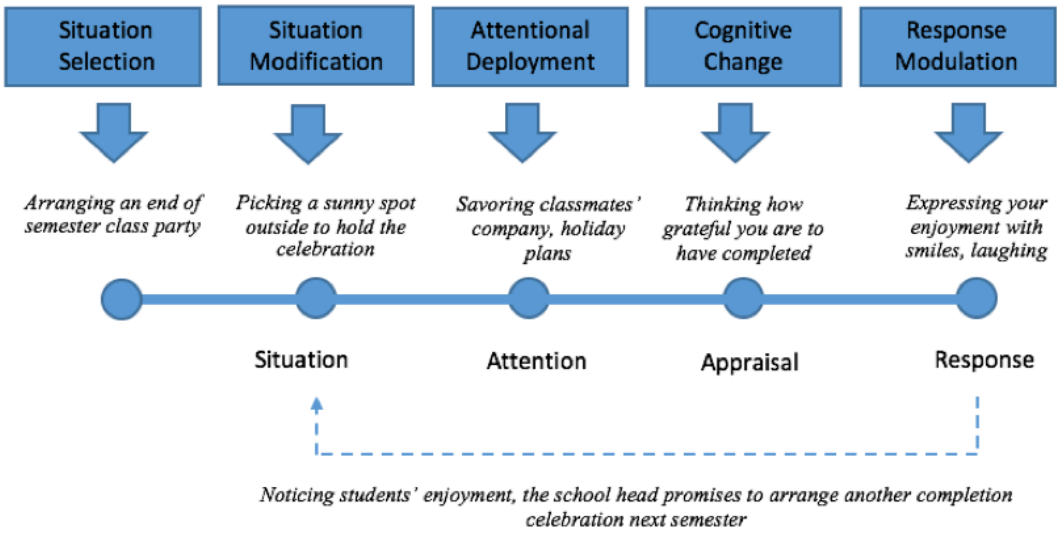
documented (e.g., Aldao, 2013; Butler et al., 2003), in the majority of contexts ER strategies are engaged in attempts to up-regulate positive emotions and down-regulate negative emotions (Gross, Richards, & John, 2006). Historically, ER research has focused predominantly on the regulation of negative emotional states, revealing that difficulties down-regulating negative affect are associated with psychological distress and dysfunction (Aldao, Nolen-Hoeksema, & Schweizer, 2010) and contribute to poorer academic outcomes (Ivcevic & Brackett, 2015). In contrast, the tendency to down-regulate *positive* affect contributes to mental ill-health, and the use of putatively adaptive ER strategies can protect against the development of mental ill-health (Aldao et al., 2010; Aldao & Nolen-Hoeksema, 2012; Carl et al., 2013). Empirical examination of the regulation of positive affective states has grown extensively in the last five years, and demonstrate that the ability to up-regulate positive affect plays an important role in maintaining and even improving psychological wellbeing (Gruber, Kogan, Quoidbach, & Mauss, 2013; Kashdan & Rottenberg, 2010; Quoidbach et al.,2015). This emerging interest in the use of ER strategies to enhance positive emotion parallels developments in the field of positive psychology, which seeks to increase wellbeing by building positive affect and positive psychosocial resources (Fredrickson, 2001). Given considerable overlap between these two fields, it is unsurprising that models of ER are now considered as organizing frameworks to understand, categorize, and build upon existing PPIs (Quiodbach et al, 2015; Weytens, Luminet, Verhofstandt, and Mikolajczak, 2014).

1.1. The Process Model of emotion regulation: Reconceptualizing positive psychology interventions

The Process Model of ER (Gross, 1998) is the most widely used conceptual model of ER to date (Webb, Miles, & Sheeran, 2012). It provides a valuable framework from which to organize and explain existing literature on PPIs (Quoidbach et al., 2015), and may further one's understanding of the relationship between ER processes and school-based wellbeing interventions. This model distinguishes five phases in the emotion-generative process, during which different families of ER strategies may be implemented. The first family of ER strategies, *situation selection*, involves choosing situations likely to promote positive emotion or reduce or avoid negative emotion. The second family of ER strategies, *situation modification*, involves changing qualities of the situation once it has commenced in order to modify its emotional effect. The third ER category, *attentional deployment*, refers to directing attention to particular features of the situation to alter the affective experience. *Cognitive*

change, the fourth category, involves changing one's appraisal of a situation in order to alter its affective impact. The final family of strategies is *response modulation*, which refers to attempts to modify affective experiences by altering one's physiological, cognitive, and behavioral responses to the emotion-eliciting event. Response modulation strategies may reciprocally influence earlier stages of the emotion-generative cycle via a positive feedback loop. The Process Model of ER is presented in Figure 2 (also see Gross, 1998; Quiodbach et al., 2015; for a comprehensive description).

Figure 2. The Process Model of emotion regulation.
Modified from Quoidbach, Mikolajczac, & Gross (2015).



In the context of wellbeing interventions, PPIs can be understood as ER strategies that are specifically designed to enhance positive affect before, during, or after pleasant emotional experiences (Quoidbach et al., 2015). For example, interventions such cultivating optimism and gratitude can be seen to target conscious (*cognitive change*) ER strategies that seek to positively reframe or evaluate future, current, and past events (see Quoidbach et al., 2015, for a review). Likewise, savoring involves anticipating future enjoyment, attending to current enjoyment, or recalling past enjoyment, respectively (and comprise *attentional deployment* or *situational modification* strategies). Positive education programs, therefore, can be thought of as implicitly utilising ER processes in order to enhance adolescent wellbeing. This perspective, which identifies ER as a potential mechanism contributing to the success of

PPIs, remains to be examined in relation to adolescent populations and comprehensive PPI programs such as positive education. Further, the paucity of literature examining ER in the context of adolescent wellbeing interventions underscores the need to incorporate research on ER into positive psychology frameworks, which have, until recently, remained relatively disparate fields of enquiry.

1.2. The present review

This article seeks to address this gap in knowledge by synthesizing contemporary research on ER relating to both adolescent wellbeing and positive education programs. Three key aims were identified. First, to evaluate the relevance of ER to components of adolescent wellbeing targeted by school-based PPIs, including positive emotions, engagement, relationships, meaning, achievement, and health (i.e., the revised PERMA model of wellbeing; Norrish & Seligman, 2015). The second aim was to examine whether participation in school-based PPIs can improve adolescents' ER capacity. The third and final aim was to assess whether ER processes represent a mechanism through which school-based PPIs lead to improvements in wellbeing.

1.3 Literature search strategy

Given the diversity of research topics to be examined, an integrative, narrative review was conducted. Narrative reviews provide a useful alternative to systematic reviews when aggregating data across numerous fields of research for the purposes of interconnection and hypothesis-building (Baumeister & Leary, 1997). Literature was identified via an extensive search of electronic databases conducted between January and August 2016, including EBSCOhost, PsycINFO, Medline, ERIC, Web of Science, and Google Scholar. Literature relating to ER and adolescent wellbeing was identified using combinations of search terms relating to ER, PPIs commonly implemented in Seligman's (2011) PERMA wellbeing model, ER interventions, wellbeing programs, and positive education programs. Alternative wordings of key search terms were also examined. Additional literature was identified via manual inspection of reference lists of key articles. Grey literature was identified using internet search engines (e.g., Google) and correspondence with authors. A total of 396 articles were shortlisted based on title and abstract content, and inspected against selection criteria. One hundred and ninety relevant articles were identified and categorized using thematic analysis, with illustrative and relevant articles, based on the inclusion criteria,

included in the final manuscript. Search terms and selection criteria are outlined in Tables 1 and 2, below.

Table 1. Literature Search Terms

Subject	Search Terms
Emotion regulation	'emotion regulation', 'emotional control', 'cognitive coping', 'affect regulation'
PERMA framework (modified)	
Positive emotions	'positive affect' 'positive emotion', optimism, gratitude,
Positive engagement	savouring
Positive relationships	engagement, flow, 'behavioral activation', planning, 'goal setting'
Positive purpose (meaning)	'positive relationship', 'social adjustment', pro-social, social
Positive accomplishment	purpose, meaning
Positive health & resilience	accomplishment, 'growth mindset', grit, perseverance, hope
	resilience, 'cognitive restructuring', mindfulness
Well-being intervention	'positive education', 'positive psychology', 'social emotional learning'
	'school program', intervention, 'cognitive behavior therapy'

Table 2. Review Inclusion and Exclusion Criteria

Inclusion criteria	Exclusion criteria
• Published between January 1995 to June 2016 • English language • Focused on ER and well-being, mental health, or well-being interventions • Include adolescent or young adult samples (aged 12 to 30) • Examined ER according to theoretical framework consistent with Gross' process model, as well as either: 1) examination of at least one PERMA domain, including positive health & resilience 2) description or assessment of an intervention that involved group, classroom, or whole-school settings	• Included participants with Axis II disorders (i.e., intellectual disability, personality disorder) or Axis I disorder other than depression or anxiety. • Involved forensic samples

Emotion Regulation and PERMA: A Review of the Literature

2.1 Emotion regulation and positive emotions.

Positive emotions are central to wellbeing, and initiating, building, and prolonging positive emotional experiences are key aims of positive education (Vella-Brodrick, Park, & Peterson, 2009). Positive affect can be enhanced via ER processes including positive reappraisal (Tugade & Fredrickson, 2004), savoring positive experiences (Quoidbach et al., 2010) and expressing gratitude (Fredrickson, Tugade, Waugh, & Larkin, 2003). The use of a broader repertoire of ER strategies is associated with greater self-reported positive affect (Quoidbach et al., 2010), suggesting that individuals can benefit from building a psychological 'toolbox' of various positive ER strategies. ER capacity can buffer youth against the detrimental effects of stress on life satisfaction (Saklofske, Austin, Mastoras, Beaton, & Osborne, 2012), while the ability to identify emotions, a crucial component of ER, may protect young people against declines in negative affect. In a longitudinal study of 667 adolescents, Ciarrochi, Heaven, and Supavadeeprasit (2008) found that low emotional identification skill (i.e., emotional

awareness) in Year 8 predicted increases in negative affect, and reductions in positive affect and social support in Year 9. Notably, up-regulating positive affect in response to positive experiences has also been found to mediate the relationship between the personality trait of extraversion and positive affect, suggesting that developing positive ER skills may contribute to positive outcomes associated with extraversion (Costa & McCrae, 1980).

Coping and appraisal style has also been found to mediate the relationship between a fearful temperament and adjustment to stress in pre-adolescents (Thompson et al., 2014), suggesting that ER may be protective against the negative effects of stress in vulnerable youth. Additional studies show that age-related increases in positive affect across adolescence are mediated by ER capacity, as measured by less reactivity to emotionally challenging situations and less use of the maladaptive ER strategies of threatening appraisal and distraction (Yeung, Wong, & Lok, 2011; Luong & Charles, 2014). Such findings suggest that intentionally cultivating adaptive ER strategies may accelerate age-related improvements in positive affect and buffer against the negative effect of stress, and lends further support for the importance of building ER skills into wellbeing interventions with youth.

2.2 Emotion regulation and positive engagement.

Positive engagement is defined as "living a life high on interest, curiosity, and absorption, and pursuing goals with determination and vitality", and a state of mind characterized by participation, focused attention, and immersion in an activity (Norrish & Seligman, 2015, p. 202). Greater engagement is associated with numerous positive outcomes in youth including greater life satisfaction, positive affect, pro-social behavior, and self-esteem (Froh et al, 2010; Seligman, 2011). Central to engagement is fostering a state of flow, which is a complete absorption in a task or activity (Csikszentmihalyi, 1990). Curiosity and goal-setting are equally important, and assist young people to identify and approach activities that provide a level of challenge matched to the individual's capability (i.e., skill-challenge balance; Nakamura & Csikszenmihalyi, 2009).

ER may promote positive engagement by managing potential emotional barriers to seeking out or maintaining engagement with people or activities, for example, feelings of anxiety that arise when trying something new or stepping beyond one's comfort zone. ER strategies can facilitate engagement with valued activities, for example, by increasing positive affect (e.g., getting 'pumped up') in anticipation to an upcoming event (Quoidbach et al., 2015). In fact, some ER strategies may implicitly foster engagement, and these have been associated with higher levels of wellbeing. To illustrate, Livingstone and Srivastava (2012)

used principal component analysis to categorise 75 ER strategies commonly used by individuals in order to up-regulate positive affect. Three category domains emerged, including engagement (socializing, savoring), betterment (goal pursuit, personal growth), and indulgence (substance use, fantasy). Of these, engagement positively correlated with wellbeing and state and trait positive affect, while the categories of betterment and indulgence also correlated positively with greater trait and state positive affect only. These finding suggest that positive ER strategies involving engagement with people and experiences are particularly effective in fostering wellbeing. In another study supporting the use of engagement-oriented ER strategies to enhance positive functioning, Barber et al. (2010) examined a sample of 380 university undergraduate students to determine whether individuals with optimal psychological health (i.e., flourishing) could be differentiated from those with moderate and poor wellbeing (i.e., languishing) on the basis of commonly used ER strategies. They found that languishing and non-languishing (flourishing and moderate wellbeing) students significantly differed on the use of nine ER strategies, including analysing/understanding feelings, making plans, doing something enjoyable, talking to someone, being grateful, treating oneself, alcohol & caffeine use, and consulting a mentor. Six ER strategies distinguished flourishing students from those with moderate levels of wellbeing, including withdrawal, emotional suppression, keeping to oneself, making downward social comparisons, daydreaming, and eating. The researchers concluded that flourishing students differed from moderately well and languishing groups in their use of engagement-oriented ER strategies, while groups with lower wellbeing typically adopted socially-distancing and 'avoidance' behaviors – such as the use of distraction and disengagement.

Central also to positive engagement is the state of flow, which is understood as a state of mind involving complete focus on a task or activity, of being fully engaged with what one is doing (Csikszentmihalyi, 1990). Experiencing flow is thought to generate feelings of strength, alertness, and unselfconsciousness (Csikszentmihalyi). It can be understood as falling within the *attentional deployment* family of ER strategies, in that it involves focusing attention on a specific aspect of a situation in order to influence the affective qualities of it (Gross, 1998). Beyond theoretical proposals linking flow and ER (e.g., Quoidbach et al., 2015), the relationship between these variables has not been widely researched. Preliminary results do, however, link flow to adaptive processes associated with ER. In a sample of 101 undergraduate college students (*M* age = 20), Moore (2013) investigated the cognitive skills related to flow disposition, a trait measure of flow. After controlling for demographic

variables and participants' history of mindfulness meditation, ER-related measures including mindfulness and cognitive flexibility were found to predict flow disposition, with a moderate effect size.

2.3 Emotion regulation and positive relationships.

Social connection is essential to physical and emotional health (Uchino, 2006), and positive relationships become particularly important during emerging adulthood (O'Connor et al., 2011). During adolescence, perceptions of school connectedness and teacher relationships predict a young person's emotional health (Kidger, Araya, Donovan, & Dunnell, 2012). Positive relationships are promoted in positive education programs via a range of activities including cultivating co-operation, compassion, kindness, and positive communication (Norrish & Seligman, 2015). The acquisition of adaptive and flexible ER strategies represents a crucial skill for building and maintaining positive relationships, including the social skills targeted by positive education (Hubbard & Coie, 1994). The adaptive use of ER strategies is associated with greater peer acceptance in children and adolescence (Halligan et al., 2013) and contributes to social wellbeing in emerging adults (Zambianchi & Bitti, 2014). For example, a longitudinal study of maltreated and non-maltreated children aged 6-12 years found that higher ER ability, as measured by observational reports at baseline, predicted greater peer acceptance 12-months later. Conversely, lower ER was associated with higher antisocial behavior (e.g. aggressive communication, delinquent behavior) at baseline, which contributed to peer rejection and more antisocial behavior at follow-up (Kim and Cicchetti, 2010). In sum, converging evidence based on self-report and observational measures of ER demonstrate that successful ER contributes to positive relationships by bolstering social competence (e.g., communication, co-operation) and also protects against the development of antisocial behavior in young people.

Compassion refers to the feeling that arises in response to another's suffering and motivates a desire to help (Goetz, Keltner, & Simon-Thomas, 2010). It involves a combination of motives, emotions, thoughts and behaviors that encourage positive social relationships (Gilbert, 2005). Cultivating compassion for others can influence the impact of emotion-eliciting events, and may thus contribute to adaptive ER (Gilbert, 2009). It involves *situation selection* strategies, that is, engaging in behaviors to aid others; and *cognitive change* strategies, which involve modifying one's appraisals of an emotionally-triggering situation in a manner that generates compassion for others. In a recent fMRI study, Engen and Singer (2016) instructed 15 experienced practitioners of compassion-focused mediation

(i.e., a form of meditation to cultivate kindness and goodwill to others) to generate compassionate thoughts, to use cognitive reappraisal, or passively view a film of distressed individuals. Both reappraisal and compassion conditions successfully regulated affective states. The reappraisal condition, compared to control and compassion conditions, primarily down-regulated negative affect. In contrast, compassion primarily up-regulated positive affect, as indicated by increased activation in regions of the brain (ventral striatum, medial orbitofrontal cortex) associated with positive affect, affiliation, and positive reward (Engen & Singer, 2016). This suggests that the ER strategies of compassion and reappraisal provide complementary self-regulatory functions. Similar findings were reported by vanOyer Witvliet et al. (2010), who examined self-reported and physiological responses to three *cognitive change* ER strategies in 72 healthy adults. Participants recalled a past interpersonal offence and were instructed to respond with rumination or one of two cognitive reappraisal strategies: compassion-focused reappraisal (to emphasize the offender's humanity) or benefit-focused reappraisal (to contemplate the participant's own strengths). Both strategies increased positive affect and decreased negative affect, yet compassion-focused reappraisal generated more empathy, forgiveness, and reductions in heart rate and physical tension, while benefit-focused reappraisal led to smiling and feelings of gratitude. Results show that different reappraisal strategies – one focusing on positive relationships, the other focusing on personal meaning, generate distinct subjective experiences and physiological responses. This integration of ER and positive psychology demonstrates that positive ER strategies can be tailored to cultivate specific wellbeing domains, and sheds light on difference mechanisms underlying PPIs incorporated in positive education programs.

2.4 Emotion regulation and positive purpose.

Positive purpose involves cultivating a sense of meaning greater than the self – be that spiritual, humanitarian, or otherwise altruistic (Norrish & Seligman, 2015). Deliberate engagement in activities to benefit others likely involves *situation selection* family of ER strategies, however, a range of ER strategies occurring across Gross' (1998) ER domains may be involved. For example, perceiving greater meaning in an activity is likely to influence one's perceptions, recollections, or reactions to it (involving *situation modification*, *cognitive change*, and *response modulation* strategies, respectively). Similarly, frequent use of cognitive reappraisal, a *cognitive change* ER strategy, may reinforce the value of a particular situation and foster a greater sense of meaning and purpose (e.g., deliberate efforts to cope with a situation via attributing positive meaning to it; Park, 2010).

Engagement in meaningful activities may also increase ER capacity, suggesting that the relationship between meaning and ER is bidirectional. Semplonius, Good, and Willoughby (2015) argue that engagement in religious activities provides an opportunity to build ER capacity, which in turn assists young people to successfully navigate social interactions. In this three-year, longitudinal study of 1,132 university students, ER capacity was found to mediate the relationship between involvement in religious activities and improved social connectedness. Importantly, spirituality *per se* did not predict social connectedness nor ER, indicating that engagement with religious *activities* has particular social and emotional benefits above those conveyed by religiosity alone. It is possible that such benefits are attributable to deliberate engagement with personally meaningful activities – supporting the importance of taking action, or approaching, contributors to wellbeing.

2.5 Emotion regulation and positive accomplishment.

Positive accomplishment refers to achievements that nurture oneself and others, across multiple domains including academic, social, emotional, physical and spiritual success (Norrish & Seligman, 2015). It is thought that accomplishment can be fostered by cultivating attributes and behaviors including adopting a growth mindset in the face of new challenges, cultivating grit and perseverance, and maintaining a sense of hope in the face of challenges and setbacks (Norrish & Seligman). These components of positive accomplishment are examined below.

Maintaining a growth mindset can facilitate positive accomplishment, and is synonymous with the belief that talent and ability can be developed over time, rather than as pre-determined or fixed (Dweck, 2006). An essential component of a growth mindset is the understanding that achievement requires ongoing effort and determination, especially in response to setbacks. Fostering a growth mindset involves reappraising difficulties or 'failures' as opportunities to learn, and therefore, may represent a form of positive reappraisal – an ER strategy falling under the *cognitive change* family. Brooks (2014) supports this position, arguing that positive reappraisal assists students to manage school-related performance anxiety. By reappraising physiological indicators of anxiety as excitement, students are encouraged to develop an arousal-congruent "opportunity mindset" as opposed to a "threat mindset", thus improving their task performance.

Another psychological factor contributing to positive accomplishment is grit. Grit is defined as the perseverance and passion for long-term goals, paired with a strong motivation to achieve them (Duckworth, Peterson, Matthews, & Kelly, 2007). ER may be regarded as a

strategy used to cultivate grit, for example, by selecting situations aligned with one's passions, or by reappraising frustrations or setbacks as unavoidable steps towards attaining long-term goals. While there is a paucity of empirical research outlining the relationship between grit and ER directly, recent findings highlight the importance of transforming ideas into eventualities. In one study of 223 high-school students (*M* age = 17), Ivcevic and Brackett (2015) found that ER ability mediated the relationship between openness to experience (i.e., a personality disposition for creativity) and creative achievement (i.e., the ability to actualize creative goals in the face of emotional, social and practical challenges). This study indicates that building students' capacity for ER is a valuable tool in cultivating persistence, or grit, in order to mobilize creative potential to achieve valued goals. Further, prospective research is required to determine if building students' capacity for ER may improve persistence and achievement across a wider range of academic domains.

The capacity for hope is another characteristic linked to positive accomplishment. Hope may be understood in relation to the *situation modification* family of ER strategies, as it involves directing one's attention to the positive potential of a given situation (Quoidbach et al., 2015). Hope therapy (Lopez, Floyd, Keith, Ulven, & Snyder, 2000) involves enhancing hope by setting goals, producing pathways to achieve them, and maintaining motivation to succeed. It has been found to increase participants' sense of hope (agency), self-efficacy, and meaning in life, and to reduce symptoms of depression and anxiety (Cheavens, Feldman, Gum, Michael, & Snyder, 2006). Preliminary research with adolescents reveals similar relationships. In a sample of 712 youth (*M* age = 15), Leung and colleagues (2015) used structural equation modelling to examine the relationship between hope and psychosocial wellbeing. As predicted, results showed a beneficial effect of hope on subjective happiness, symptoms of depression and anxiety, and interpersonal difficulties. Importantly, these relationships were partially mediated by positive refocusing, that is, a situation modification strategy of directing attention to positive aspects of a situation (Garnefski & Kraaij, 2006). Further research is necessary in order to replicate and extend such findings.

2.6 Emotion regulation, health and resilience.

A recent addition to the PERMA model, positive health refers to engaging in sustainable behaviors to promote physical and psychological health, including resilience and mindfulness (Norrish, Robinson, & Williams, 2011). Resilience is broadly defined as the ability to recover following adversity, to achieve normal development under difficult conditions, or patterns of functional behavior despite risk (Olsson, Bond, Burns, Vella-Brodrick, & Sawyer, 2003).

Resilience provides a broad index of adaptive psychosocial functioning that is increasingly linked to processes of ER (e.g., Tugade & Fredrickson, 2007). From the perspective of positive education, resilience represents an ability to maintain a healthy and flourishing life, despite experiencing challenges and difficulties (Norrish & Seligman, 2015). Resilience may be cultivated in students via building their capacity for cognitive reappraisal (i.e., altering the meaning attributed to events in order to alter their emotional impact; Beck, 2011) and mindfulness practice (i.e., non-judgmental awareness of present-moment experience; Germer, Siegel, & Fulton, 2013), each of which is considered an adaptive ER strategy (Chambers et al., 2009, Gross, 1998). Indeed, ER has been conceptualized as a protective factor contributing to resilience following stress, or conversely, a trait that builds resources to cope in the face of adversity (Cohn, Fredrickson, Brown, Mikels, & Conway, 2009).

Adaptive ER is considered an important marker of resilience in adults, and ER skills may also bolster a young person's capacity for resilience (Garnefski, Legerstee, Kraaij, Van Den Kommer, & Teerds, 2002; Mak et al., 2011). Genet and Siemer (2011) examined the cognitive abilities underlying trait resilience in 64 university undergraduates *(M* age = 19*),* and found that cognitive flexibility and flexible affective processing – abilities central to effective ER, were unique predictors of trait resilience. Further, working memory capacity was not predictive of resilience, indicating that trait resilience is linked to specific regulatory functions rather than better cognitive functioning per se. Further, results of meta-analyses consistently show that the capacity to understand and recognize emotional experiences of oneself and others, as well as to effectively regulate these emotions, is associated with better physical and psychological health outcomes (Martins, Ramalho, & Morin, 2010; Schutte, Malouff, Thorsteinsson, Bhullar, & Rooke, 2007).

Mindfulness, defined as awareness of present-moment experience without judgment (Germer et al., 2013), is an increasingly popular strategy to promote physical and emotional wellbeing in youth (Prazak et al, 2012). Mindfulness-based interventions effectively reduce symptoms of mental ill-health (Kallapiran, Koo, Kirubakaran, & Hancock, 2015) and improve adolescent wellbeing when delivered in school-based formats (Zenner, Hernnleben-Kurz, & Walach, 2014). Importantly, mindfulness can support ER skills via regulation of attention to momentary emotional, cognitive, and physical experiences. Cultivating nonjudgmental awareness is thought to improve one's regulatory capacity by decreasing reactivity to emotion-eliciting events, supporting the use of mindfulness training to increase adolescents' ER capacity (Metz et al., 2013). One school-based mindfulness intervention implemented with 213 high-school students from two US public schools found that compared

to controls, the mindfulness training condition (involving six, 15-25 minute sessions), lead to improvements in ER including greater emotional awareness, emotional clarity, and access to ER strategies, and also reduced perceived and somatic symptoms of stress (Metz et al., 2013). Improvements in ER capacity have also been reported following a six-week mindfulness program with a community adolescent sample (Monshat et al., 2013), an eight-week program with high-school students with sub-clinical symptoms of anxiety and depression (van Gordon et al., 2015), and a 16-week program with educational staff (Harris, Jennings, Katz, Abenavoli, & Greenberg, 2016).

The addition of mindfulness training in social-emotional interventions may enhance these programs' effectiveness, particularly regarding ER-related processes. For example, individuals trained in mindfulness-based cognitive therapy (MBCT) demonstrate greater cognitive reappraisal ability compared to those with trained in CBT and with no training (Troy, Shallcross, Davis, & Mauss, 2013). Moreover, a comparison of two classroom-based interventions with 100 randomly-allocated fourth and fifth grade students found that, compared to a social responsibility group, the social-emotional learning with mindfulness group reported greater emotional control, empathy, mindful awareness, and perspective-taking, and were rated by peers as more pro-social and accepted (Schonert-Reichl et al., 2015). This intervention was similar to positive education in its focus on building social and emotional skills, and provides promising support for the application of PEPs to enhance ER capacity in youth.

It is generally accepted that mindfulness plays a causal role in improvements in ER (see reviews by Chambers, Gullone, & Allen, 2009; Roemer et al., 2015), yet the precise mechanisms behind these are debated (e.g., Pagnini & Langer, 2015). One emerging theory posits that mindfulness improves ER and wellbeing by increasing one's capacity for positive reappraisal, a *cognitive change* class of ER strategy that involves directing attention to positive aspects of a situation to improve its affective impact (Garland, Farb, Goldin, & Fredrickson, 2015a). It is thought that mindfulness facilitates positive reappraisal via disengagement from negative cognitions in response to a stressor. This in turn allows a broadening of attention to incorporate positive information (i.e., an ER strategy labelled *positive refocusing*) and subsequent reappraisal of the situation in a more positive light (i.e., an ER strategy called *positive reappraisal*; Garland, Gaylord, & Fredrickson, 2011; Garland et al., 2015a). Practicing mindfulness is thought to provide an entry point in a "positive upward spiral" of more frequent positive cognitive appraisals, which in turn increase positive affect, and contribute to flourishing (Garland et al., 2015a; Garland, Farb, Goldin, &

Fredrickson, 2015b). Preliminary research in 101 young adolescents and an aggregated sample of 817 clinical and community-dwelling adults provides initial support this theory. After controlling for variables previously linked to positive reappraisal including wellbeing, positive affect, and positive refocusing, Hanley & Garland (2014) found that dispositional mindfulness was consistently and positively related to positive reappraisal. Physiological data provides further insight into the mechanisms by which mindfulness practice supports engaging adaptive ER strategies. For example, a recent fMRI study of 53 healthy adults demonstrated that mindfulness practice recruits the same neural circuits as used when practicing positive reappraisal, as reflected by comparable activity of the medial prefrontal cortex and amygdala (Opialla et al., 2015). In sum, there is a growing evidence base to support theoretical associations between ER and mindfulness. Further research is required to replicate these findings and establish the relationship between mindfulness practice and a broader range of specific ER strategies in adolescent samples, and to clarify the mechanisms via which cultivating mindfulness contributes to ER capacity in youth.

Can positive education programs improve emotion regulation capacity in youth?

The second key aim of this review was to evaluate literature outlining whether ER capacity could be improved following school-based PPIs, including positive education programs. If PPIs can be accurately characterized as a subset of ER strategies (Quoidbach et al., 2015), it must then be established if positive ER training via school-based PPIs can improve adolescents' ER capacity broadly. It is known that ER strategies can be successfully taught via targeted, psychological interventions (Carl et al., 2013). Prospective research indicates that adaptive psychological ER strategies can be taught in youth via group training (Hammond, Westhues, & Hanbidge, 2009; Suveg et al., 2009) and school-based intervention programs (Bradley et al., 2010; Ghahremani et al., 2013). ER training can improve adolescents' physiological capacity for ER, as reflected in functional changes in brain regions such as the prefrontal cortex (McRae et al., 2012). Similarly, promoting social and emotional skills via group and school-based programs also bolster ER processes (Bradley et al., 2010; McCraty et al., 1999) and buffer individuals against the physiological impact of stress (Walker et al., 2014).

Together, the above research demonstrates that ER processes can be enhanced in adolescents following exposure to wellbeing interventions conceptually similar to PEPs – programs that focus on building resilience, positive relationships, and positive emotions. It remains unclear, however, whether a young person's ER capacity can be improved as a result

of participating in school-based PPIs. This question is addressed in the following section of this review. Given the paucity of published research that has focused specifically on ER and school-based PPIs, the scope of this question was broadened to include constructs conceptually similar to ER, including cognitive coping (i.e., the individual's cognitive efforts to manage taxing internal or external demands; Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986) and self-control (i.e., the individual's efforts to inhibit immediate urges, behaviors or desires to meet long-term goals; Muraven & Beumeister, 2000). Wellbeing interventions incorporating PPIs but delivered with adolescents in settings beyond the school classroom (e.g., group programs, college settings) were also examined.

In an evaluation of a pioneering school-based PPI program, Seligman, Ernst, Gillham, Reivich, and Linkins (2009) assessed 347 year 9 students from a US secondary school at four time points – pre, post, 6- and 18-months after the year-long intervention. This program provided the foundations of current PEPs, and involved 20 to 25 80-minute classes of discussion, interactive activities, a real-world homework activity, and follow-up journal reflection. Skills targeted in this program included identifying and cultivating character strengths, as well as the promotion of kindness, perseverance, resilience, positive emotion, and purpose. Results of self-report measures from students, teachers, and students' parents, found that, compared to the control group, students exposed to the intervention lead to improvements in social skills including self-control, that is, the ability to control one's emotions and behaviors in order to achieve goals. Interestingly, benefits were reported by both teachers and parents, but not students, suggesting that any benefits to self-control were not sufficiently identified, valued, or recalled by students themselves. Further research is required to replicate and explore such findings, and to determine whether any physiological benefits are observed in the absence of positive subjective reports.

More recently, Shoshani and Steinmetz (2014) reported the outcomes of an Israeli positive education program involving 537 year 7 to year 9 students *(M* age = 14), which was compared against 501 students in a demographically similar, wait-list control school. This two-year longitudinal study involved 15, two hour-long group sessions throughout one school year, in which students engaged in class discussion, exercises, self-reflection, and home-practice activities to build understanding and use of six empirically-based PPIs including gratitude, positive emotions, goals fulfilment, optimism, character strengths, and positive relationships. Students were assessed at four time points over the two years – pre-treatment, post-treatment, and at 6- and 12-months follow-up. Hierarchical linear modelling revealed that compared to controls, the intervention group reported improvements in self-efficacy (i.e.,

the perceived ability to cope with stressful events and life hassles), with a medium to large effect size. Students also reported improvements in self-esteem and optimism, and decreases in general distress, interpersonal sensitivity, and symptoms of depression and anxiety. These findings indicate that integrated PPIs, when applied in a classroom setting, have considerable impact on adolescents' self-reported ER capacity in response to stressful events and daily hassles.

School-based PPIs may also lead to improvements in social functioning and cognitive processes reflective of ER. In one study, Schonert-Reichl et al. (2015) examined the efficacy of a mindfulness and social-emotional learning program (MindUp) with 99 Canadian fourth and fifth grade students (*M* age = 10), which sought to promote children's cognitive control and regulation of stress, wellbeing, and prosocial behavior. The MindUp curriculum was informed by positive psychology, developmental neuroscience, and the mindfulness literature, and included 12 sequential, 40-50 min weekly lessons involving mindfulness practices, PPIs (e.g., optimism, gratitude), social-emotional exercises (e.g., perspective-taking), self-reflection, and pro-social activities. This intervention adopted an integrated delivery framework, in which teachers' generalized the curriculum-based skills throughout the day. Post-intervention, MindUp participants, compared to a matched, wellbeing-as-usual control condition, demonstrated improvements in self-reported emotional control (i.e., the ability to moderate emotional reactions), mindfulness, optimism, and perspective-taking, and were rated by peers as more prosocial and accepted. Further, participants reported reductions in depression and were rated by peers as less aggressive. These findings support the ecological effectiveness of a school-based wellbeing program which is similar to the positive education framework in its focus on building social-emotional competencies via PPIs, mindfulness training, and pro-social activities.

Further support for the efficacy of school-based wellbeing programs to enhance ER capacity comes from the work of Tak, Kleinjan, Lichtward-Aschoff, and Engels (2014), who evaluated the long-term effects of a school-based wellbeing program on cognitive coping. This randomized controlled trial of 1341 adolescents involved 16 weekly (50 minute) teachings on CBT principles, coping, decision-making, and problem-solving. Post-intervention, the intervention group reported small improvements in cognitive coping compared to controls. Cognitive coping increased further by the 6-month follow-up, indicating that ER-related skills continued with ongoing practice. Together, these findings provide preliminary evidence that school-based PPIs can enhance students' ER capacity, and

justify further examination of the role of ER in positive education program outcomes to determine if initial findings generalize to other youth samples.

Finally, in a college sample of 113 older adolescents (*M* age = 22, 78% female), Weytens et al. (2014) delivered a group-based wellbeing program that explicitly incorporated PPIs in an ER framework. This program involved explicit teaching of Gross' (1998) Process Model of ER, with a focus on up-regulating positive affect via the use of PPIs categorized under all five families of ER strategies (i.e., *situation selection* & *modification*, *attentional deployment*, *cognitive change*, and *response-modulation*). In a series of six weekly workshops, participants were encouraged to identify and employ different PPIs before, during, and after daily events, in order to positively influence their experiences. This positive emotion regulation program was then compared against a wait-list control condition and a validated, Loving Kindness Meditation PPI (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008). Results revealed significantly lower participant drop-out in the positive ER group compared to the Loving Kindness Meditation group. Relative to controls, the positive ER group reported increases in subjective wellbeing and life satisfaction and decreases in depression and physical symptoms. This research provides preliminary support for the use of the Process Model of ER as an organizing framework for the delivery of PPIs in group settings, however it must be noted that the researchers did not measure change in ER capacity post-treatment, and this is an important limitation. Further research is required with larger and younger samples to determine whether the adoption of an ER framework may also benefit a wider array of PPIs, including those implemented in positive education programs.

3.1. Is emotion regulation a mechanism for change in school-based positive psychology interventions?

The potential mechanisms via which school-based PPIs lead to improvements in wellbeing remain to be examined extensively, and the role of ER in such outcomes are currently unclear. If PPIs indeed represent a subset of ER strategies, it is possible that wellbeing outcomes resulting from PPIs are attributable to improvements in ER capacity. Further, incorporating established ER interventions (targeting the regulation of both positive and negative affect) into school-based PPIs may supplement current content to deliver a more comprehensive and effective positive education program. Another likely benefit relates to identifying students in need of the wellbeing intervention provided by positive education. In circumstances in which allocation to school-based PPIs are selective, for example, due to issues of cost or availability, ER capacity could be used to identify adolescents likely to

benefit most, thereby assisting allocation and delivery of these programs. In sum, understanding the role of ER to positive education can be be used to further refine the content, delivery, and ultimately, the efficacy of positive education.

Evaluations of group-based interventions with adolescent samples reveal that increasing ER capacity via education about emotions, communication skills, and stress management can increase positive affect and satisfaction with life (see Quoidbach et al., 2015), and reduce negative affect and stress (Horn, Pössel, & McCraty, 2011; McCraty, Atkinson, Tomasino, & Goelitz, & Mayrovitz, 1999). In relation to school-based PPIs, an Australian study suggests that ER capacity may in fact moderate the relationship between participation in positive education and subsequent changes in wellbeing (Vella-Brodrick, Rickard, and Chin, 2014). These researchers conducted a 12-month prospective investigation of the efficacy of a best-practice positive education program with 119 Year 9 students, and demonstrated that a young person's cognitive ER capacity may influence their response to positive education. Specifically, it was found that students' cognitive coping style could distinguish those whose life satisfaction increased over the year from those whose life satisfaction remained stable or declined. Students with higher life satisfaction used more positive strategies (e.g., savoring the moment) in response to positive events and fewer negative strategies (e.g., avoiding the situation; taking my negative feelings out on others) in response to negative events, when compared with students whose wellbeing decreased or remained stable. Students who displayed this adaptive ER pattern were able to increase their life satisfaction compared to students who reported a less adaptive pattern of ER. Similarly, in an investigation of 56 young adolescents (M = 11.88, 45% female), Gentzler, Ramsey, Yi, Palmer, and Morey (2014) found that effortful control (i.e., the capacity to direct attention and control behavior) predicted more savoring and positive affect in response to real-life, intense, positive emotional events than did adolescents' attachment security to caregivers. Together, these findings suggest that capabilities closely related to ER (i.e., cognitive coping and control) contribute to positive outcomes targeted by school-based PPIs, and shed light onto the pathway through which positive education programs lead to improvements in wellbeing. Further research is needed to replicate such findings using direct measures of ER, in larger and more diverse adolescent samples, and in the context of positive education programs.

Summary and Conclusions

Previous research indicates that the use of adaptive ER strategies constitutes a protective factor that promotes psychological flexibility, resilience and wellbeing in youth (Ciarrochi et al., 2008; Kashdan & Rottenberg, 2010; Quoidbach et al., 2010). Positive education programs are school-based wellbeing interventions that implement PPIs in order to increase psychological wellbeing and reduce mental ill-health. Despite considerable overlap between school-based PPIs and ER models, the role and relevance of ER to positive education programs remains unclear. The purpose of this review was to evaluate the relationship of ER to positive education wellbeing programs targeting adolescents. Three aims were identified. First, to evaluate the relationship of ER to domains of wellbeing targeted by school-based PPIs. Second, to examine whether school-based PPIs can improve adolescents' ER capacity. Third, to evaluate the role of ER in wellbeing outcomes following school-based PPIs. Results support the relevance of ER to domains of wellbeing outlined by the extended PERMA model. Within the domain of positive emotions (P), it has been shown that ER capacity is prospectively related to positive affect, can protect against the development of negative affect, and mediates the relationship between exposure to stress and life satisfaction. In relation to positive engagement (E), the use of self-reported ER strategies has been found to promote wellbeing via social and emotional engagement. Further research is required to clarify the relationship between flow, goal-setting, and ER. In the domain of positive relationships (R), a greater capacity for ER is associated with better social adjustment, with some emerging research indicating that generating compassion towards others comprises and effective ER strategy. Research investigating positive purpose (M) and ER is scarce, yet preliminary findings suggest that cultivating a positive sense of purpose can be understood to fall under the *cognitive change* family of ER. Within the domain of positive health and resilience (H), a growing body of literature indicates that mindfulness practice may enhance ER capacity via cultivating non-reactivity and non-judgmental awareness of emotional, cognitive, and physical experiences. An important caveat to these findings, however, related to the small and heterogeneous group of interventions examined in the current review. Further research is vital for a comprehensive understanding of the role of ER in relation to PPIs in adolescent samples. In relation to positive education programs and similar school-based wellbeing programs, preliminary evaluations suggest that abilities conceptually related to ER (i.e., cognitive coping and control) can influence the degree to which students benefit

from participation in such programs. It remains to be determined whether ER capacity is improved as a result of exposure to positive education programs, however emerging research indicates that similar wellbeing programs delivered in school and university settings can improve ER and related constructs.

Questions requiring additional investigation include the degree to which ER capacity influences, and is implicated in, the process of positive changes in wellbeing, whether positive education programs enhance ER capacity in youth, and how current positive education programs might be enhanced through an understanding and incorporation of ER into PPI theory and practice. Although the PERMA wellbeing model provides a conceptual framework for positive education, it does not provide a comprehensive explanatory model outlining *how* positive education enhances wellbeing. One might argue, therefore, the need for an integrated framework that provides insight into the possible mechanisms by which PPIs lead to benefits in wellbeing, such as the Process Model of ER (see Quoidbach et al., 2015). As the popularity of PPIs and positive education programs continue to grow, so does the opportunity to extend understanding of the mechanisms underlying their effectiveness via examining them from an ER perspective. This knowledge may then be used to further promote the psychological wellbeing of adolescents – a defining goal of the positive education model.

Chapter Three: Study 1

Multi-method Assessment of Emotion Regulation: Longitudinal Covariance of Heart Rate Variability and Self-Report Measures in an Australian Adolescent Sample

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Abstract

Cross-sectional evidence suggests that heart rate variability (HRV) provides an index of emotion regulation (ER) capacity in adolescents. However, it remains unclear whether HRV is sensitive to change in ER over time, and whether HRV is associated with the characteristic use of adaptive ER strategies. *Method:* This study of 101 adolescents (aged 14-16 years, 36% female) examined correlations between change in HRV measures and self-reported ER strategies across two time points. *Results:* As predicted, change in high-frequency HRV predicted change in cognitive difficulties in ER, as measured by the Difficulties in Emotion Regulation Scale total score. Difficulties in emotional clarity – the ability to identify, understand and differentiate emotional experiences – was the only self-reported ER dimension consistently predicted across multiple HRV measures. HRV was not significantly related to any adaptive ER strategies examined. *Conclusions:* Overall, these findings suggest inconsistent relationships between different assessments of HRV and self-reported ER strategies in young people, supporting the incorporation of multiple ER measures in studies of adolescent wellbeing.

Keywords: adolescence; emotion regulation; heart rate variability; respiratory sinus arrhythmia; self-regulation

The emergence of emotion regulation (ER) is a critical feature of adolescent development that has immediate and potentially long-term consequences for the mental health of young people (Ahmed, Bittencourt-Hewitt, & Sebastian, 2015). ER involves the initiation, inhibition and modulation of emotional experience and expression to allow the individual to flexibly adapt to environmental demands (Thompson, 1994), which occurs via complex interactions between physiological, cognitive, expressive and behavioral processes (Adrian, Zeman, & Veits, 2011). Although adaptive emotional responses that are consistent with environmental conditions or personal goals contribute to mental health and wellbeing, rigid or contextually inappropriate emotional responses (i.e., emotional dysregulation) impair health, damage social engagement, and contribute to psychological distress and dysfunction (DeSteno, Gross, & Kubzanski, 2013). There is now considerable evidence to suggest that many of the neurocognitive and socio-emotional changes particular to adolescence create a unique window in which both the capacity for adaptive ER increases, as well as the risk of developing ER deficits (see Ahmed, Bittencourt-Hewitt, & Sebastian, 2015). Thus, the developmental period of adolescent has been identified as an important target for research and interventions focusing on the relationship between ER and mental health (Beauchaine, 2015).

Due to the multidimensional nature of ER and the difficulties involved in measuring largely unobservable, internally-driven emotional processes, inferences about ER will ideally be based on the convergence of data drawn from multiple levels of assessment (Beauchaine, 2015). Until recently, however, the majority of ER research in adolescent samples has relied chiefly on self-report questionnaires (Adrian et al., 2011). Although self-report is an effective tool for accessing cognitive and behavioral ER strategies, it is also limited by factors such as the respondent's degree of emotional literacy, capacity for self-reflection, and motivation. For example, automatic and unconscious (typically physiological) processes that contribute to ER cannot be assessed via self-report (Thayer, Ahs, Fredrickson, Sollers III, & Wager, 2012).

Incorporating physiological assessments can therefore complement self-report by measuring the otherwise unobservable psychobiological processes involved in ER. A range of physiological systems are implicated in ER, including the brain (e.g., the orbitofrontal cortex, anterior cingulate cortex, amygdala and temporal-occipital cortices; Ahmed, Bittencourt-Hewitt, & Sebastian, 2015), and parasympathetic and sympathetic branches of the central nervous system (Thayer & Lane, 2000). Heart rate variability (HRV) has been identified as a particularly useful psychophysiological measure of ER (Mather & Thayer, 2018). By capturing beat-to-beat variations in heart rate, this provides a non-invasive index of

parasympathetically-mediated cardiac activity (Thayer & Lane, 2000). HRV has been linked to brain regions associated with cognitive, emotional, and behavior regulation, and it is considered to be a reliable physiological marker of adaptive ER capacity (Beauchaine & Thayer, 2015; Mather & Thayer, 2018). HRV may complement self-report by indexing the physiological, automatic processes that contribute to ER, while circumventing common reporting biases (Rickard & Vella-Brodrick, 2014). Given that HRV measurement involves minimal discomfort to participants and is both time and cost efficient, it is suitable for a wide range of clinical and research settings.

According to the *Model of Neurovisceral Integration* (Thayer & Lane, 2000), resting HRV reflects neurophysiological processes that contribute to executive cognitive control, while self-report measures of ER capture the subjective outcome of such processes – those cognitive and behavioral strategies consciously used by the individual to manage, modify or respond to emotional experiences (Park & Thayer, 2014). Consistent with this framework, a growing body of evidence shows that lower tonic HRV is reflective of greater difficulty engaging in ER processes, while higher resting HRV is associated with more adaptive and functional cognitive processing and ER (see Park & Thayer, 2014, for a review). In adolescents, HRV is negatively associated with subjective reports of stress (Oldehinkel et al., 2011), and positively associated with self-reported ER capacity and cognitive control (Chapman, Woltering, Lamm, & Lewis, 2010; Scott & Weems, 2014). Notably, HRV has also been found to improve following a targeted ER intervention in youth (N= 134, Mage = 15.3), an outcome that further highlights the link between HRV and cognitive ER processes (Bradley et al., 2010).

Although it is now widely accepted that HRV and self-reported ER are related, few studies have directly assessed the reliability and strength of this relationship. In cross-sectional research with 168 university students, Williams et al. (2015) correlated HRV and a range of self-reported ER difficulties. They found that after controlling for a number of variables thought to influence HRV (i.e., age, body mass index, gender, ethnicity), lower resting HRV was associated with greater self-reported problems of ER. Similarly, Nardelli et al. (2015) compared numerous HRV measures (e.g., time- and frequency-domain measures) in a normative sample of 29 young adults categorized as high or low on a range of ER difficulties. Significant, inverse relationships were found between all ER difficulties and HRV measures, regardless of the statistical method used to calculate HRV, suggesting that as HRV decreases, so does one's regulatory flexibility (Nardelli et al., 2015).

These studies make an important contribution to the literature by confirming that HRV correlates with ER in expected directions, yet further research is required to determine whether HRV is a useful index of change in ER over time. Establishing the strength, stability and direction of *longitudinal* relationships between HRV and self-reported ER strategies is a valuable precursor to research investigating the development of ER throughout the formative adolescence years. It is also important for research that tracks change following wellbeing interventions that either directly or indirectly impact ER capacity in youth, such as clinical treatments for mental ill-health or school-based social and emotional learning programs (e.g., Tak et al., 2014). In addition to ER *deficits*, it is also important to consider whether HRV relates to *adaptive* ER strategies, such as acceptance, positive reappraisal and positive refocusing (Aldao & Nolen-Hoeksema, 2010; Beauchaine, 2015). Finally, it remains to be determined whether change in HRV is associated with change in self-reported ER in younger adolescents.

The principal aim of the current study was therefore to examine whether changes in HRV over two time points correlated with changes in self-reported indices of ER. Based upon previous research demonstrating cross-sectional correspondence between HRV and ER (Nardelli et al., 2015; Williams et al., 2015), it was hypothesized that significant, inverse relationships would be identified between change in HRV scores and change in self-reported ER difficulties. This study also sought to explore whether the previously established relationship between HRV and self-reported ER extends to younger adolescent samples, and beyond deficits of ER to include adaptive ER strategies.

Method

Participants and Procedure

Participants were 14 to 16 year-old, Year 10 students ($N = 101$, 36% female, 5% non English-speaking background) enrolled in one of three Victorian private schools, randomly recruited from a pool of consenting students participating in a larger, longitudinal study of Australian adolescent wellbeing. Data were collected during terms one and four of the school year, eight months apart. Informed consent was provided by students and their guardians prior to their commencement of the larger research project, and verbally by students prior to each testing session. Data collection occurred between 9am and 3pm throughout the school day. Participants arrived individually to a private, quiet, low-stimuli experimental room, where HRV was recorded before they completed ER questionnaires. The total duration for each monitoring session was approximately 15 minutes (5 minutes of HRV recording, 10 minutes

to complete the questionnaire). This study was approved by the University of Melbourne Human Research Ethics Committee. No payment for participation was provided. Students who declined participation after term 1 or otherwise provided incomplete data (i.e., missing full ER questionnaires or HRV data at time 1 or 2) were removed from the final analyses, resulting in a final sample of 86 young people (38% female). Reasons for missing data included absence from school on the day of testing, leaving the school since commencement of the research, or providing inconsistent identification codes on self-report data across each time point.

Materials

Heart rate variability.

To assess tonic HRV, electrocardiography (ECG) and respiration data were recorded by an integrated system and software package (Nexxus-10, Mind Media, 2004-2006), sampled at a rate of 1000Hz. Cardiac activity was monitored using disposable electrodes positioned in a standard, lead II (bipolar) configuration 1cm below the clavicle and on the lower ribcage (Bernston, Quigley, & Lozano, 2007). Breathing rate and rhythm were monitored with a respiration strap positioned around the abdomen. Breathing rates of less than 10 breaths per minute are recommended to yield maximum R-R interval power (Brown, Beightol, Koh, & Eckberg, 1993). Therefore, to control for the potential influence of respiration on HRV, participants observed a neutral breathing pacer set at nine breaths per minute throughout HRV recording. As recommended for recording periods of short duration, five minutes of continuous recording was obtained while participants rested in a still, seated position (Berntson et al., 1997).

Given the absence of consensus surrounding the "gold standard" approach to HRV measurement (Allen, Chambers, & Towers, 2007; Bernston et al., 1997), three measures were extracted using BioTrace software and examined in the current study – the Root Mean Square Successive Difference (RMSSD); the percentage of the absolute differences between consecutive IBIs that are greater than 50 ms (Pnn50); and high-frequency HRV (HF HRV). RMSSD reflects the beat-to-beat variance in heart rate, which is nominally independent of basal heart rate (Bernston, Quigley, & Lozano, 2007). As RMSSD filters out lower frequency variability, it is regarded a measure of respiratory sinus arrhythmia, that is, HRV that occurs in synchrony with respiration (RSA; Bernston et al., 2007). Similarly, HF HRV is a frequency domain (spectral) measure of HRV that occurs within the respiratory frequency range (0.15 – 0.40 Hz), also considered a marker of RSA. Finally, Pnn50 is a time-domain

measure of HRV reflective of respiratory-linked changes in heart rate, and thus also associated with RSA (Sandercock, Bromley, & Brodie, 2005). RMSSD, HF, and Pnn50 are thought to differentially reflect vagally-mediated parasympathetic influences on the heart (Allen et al., 2007; Peltola, 2012), and strong correlations have been found between them when assessed from 24-hour monitoring periods (r's = .92 - .98; Klieger et al., 1991), and from 5-minute periods measured at rest (*r*'s = .88 - .91; Allen et al., 2007). All three HRV measures examined have been recommended for use in psychophysiological research (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996; Quinntana et al., 2016).

Self-reported emotion regulation.

The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). The DERS includes 36-items and six subscales used to assess self-reported difficulties in ER relating to awareness, understanding, and acceptance of emotions (e.g., Awareness, Clarity, Non-acceptance); the ability to engage in goal-directed behavior or control impulsive behavior when experiencing negative emotions (e.g., Goals, Impulses); and access to effective ER strategies (Strategies). Items are scored on a five-point Likert scale ranging from 1 (almost never) to 5 (almost always), with higher scores reflecting greater difficulty in ER. The DERS has been validated for use in adolescent samples aged 12-17 years, and has good psychometric properties (e.g., Cronbach's α of all scales > .80; Neumann, van Lier, Gratz, & Koot, 2009).

The Cognitive Emotion Regulation Questionnaire – short version (CERQ-short; Garnefski & Kraaij, 2006).

Three CERQ subscales were used to measure the additional ER strategies of accepting emotional experiences (Acceptance); the ability to re-focus attention to pleasant experiences (Positive Refocusing); and to identify positive aspects of an emotional experience (Positive Reappraisal). These scales represent adaptive ER strategies used in response to unpleasant life events (e.g., '*I think that I can become a stronger person as a result of what has happened'*). Items are measured on a 5-point Likert scale ranging from 1 (almost never) to 5 (almost always), with higher scores reflecting greater use of adaptive ER strategies. The CERQ-short is suitable for use with adolescents aged 12 and above, and has acceptable internal consistency (Cronbach's α of all scales > .72) (Garnefski & Kraaij, 2006).

Data Analyses

The first 60-seconds of the five-minute HRV recording period were trimmed to ensure optimal relaxation and to exclude setting-related disturbances (Quintana et al., 2016). A time series of heart rate interbeat intervals (IBIs) was generated using Nexxus software (Mind Media, 2004-2006), and pre-processed and screened for artifacts, including ectopic beats, noise and participant movement. Data from three participants was excluded due to equipment malfunction. Raw IBIs were screened using the following criteria: (1) IBIs were between 500 and 1500 ms; and 2) IBIs differing by more than 25% from the previous IBI were considered an artifact and removed from analyses and replaced with interpolated data (IBI[n] = (IBI[n-1] + IBI)/2); Mind Media, 2004-2006). The mean percentage of artifact removed from each participant was 5.5% at time 1 (*SD* = 4.28) and 7% at time 2 (*SD*= 11.0). The remaining four minutes of HRV data were then processed in full, using both time- (RMSSD; Pnn50) and frequency-domain (HF HRV) measures.

ER self-report data were inspected for missing data. Four randomly missing items were substituted by the item mean score and rounded to a discrete value, before DERS and CERQ-short subscale scores were calculated for each participant as per the scale-developer's instructions (Garnefski & Kraaij, 2006; Gratz & Roemer, 2004).

The influence of potential covariates of HRV measures was examined via independent samples t-tests. There was no significant effect of gender on measures of HRV at time 1 (t (94) = -.304 to -.354, $p > 0.73$) or time 2 (t (91) = -1.26 to -1.63, $p > 0.11$,), and no significant effect of participant's self-reported level of relaxation at time 1 (t (88) = -1.77 to .390, $p > 0.70$) or time 2 (t (91) = -.526 to -.075, $p > 0.60$) therefore, these covariates were not examined in further statistical analyses. Given the small sample size, relationships between HRV and self-reported ER measures over time were examined by using change scores to increase the power of statistical models, control for baseline individual differences in HRV, and reduce the confounding influence of multiple comparisons (Oakes & Feldman, 2001). Change scores over time were calculated by subtracting Time 1 from Time 2 scores on all corresponding HRV and self-report ER variables. Six univariate outliers with z-scores > 3.3 were identified and imputed using the Winsor method (Ghosh & Vogt, 2012). All change scores were found to be normally distributed and a G* power analysis revealed that the sample size exceeded the required sample of 82 to reliably detect a medium effect size of 0.3. Finally, a series of Pearson's r correlation analyses were conducted to detect any significant, bivariate correlations between HRV and self-reported ER change scores. All statistical analyses were conducted using SPSS version 22.

Results

Descriptive statistics for both the raw and change scores in HRV and self-reported ER are presented in Table 3. Log-transformed HRV values are also reported, to facilitate comparisons with previous data. Correlation of variation calculations revealed that the reliability of HRV and self-report measures were highly varied, ranging from <1% to >100%. These findings are similar to those reported elsewhere (Sandercock, Bromley, and Brodie, 2005). Overall, significant improvement in the DERS Awareness subscale was observed between time points (t (85) = 2.11, $p < .05$), however there was no significant change for HRV measures nor other self-report subscales.

Mean values of RMSSD (58.6) in the current study were marginally higher than those reported in both a large sample of Brazilian male youth (RMSSD = 54.5; Farah et al., 2014), and moderately higher than a pooled, international sample of healthy adults (RMSSD = 42; Nunan et al., 2010). Conversely, log-transformed HF HRV values (3.86) were lower than those observed in short-term recordings of young adults published elsewhere (e.g., HFlg10 = 6.27; Yukishita et al., 2010).

Table 3. Descriptive Statistics for HRV and self-report raw & change scores.

Variable	Time 1			Time 2			Change (Time 2 – Time 1)			
	n	Mean	SD	*n*	Mean	SD	*n*	Mean	S.D	Range	CV(%)
RMSSD	97	58.64	28.26	93	60.35	26.82	89	2.73	29.08	-56 – 119	1 - 97
RMSSDlg10	97	1.71	0.22	93	1.74	0.20	89	.03	0.24	-0.66 - .73	0 - 33
Pnn50	97	76.26	32.77	93	34.11	18.50	89	2.42	21.67	-42 – 61	0 - 139
Pnn50lg10	97	1.36	0.45	93	1.43	0.36	89	0.10	0.52	-1.69 – 2.01	0 - 200
HF HRV	97	12357	15018	93	11672	12754	89	-698	15983	-66296 - 70457	3 - 129
HFlg10	97	3.86	0.46	93	3.85	0.46	89	0.01	0.50	-1.29 – 1.26	0 - 250
DERS total	92	79.36	17.23	94	73.95	19.89	86	-5.71	15.58	-44 - 45	0 - 49
CLARITY	92	21.00	10.70	94	10.18	3.05	86	-0.45	2.77	-6 - 7	0 - 47
AWARE	92	15.73	3.49	94	14.87	4.26	86	-0.87	3.83*	-12 - 9	0 - 53
STRATEGY	92	16.55	5.02	94	14.43	5.89	86	-2.31	4.84	-18 - 11	0 - 67
NON-ACP	92	11.92	4.72	94	11.03	4.93	86	-0.85	4.99	-19 - 11	0 - 77
IMPULSE	92	11.40	4.00	94	10.80	3.76	86	-0.63	3.04	-9 - 7	0 - 47
GOALS	92	13.05	4.09	94	12.64	4.15	86	-0.59	4.07	-8 - 14	0 - 82
ACCEPT	92	6.62	1.78	94	7.00	1.97	86	0.34	2.30	-5 - 6	0 - 64
REAPPR	92	6.76	2.01	94	7.17	1.73	86	0.34	2.11	-4 - 6	0 - 61
REFOCUS	92	5.09	2.00	94	5.23	2.06	86	0.17	2.11	-5 - 6	0 - 71

* $p < .05$ ** $p < .01$
SD = standard deviation; CV = coefficient of variation; RMSSD = root mean square of successive differences, in milliseconds; RMSSDlg10 = Natural log transformation of RMSSD; Pnn50 = percentage of the absolute differences between consecutive IBIs that are greater than 50 milliseconds; Pnn5-lg10 = natural log transformation of Pnn50; HF HRV = heart rate variability that occurs within the the high frequency range of 0.15 – 0.40 Hz; HFlg10 = natural log transformation of HF HRV; DERS total = Difficulties in Emotion Scale total score; CLARITY = DERS clarity subscale; AWARE = DERS awareness subscale; STRATEGY = DERS strategies subscale; NON-ACP = DERS non-acceptance subscale; IMPULSE = DERS impulses subscale; GOALS = DERS goals subscale; ACCEPT = CERQ-short acceptance subscale; REAPPR = CERQ-short positive reappraisal subscale; REFOCUS = CERQ-short positive refocusing subscale.

Results of Pearson's *r* correlation analyses are presented in Table 4. Analyses revealed that change in HRV, as measured by HF HRV, was significantly and inversely related to change

in participants' total DERS scores (r (81) = -.23, R^2 = 0.05). Significant inverse, small to medium relationships were also found between change in the DERS subscale of Clarity, and all three HRV indices (RMSSD, r (81) = -.29, R^2 = 0.08; Pnn50, r (81) = -.28, R^2 = 0.08; and HF HRV, r (81) = -.30, R^2 = 0.09). No significant relationships were found between HRV and the remaining DERS subscales of Awareness, Non-acceptance, Impulses, Goals, or Strategies, nor the CERQ subscales of Acceptance, Positive Refocusing, or Positive Reappraisal.

Table 4. Correlation matrix of change scores in HRV and ER variables

Measure	1	2	3	4	5	6	7	8	9	10	11	
RMSSD (1)												
Pnn50 (2)	.931**											
HF HRV (3)	.713**	.609**										
DERS total (4)	-.152	-.083	-.227*									
CLARITY (5)	-.287**	-.293**	-.296**	.630**								
AWARE (6)	-.157	-.154	-.111	.326**	.287**							
STRATEGY (7)	-.057	.024	-.214	.815**	.350**	.045						
NONACPT (8)	-.111	-.066	-.110	.810**	.513**	.100	.609**					
IMPULSE (9)	-.064	.005	-.063	.601**	.228*	-.061	.516**	.360**				
GOALS (10)	.005	.072	-.142	.678**	.242**	-.020	.516**	.434**	.399**			
ACCEPT (11)	.059	.091	.125	-.115	-.138	-.201	-.009	.073	-.190	-.093		
REAPPR (12)	.050	.039	.023	-.107	-.113	-.304**	.015	.034	-.130	-.008	.304**	
REFOCUS (13)	.119	.103	.008	-.119	-.109	-.192	.049	-.111	-.089	-.055	.121	.331**

* p <.05 ** p <.01

RMSSD = root mean square of successive differences; Pnn50 = ; HF HRV = heart rate variability in the high frequency range (.015 - .040); DERS total = Difficulties in Emotion Scale total score; CLARITY,= DERS clarity subscale; AWARE = DERS awareness subscale; STRATEGY = DERS strategies subscale; NON-ACCPT = DERS non-acceptance subscale; IMPULSE = DERS impulses subscale; GOALS = DERS goals subscale; ACCEPT = CERQ-short acceptance subscale; REAPPR = CERQ-short positive reappraisal subscale; REFOCUS = CERQ-short positive refocusing subscale

Discussion

The principal aim of this study was to determine whether changes in HRV measures across time were significantly related to changes across different, self-reported cognitive markers of ER in an adolescent sample. Results provided partial support for the hypotheses, revealing significant, negative correlations between change in HRV and a subset of self-reported difficulties in ER scores over an eight-month period. Specifically, change in HF HRV was inversely related to changes in the DERS total score, suggesting that decreases in HRV over time are reflected by overall increases in ER difficulties. These findings provide some empirical support for Thayer and Lane's (2000) Neurovisceral Integration theory, which links both HRV and self-reported ER to neurophysiological mechanisms of emotional, cognitive, and behavioral self-regulation.

Inverse relationships were also observed between change across all three HRV measures (RMSSD, Pnn50, HF HRV) and the DERS Clarity subscale, indicating that decreases across multiple assessments of HRV over time correspond to increases in ER difficulties relating to young people's ability to identify, understand and differentiate emotional experiences (Gratz & Roemer, 2004). The strength and direction of these relationships are comparable to previous data presented by Williams et al. (2015), who found that HRV (RMSSD) predicted approximately 6% of the variance in the DERS Clarity subscale. Notably, the DERS Clarity subscale captures skills central to emotional recognition, that is, the ability to understand and respond appropriately to emotional cues. Consistent with the current findings, Quintana, Guastella, Outhred, Hickie, and Kemp (2012) found that performance on an emotional recognition task was positively related to HRV, suggesting that skills of emotional recognition (or clarity) are foundational to building emotional competence. Indeed, skills of emotional clarity are considered precursors to engaging in further adaptive ER strategies (Ciarrochi, Heaven, & Supavadeeprasit, 2008). For example, in order to accept one's difficult or unpleasant emotional experience (i.e., engage in the ER strategy of acceptance), it is first necessary to identify and recognize that a difficult emotion has arisen (i.e., have a reasonable capacity for emotional clarity; Larsen, 2000). Similarly, the capacity to differentiate emotional reactions provides the individual with a more detailed, nuanced understanding of how environmental experiences shapes one's emotional experiences, allowing the individual to respond appropriately. Results of this study thus support the view that emotional clarity represents a particularly influential component of ER, which may moderate the extent to which an individual engages in further, cognitive ER strategies captured by the DERS and CERQ. Although more research is required to validate

these findings in different populations, this study provides preliminary evidence that both time- and frequency-domain measures of HRV provide an effective means to capture change in a limited subset of maladaptive ER strategies in a sample of Australian adolescents, over moderate timeframes (e.g., the academic school year).

Interestingly, change in HRV did not significantly correlate with change in the remaining DERS subscales of Awareness, Nonacceptance, Goals, Impulses, or Strategies. It could be argued, then, that HRV represents one of several important ER mechanisms; a finding that corroborates recent calls to incorporate multi-method, global assessment of ER in empirical research designs (Beauchaine, 2015; Rickard, Chin, & Vella-Brodrick, 2014). Results of the current research differ from a previous cross-sectional study that has demonstrated inverse relationships between HRV and five of six DERS subscales (Williams et al., 2015). This difference may be partly explained by variation in sampling characteristics – while the current study recruited Australian mid-adolescents, Williams and colleagues (2015) used an aggregate sample of United States college students. It is also possible that the modest sample size of 83 may have adversely affected the power of statistical analyses, particularly given the high degree of variability in HRV outcomes observed across studies (Sandercock et al., 2005). Alternatively, the 8-month follow-up period may have been too brief to detect significant change in some of the measures examined, despite research indicating change in HRV after only 9 weeks (Kok & Fredrickson, 2010). This explanation is consistent with previous research suggesting that HRV is relatively stable over periods of up to 18 months (Li et al., 2009). Future research with larger samples and a longer follow-up period is therefore required to clarify the relationships between HRV and cognitive aspects of ER.

The second aim of this investigation was to explore whether the relationship between HRV and self-reported ER extends beyond maladaptive ER strategies to include adaptive cognitive strategies, such as positive reappraisal. No significant associations were observed between any of the examined HRV measures and subscales reflecting adaptive ER strategies. As far as we are aware, these results are the first to investigate correspondence between HRV and responses on the CERQ-short. In light of the findings discussed above, the current analyses suggest that HRV more closely reflects a general pattern of dysregulated ER than an index of adaptive ER. Consistent with this, the association between low HRV and adolescent psychopathology is well-established (Beauchaine, 2015), and previous research has found that maladaptive ER strategies (e.g., rumination) load more highly on a latent cognitive ER factor than adaptive ER strategies (e.g., Reappraisal; Aldao & Nolen-Hoeksema, 2010).

Stronger, inverse relationships found between HRV and ER difficulties support the proposal that lower HRV represents an impaired capacity to modulate physiological systems (e.g., the vagal influence of the ANS) that facilitate higher-order, adaptive ER processes (Thayer & Lane, 2000). In other words, if ER capacity is impaired at a physiological level, this is likely to negatively impact higher-order executive functions such as cognitive ER strategies (Thayer et al., 2012). Conversely, the presence of an appropriately responsive ANS is likely to facilitate adaptive cognitive strategies, but in and of itself, is unlikely to be sufficient to produce them.

There are a number of limitations to this study that should be noted. First, the small sample size is likely to have adversely affected the generalizability of these results. Furthermore, since the sample comprised predominantly male, private secondary school students from an English-speaking background, our findings do not generalize to other populations. Further studies using larger samples of young people from culturally, socio-demographically, and gender diverse backgrounds are required to investigate the relationship between HRV and ER in adolescents more broadly. Second, certain extraneous variables thought to influence HRV were not measured and statistically controlled for in the current study (e.g. food and water intake, bladder filling, caffeine intake, inter-individual differences in time of HRV monitoring). However, to some extent, our measurement of change scores addresses inter-individual differences in HRV by providing greater accuracy of between-person differences in HRV and respiration rate than estimates of the mean or absolute level of vagal control, and by accounting for non-linear relationships between differences in HR and respiration (Quintana & Heathers, 2014). A third limitation relates to our specific approach to measuring HRV. In particular, the examination of change in HRV before, during, and after an emotion-inducing task may have provided insights into the relationship between HRV and self-reported ER beyond those that can be obtained by measuring HRV at rest. Finally, youth in the current study had, on average, higher time-domain measures of HRV compared to previously reported studies of adolescent males (Farah et al., 2014) and adults (Nunan et al., 2010). Such variation is somewhat unsurprising, given the broad variation in HRV reported elsewhere (Sandercock et al., 2005). Due to the paucity of normative data for adolescent samples to compare with our own, further research is needed to determine how HRV data in the current sample compares to similar populations. Additional research, using larger adolescent samples, experimental designs, and more extensive measurements of relevant covariates, is also required to address the abovementioned limitations of our study.

In sum, the current research is among the first to examine the dynamic relationships between HRV and multiple measures of ER. These findings support theoretical associations between HRV and emotional clarity, and contribute to the growing body of research supporting a multi-method approach to the assessment of ER in adolescents. Future research using larger samples and several time points could extend our understanding of the relationship between HRV and self-reported ER by shedding light on the particular ways in which self-reported ER and HRV interact over time – information that could, in turn, be used to inform the development of future interventions targeting ER in adolescent populations.

Compliance with Ethical Standards

All procedures performed in this study were in accordance with the ethical standards of the University of Melbourne Human Research Ethics Committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent was obtained from all individual participants included in the study.

Chapter 4: Study Two

The role of physiological and subjective measures of emotion regulation in predicting adolescent wellbeing

Morrish, L., Rickard, N., Chin, T.C., Sigley-Taylor, P., & Vella-Brodrick, D. (in press). The role of physiological and subjective measures of emotion regulation in predicting adolescent student wellbeing**.** *International Journal of Wellbeing.*

Abstract

Emotion regulation (ER) is a key contributor to psychosocial adjustment in adolescence, while ER deficits contribute to psychological distress and dysfunction. To date, research with adolescents has examined a limited subset of ER processes, often in relation to mental ill-health. This study examined associations between multiple ER measures and wellbeing in a normative sample of 119 adolescents (*M*age = 15.73). ER was measured using self-report and physiological (RSA) indices. Multiple measures of positive and negative functioning were examined. After controlling for covariates, hierarchical regression analyses revealed that self-reported ER predicted resilience, perseverance, connectedness, and happiness; and fewer depression and anxiety symptoms. Higher tonic RSA predicted resilience and perseverance. Effect sizes were small to moderate. Theoretical and practical implications are discussed.

Keywords: adolescence; emotion regulation; respiratory sinus arrhythmia; mental health; positive youth development; resilience; wellbeing

Adolescence is a period marked by vast emotional change, and the capacity for adaptive emotion regulation (ER) contributes to the successful transition into adulthood (Silk, Steinberg, & Morris, 2003). During adolescence, the capacity to successfully regulate emotional experiences facilitates the building and maintenance of social relationships (Halligan et al., 2013), bolsters positive affect (Tugade & Fredrickson, 2007), and promotes academic achievement (Ivcevic & Brackett, 2014). Conversely, the absence of adaptive ER skills and the development of maladaptive ER strategies contributes to psychological distress and dysfunction (see meta-analytic reviews by Aldao et al., 2010; Graziano & Derefinko, 2013). ER can, therefore, be regarded as a key feature of positive youth development, and of the wellbeing spectrum more broadly (Keyes, 2005).

ER is defined as the ability to manage, modify, and respond to emotional experiences in a contextually appropriate manner (Thompson, 1994). A multidimensional construct, ER involves a variety of physiological, cognitive, and behavioral processes that emerge as particularly relevant during adolescence development (Steinberg, 2016). Mid-adolescence, for example, involves a developmental window characterized by maturational disparity between the prefrontal cortex and limbic system, leading to a period in which emotion- and reward-driven behavior dominates rational decision making (Casey, Jones, & Hare, 2008). ER is thought to be a pre-requisite to effective impulse control, delayed gratification, and goal-directed behavior, and modulates emotion-driven urges (Davidson, Putnam, & Larson, 2000; Ochsner & Gross, 2005; Steinberg, 2016). Further, ER can buffer against the impact of early childhood experiences, biological and socio-cultural changes associated with puberty, and adverse environmental conditions on adolescent wellbeing (see Beauchaine 2015, for a review).

In contrast to the protective role of adaptive ER processes, ER disruption occurs when an individual's response to emotional arousal loses flexibility or is unresponsive to contextual demands (Cole, Martin, & Dennis, 2004). Once a dysregulatory pattern is established, it becomes maladaptive and may sustain or promote mental ill-health (Berking & Wupperman, 2012). As such, limited access to adaptive ER strategies and use of maladaptive strategies impairs wellbeing and contributes to the development of numerous forms of psychological distress and disorder (see meta-analytic reviews by Aldao et al., 2010; Graziano & Derefinko,

2013). To date, the majority of ER research with young people has focused on its relation to psychological dysfunction. This is certainly warranted, given that adolescence is a period of risk for the onset of mental distress and ill-health and deficits of ER represent a common feature of numerous mental disorders (Aldao et al., 2010). However, emerging theory suggests that processes of ER also contribute to positive psychological functioning in adolescent (Morrish, Rickard, Chin, & Vella-Brodrick, 2017) and adult samples (Quoidbach, Mikolajczak, & Gross, 2015), and despite these investigative inroads, empirical investigation of the role of ER to a broad range of measures of positive functioning in young people remains under explored. This represents a clear gap in our current understanding and fails to acknowledge the full spectrum of mental health, which includes distinct dimensions of positive and negative functioning (Westerhof & Keyes, 2010).

Emotion regulation and adolescent wellbeing

Consistent with contemporary definitions of wellbeing as the combination of feeling good and functioning well (Huppert, 2009), wellbeing involves positive functioning across a range of biopsychosocial domains. The PERMA model (Seligman, 2011) identifies five interrelated facets including Positive emotion, Engagement, positive Relationships, Meaning or purpose in life, and Accomplishment. In principal, the same ER processes that protect against the development of mental ill-health can also be utilized to promote positive psychological functioning, and PERMA specifically, in young people. To elaborate, adaptive ER involves harnessing one's physiological and cognitive resources in order to (i) select an appropriate strategy to influence one's affective experience and actions; and (ii) promote goal-attainment in emotionally charged situations (Gratz & Roemer, 2004). These abilities become particularly important in the face of setbacks, challenges, or competing goals (Ivcevic & Brackett, 2014). By engaging one's adaptive resources, processes of ER likely play a driving role in the realization and maintenance of psychological health (DeSteno, Gross, & Kubzansky, 2013). For example, the use of adaptive cognitive ER strategies including reappraisal, savoring, and gratitude have all been found to enhance positive affect, while physiological measures linked to ER capacity (i.e., respiratory sinus arrhythmia) correlate with measures of trait positive affect and greater stability of positive affect in young adult samples (Fredrickson et al., 2003; Koval et al., 2013; Oveis et al., 2009; Quoidbach et

al., 2010; Tugade & Fredrickson, 2007; Wang, Liu, & Qin, 2013). Furthermore, in a sample of 210 undergraduate students (mean age = 21), Gross and John (2003) found that reappraisal strategy use was positively associated with six domains of wellbeing (Ryff & Keyes, 1995) including environmental mastery, autonomy, personal growth, self-acceptance, and positive relations with others; as well as measures of optimism, self-esteem, and life satisfaction. Conversely, a putatively maladaptive cognitive ER strategy, expressive suppression, was inversely related to these domains. Such findings demonstrate a link between at least two specific ER strategies and well-being, however, there remains a clear need to move beyond "the usual suspects" of reappraisal and suppression, and extend current knowledge by considering the relationship of a more comprehensive range of ER capabilities to positive functioning (Gratz, Weiss, & Tull, 2015).

Emotion regulation: A mixed-model approach

Given the multidimensional nature of ER, which involves both cognitive and physiological components, comprehensive assessment of its relationship to adolescent wellbeing requires a mixed-method approach (Beauchaine & Thayer, 2015), which in addition to self-report includes physiological measures of neural and cardiovascular processes underlying ER (DeSteno, Gross, & Kubzanski, 2013; Thayer, Åhs, Fredrikson, Sollers III, & Wager, 2012). Typically, research with adolescent samples has involved only one method of measuring ER (Adrian et al., 2011). This approach is problematic as it limits cross-study comparisons and provides a partial understanding of the relationship of ER to mental health, and specifically, to positive aspects of psychological functioning that remain largely unexplored in mixed-method designs. Cognitive ER strategies, assessed via self-report, are most often represented in the literature and refer to the ways individuals think about their emotions to make sense of, manage, and respond appropriately to them (Garnefski et al., 2001). However, physiological indices of ER - thought to reflect an individual's capacity to engage in adaptive ER processes (Thayer et al., 2012) - are increasingly examined, and involve changes in neurocognitive and autonomic nervous system functioning associated with emotional experience and regulation.

Capturing physiological processes of emotion regulation: Respiratory Sinus Arrhythmia

A number of physiological indices of ER are available to psychological

researchers (e.g., electroencephalogram, functional magnetic resonance imaging, cortisol assays), of which respiratory sinus arrhythmia (RSA) is the most commonly cited measure in research with adolescents (Beauchaine, 2015). RSA is a measure of beat-to-beat intervals in heart rate that occur in synchrony with respiration, which reflects changes in the balance between sympathetic and parasympathetic influences on the heart (Thayer et al., 2012). RSA provides an index of autonomic influence on prefrontal cortical activity and executive functioning, and as such, represents a non-invasive measure of ER capacity (Thayer, Hansen, Saus-Rose, & Johnsen, 2009). More specifically, RSA is thought to represent an individual's physiological capacity to appropriately and flexibly meet environmental demands (Li et al., 2009; Rickard & Vella-Brodrick, 2014). Tonic RSA (i.e., taken at rest) is thought to represent a global measure of ER capacity, with higher values indicating a greater general aptitude for ER (Appelhans & Leucken, 2006). Lower values, conversely, are predictive of mental ill-health (Beauchaine & Thayer, 2015).

As an overall measure of regulatory capacity, tonic RSA may represent for example, how successfully the body mobilizes cognitive and metabolic resources during times of stress (e.g., during a class presentation) and engages in restorative functions and reducing energy expenditure when environmental demands decrease (e.g., once the presentation is completed). The use of tonic RSA to assess ER capacity, in this regard, can be likened to the measurement of muscle mass as a proxy for overall body strength. Importantly, tonic RSA supports efficient cognitive ER processes, and thus contributes to effective ER above and beyond the use of ER capacities captured via self-report alone (Hildebradt, McCall, Enger, & Singer, 2016). More specifically, RSA is thought to facilitate effective cognitive processing of emotional experiences by enhancing executive functioning and impulse inhibition (Thayer et al., 2012; Park, Van Bavel, Vasey, & Thayer, 2012). Thus, individual differences in RSA may reflect differences in the capacity to inhibit unhelpful responses to emotional stimuli and engage in more adaptive processes, which in turn, is likely to promote differentiated and appropriately-matched responses to environmental stressors (Lang, Bradley, & Cuthbert, 1990; Thayer & Lane, 2000). Moreover, assessment of RSA can bypass the reporting biases associated with self-report and is considered an objective measure of ER capacity (Appelhans & Leucken, 2006; Walker, Pfingst, Carnevali, Sgoifo, & Nalivaiko, 2010).

In young adults, measures of RSA are found to be inversely related to self-reported ER difficulties (Williams et al., 2015) and markers of mental ill-health (Beauchaine, 2015). Notably, lower resting RSA is primarily linked to mental distress in young people diagnosed with, or at high-risk of developing, mental disorders (see review by Beauchaine, 2015). RSA may also protect against the detrimental effects of stress and enhance positive psychological functioning, with research of vulnerable youth finding that individuals with higher tonic RSA displayed greater resilience in the face of stress, and were rated as more popular with peers (Kim & Cicchetti, 2010). Research with adult samples has also linked higher tonic RSA to increased recovery from stress (Souza et al., 2007; Souza et al., 2013). The ability to effectively regulate emotions and inhibit unhelpful impulses also contributes to successful social functioning, and RSA has been linked to social connectedness (Geisler, Kubiak, & Siewert, 2013) in adults, in children (Patriquin, Lorenzi, Scarpa & Bell, 2014), and in adolescents with autistic spectrum disorders (Partiquin, Scarpa, Friedman, & Porges, 2013). It remains unclear, however, whether the buffering effect of higher tonic RSA against mental ill-health extends to non-clinical and community-based adolescent samples, and how RSA relates to a broader range of markers of positive psychological functioning in adolescent groups, for example, engagement, perseverance, and optimism.

The current study

The current study aimed to address the aforementioned gaps in the literature by examining the cross-sectional relationship between ER and wellbeing in a healthy adolescent sample. Both positive and negative functioning are central to understanding resilience, wellbeing, and mental health in adolescent samples (Rickard, Chin, & Vella-Brodrick, 2016). Therefore, to reflect the full spectrum of mental health (Keyes, 2005; Westerhoff & Keyes, 2010), the relationship between ER and numerous measures of positive functioning and mental distress was examined. Consistent with best-practice recommendations (Beauchaine, 2015), a multi-method approach was used to measure ER by including both self-reported ER and RSA. The evaluation of self-reported ER provides access to the conscious strategies and unobservable processes typically used by individuals in the face of emotional experiences – that is, 'top down' processes linked to ER. The inclusion of RSA, on the other hand, provides an objective, physiological measure marker of ER

(Appelhans & Leucken, 20006; Thayer et al., 2012). RSA circumvents a number of potential limitations of self-report (e.g. response biases, limited insight, motivational level), while also capturing 'bottom-up' cortical and subcortical processes supporting the flexible, effective regulation of emotion (Park, et al., 2012).

Two empirical studies that have examined the association between RSA and other vagally-mediated measures of heart rate variability and self-reported ER found inverse correlations of small to medium magnitude between RSA and scales of the Difficulties in Emotion Regulation Scale (DERS), suggesting that although related, each measure captures unique variance of the ER construct (Visted et al., 2017; Williams et al., 2015). It is yet to be determined which components of ER – cognitive appraisals about the ER capabilities or underlying physiological processes, are most relevant to domains of adolescent well-being. Thus, the incorporation of both methods extends previous research that has focused primarily on self-reported ER processes in youth, and aims to provide a more comprehensive picture of the relationship of ER processes to adolescent functioning. Understanding the relative contribution of RSA and self-reported ER to adolescent well-being may inform the development of targeted ER interventions to enhance specific domains of wellbeing in young people.

It was predicted that ER capacity, as measured by lower self-reported ER difficulties and higher tonic RSA, would be positively related to resilience and domains of wellbeing thought to support optimal psychological functioning (i.e., flourishing) in adulthood, including engagement, perseverance, optimism, connectedness, and happiness (Kern et al., 2016). Second, it was predicted that ER capacity, as measured by lower self-reported difficulties and higher tonic RSA would be negatively related to symptoms of depression and anxiety.

Method

Participants

Participants were 187 secondary school students enrolled in Years 10 and 11 at one of five Victorian schools (2 Government, 3 Independent), randomly selected to complete the ER assessments from a larger sample of approximately 600 students participating in a school-based evaluation of adolescent wellbeing. Of the initial sample, 65 did not complete the full assessment (i.e., RSA monitoring, wellbeing and ER questionnaires). Reasons for incomplete data included absence from school on the day

of testing, internet dropout while completing online wellbeing surveys, or withdrawing from participation prior to completing all assessments. This resulted in a final sample of 119 students (52% female, 87% Australian, age range 14 – 18, *M* age = 15.73, *SD* = 0.87).

Procedure

Informed consent was provided by both students and their guardians prior to participation. Wellbeing data were collected via an online assessment battery, which participants of the larger study completed as part of scheduled wellbeing classes at their respective schools. ER data was collected within a two-week timeframe of the online assessment, and involved students individually presenting to a low-stimulus experimental room throughout the school day (8.30am – 4pm). Participants were provided details of the testing procedure, and verbally provided informed consent. To assess tonic RSA, electrocardiography (ECG) and respiration data were recorded by a trained experimenter using an integrated computer system and software package (Nexxus-10, Mind Media, 2004-2006. Following RSA recording, participants then completed a self-report battery of ER questionnaires. The total duration for data collection was approximately 20 minutes per participant.

Materials

Respiratory Sinus Arrhythmia (RSA). RSA occurs within the frequency of respiration (0.15 – 0.40 Hz); is considered a relatively stable measure of vagally-mediated heart rate variability (HRV, Li et al, 2009; Thayer & Sternberg, 2010); and is an appropriate HRV measure for short-term recordings of five minutes (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996).

To monitor RSA, researchers applied disposable electrodes in a standard Lead 2 bipolar configuration, approximately 1cm below the clavicle and on the lower ribcage (Bernston, Quigley, & Lozano, 2007). Respiration rate and rhythm were monitored via a sensor positioned around the lower abdomen. A neutral breathing pacer program was used to standardize breathing rate and rhythm, and was set at the recommended rate of 9 (< 10) breaths per minute in order to yield maximum R-R interval power (Brown, Beightol, Koh, & Eckberg, 1993). Given the potential for paced breathing to contribute to stress-related changes in RSA as a result of increased mental effort (Bernston et al., 1997), instructions were provided to participants to "try

and breathe along with this pacer, however if it feels difficult or unnatural, just breathe at a consistent, relaxed pace that feels right to you" (Kobayashi, 2009). Electrocardiography (ECG) and respiration data were then recorded at a sampling rate of 1000Hz by an integrated system and software package (Nexxus-10, Mind Media, 2004-2006). As recommended for RSA assessments of short duration, five minutes of continuous recording was obtained while participants remained in a still, seated position (Quintana et al., 2016; Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). RSA monitoring software was concealed from the participant during the recording, to avoid potentially confounding effects including increased sympathetic arousal, distraction, or interference of respiration or heart rate via biofeedback processes.

Self-reported Emotion Regulation Strategies. The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) includes 36-items and six subscales designed to assess perceived difficulties in ER relating to a) awareness and understanding of emotions, b) acceptance of emotions, c) the ability to engage in goal-directed behavior when experiencing negative emotions, and d) access to effective ER strategies. Items are scored on a five-point Likert scale ranging from 1 (almost never) to 5 (almost always), with higher scores representing greater ER difficulties (example item '*When I'm upset, I have difficulty controlling my behavior*'). The six subscales represent specific problems with ER, including lack of emotional clarity (Clarity; $\alpha = .82$); lack of emotional awareness (Awareness; $\alpha = .81$); difficulties controlling impulsive behaviors when distressed (Impulses; $\alpha = .89$); non-acceptance of emotional responses (Non acceptance; $\alpha = .94$); and limited access to effective emotion regulation strategies (Strategies; $\alpha = .91$). These subscales are then summed to calculate a total score (DERS total). The DERS has been validated for use in adolescent samples aged between 12 to 17 years (Neumann, van Lier, Gratz, & Koot, 2010), and the DERS total demonstrated good internal consistency in the current study ($\alpha = .85$).

Psychological Wellbeing. The EPOCH Measure of Adolescent Well-being *(*EPOCH; Kern, Benson, Steinberg, & Steinberg, 2016) is a 20-item, multidimensional self-report measure of adolescent wellbeing that assesses five positive psychological characteristics thought to foster flourishing (i.e., optimal psychological functioning) in adulthood (ie., PERMA; Seligman, 2011). Items are

rated on a five-point Likert scale, from 1 (almost never/ not at all like me) to 5 (almost always/ very much like me) and each scale is computed as the average of its four respective items. These scales measure engagement with valued activities (Engagement; α = .78; e.g., *'I get completely absorbed in what I am doing'*); persistence in the face of challenges or to achieve goals (Perseverance; α = .81; e.g., '*I finish whatever I begin*'); optimism (Optimism; α = .86; e.g., '*I am optimistic about my future*'); connectedness to peers and loved ones (Connectedness; α = .88; e.g., '*There are people in my life who really care about me*'); and subjective feelings of happiness (Happiness; α = .90; e.g., '*I feel happy*'). The EPOCH has been validated for use in adolescents aged between 10 and 18 years in Australia and the United States. Each scale has acceptable psychometric properties including construct and discriminant validity (Kern, et al., 2016), and had acceptable internal consistency in the current sample (α = .78 - .90).

Resilience. The Connor-Davidson Resilience Scale (CD-RISC; Campbell-Sills & Stein, 2007) is a self-report measure that conceptualizes resilience as positive adaptation following stress or adversity. It comprises 10 items (e.g., '*I believe I can achieve my goals even if there are obstacles'*), each of which is rated on a five-point scale ranging from 0 to 4. Scores range from 0 to 40, with higher scores reflecting greater resilience. The scale demonstrates excellent psychometric properties in late adolescent populations (*M* age = 18.8; Campbell-Sills & Stein, 2007). In the current study it showed excellent internal consistency (α = .90).

Mental Distress. The PHQ-4 (Löwe et al., 2010*)* is a four-item self-report screening tool used to detect the presence of core symptoms of depression and anxiety (e.g., '*In the past two weeks, how often have you been bothered by feeling nervous, anxious, or on edge?'*). Items are measured on a five-point Likert scale ranging from 0 (not at all) to 4 (nearly every day), with higher scores indicating the presence of greater mental distress. Scores on each scale range from 0 to 6, with scores of 3 or above indicating the likely presence of depression or anxiety. The PHQ-4 has been validated for use in the general population aged 11 years and over (Kroenke et al., 2009). In the current study, the depression subscale demonstrated borderline internal consistency (α = .68), while the anxiety subscale showed good internal consistency (α = .83).

Data analyses

RSA data were generated and pre-processed using the Nexus software package (Mind Media, 2004-2006). The first 60-seconds of the five-minute RSA recording was excluded from analysis, to ensure participants were settled and sufficiently relaxed. A time series of heart rate interbeat intervals (IBIs) were then generated. Raw IBIs were then screened for artifact using the following criteria: (1) IBIs were between 500 and 1500 ms; and 2) IBIs differing by more than 25% from the previous IBI were considered an artifact and removed from analyses and replaced with interpolated data (IBI[n] = (IBI[n-1] + IBI)/2); Mind Media, 2004-2006). The mean percentage of artifact removed from each participant was 3.6 seconds of data (*SD* = 5.90). The remaining four minutes of data were then processed in full, and RSA values (i.e., HRV in the high-frequency band of 0.15 -0.40 Hz) were extracted. RSA data was then log transformed to better approximate a normal distribution and meet assumptions of linear regression (Ellis, Soller, Edelstein, & Thayer, 2008). RSA and self-report data were entered into SPSS for all statistical analyses (version 23, IBM Chicago, IL, USA).

Four randomly missing items on the DERS and CD-RISC questionnaires were substituted by the item mean score, rounded to a discrete value, before subscale and total scores were calculated for each participant as per scale-developer's instructions (Gratz & Roemer, 2004). Two participants provided DERS scores ± 2 standard deviations from the mean, which were imputed using the Winsor method (item mean + (3 x SD)). No outliers were detected in EPOCH, CD-RISC, PHQ-4 subscales or HRV data.

To identify potential confounds previously documented in the literature, including age, sex, ethnicity, and SES, independent t-tests were conducted with the variables of interest (Currie et al., 2009; Nolen-Hoeksema & Girgus, 1994; Martinez & Dukes, 1997). No significant differences ($p > .05$) were found for sex or ethnicity on any of the examined measures of well-being, mental distress, or ER. Therefore, sex was not controlled for in subsequent analyses. As two of the privately funded schools were boarding schools, and two schools (1 public, 1 private) shared a postcode, postcode-generated SES was considered to be an inappropriate measure of social privilege in the current sample. Instead, school funding type (public or private) was used as an index of SES. Significant between-group differences were found for school type on measures of mental distress including PHQ-4 anxiety *(t* (117) = 4.64, *p*

<.001), PHQ-4 depression *(t* (117) = 4.96, *p* <.001), as well as RSA *(t* (117) = 2.80, *p* <.01). Pearson's bivariate correlations showed significant relationships between age and variables including PHQ anxiety *(r* = -.453, *p* <.001), PHQ-4 depression *(r* = -.399, *p* <.001), and RSA *(r* = -.259, *p* <.01). Thus, age and school were statistically controlled for in all analyses.

A series of hierarchical multiple regression analyses were then conducted to assess the relationship between ER (RSA and self-reported DERS total) and each of the wellbeing variables. Step one included the covariates of age and school type. Step two included the cognitive and physiological ER variables (i.e., DERS total and RSA, respectively). Due to expected multicolinearity, independent regression analyses were run for each EPOCH scale. All performed tests were two-tailed and analysed at a significance level of $p < .05$.

Results

Descriptive statistics for ER, well-being, and demographic characteristics are presented in Table 5. Results are presented for the total sample, and stratified according to sex.

Table 5. Descriptive Statistics for Emotion Regulation, Wellbeing & Mental Distress Variables, and Demographic Characteristics

Variable	Total (*N* = 119) *M* ± *SD*	Females (*n* = 62) *M* ± *SD*	Males (*n* = 57) *M* ± *SD*
DERS Total Score	76.08 ± 24.51	79.16 ± 28.94	72.74 ± 18.22
RSA	3.52 ± 0.50	3.54 ± 0.55	3.50 ± 0.45
EPOCH Engagement	17.35 ± 4.32	16.90 ± 4.47	17.84 ± 4.13
EPOCH Perseverance	16.97 ± 4.33	16.76 ± 4.49	17.19 ± 4.18
EPOCH Optimism	17.64 ± 4.87	17.11 ± 5.11	18.23 ± 4.56
EPOCH Connectedness	19.81 ± 4.27	20.26 ± 4.36	19.31 ± 4.15
EPOCH Happiness	19.29 ± 4.80	19.26 ± 5.01	19.33 ± 4.59
CD Resilience	36.85 ± 7.77	36.18 ± 8.03	37.58 ± 7.47
PHQ Depression	2.60 ± 1.87	2.68 ± 2.06	2.51 ± 1.66
PHQ Anxiety	2.69 ± 1.98	2.81 ± 2.25	2.56 ± 1.64
Age (years)	15.73 ± 0.87	15.82 ± 0.95	15.63 ± 0.77

Table 5 depicts the mean and standard deviation values on emotion regulation, wellbeing, and mental distress measures for the full sample, and stratified according to sex. DERS = Difficulties in Emotion Regulation Scale; RSA = log-transformed RSA; EPOCH = EPOCH Measure of Adolescent Wellbeing; CD Resilience = Connor-Davidson Resilience Scale; PHQ = Patient Health Questionnaire 4-item version.

Results of bivariate correlations showed a significant positive relationship between RSA and the EPOCH scale Perseverance ($r = 0.24, p < .05$) and CD-RISC Resilience ($r = 0.21, p < .05$). As predicted, significant negative relationships were found between DERS total scores (representing greater ER difficulties) and CD-RISC Resilience ($r = -0.36, p < .01$), and all EPOCH scales. Significant positive relationships were found between DERS total scores and mental distress, as measured by PHQ-4 Depression ($r = 0.46, p < .01$) and PHQ-4 Anxiety ($r = 0.40, p < .01$). A non-significant correlation was found between HRV and DERS total score ($r = 0.05$, $p > .05$). A correlation matrix of ER, wellbeing, and mental distress variables is presented in Table 6.

Table 6. Correlation matrix of Emotion Regulation, Wellbeing, and Mental Distress Variables (N = 119)

Measure		1	2	3	4	5	6	7	8	9
DERS Total Score	(1)									
RSA	(2)	.05								
EPOCH Engagement	(3)	**-.29****	.11							
EPOCH Perseverance	(4)	**-.36****	**.24***	.77**						
EPOCH Optimism	(5)	**-.40****	.09	.82**	.80**					
EPOCH Connectedness	(6)	**-.23***	.13	.55**	.63**	.71**				
EPOCH Happiness	(7)	**-.33****	.14	.74**	.68**	.87**	.75**			
CD Resilience	(8)	**-.36****	**.21***	.61**	.61**	.68**	.43**	.59**		
PHQ Depression	(9)	**.46****	.11	-.35**	-.42**	-.42**	-.38**	-.41**	-.27**	
PHQ Anxiety	(10)	**.40****	.10	-.19*	-.28**	-.28**	-.21*	-.29**	-.30**	.75**

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

Table 2 shows bivariate (Pearson's r) correlation coefficients between emotion regulation, wellbeing, and mental distress variables. Statistically significant coefficients are presented in bold font. DERS = Difficulties in Emotion Regulation Scale; RSA = log-transformed RSA; EPOCH = EPOCH Measure of Adolescent Well-being; CD Resilience = Connor-Davidson Resilience Scale; PHQ = Patient Health Questionnaire 4-item version.

Multiple hierarchical regression analyses showed that after controlling for age and school type, DERS total scores were significantly and negatively associated with all measures of wellbeing, consistent with our hypotheses. In relation to physiological

ER, RSA was positively related to both EPOCH Perseverance and CD-RISC Resilience. Semi-partial correlations squared (sr^2) revealed small to medium effect sizes for each significant predictor, which independently accounted for between 5% and 16% of the variance in well-being outcomes. A summary of the full hierarchical regression models in which both the DERS total score and RSA predicted wellbeing is presented in Table 7.

Table 7. Hierarchical Multiple Regression Models Examining Emotion Regulation Variables & Wellbeing

Hierarchical regression step	EPOCH Engagement	*B*	*β*	*t*	*p*	95% CI for Lower	95% CI for Upper	*r*	sr^2
Model 1	Age	0.02	0.01	0.04	.97	-1.26	1.31	-.05	.00
	School	-0.66	-0.08	-0.58	.56	-2.89	1.57	-.07	.00
R^2 = .01 (p = .73)									
Model 2	Age	0.08	0.02	0.13	.90	-1.16	1.32	-.05	.00
	School	-0.50	-0.06	-0.46	.65	-2.65	1.65	-.07	.00
	DERS Total	-0.05	-0.30	-3.32	**.001**	-0.08	-0.02	-.29	.09
	RSA	1.00	0.12	1.26	.21	-0.57	2.57	.11	.01
R^2 change = .10 (p = .003)									

Hierarchical regression step	EPOCH Perseverance	*B*	*β*	*t*	*p*	95% CI for Lower	95% CI for Upper	*r*	sr^2
Model 1	Age	-0.10	-.02	0.15	.88	-1.21	1.19	.06	.00
	School	-0.45	-.05	0.40	.69	-2.69	1.79	.07	.00
R^2 = .01 (p =.77)									
Model 2	Age	0.06	.01	0.10	.92	-1.12	1.24	.06	.00
	School	-0.13	-.01	0.12	.90	-2.17	1.92	.07	.00
	DERS Total	-0.07	-.37	4.36	**.000**	-0.95	-0.04	.36	.13
	RSA	2.18	.25	2.88	**.005**	0.68	3.67	.24	.06
R^2 change = .11 (p =.000)									

Hierarchical regression step	EPOCH Optimism	*B*	*β*	*t*	*p*	95% CI for Lower	95% CI for Upper	*r*	sr^2
Model 1	Age	0.07	0.01	0.09	.93	-1.37	1.50	-.08	.00
	School	-1.28	-0.13	-1.02	.31	-3.78	1.22	-.12	.01
R^2 = .02 (p =.41)									
Model 2	Age	0.09	0.02	0.13	.90	-1.24	1.42	-.08	.00
	School	-1.14	-0.12	-0.98	.33	-3.44	1.17	-.12	.01
	DERS Total	-0.08	-0.41	-4.78	**.000**	-0.11	-0.05	-.40	.16
	RSA	0.80	0.08	0.94	.35	-0.88	2.49	.09	.01
R^2 change = .17 (p =.000)									

Hierarchical regression step	EPOCH Connectedness	*B*	*β*	*t*	*p*	95% CI for Lower	95% CI for Upper	*r*	sr^2
Model 1	Age	-0.38	-0.08	-0.60	.53	-1.64	0.88	-.13	.00
	School	-0.68	-0.08	-0.61	.54	-2.86	1.51	-.13	.00
R^2 = .02 (p =.30)									
Model 2	Age	-0.32	-0.07	-0.52	.61	-1.56	0.92	-.13	.00
	School	-0.54	-0.06	-0.50	.62	-2.68	1.61	-.13	.00
	DERS Total	-0.04	-0.23	-2.60	**.01**	-0.07	-0.01	-.23	.05
	RSA	0.90	0.11	1.14	.26	-0.67	2.47	.13	.01
R^2 change = .06 (p <.02)									

Hierarchical regression step	EPOCH Happiness	*B*	*β*	*t*	*p*	95% CI for Lower	95% CI for Upper	*r*	sr^2
Model 1	Age	0.09	0.02	0.12	.91	-1.33	1.50	-.10	0.00
	School	-1.55	-0.16	-1.25	.21	-4.00	0.90	-.15	0.01
R^2 = .02 (p =.26)									
Model 2	Age	0.16	0.03	0.23	.82	-1.18	1.50	-.10	0.00
	School	-1.36	-0.14	-1.16	.25	-3.68	0.97	-.15	0.01
	DERS Total	-0.07	-0.34	-3.87	**.000**	-0.10	-0.03	-.33	0.11
	RSA	1.24	0.13	1.44	.15	-0.46	2.94	.14	0.02
R^2 change = .12 (p =.000)									

Hierarchical regression step	CD Resilience	*B*	*β*	*t*	*p*	95% CI for Lower	95% CI for Upper	*r*	sr^2
Model 1	Age	3.19	0.36	2.83	**.005**	0.96	5.42	.12	.06
	School	-5.13	0.33	2.62	**.01**	-9.00	-1.26	.08	.06
R^2 = .07 (p =.01)									
Model 2	Age	3.48	0.39	3.41	**.001**	1.46	5.50	.12	.08
	School	-4.54	0.29	2.57	**.01**	-8.05	-1.03	.08	.04
	DERS Total	-0.12	-0.37	-4.57	**.000**	-0.17	-0.07	-.36	.14
	RSA	3.97	0.26	3.06	**.003**	1.40	6.53	.21	.06
R^2 change = .19 (p =.001)									

Significant relationships between emotion regulation and measures of wellbeing are presented in bold font. DERS Total = Difficulties in Emotion Regulation Scale total score; RSA = log-transformed RSA; EPOCH = EPOCH Measure of Adolescent Wellbeing; CD Resilience = Connor-Davidson Resilience Scale; PHQ = Patient Health Questionnaire 4-item version.

As predicted, multiple hierarchical regression analyses revealed that after controlling for age and school type, DERS total scores were significantly and positively related to mental distress, as measured by PHQ-4 Depression and Anxiety subscales. Semi-partial correlations squared (sr^2) revealed medium effect sizes for self-reported ER (i.e., DERS total), which independently explained 21% of the variance in depression symptoms, and 15% of the variance in anxiety symptoms. RSA did not significantly predict symptoms of depression or anxiety. A summary of these analyses is presented in Table 8

Table 8. Hierarchical Multiple Regression Models Examining Emotion Regulation Variables & Mental Distress

Hierarchical regression step	PHQ Depression	*B*	*β*	*t*	*p*	95% CI for Lower	95% CI for Upper	*r*	sr^2
Block 1	Age	-0.45	-0.21	-1.79	.08	-0.95	0.05	-.40	.02
	School	-1.01	-0.27	-2.30	.02	-1.88	-0.14	-.42	.04
R^2 = .196 (p =.000)									
Block 2	Age	-0.439	-0.204	-1.99	.05	-0.88	-0.002	-.40	.02
	School	-1.040	-0.278	-2.72	**.008**	-1.80	-0.28	-.42	.04
	DERS Total	0.035	0.457	6.32	**.000**	0.02	0.05	.46	.21
	RSA	-0.128	-0.034	-0.46	.65	-0.68	0.43	.11	.00
R^2 change = .21 (p =.000)									
Hierarchical regression step	PHQ Anxiety	*B*	*β*	*t*	*p*	95% CI for Lower		*r*	sr^2
Block 1	Age	-0.79	-0.35	-3.00	**.003**	-1.31	-0.27	-.45	.06
	School	-0.59	-0.15	-1.30	.20	-1.50	0.31	-.40	.01
R^2 = .22 (p =.000)									
Block 2	Age	-0.78	-0.35	-3.27	**.001**	-1.26	-0.31	-.45	.06
	School	-0.63	-0.16	-1.52	.13	-1.46	0.19	-.40	.01
	DERS Total	0.03	0.39	5.26	**.000**	0.02	0.04	.40	.15
	RSA	-0.19	-0.05	-0.05	.54	-0.79	0.42	.10	.00
R^2 change = .15 (p =.000)									

Significant relationships between emotion regulation and measures of mental distress are presented in bold font.

DERS Total = Difficulties in Emotion Regulation Scale total score, RSA = log transformed RSA; PHQ = Patient Health Questionnaire

Discussion

This study examined the relationship between physiological and self-reported markers of ER and multiple measures of positive psychological functioning and mental distress in a normative, adolescent sample. Specifically, we sought to clarify the strength and direction of relationships between ER using subjective and objective indices and dimensions of wellbeing, resilience, and symptoms of depression and anxiety.

Emotion regulation and positive psychological functioning

It was hypothesized that ER capacity, as measured by lower self-reported ER difficulties and higher tonic RSA, would be positively related to resilience and domains of wellbeing including engagement, perseverance, optimism, connectedness, and happiness. As predicted, ER capacity significantly predicted numerous measures of wellbeing after controlling for the effects of age and school type, with small to medium effect sizes. Lower scores on the DERS total, indicative of poorer ER capacity, were inversely related to resilience and the wellbeing domains of perseverance, optimism, connectedness, and happiness. In addition, after controlling for the effects of age and school, significant positive relationships were found between RSA and resilience and perseverance. To our knowledge, this is the first study to examine the relationship between multiple measures of ER and wellbeing in a normative, school-based adolescent sample.

Results of this study indicate that ER is meaningfully related to aspects of positive psychological functioning in young people, with self-reported ER predictive of a broader range of wellbeing domains than RSA and with larger effect sizes. While previous research shows that deficits of ER contribute to mental distress and dysfunction, the current findings indicate that more adaptive ER profiles may also contribute to wellbeing in young people. Indeed, a selection of longitudinal research with adolescent and young adult samples support this position and show that ER capacity contributes to improvements in positive affect (i.e., Happiness; Yeung, Wong, & Lok, 2011) and peer acceptance (i.e., Connectedness; Kim & Cicchetti, 2010). Similarly, an adaptive, self-reported ER (positive refocusing) was found to mediate the relationship between optimism and subjective wellbeing (Yeung, Ho, & Mak, 2015), while improvements in life satisfaction were found over a 9-month

period in students displaying an adaptive cognitive coping style compared to those displaying less adaptive coping (Vella-Brodrick, Rickard, & Chin, 2014). Further, ER strategies including positive reappraisal (i.e., thinking about a challenging situation in a more positive manner) and attentional deployment (i.e., attending to non-threatening aspects of a situation) have been found to help individuals cope with a range of stressors across interpersonal and performance domains (Ivcevic & Brackett, 2014; Libbrecht, Lievens, Carette, & Cote, 2013; Troy & Mauss, 2011). The current findings build upon past findings examining limited ER strategies by demonstrating that a broader suite of ER abilities, that is, the ability to identify, select, and employ cognitive ER strategies, facilitates resilience and wellbeing in the face of stress and setbacks.

In addition to self-reported ER capacity, a novel contribution of this study is its examination of the relationship between an objective ER measure, RSA, and a comprehensive suite of measures of positive psychological functioning in young people. Previous examination of RSA specifically with adolescent samples has focused predominantly on negative aspects of functioning, such as mental ill-health (Beauchaine, 2015), antisocial behavior (Beauchaine, Gatze-Kopp, & Mead, 2007), and self-harm (Weildrus, Aldrich, Mezulis, & Crowell, 2016). Although there is increasing support for the role of RSA to social connectedness (Patriquin, et al., 2014; Partiquin, et al., 2013) and positive affect (Kok & Fredrickson, 2010; Oveis et al, 2009), it has not previously been examined in relation to additional wellbeing domains outlined by the PERMA model. The current research thus contributes to existing literature outlining the relationship between RSA and wellbeing, and supports theory positing that higher tonic RSA can facilitate the flexible engagement of ER processes (Appelhans & Leucken, 2006; Beauchaine & Thayer, 2015).

Our results demonstrate significant positive relationships between resting RSA and self-reported resilience and perseverance. Resilience measures an individual's capacity for adaptive functioning following stress or adversity (Campbell-Sills & Stein, 2007), whereas perseverance is characterized by tenacity in the face of challenges (Kern et al., 2016). Both abilities are supported by efficient cortical-subcortical integration, as reflected by high tonic RSA. To elaborate, RSA is thought to reflect output of the inhibitory cortico-subcortical neurocircuit of the central autonomic nervous system, which includes the brainstem, amygdala, insula, cingulate

cortex, and prefrontal cortex (Davidson, Jackson, & Kalin, 2000; Kemp & Quintana, 2013). This neurocircuit is involved in the regulation of visceral responses to emotional stimuli, a process that recruits executive functions such as the selection and implementation of appropriate cognitive ER strategies (Thayer & Lane, 2000; 2009). Resilience and perseverance are similar in that they involve adaptive functioning despite persistent or repeated exposure to emotionally challenging experiences, therefore a strong capacity to regulate underlying physiological arousal may be particularly important in cultivating these domains of positive functioning. Interventions designed to enhance RSA, such as cultivating mindfulness (Chambers, Gullone, & Allen, 2009), bio-feedback training (McCraty & Zayas, 2014), and enhancing physical fitness (Routledge, Campbell, McFetridge-Durdle, & Bacon, 2010), may be beneficial in bolstering resilience and perseverance in adolescent groups.

Consistent with this hypothesis, ER capacity can facilitate approach-behaviors in response to environmental stressors, such as persevering on a difficult homework assignment or managing ongoing interpersonal difficulties with teachers, peers, or parents (Troy & Mauss, 2011). In the context of a broader body of positive psychological research, resilience and perseverance appear conceptually similar to the construct of *grit*, defined as perseverance and passion for long-term goals (Duckworth, Peterson, Matthews, & Kelly, 2007). Results of a recent meta-analysis revealed that one facet of grit, perseverance of effort, predicts academic success after controlling for conscientiousness, a personality trait characterised by directedness and a will to achieve (Crede, Tynam, & Harms, 2016; McCrae & Costa, 1987). Further, it has been proposed that ER processes associated with RSA (e.g., the ability to inhibit strong emotional impulses), may share common underlying mechanisms with grit (Duckworth & Gross, 2014). Together, these findings shed light on the role of both physiological and cognitive ER processes in resilience and perseverance in school-age adolescents, and provides a promising direction to bolster resilience in young people, for example, via explicit teaching of cognitive ER strategies or modifying RSA via structured training (e.g., McCraty & Zayas, 2014).

Emotion regulation and mental distress

In relation to mental distress, we found moderate, inverse relationships between self-reported ER capacity and depression and anxiety symptoms, after

controlling for age and school type. Mental ill-health broadly involves the experience of one or more unpleasant emotions (e.g., sadness, fear) that is either too intense or endured for too long to be adaptive (Beauchaine, 2007). Difficulties identifying emotional distress, the belief that emotions are unchangeable, and the absence of adaptive ER strategies all represent ER difficulties that contribute to mental distress and disorder (De Castella et al., 2013; Hatzenbuehler et al., 2008). Unsurprisingly, deficits of ER are regarded as a transdiagnostic risk-factor for the development of mental ill-health in both adults and adolescents (Aldao et al., 2010; McLaughlin, Hatzenbuehler, Mennin, & Nolen-Hoeksema, 2011). Results of the current study show that moderate relationships between ER difficulties and mental distress exist even in a healthy, normative sample of young people (see also Garnefski, Kraaij, & van Etten, 2005; Garnefski, Legerstee, Kraaij, Van Den Kommer, & Teerds, 2002; Silk, et al., 2003). Based on these findings, it appears that mental health promotion for young people would benefit from including a greater emphasis on ER skills training, for example, increasing one's ability to acknowledge, identify, and actively modify difficult emotional experiences. These skills can be effectively taught in relatively brief training programs (Berking et al., 2008), may be built into existing mental health interventions accessible to a broad adolescent population, such as school-based social emotional learning programs (Hamilton & Hamilton, 2009).

Covariance of self-reported ER and RSA

The experience and regulation of emotion is thought to involve coordinated responses across subjective, cognitive, behavioral, and physiological measures (Marsh, Beauchaine & Williams, 2008). Results of the current study revealed negligible covariance between subjective reports of ER capacity and RSA (r = .05), suggesting that each measure captures distinct processes contributing to ER. These findings differ from previous research that reported significant, inverse, small to medium sized correlations between ER difficulties and a tonic measure of RSA in young adult samples in Norway (Visted et al., 2017) and the USA (Williams et al., 2015). Further research is needed to explore differences between the examined samples that may have contributed to these disparate results, such as the age of participants. Broader examination of the literature reveals that low covariance between experiential and physiological measures of emotion and related processes is commonly cited (Bonnano & Keltner, 2004; Evers et al., 2014), leading some researchers to conclude that the

correlation between emotional response systems is weak in the absence of intense emotional experiences or very specific contexts (Crowell et al., 2014; Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005). For example, Evers et al. (2014) draw upon the dual process framework, which propose that psychological responses comprise two largely independent processes – one automatic (e.g., physiological processes) and one reflective (e.g., subjective, experiential processes), and demonstrate that that low coherence exists between automatic (e.g. RSA) and reflective measures (e.g. self-report). Such findings reinforce the importance of adopting a multi-method approach to ER research in order to capture a range of ER processes, while also drawing to question the appropriateness of comparing research that has measured ER with considerably different measures (for a discussion of this issue, see Cole et al., 2004; Naragon-Gainey et al., 2017).

As this study involved cross-sectional data taken at a particular point in the school year, it cannot be determined whether the identified associations between ER and wellbeing represent stable relationships or if ER capacity plays a causal role in the development of adolescent wellbeing. This is a notable limitation. Further, longitudinal research is required to clarify whether ER capacity contributes to differences in wellbeing outcomes over time. Due to the small sample, which predominantly comprised Australian-born adolescents from English-speaking backgrounds, the generalizability of our findings to other adolescent groups is restricted. Certain factors thought to influence RSA could not be statistically controlled for in this study. These include variation in the time that RSA was assessed (i.e., at different times throughout the school day), body mass index, and possible caffeine, nicotine, or medication use by participants (Quintana & Heathers, 2014). It is likely that the use of a school sample limited potential variation on a number of these variables (e.g. caffeine & nicotine intake), however, results should be interpreted with these caveats in mind. Finally, the potential influence of common method variance in explaining the relationship between the self-report scales examined in this study, specifically between ER and wellbeing, may have contributed to the current findings and must be considered.

Despite these limitations, results of the current study position ER, and in particular self-reported ER strategies, as an important correlate of wellbeing in youth. Cultivating a young person's repertoire of adaptive ER skills and strategies may be a

promising target for interventions aiming to enhance wellbeing in adolescent populations, including treatments that seek to reduce symptoms of mental distress (Morrish et al., 2017). Our findings may be of particular relevance to school-based social-emotional literacy platforms, which represent early intervention programs seeking to enhance psychological health within a school cohort of students. Furthermore, the moderate correlations found between self-reported ER and EPOCH wellbeing domains suggest that youth-focused interventions seeking to enhance wellbeing might be further enhanced by including a greater focus on adaptive ER strategies (see also Lü, Wang, & Liu, 2013; Weytens, Luminet, Verhofstadt, & Mikolajczak, 2014). Due to their association with both physiological and self-reported ER, the current findings suggest that cultivating young people's ER capacity – both via physiological markers and self-reported strategy use – may provide a particularly valuable supplement to intervention programs seeking to bolster resilience and perseverance in the face of stress (Souza et al., 2013; Troy & Mauss, 2011). These qualities are key to positive psychological functioning and foster success across key challenges of adolescence including academic performance and navigating important life transitions (Zoloski & Bullock, 2012). Future research should explore the predictive value of specific ER skills and strategies to wellbeing, occurring across the various stages of the emotion-generation cycle (see Ochsner et al., 2009; Ochsner & Gross, 2005). Experimental designs that examine the impact of enhancing student's cognitive and physiological ER capacity on wellbeing outcomes are also recommended.

In sum, the current study provides clear support for the relevance of self-reported, cognitive ER capacity to young people's wellbeing and mental distress. It also adds uniquely to the existing literature by evidencing the contribution of RSA, a physiological marker of ER capacity, to both resilience and perseverance in a healthy youth sample. Recognising the relevance of both self-reported and physiological ER processes to positive psychological functioning in adolescents broadens the scope for ER-oriented interventions, which may be used to complement and enhance existing preventative and early intervention treatment approaches that aim to bolster adolescent wellbeing and encourage flourishing throughout adulthood.

Chapter 5: Study Three

The Influence of Emotion Regulation on Adolescents' Happiness and Social Connection Following a Positive Education Intervention: A Preliminary Study

Morrish, L., Chin, T.C., Rickard, N., & Vella-Brodrick, D. (submitted). The influence of emotion regulation on adolescents' happiness and social connection following a positive education intervention: A preliminary study. *Journal of Happiness Studies.*

Abstract

Positive education programs (PEPs) are effective in increasing adolescent wellbeing and reducing distress. However, their underlying mechanisms remain unclear. Emotion regulation (ER) is a potential candidate. This study examined the relationship of two self-report measures of ER with change in wellbeing in 44 Year 10 adolescents (50% female, *m* age = 15.1), following a year-long PEP compared to a wellbeing-as-usual comparison group (*n* = 36, 19% female, *m* age = 15.1). Results of linear mixed modelling revealed that ER meaningfully predicted change in wellbeing over time. Adolescents with low ER capacity in the PEP group showed improvements in happiness and social connection following PEP exposure, and benefits were sustained at least 6-months post treatment. Irrespective of group membership, greater ER capacity was associated with higher wellbeing and resilience, and fewer symptoms of depression and anxiety over time. PEP did not predict students' ER capacity over time. Theoretical and practical implications are discussed.

Keywords: adolescence; cognitive coping; emotion regulation; mental health; positive psychology; reappraisal; wellbeing

Enhancing adolescent wellbeing is a key focus of 21st century schooling, and school-based wellbeing programs have emerged as a popular platform to address increasing rates of mental ill-health observed within adolescent populations (Waters, 2011). Positive education, defined as "applied positive psychology in education" (Green, Oades, & Robinson, 2011, p.16), is a relatively recent school-based wellbeing intervention framework that incorporates both traditional academic skill development and evidence-based strategies to promote wellbeing and mental health (Seligman, Ernst, Gillham, Reivich, & Linkins, 2009). Best-practice PEPs are school-wide, long-term and embedded programs that incorporate empirically supported interventions derived from positive psychology and cognitive behavior therapy (CBT) (Norrish, 2016). When integrated into a full year of the school curriculum, PEPs are found to effectively increase students' positive emotions, peer interactions, cognitive and emotional engagement, and academic achievement (Shoshani & Steinmetz, 2014; Shoshani, Steinmetz, & Kanat-Maymon, 2016). Although the evidence-base supporting the efficacy of PEPs is growing, little is known about the underlying mechanisms that contribute to such positive psychological outcomes. A potentially important candidate that has received relatively scant attention in the positive education literature is ER.

Emotion regulation and adolescent wellbeing

ER refers to the constellation of processes by which individuals identify, manage, and modify emotional experiences to achieve personal goals and adapt to environmental challenges (Thompson, 1994). An individual's capacity to engage in cognitive processes of ER is particularly important to adaptive psychological functioning (Ochsner et al., 2012). These processes include the awareness, understanding and acceptance of one's emotional experience; the ability to control impulsive behaviors and behave in accordance with desired goals when experiencing negative emotions; and the ability to apply contextually appropriate ER strategies to flexibly modulate emotional responses (Gratz & Roemer, 2004). Conversely, difficulties in cognitive ER include an inability to identify, label, or accept emotional experiences; difficulties implementing effective ER strategies in response to emotionally challenging events; and problems engaging in goal-directed behavior when experiencing uncomfortable emotions (Gratz & Roemer, 2004). Processes of ER can occur across various stages of the emotion generation cycle, as outlined in Gross' (1998) Process Model of ER. This

model is described in depth elsewhere (Gross, 1998; 2014; Quoidbach, Mikolajczak, & Gross, 2015). In sum, his model distinguishes five phases in the emotion-generative process, during which different families of ER strategies may be implemented. The first family of ER strategies, *situation selection*, refers to engaging in situations that may increase positive affect or decrease negative affect, for example, choosing to participate in an enjoyed activity. The second family of ER strategies, *situation modification*, involves changing qualities of an existing situation to enhance one's experience of it. *Attentional deployment*, the third category, refers to directing attention to particular aspects of a situation to influence its emotional impact. The fourth category, *cognitive change*, involves thinking differently about the situation in order to change its emotional impact. The fifth group of strategies is *response modulation*, and refers to efforts to modify an emotional situation by controlling one's physiological, cognitive, and behavioral responses to it.

A greater capacity to engage in these ER processes contributes to more adaptive ER functioning, whereas deficits in any of these processes will lead to greater ER difficulties. Indeed, cultivating effective ER strategies is considered a key milestone of adolescent development, and possessing a greater cognitive ER capacity is associated with more positive affect and life satisfaction (Saxena, Dubey, & Pandy, 2011); higher scores on indices of wellbeing, including perseverance, optimism, connectedness, and happiness (Morrish, Chin, Rickard, Sigley-Taylor, & Vella-Brodrick, *in press*); and school success (Ivcevic & Brackett, 2014). Moreover, deficits in ER play a critical role in the development of mental ill-health and are implicated in a wide range of psychological disorders (Aldao, Nolen-Hoeksema, & Schweizer, 2010). As such, improving ER capacity is a key aim of numerous mental health interventions (Gratz, Weiss, & Tull, 2015).

In addition to the broader suite of cognitive functions thought to contribute to adaptive ER (Gratz & Roemer, 2004), the use of *reappraisal* in response to challenging emotional events represents a specific cognitive ER strategy that is particularly relevant to evaluations of wellbeing (Morrish, Rickard, Chin, & Vella-Brodrick, 2017). Reappraisal falls under the cognitive change family of ER strategies (Gross, 1998) and involves reframing an emotionally eliciting event to change its emotional impact; for example, by interpreting it in a more positive or less threatening light (Gross & Thompson, 2007). When used habitually, reappraisal is associated with adaptive psychological outcomes (Aldao & Nolen-Hoeksema, 2010; Gross & John,

2003; Naragon-Gainey et al., 2017; but see Troy, Ford, McRae, Zarolia, & Mauss, 2016)[1]. For instance, the use of reappraisal has been found to reduce negative emotions (Goldin et al., 2008; Webb, Miles, & Sheeran, 2012); to buffer individuals against the development of depression (Kraaij et al., 2002); to contribute to resilience during periods of stress (Tugade & Fredrickson, 2003; Troy & Mauss, 2011); and bolster positive affect (Shiota, 2006). Further, the process of reappraisal is thought to underpin a number of positive psychological interventions designed to enhance positive affect, such as cultivating gratitude, savoring, or hope (as reviewed by Morrish et al., 2017; Quoidbach et al., 2015).

Importantly, reappraisal is both a commonly studied and highly effective ER strategy (Birk & Bonnano, 2016), which is represented in numerous theoretical models of ER, including temporal-structural models (e.g., Gross & John, 1998), strategy-based models (e.g., Aldao & Nolen-Hoeksema, 2012) and ability-based models (e.g., Gratz & Roemer, 2004); see Naragon-Gainey et al. (2017) for a review of theoretical approaches to ER. Regardless of how ER is conceptualized, the habitual use of reappraisal has been identified as a specific, adaptive cognitive ER strategy that contributes to wellbeing (Belzarotti, Biassoni, Villani, Prunas, & Velotti, 2016; Gross, 2002) and is highly influenced by social and environmental conditions (McRae et al., 2017).

The role of emotion regulation in positive education

As highlighted previously, the role of ER processes remains to be explicitly examined in relation to PEP outcomes. However, a growing body of research suggests that both general cognitive processes of ER, and the use of the cognitive ER strategy of reappraisal, are central to the therapeutic frameworks that represent the 'building blocks' of PEPs; namely, CBT and positive psychology interventions (Compare et al., 2014; Morrish et al., 2017; Quoidbach et al., 2015). CBT teaches cognitive and emotional competencies such as thinking flexibly and accurately, emotional awareness and understanding, problem solving and decision-making. Collectively, these skills contribute to wellbeing and positive social functioning in young people when taught via school-based programs (Bird & Markle, 2012; Dobson, 2010), and CBT-oriented school-based interventions have been found to be effective in reducing

[1] For a detailed overview of these theoretical models of ER, see Naragon-Gainey, Tierney, McMahon and Chacko (2017).

depression, anxiety, and behavioral problems up to 12-months post-treatment (Brunwasser, Gillham, & Kim, 2009).

Positive psychology interventions incorporate another set of strategies that aim to cultivate pleasure, engagement and meaning, all of which predict aspects of wellbeing such as life satisfaction (Vella-Brodrick, Park, & Peterson, 2009). Positive psychology interventions are effective in improving wellbeing and reducing depression in adult and adolescent samples (Bolier et al., 2013; Sin & Lyubomirsky, 2009), and wellbeing, in turn, is associated with a constellation of positive outcomes relevant to school achievement, including productivity, effective learning, positive relationships, creativity, and prosocial behavior (Huppert & So, 2013).

In the context of PEPs, CBT and positive psychology interventions appear to have complementary functions, with each predominantly seeking to promote the adaptive regulation of negative and positive emotion, respectively. CBT primarily operates by reducing negative affective states (Brunwasser et al., 2009); for example, by teaching individuals to better tolerate difficult emotional experiences. In contrast, positive psychology interventions aim to enhance wellbeing by building a greater repertoire of strategies that can increase, maintain, or otherwise optimize positive and healthy emotional experiences (Sin & Lyubomirsky, 2009). Although targeting different affective states, both CBT and positive psychology interventions draw upon, and implicitly involve, processes of ER. To illustrate, CBT seeks to enhance one's coping resources by identifying relationships between thoughts and emotions (i.e., improving emotional awareness), directing attention to malleable aspects of a situation (i.e., implementing context-specific strategies), and engaging in activities that provide a sense of accomplishment or enjoyment (i.e., inhibiting unhelpful impulses and engaging in goal-directed behavior; Gratz & Roemer, 2004). Such skills help young people counteract negative or unhelpful cognitive styles, disengage from unhelpful behavioral patterns, and approach enjoyable or motivating activities in favor of depressogenic ones (e.g., to speak to a friend rather than withdraw when feeling down). These skills, while not explicitly framed as ER interventions, draw upon processes of ER and are ultimately designed to improve an individual's capacity to identify, manage, or modify emotional experiences to appropriately meet personal and contextual needs.

Similarly, processes of ER are implicated in contemporary models of positive psychology, which aim to enhance positive affect and functioning in individuals,

communities, and organizations (Gable & Haidt, 2005; Quoidbach, Mikolajczak, & Gross, 2015). Positive psychology interventions that promote positive affective states such as gratitude, hope, and savoring have been conceptualized as a specific subset of ER intervention that aims to enhance positive psychological functioning that can be applied in response to challenging events (Quoidbach et al., 2015). Indeed, positive emotions are thought to contribute to psychological and physical wellbeing by improving coping resources that can buffer against the detrimental effects of stress (Folkman & Moskowitz, 2000; Fredrickson, Tugade, Waugh, & Larkin, 2003; Tugade, Fredrickson, & Barrett, 2004). In relation to positive psychology interventions incorporated into PEPs, a number of specific strategies draw upon components of adaptive ER functioning (see Gratz & Roemer, 2004). For example, cultivating mindful awareness – a core component of PEPs – involves nonjudgmental awareness of inner experiences and thus draws upon the skill of emotional identification and awareness (Chambers et al., 2009; Ciarrochi, Heaven, & Supavadeeprasit, 2009; Kabat-Zinn, 2009), while the cognitive ER skill of inhibiting impulsive behavioral responses to meet personal or environmental goals is likely implicated in applying one's values to decision-making (e.g., turning down an opportunity to socialize in order to study). The use of active-constructive responding – that is, responding in a positive and active way towards others – often involves the ability to respond in a contextually-appropriate manner despite experiencing difficult or counterproductive emotions (e.g., congratulating a classmate on receiving an academic award despite feelings of disappointment about personally missing out). Similarly, the cultivation of self-compassion – providing kindness to oneself in times of disappointment or hardship – is thought to draw upon the cognitive ER strategy of reappraisal (Trompetter, de Kleine, & Bohmeijer, 2017). Finally, the use of gratitude – focusing on what one has to be thankful for in a given situation – is another example of reappraisal; that is, thinking about a situation in a way to feel more positive about it (Quoidbach et al., 2015). A summary of validated interventions included in PEPs and their relation to Gross' (1998) Process Model of ER is presented in Table 1.

Preliminary evidence reveals that PEP participation leads to improvements in outcomes conceptually related to ER. For example, evaluations of year-long PEP programs with adolescent samples have found that compared to controls, program participation leads to improvements in self-control (i.e., the ability to control one's emotions and behaviors to meet desired goals; Seligman, Ernst, Gillham, Reivich, &

Linkins, 2009) and medium to large improvements in self-efficacy (i.e., the perceived ability to manage stressful events; Shoshani & Steinmetz, 2014). School-based social-emotional learning programs that target domains of wellbeing similar to PEPs have also been found to improve students' emotional control, capacity for perspective-taking, and cognitive coping (Schonert-Reichl et al., 2015; Tak, Kleinjan, Lichtward-Aschoff, & Engels, 2014).

Moreover, emerging evidence suggests that a young person's ER capacity may influence their response to PEPs. Specifically, in a 12-month prospective study, Vella-Brodrick, Rickard and Chin (2014) evaluated the impact of a year-long, Australian Year 9 PEP on wellbeing outcomes. The researchers found that a young person's cognitive coping style on entering the program could distinguish students whose life satisfaction improved post-intervention from those whose life satisfaction remained stable or declined. Students with a more positive cognitive coping style demonstrated improvements in wellbeing over time, by optimizing positive experiences (e.g., via use of savoring) and using fewer maladaptive coping strategies (e.g., avoiding the situation) in response to unpleasant events. Similarly, Gentzler, Ramsay, Yu, Palmer & Morey (2013) found that adolescents with greater effortful control (i.e., the capacity to intentionally direct one's attention and behavior) demonstrated greater savoring and positive affect in response to real-life, positive emotional events.

Together, the aforementioned findings indicate that students with well-developed coping strategies may be better positioned to benefit from the strategies conveyed by PEPs. In order to optimally apply and adopt cognitive-driven positive psychology and CBT interventions, it has been argued that students must be equipped with a sufficient and developmentally appropriate capacity for ER (Brunzell, Stokes, & Waters, 2016). This may involve both general cognitive abilities necessary for adaptive ER (Gratz & Tull, 2004), as well as the habitual use of reappraisal, a specific ER strategy thought to be involved in PEP interventions (Morrish et al., 2017; Quoidbach et al., 2015). We propose, therefore, that ER represents a potential mechanism through which PEPs lead to improvements in wellbeing and protect against the development of mental ill-health. To test this hypothesis, and to address the paucity of research directly examining ER processes in the context of PEPs, the current study explored whether individuals with higher overall ER capacity and greater use of reappraisal prior to program engagement would show greater

psychological benefit from the PEP intervention than those with lower ER capacity and reappraisal use.

Table 9. Validated interventions included in the positive education program: Relationship to Gross' (1998) Process Model of emotion regulation

Intervention	Description	Stage of ER applied
Acts of Kindness	Seeking out & engaging in kind act towards others	Situation selection
Flow	Engaging in activities in which perceived challenge and skill level are in balance	Situation selection
Goal setting & planning (Behavioral activation)	Setting goals & developing strategies to achieve them	Situation selection
Gratitude	Adopting a grateful outlook	Cognitive change
Growth mindset	Belief that abilities can be developed through practice & perseverance	Cognitive change
Mindfulness	Directing attention to the current moment	Attentional deployment[2] Response modulation
Optimism	Imagining or expecting positive outcomes of future events	Attentional deployment
Savoring	A strategy to maintain or increase positive affect & experiences	Situation modification[3] Attentional deployment
Signature Strengths	Identifying & using character strengths in new ways	Situation selection

The present research

The current study represents one component of a larger study (Vella-Brodrick, Rickard, Hattie, Cross, & Chin, 2015; Vella-Brodrick et al., 2017) that examined the

[2] It is thought that mindfulness may relate to ER differently depending on the individual's stage of practice, and there is disagreement surrounding its relationship to Gross' (1998) process model. While some (e.g. Chambers et al., 2009; Teper et al., 2013) consider mindfulness to be distinct from cognitive reappraisal strategies, others (e.g. Garland et al., 2011; Webb et al., 2012; Quoidbach et al., 2015) categorize it as a form of reappraisal. See Roemer, Williston, & Rollins, 2015, for detailed discussion. Mindfulness is thought to reduce reactivity to stressful events, thus has also been categorized as a response modulation strategy (Carl et al., 2013).

[3] Quoidbach et al. (2015) regard savoring as a situation modification strategy, whereas Carl et al. (2013) classify it as an attentional deployment strategy

effects of an integrated, year-long school-based PEP versus a wellbeing-as-usual comparison group, who had not been directly exposed to positive education. The present study had three aims. The first was to extend previous literature (Morrish et al., 2017) by examining the longitudinal relationship between ER and adolescent wellbeing. Effective ER involves not only the absence of ER deficits, but also the use of adaptive ER strategies. Accordingly, the current study used two ER measures to capture a range of cognitive and behavioral ER strategies and collectively assess both adaptive and maladaptive ER: The Cognitive Emotion Regulation Questionnaire positive reappraisal subscale (CERQ-short; Garnefski & Kraaij, 2006), and the Difficulties in Emotion Regulation Scale total score (DERS; Gratz & Roemer, 2004). On the basis of these measures, ER was defined as involving a greater use of reappraisal as well as the presence of fewer ER deficits. Consistent with cross-sectional evidence (Morrish et al., under review; Saxena, Dubey, & Pandey, 2011), it was hypothesized that an inverse relationship would be found between deficits in ER and indices of positive psychological functioning. In contrast, it was expected that the use of reappraisal, a putatively adaptive ER strategy, would be positively associated with domains of positive psychological functioning and inversely related to indicators of mental ill-health.

The second aim was to determine whether the PEP was effective in increasing student's ER capacity over a two-year period, compared to the wellbeing-as-usual comparison group. To assess the sustainability of program outcomes, capture any lagged effects, and evaluate interaction effects, ER was measured at three time points: immediately post-intervention, and at 6- and 15-month follow-ups. Following the existing literature outlining a relationship between PEP participation and improvements in wellbeing (Shoshani & Steinmetz, 2014; Shoshani et al., 2016), and positive associations between ER and wellbeing (Shiota, 2006), it was hypothesized that participants in the PEP condition would report greater decreases in ER difficulties and greater increases in the use of positive reappraisal post-intervention, compared to students in the wellbeing-as-usual group.

Finally, this study examined whether students' pre-treatment ER capacity influenced the efficacy of the PEP on multiple measures of wellbeing, compared to the wellbeing-as-usual comparison condition. It was hypothesized that significant time-by-group-by-ER interactions would be identified, indicating that pre-treatment ER capacity influenced the effects of the PEP intervention on indices of positive

psychological functioning (e.g., resilience, wellbeing), and mental distress (i.e., anxiety, depression) over time. It was predicted that students reporting a higher overall ER capacity and greater use of reappraisal prior to program engagement would show greater psychological benefit from the PEP intervention than those with lower ER capacity and reappraisal use.

Method

Participants

Participants were 80 Year 10 secondary school students (44.7% female, 63% Australian-born, *M* age = 15.09, *SD* = 0.43) enrolled at one of three independent schools in Victoria, Australia. The intervention group comprised 44 adolescents (50% female, 66.1% Australian-born, *M* age = 15.07, *SD* = 0.45) that were randomly selected to complete ER measures from a larger pool of approximately 300 students who consented to participate in a broader, Australian Research Council (ARC) funded evaluation of a Year 10 PEP implemented at an independent school located in regional Victoria. Students in the comparison group were from two self-selected, independent schools (one co-educational, one single-sex boys' school) located in regional and metropolitan Victoria, respectively. A number of schools interested in participating as a comparison school in the larger, ARC funded project provided expressions of interest to the projects' Chief Examiner. Selection of the schools from which control participants were sourced was based on their sociodemographic similarity to the experimental school, as determined by parental employment type and postcode (Australian Bureau of Statistics, 2011), and lack of exposure to PEPs. Five schools were initially assessed for their eligibility to participate as comparison schools, of which two declined to participate and one was poorly matched to the intervention group on sociodemographic variables and was hence excluded. The final comparison sample included 36 Year 10 students (18.8% female, 63.7% Australian-born, *M* age = 15.11, *SD* = 0.40) randomly selected to complete ER measures from a larger group of students (63% of Year 10 students enrolled in the comparison schools) who consented to participate in the broader study. All students and their parent or legal guardians provided informed consent to participate in this study, and all procedures were approved by the University of Melbourne Human Research Ethics Committee.

The evaluated Positive Education Program.

The Year 10 intervention evaluated in the current research is an evidence-based PEP that conforms to best-practice guidelines for the implementation of social-emotional learning programs (Durlak, Weissberg, Dymnickie, & Taylor, 2011; Weare & Nind, 2011). Specifically, it involves well-being promotion rather than an exclusive focus on deficit; interactive delivery of relatable and practical content; a school-wide approach that facilitates development of a positive school culture and environment; a long-term intervention of 12 months; and follow-up sessions to consolidate learning. This program is based on Seligman's (2011) PERMA model of wellbeing, which seeks to enhance positive psychological health through the promotion of five domains – positive emotion (P), engagement with valued activities (E), fostering positive relationships (R), cultivating life purpose and meaning (M), and pursuing valued accomplishments. A sixth facet is also included in this particular school program: positive health and resilience (see Norrish et al., 2013; for a detailed overview). The Year 10 PEP involved a series of weekly 90-minute interactive lessons provided by classroom teachers during regular, allocated classes. Extensive training of all Year 10 teachers in PEP content and delivery methods was provided by school leaders via professional development and training workshops. Program content included a range of positive psychology interventions and CBT skills taught with reference to the PERMA framework, and are presented in Table 10.

Table 10. Overview of the evaluated Year 10 Positive Education Program

Well-being framework	**PERMA Positive Education Model** • Positive emotions • Positive engagement • Positive purpose • Positive relationships • Positive accomplishment • Positive health
Frequency of lessons	Weekly
Duration of lessons	90 minutes
Program facilitators	Classroom & homegroup teachers, trained in content delivery
Program topics	What is flourishing?
	Exploring character strengths
	Using your strengths
	Spotting character strengths
	Developing a growth mindset
	Training your brain
	Exploring resilience
	Thinking flexibly Building strong relationships in good & bad times
	Igniting your passion
	Exploring meaning & purpose in life
	Understanding positivity
	Encouraging gratitude
	Nurturing hope & optimism
	Mindfulness training

Measures

Emotion Regulation Capacity.

Difficulties in Emotion Regulation Scale: The DERS (Gratz & Roemer, 2004) is a self-report measure of perceived difficulties in ER relating to: a) awareness and understanding of emotions; b) acceptance of emotions; c) the ability to engage in goal-directed behavior when experiencing negative emotions; and d) access to effective ER strategies. The DERS includes 36-items and six subscales (e.g., '*When I'm upset, I have difficulty controlling my behavior*'), with each item scored on a five-point Likert scale ranging from 1 (almost never) to 5 (almost always). The six subscales represent specific impairments in ER, including lack of emotional clarity; lack of emotional awareness; difficulties controlling impulsive behaviors when distressed; difficulties engaging in goal-directed behaviors when distressed; non-acceptance of emotional responses; and limited access to effective ER strategies. These subscales are then summed to calculate a total score (DERS total), with higher scores representing greater ER difficulties. The DERS has been validated for use in adolescent samples aged between 12 to 17 years (Neumann, van Lier, Gratz, & Koot, 2010), and the DERS total demonstrated good internal consistency in the current study ($\alpha = .78$).

Cognitive Emotion Regulation Questionnaire, Short Version (CERQ-short): The CERQ-short (Garnefski & Kraaij, 2006) is an 18-item self-report questionnaire consisting of nine conceptually distinct subscales that assess cognitive approaches to managing emotional arousal in response to difficult or unpleasant life events. The positive reappraisal subscale involves two items, measured on a 5-point Likert scale ranging from 1 (almost never) to 5 (almost always), which captures the use of reappraisal, an adaptive ER strategy that involves thinking about the positive aspects of a challenging event in order to change its emotional impact (e.g., '*I think I can learn something from the situation'*). The CERQ-short has been validated for use in adolescent samples (Garnefski & Kraaij, 2006a), and the positive reappraisal subscale was found to have excellent reliability in the current study ($\alpha = .82$).

Psychological Wellbeing.

The EPOCH Measure of Adolescent Wellbeing (EPOCH): The EPOCH (Kern, Benson, Steinberg, & Steinberg, 2016) is a 20-item, self-report measure of adolescent wellbeing comprising five subscales, each of which assesses a positive psychological characteristic thought to foster optimal psychological functioning in adulthood

(Seligman, 2011). Items are rated on a 5-point Likert scale, ranging from 1 (almost never/ not at all like me) to 5 (almost always/ very much like me), and showed good internal consistency in the current sample (α > .78). Its respective subscales evaluate engagement with valued activities (Engagement; α = .78); persistence in the face of challenges or to achieve goals (Perseverance; α = .81); optimism (Optimism; α = .86); connectedness to peers and loved ones (Connectedness; α = .88); and subjective feelings of happiness (Happiness; α = .90). The EPOCH has been validated for use in adolescents aged between 10 and 18 years in Australia and the United States, and demonstrates acceptable construct and discriminant validity (Kern, et al., 2016).

The Connor-Davidson Resilience Scale (CD-RISC): The CD-RISC (Campbell-Sills & Stein, 2007) is a self-report measure of positive adaptation following stress or adversity. It comprises 10 items (e.g., '*I believe I can achieve my goals even if there are obstacles'*), each rated on a 5-point scale, ranging from 0 (not at all) to 4 (almost always). Total scores range from 0 to 40, with higher scores reflecting greater resilience. The scale demonstrates excellent psychometric properties in late adolescent populations (*M* age = 18.8; Campbell-Sills & Stein, 2007), and showed excellent internal consistency in the current study (α = .92).

Mental Distress.

The Patient Health Questionnaire-4 (PHQ-4): The PHQ-4 (Löwe et al., 2010) is a screening tool used to identify the presence of symptoms critical to depression and anxiety diagnoses (e.g., '*In the past two weeks, how often have you been bothered by feeling nervous, anxious, or on edge?'*). The four items (two questions each for depression and anxiety scales) are measured on a 4-point Likert scale ranging from 0 (not at all) to 3 (nearly every day); scores equal to or greater than 3 (of a maximum of 6) on each scale indicate the likely presence of depression or anxiety. The PHQ-4 has been validated for use in individuals aged 11 years and over (Kroenke et al., 2009), and both scales demonstrated adequate internal consistency in in an Australian adolescent sample (depression: α = .68; anxiety: α = .83; Morrish et al., under review).

Procedure

Data were collected by a trained, independent team of researchers at four time points across the three school years (Years 10 to 12). Baseline data were assessed at the commencement of the Year 10 school year (March 2014), and post-treatment data

were assessed at the end of that school year (November 2014). To evaluate the durability of potential PEP benefits and capture any delayed treatment effects, follow up assessments were conducted at two time points across the following school year: six-months post-intervention (i.e., the commencement of Year 11; March 2015), and 15-month post- intervention (i.e., the commencement of Year 12; February 2016). Wellbeing data were captured via an online survey platform, Survey Gizmo (www.surveygizmo.com). Students were each provided with a de-identified participant code, used to match their responses across each time point. Wellbeing data were collected at each time point and was completed as part of scheduled wellbeing classes at their respective schools. ER data were collected individually and during a broader assessment schedule, within a two-week timeframe of the online assessment. The total duration for data collection at each assessment point was approximately 20 minutes per participant.

Data analyses

Wellbeing and ER self-reported data were first inspected for missing values. Less than 5% of ER and wellbeing data were incomplete. Missing data were substituted by the item mean score, rounded to a discrete value. Subscale and total scores were then calculated for each questionnaire as per the scale-developers' instructions. Data were then inspected for univariate outliers, which were identified as scores ± 2 standard deviations from the scale mean, and were treated with the Winsor imputation method (item mean + (3 x SD)). Mahalanobis distance was acceptable for all variables, indicating the presence of no multivariate outliers at each time point. No outliers were detected in the EPOCH, CD-RISC, or PHQ-4 subscales.

Next, a series of independent samples t-tests were conducted to determine whether significant between-group differences in the dependent variables existed at baseline. A chi-square test was conducted to compare the ratio of male to female participants in each condition. Finally, to analyze relationships between ER, PEP participation over time and psychological wellbeing variables, a series of linear multivariate modelling (LMM) analyses were performed, using the different wellbeing scales as respective outcome variables. LMM is used to analyze correlations between repeated data and maximizes power by including all available data from each time point (i.e., it is robust in the absence of complete data). LMM manages correlated data and unequal variances and allows for the measurement of

nested data. To assist interpretation, a tertile split was conducted on DERS total scores, representing high, medium, and low ER capacity. Psychological wellbeing variables, participant group (PEP or comparison), time point (1, 2, 3, 4) and baseline ER (DERS total score or positive reappraisal) were entered as fixed factors in each model. To control for previously reported sex differences in measures of positive and negative psychological functioning (Karairmak, 2010; Löwe et al., 2010; Notario-Pacheco et al., 2011), sex was also included as a fixed factor. As participants were relatively homogenous in age (M = 15.09, SD = 0.49) and comprised the same year level cohort, age was not included. Participants were treated as a random effect and a random intercept was estimated. To examine whether different patterns of wellbeing emerged over time between the PEP and comparison group, a time-by-group interaction was added to the model. A group-by-baseline ER interaction was also included to examine whether the impact of PEP participation on wellbeing outcomes differed according to students' ER capacity at baseline. To determine whether the current sample size (N = 80) was sufficient to conduct moderation analyses, power analysis was conducted using G*Power (Faul, Erdefelder, Bucnhner, & Lang, 2013). In order to detect a medium effect size (f^2) of .15 with an alpha of .05, a standard power level of .80 and a total of 3 tested predictors, results of this analysis revealed that our sample met the minimum requirement of 77 participants needed to achieve sufficient power for moderation. A separate model was estimated for each wellbeing variable examined. A total of 16 models were estimated, using the restricted maximum likelihood (REML) method of estimation. Visual inspection of the distribution of residuals revealed that the assumptions of LMM, normality and equal variances, had been satisfied. All analyses were conducted using SPSS (version 23, IBM Chicago, IL, USA), using a 95% (p = .05) confidence level.

Results

Descriptive statistics for each sample at baseline and post-intervention are presented in Table 11. Means and standard deviations for the EPOCH wellbeing scales are comparable to those previously reported in Australian adolescent samples (Kern et al., 2015; Rickard, Chin, & Vella-Brodrick, 2016). ER scores were also comparable to adolescent norms reported elsewhere, as measured by total difficulties in ER (M = 78.53, SD = 4.49; Neumann, van Lier, Gratz, & Koot, 2009), and positive reappraisal scores (M = 6.23, SD = 2.25; Garnefski & Kraaij, 2006). At

commencement of the Year 10 program, resilience was slightly lower than previously reported norms (*M* = 2.91, *SD* = .59, Madewell & Ponce-Garcia, 2016). Depression and anxiety scores were comparable at baseline to early adolescent norms (depression: *M* = 1.27, *SD* = .65; anxiety: *M* = 1.42, *SD* = .80; Campbell-Sills & Stein, 2007), however, depression and anxiety scores were considerably higher at 6- and 15-months follow-up compared to an adolescent college sample (depression: *M* = 1.06, *SD* = .63; anxiety: *M* = 1.91, *SD* = .72; Khubchandani, Brey, Kotecki, Kleinfelder, & Anderson, 2016).

At baseline, independent samples t-tests revealed that the groups did not statistically differ on any of the ER or wellbeing variables examined. Results of a Chi-square test showed that the ratio of male to female students in each group was also non-significant; $\chi(1) = 3.5$, $p = .061$.

Examination of rates of attrition revealed higher drop-out at follow-up time points for the comparison group compared to the treatment group $\chi(1) = 4.4$, $p = .036$.

Table 11. Descriptive statistics for pre- and post-intervention outcomes for the adolescent sample

Variable	Pre-intervention				Post-intervention				6-months follow-up				15-month follow-up			
	PEP *n* = 44		Control *n* = 36		PEP *n* = 44		Control *n* = 36		PEP *n* = 38		Control *n* = 25		PEP *n* = 38		Control *n* = 24	
	m	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*
DERS Total	81.41	3.05	76.85	3.30	73.17	3.09	72.68	3.96	76.00	2.98	78.33	5.20	76.61	3.41	80.19	6.47
Positive Reappraisal	6.97	2.10	6.79	1.91	7.26	1.67	7.14	1.72	7.00	2.01	7.48	1.45	7.32	2.03	7.45	2.32
Engagement	3.57	0.66	3.57	0.66	3.44	0.57	3.43	0.72	3.56	0.59	3.44	0.94	3.25	0.67	3.44	0.65
Perseverance	3.53	0.57	3.51	0.72	3.41	0.74	3.22	0.89	3.55	0.60	3.30	0.92	3.35	0.74	3.25	0.73
Optimism	3.62	0.56	3.68	0.64	3.60	0.67	3.43	0.85	3.66	0.65	3.78	1.07	3.37	0.70	3.43	0.80
Connected	4.04	0.60	4.10	0.62	3.93	0.56	3.88	0.71	4.19	0.63	3.78	0.99	4.04	0.73	4.00	0.82
Happiness	3.96	0.57	3.91	0.84	3.83	0.64	3.74	0.95	4.12	0.66	3.83	1.04	3.67	0.67	3.88	0.84
Resilience	2.21	0.85	2.76	1.16	2.59	1.16	2.64	1.08	3.71	1.01	3.85	1.46	3.63	1.18	3.79	1.03
Depression	0.90	0.15	1.78	0.22	1.71	0.22	2.12	0.33	3.39	0.21	3.67	0.35	3.61	0.25	3.75	0.39
Anxiety	1.15	0.16	1.56	0.30	1.98	0.28	1.96	0.35	3.51	0.26	3.52	0.39	3.81	0.28	3.56	0.40

SD = standard deviation; BMI = body mass index; DERS Total = Difficulties in Emotion Regulation Scale Total Score (note – higher scores represent poorer emotion regulation capacity; HRV = high frequency heart rate variability; HRV^{log} = log-transformed HRV; EPOCH = EPOCH Measure of Adolescent Well-being; Resilience = Connor-Davidson Resilience Total Score; PHQ-4 = Patient Health Questionnaire four-item version. p^{t*g} = time * group interaction significance levels using data across all four time points.

Bivariate correlations between pre-treatment ER capacity and dependent variables (positive psychological functioning and mental ill-health symptoms) at baseline, post-intervention, six months follow up, and 15 months follow up are presented in Table 12. Results revealed that the strength of correlations between ER and dependent variables increased from baseline to six months' post treatment in the PEP group, but not in the comparison group.

Results of LMM analyses examining relationships between baseline ER, PEP participation over time and psychological wellbeing variables are presented in Tables 13 and 14. **S**ignificant main effects for baseline DERS total scores showed that greater self-reported ER capacity was positively associated with numerous domains of wellbeing, including perseverance, connectedness, happiness, and resilience. Although not reaching statistical significance, a positive trend was also observed for the relationship between ER capacity, as measured by lower DERS total scores, and optimism. Greater use of reappraisal predicted higher scores across all measures of positive psychological functioning, including the five domains of wellbeing and resilience. As predicted, significant inverse relationships were found between ER capacity and symptoms of depression and anxiety, as measured by both lower DERS Total scores and higher positive reappraisal scores.

Irrespective of ER capacity on entering the Year 10 program, significant increases in depression were observed from baseline (m = 1.50) to six-months post-treatment (m = 3.35), with the greatest mean increase in depression reported from term one of Year 10 to term one of Year 11. Similar significant increases were observed for anxiety from baseline (m = 1.50) to six months' post-treatment (m = 3.28), with the greatest increase reported from term one of Year 10 to term one of Year 12. A significant main effect of sex showed that females reported higher levels of depression $F(1, 53) = 7.01$, $p = .011$) and anxiety $F(1, 55) = 13.62$, $p = .001$) compared to males. Despite increases in symptoms of depression and anxiety over time, student resilience also increased significantly from commencement of Year 10 (m = 26.55) to six months' post-treatment (m = 37.55). There was no main effect of sex for resilience $F(1, 56) = 0.49$, $p = .489$).

Table 12. Bivariate correlations of pre-treatment ER capacity with study outcomes at pre-treatment, post-treatment, six-months and fifteen-months follow-up for PEP and comparison groups ($N = 80$)

Variable	Pre-treatment		Post-treatment		6-months follow-up		15 months follow-up	
	DERS total	Reappraisal	DERS total	Reappraisal	DERS total	Reappraisal	DERS total	Reappraisal
PEP condition								
Engagement	-.02	-.11	-.19	.09	**-.36***	**.40***	.32	.30
Perseverance	-.29	-.13	**-.32***	**.32***	**-.35***	**.44****	.08	.31
Optimism	-.31	-.14	**-.34***	.26	**-.47****	**.44****	-.03	**.38***
Connectedness	-.06	-.21	-.12	.28	-.19	.32	.12	.24
Happiness	-.03	-.23	-.15	**.32***	**-.42***	.27	.14	.31
Resilience	**-.36***	.20	**-.42****	**.34***	**-.37***	**.38***	.02	**.39***
Depression	**.34***	.09	.28	-.05	**.45****	-.29	.14	**-.50****
Anxiety	.27	.27	.30	-.16	**.49****	-.14	.12	-.27
Control condition								
Engagement	.04	.34	-.19	.28	.05	.30	.06	.16
Perseverance	-.34	.27	**-.53****	.32	-.45	**.45***	**-.73****	.22
Optimism	-.21	.36	-.31	.24	-.13	.17	-.46	.15
Connectedness	.06	.21	-.04	-.32	-.35	-.01	-.42	-.13
Happiness	-.35	.37	-.29	.12	-.20	.05	-.09	.17
Resilience	**-.43***	.10	**-.45***	.35	-.44	.24	-.23	-.04
Depression	**.48***	-.06	**.41***	-.08	.45	-.16	**.48***	-.09
Anxiety	**.45***	.22	**.56****	.05	.35	-.11	**.59****	.00

Table 13. Results of linear mixed model analyses, associating psychological factors with self-reported emotion regulation capacity ($N = 80$)

	Time*Group interaction		Time*Group*ER interaction		Direct effect of ER (DERS)		Direct effect of time		Direct effect of group		Direct effect of sex	
	F	*p*	*F*	*p*	*F*	*p*	*F*	*p*	*F*	*p*	*F*	*p*
Well-being												
Engagement	1.66	.178	0.56	.762	0.01	.991	1.14	.335	0.15	.703	0.01	.941
Perseverance	0.71	.550	1.16	.349	3.83	**.028**	1.37	.254	0.54	.464	0.02	.903
Optimism	1.81	.148	0.79	.582	2.93	.062	1.54	.208	0.00	.985	0.00	.986
Connectedness	0.98	.405	2.38	**.031**	4.66	**.013**	0.74	.530	0.00	.994	5.80	**.019**
Happiness	1.15	.332	2.22	**.044**	3.36	**.042**	2.88	**.038**	0.00	.998	0.55	.463
Resilience	0.62	.602	1.67	.132	4.52	**.015**	145.47	**.000**	1.24	.271	0.49	.489
Mental distress												
Depression	1.87	.137	1.22	.300	3.36	**.042**	35.09	**.000**	2.45	.123	7.01	**.011**
Anxiety	1.01	.389	1.62	.145	1.39	.258	34.53	**.000**	0.02	.889	13.62	**.001**

Table 14. Results of linear mixed model analyses, associating psychological factors with positive reappraisal capacity ($N = 80$)

	Time*Group interaction		Time*Group*PR interaction		Direct effect of PR		Direct effect of time		Direct effect of group		Direct effect of sex	
	F	*p*	*F*	*p*	*F*	*p*	*F*	*p*	*F*	*p*	*F*	*p*
Well-being												
Engagement	1.50	.217	0.78	.585	3.66	**.031**	2.01	.114	0.49	.485	0.21	.646
Perseverance	0.64	.558	0.65	.692	6.44	**.003**	0.79	.504	1.07	.305	0.25	.619
Optimism	1.42	.240	0.44	.848	5.70	**.005**	0.87	.460	0.12	.732	0.11	.896
Connectedness	0.87	.458	0.52	.792	3.93	**.024**	0.15	.929	0.00	.978	3.65	.061
Happiness	0.76	.518	0.24	.963	5.06	**.009**	1.78	.154	0.18	.677	0.17	.686
Resilience	1.03	.380	1.58	.158	6.04	**.004**	89.97	**.000**	0.58	.449	1.02	.317
Mental distress												
Depression		.477	1.27	.275	3.47	**.038**	31.97	**.000**	4.11	.047	6.78	**.012**
Anxiety	1.37	.255	1.15	.337	2.09	.132	29.54	**.000**	0.33	.569	11.97	**.001**

Results of LMM analyses revealed that when compared to the wellbeing-as-usual comparison condition, PEP participation was not associated with fewer difficulties in ER $F(3, 306) = 0.50$, $p = .684$), or greater use of reappraisal $F(3, 354) = 0.40$, $p = .754$). These results suggest that the PEP program did not significantly predict improvements in ER over time.

Finally, as shown in Table 14, results of LMM analyses showed significant three-way time-by-ER-by-group interactions for connectedness and happiness, while no significant main effects or interactions were observed for any of the other measures of positive psychological functioning and mental distress.

With respect to connectedness scores, no significant main effect of time was observed $F(3, 151) = 0.74$, $p = .530$), indicating that overall, no significant changes in students' self-reported connectedness were seen from time 1 to time 4. Similarly, a non-significant time-by-group interaction revealed that the PEP program did not lead to significant changes in connectedness when compared to the comparison condition $F(3, 151) = 0.98$, $p = .405$). However, the significant group-by-time-by-ER interaction $F(6, 151) = 2.38$, $p = .031$) indicated that self-reported ER capacity on commencement of Year 10 influenced how effective the PEP program was in improving student connectedness over time. Although levels of connectedness remained stable for students with high and moderate ER capacity in the PEP and comparison groups, different patterns emerged for students in the low ER group. Students with low ER capacity who participated in the PEP group displayed a gradual increase in connectedness from commencement of the Year 10 PEP ($\mu = 18.77$) to 15 months' post-intervention ($\mu = 19.98$). In contrast, students with low ER capacity in the comparison condition displayed a mean decrease of 5-points in connectedness from the commencement of Year 10 ($\mu = 20.49$) until six months' post intervention ($\mu = 15.59$), with some improvement seen between six and 15 months ($\mu = 18.42$). There was a significant effect of sex ($F = 5.80$, $p = .019$), with female students reporting mean levels of connectedness approximately two points higher than males (females, $\mu = 21.17$; males, $\mu = 19.42$).

With respect to happiness scores, a significant main effect of time was observed $F(3, 150) = 2.22$, $p = .044$), with levels of happiness increasing over time, irrespective of group. No significant sex differences were observed $F(1, 55) = 0.55$, $p = .463$). On the other hand, the time-by-group interaction was not significant $F(3, 150) = 1.15$, $p = .332$), indicating that membership in the PEP group did not lead to

significantly greater improvements in happiness compared to the comparison group. However, a significant time-by-group-by-ER interaction ($F(6, 150) = 2.38$, $p = .031$) revealed that students' self-reported ER capacity on commencement of the Year 10 program influenced the ability of the PEP to improve student happiness over time. Specifically, different patterns of change in happiness scores were observed for students in the low ER group. For students with low ER capacity participating in the PEP condition, an increase in self-reported happiness was seen from commencement of the Year 10 ($\mu = 19.45$) program to six months' follow-up ($\mu = 21.41$); however, a subsequent reduction in happiness was observed between six months and 15 months' post-intervention ($\mu = 17.91$). For students with low ER capacity in the comparison condition, decreases in happiness were seen from program commencement ($\mu = 18.18$) to six months' follow-up ($\mu = 15.99$), although by 15-months post-intervention, their happiness levels had increased and were comparable to students with low ER tin the PEP condition ($\mu = 17.14$). Descriptive statistics for wellbeing variables at each time point, stratified according to low, moderate, and high ER groups, are presented in Table 15.

Table 15: Descriptive statistics for pre- and post-intervention outcomes, stratified according to emotion regulation capacity (DERS total scores)

	Pre-intervention						Post-intervention					
	Low ER capacity *n* = 23		Mod ER capacity *n* = 23		High ER capacity *n* = 27		Low ER capacity *n* = 22		Mod ER capacity *n* = 22		High ER capacity *n* = 20	
	m	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*
CERQ- Positive Reap.	6.44	1.65	6.73	1.90	8.00	1.90	6.36	1.33	7.43	1.54	7.80	1.79
DERS Total	99.0	10.72	76.15	5.58	57.64	6.27	90.77	17.83	70.29	12.29	58.80	14.10
EPOCH-Engagement	17.17	3.39	17.61	3.53	18.30	3.43	16.23	4.12	16.91	2.94	18.14	3.54
EPOCH-Perseverance	16.00	4.44	17.09	3.60	18.93	3.15	14.27	4.83	17.23	2.97	18.86	4.14
EPOCH-Optimism	16.96	3.65	17.30	3.50	19.96	3.04	15.73	4.28	18.09	3.57	19.41	3.67
EPOCH-Connected.	19.22	3.66	19.57	3.91	21.33	3.19	18.77	3.61	19.68	3.60	20.18	3.68
EPOCH-Happiness	18.65	4.54	18.48	3.45	21.30	3.43	17.50	4.39	19.55	3.89	19.64	4.35
CD-RISC	25.17	6.17	25.57	5.74	28.81	5.23	22.27	5.98	26.77	5.71	29.50	6.23
PHQ Depression	1.83	1.47	1.43	1.08	0.89	0.93	2.50	1.60	1.64	1.21	1.41	1.50
PHQ Anxiety	1.78	1.70	1.52	1.04	0.96	1.13	2.77	1.95	1.36	1.40	1.45	1.62

	6-months follow-up						15-month follow-up					
	Low ER capacity *n* = 20		Mod ER capacity *n* = 20		High ER capacity *n* = 21		Low ER capacity *n* = 19		Mod ER capacity *n* = 19		High ER capacity *n* = 18	
	m	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*
CERQ- Positive Reap.	6.91	1.61	7.30	1.45	7.52	2.09	6.58	2.12	7.84	1.98	7.78	1.63
DERS Total	87.75	20.48	77.50	18.49	70.76	22.54	96.26	21.34	71.47	14.07	63.33	14.80
EPOCH-Engagement	17.05	3.73	16.64	3.55	19.23	2.80	17.47	3.10	16.37	2.73	16.73	3.69
EPOCH-Perseverance	15.37	4.00	17.59	3.34	19.18	2.35	15.76	2.93	17.05	3.61	17.47	3.48
EPOCH-Optimism	16.68	3.74	17.64	3.52	20.23	3.53	16.35	2.71	17.31	3.42	17.40	3.72
EPOCH-Connected.	19.37	3.83	19.65	5.04	22.41	2.81	19.18	3.50	20.63	3.77	20.40	4.22
EPOCH-Happiness	18.68	3.67	19.47	4.54	21.94	3.40	18.64	2.52	19.21	3.08	18.60	4.14
CD-RISC	34.71	5.80	37.62	6.19	40.56	5.03	35.87	4.00	38.00	6.64	37.57	5.36
PHQ Depression	4.21	1.27	3.35	1.58	3.06	1.43	4.12	1.65	3.47	0.90	3.25	1.06
PHQ Anxiety	4.26	1.72	3.47	1.55	3.11	1.58	4.18	1.88	3.58	1.02	3.12	1.20

CERQ-PR = Children's Emotion Regulation Questionnaire Positive Reappraisal Scale (note – higher scores represent greater emotion regulation); DERS Total = Difficulties in Emotion Regulation Scale Total Score (note – lower scores represent greater emotion regulation capacity; EPOCH E= EPOCH Measure of Adolescent Well-being Engagement scale; EPOCH P = EPOCH Measure of Adolescent Well-being Perseverance scale; EPOCH O = EPOCH Measure of Adolescent Well-being Optimism scale; EPOCH C= EPOCH Measure of Adolescent Well-being Connectedness scale; EPOCH H= EPOCH Measure of Adolescent Well-being Happiness scale; CD-RISC = Connor-Davidson Resilience Total Score; PHQ-D = Patient Health Questionnaire four-item version Depression scale; PHQ-A = Patient Health Questionnaire four-item version Anxiety scale.

Discussion

The aims of the current study were threefold. The first aim was to examine the relationship between self-reported ER and numerous measures of positive and negative psychological functioning over time in a sample of Australian secondary school students. The second was to determine whether a best-practice PEP was effective in increasing adolescents' ER capacity over a two-year period. Third, the study assessed whether students' ER capacity influences the efficacy of the PEP on multiple measures of positive psychological functioning and mental distress, compared to the wellbeing-as-usual comparison condition. Results are discussed below, in relation to these key aims.

Emotion regulation is a meaningful predictor of adolescent wellbeing.

Consistent with previous research outlining the importance of ER to positive adolescent development (Casey, Jones, & Hare, 2006; Saxena et al., 2011), the current study revealed that adolescents reporting a greater ER capacity at commencement of the Year 10 program had higher levels of wellbeing over time than those with poorer ER capacity. These findings were consistent across all ER measures and intervention groups. As predicted, fewer self-reported difficulties in ER pre-intervention predicted fewer symptoms of depression and anxiety, and stronger indicators of positive psychological functioning (i.e., perseverance, optimism, connectedness, happiness, and resilience). Furthermore, greater use of reappraisal, an adaptive ER strategy, predicted fewer symptoms of depression and anxiety, as well as higher positive psychological functioning, as measured by the engagement, perseverance, optimism, connectedness, happiness, life satisfaction, and resilience scales. Previous research indicates that young people with impaired ER capacity are more susceptible to the detrimental effects of stress on wellbeing and are more likely than peers with a greater ER capacity to develop a range of mental ill-health conditions, such as depressive and anxiety disorders (Aldao et al., 2010; McLaughlin & Hatzenbuehler, 2009; Moyira & Takahashi, 2009; Tortella-Feliu, Balle, & Sese, 2010). The current findings extend such research by demonstrating that fewer ER difficulties, and a greater use of reappraisal, meaningfully contribute to aspects of positive psychological functioning, including resilience and wellbeing. Results therefore support the importance of adolescents' ER capacity to the full spectrum of

mental health, which involves the presence of positive functioning in addition to the absence of mental ill-health (Keyes, 2005; Suldo & Shaffer, 2008). ER thus contributes to a range of protective psychological factors that can both sustain wellbeing and protect against the detrimental impact of stress when facing environmental challenges.

Improving students' emotion regulation capacity via positive education may require additional, targeted interventions

Previous research indicates that the relationship between positive affect and ER is bidirectional and reciprocal. For example, experiencing positive emotion can broaden one's though-action repertoire in response to stress-eliciting events, which in turn, facilitates the implementation of a greater range of ER skills and strategies (Fredrickson & Joiner, 2002; Tugade & Fredrickson, 2004). It was predicted, therefore, that increasing positive affect via the PEP intervention would improve students' ER capacity. Results of the current study did not support this hypothesis but suggest, firstly, that ER capacity unilaterally predicts positive affect and, second, that ER is a foundational skill that is not impacted by the PEP model examined. With this in mind, introducing ER-specific interventions into the school curricula may enhance the current PEP model and further improve wellbeing outcomes in students. For example, skills of awareness, tolerance, and active modification of negative emotions can each be effectively taught in as little as 45-minute training sessions (see Berking et al., 2008, for a detailed description of training content). Preliminary evidence has revealed that incorporating ER-focused interventions into CBT-oriented approaches can enhance wellbeing outcomes in a number of population subgroups, including children with anxiety (Suveg, Sood, Comer, & Kendall, 2009), depressed adults (Berking, Ebert, Cuijpers, & Hofmann, 2013), police officers (Berking, Meier, & Wupperman, 2010), and psychiatric inpatients (Berking et al., 2008). Similarly, presenting positive psychology interventions within an ER-specific framework was found to increase subjective wellbeing and satisfaction with life, and decreased symptoms of depression and somatic complaints, when compared to a loving-kindness and wait-list intervention in a US undergraduate college sample (Weytens, Luminet, Verhofstadt, & Mikolajczak, 2014). Although not involving adolescent samples, such findings support efforts to include a greater focus on ER in wellbeing models that are conceptually similar to PEPs. Altogether, further investigation of the

efficacy of intentionally and strategically combining ER-focused interventions with current PEP models is clearly warranted.

Students with low emotion regulation capacity at baseline benefitted most from participation in the positive education program.

The third hypothesis predicted that students' ER capacity prior to engaging in the PEP would be positively associated with resilience and dimensions of wellbeing in adolescents (i.e., engagement, perseverance, optimism, connectedness, happiness), and to reduce mental distress (i.e., anxiety, depression) following PEP. This hypothesis was partially supported. Reduced ER capacity, as measured by lower DERS total scores, moderated the effect of the PEP on two measures of wellbeing: connectedness and happiness. Among students reporting greater difficulties in ER upon commencement of the Year 10 program, participation in the PEP had a protective effect on happiness and social connectedness. Notably, improvements in both happiness and connectedness for low ER students in the PEP group were not only enduring, but continued to increase until at least 15-months post-intervention, the final point of measurement. This finding provides preliminary evidence that participation in the PEP might provide benefit to a subset of students at higher risk for the development of mental ill-health (Aldao et al., 2010), specifically, those with poorer ER capacity. Given the emphasis of the PEP curricula on enhancing wellbeing via numerous modules that focus on building social connection and positive affect (Norrish, 2016; also see Table 1), this is an important direction for future longitudinal work with larger samples, in order to tease out causal relationships between PEP participation and well-being outcomes in those with low versus high ER capacity.

The social environment is a primary context for ER, requiring the individual to balance his or her own goals, emotions and behavioral dispositions against those of others (see reviews by Campos, Walle, Dahl, & Main, 2011; Gross, 2002; Ochsner & Gross, 2008). A growing body of literature supports the importance of ER to building and maintaining interpersonal relationships. For example, ER capacity directly influences the quality and tone of interpersonal interactions (Campos et al., 2011), and has been linked to a variety of indicators of positive social functioning, including greater interpersonal sensitivity, reciprocal friendship, and prosocial behavior when measured by both self-report and peer ratings (Lopes, Salovey, Cote, & Beers, 2005). ER has also been found to be associated with greater social support, social

satisfaction, and closeness to others (Cutrona & Russell, 2017; Salvatore, Kuo, Steele, Simpson, & Collins, 2011; Srivastava, Tamir, McGonigal, John, & Gross, 2009). Similarly, a number of recent reviews outline mechanisms by which ER contributes to happiness and associated measures of wellbeing (Morrish et al., 2017; Quoidbach et al., 2015; Weytens et al., 2014). In sum, processes of ER enable individuals to enhance positive affective experiences, to dampen and recover from experiences of negative emotion, and to engage in activities that promote positive psychological functioning. Results of the current study suggest that PEP may provide necessary skills for students who enter the program with impaired self-regulatory skills, and reinforce the value of applying PEPs to at-risk groups who typically display poor ER profiles, such as students exposed to trauma, young people with behavioral or interpersonal difficulties, or adolescents with mental ill-health conditions (Brunzell et al., 2016; Brunzell, Waters, & Stokes, 2015).

Although unanticipated, the use of the ER strategy of reappraisal was not associated with wellbeing outcomes of the PEP intervention compared to the wellbeing-as-usual condition. This outcome was somewhat surprising given that reappraisal has been widely identified as a meaningful, adaptive ER strategy (Garnefski, et al., 2002; Ochsner et al., 2012) that features prominently in therapeutic treatments for mental ill-health (e.g., CBT, Acceptance and Commitment Therapy, Dialectical Behavior Therapy). Reappraisal is also drawn upon in school-based wellbeing interventions that seek to enhance positive affect, such as the Promoting Alternative Thinking Strategies (PATHS; Greenberg, Kusche, Cook, & Quamma, 1995) curriculum. However, cross-sectional research has found significant, inverse relationships between reappraisal and depressive symptoms in adults but not adolescents, suggesting that reappraisal use increases from adolescence to adulthood (Garnefski et al., 2006). Further, research employing functional magnetic resonance imaging with adolescence demonstrates a linear increase in activation of the left ventrolateral prefrontal cortex (involved in reappraisal in adults), suggesting that reappraisal capacity in young people increases linearly with age, as cognitive control increases (Buhle et al., 2013; McRae et al., 2012). Based on these considerations, it is possible that reappraisal did not represent an effective ER strategy in the examined sample. Investigating change in reappraisal use from mid- to late-adolescence may further clarify this issue.

Strengths and limitations.

To the author's knowledge, this study is the first to demonstrate the moderating role of ER to wellbeing outcomes following PEP participation. However, a number of limitations must be acknowledged. First, as this study assessed the effectiveness of a school-wide Year 10 PEP program compared to wellbeing-as-usual programs of a self-selected group of schools, participants were not randomly assigned to treatment conditions. In addition, one of the comparisons was a single-sex school, resulting in a higher number of male than female students recruited from this school. Regardless, the targeted selection of comparison groups – based on similar SES to the intervention group – appears to have been successful, with no between group differences observed at baseline. Controlling for gender in all statistical models examined also managed the potential influence of uneven distribution of sex across groups. However, given the absence of random allocation and the relatively small sample size, outcomes of this study must be interpreted with caution. An additional limitation is the number of students with missing data from at least one time point. Future evaluations may limit error variance by comparing a randomly selected sample of students exposed to the PEP intervention with a waitlist control in the same school cohort, while potential gender differences could be addressed by including equal ratios of males and females in each group. With a larger sample, effects of gender could also be examined independently by including it as a moderator in the LMM model.

Although results of G*power analysis indicated that the current sample size was sufficient ($N > 77$) to detect moderation with a medium effect size, it is possible that our relatively modest sample of 80 may have obscured more complex relationships between ER and measures of wellbeing over time. Further, attrition rates were higher at follow-up in the comparison group than the intervention group. This finding is likely influenced by a lower motivation for ongoing participation observed in the comparison schools, however other factors cannot be ruled out. Thus, replication with larger, more diverse samples of young people is warranted. Finally, this study was exploratory in nature and examined numerous outcome variables, which may have resulted in an inflated Type 1 error rate. This must also be considered in the interpretation of results. Finally, due to the correlational nature of the statistical methods used in this study, causal relationships cannot be inferred.

Despite these challenges, the current research provides a novel contribution to the literature by highlighting ER as a valuable contributor to PEP outcomes. Particular strengths of this research included its longitudinal design, which allowed assessment of the durability of PEP effects up to 15-months post-intervention; and the incorporation of multiple measures of ER and a comprehensive assessment of adolescent wellbeing that acknowledges the relevance of both positive and negative mental health outcomes (Beauchaine, 2015; Rickard & Vella-Brodrick, 2014).

Suggestions for future research and practice.

The results of the current study provide valuable insight into the role of ER in adolescent wellbeing and PEPs. Most notably, self-reported ER capacity at baseline was found to significantly predict numerous markers of positive psychological functioning across all four time points, and also moderated the relationship between participation in the PEP program and two domains of wellbeing thought to promote flourishing in adulthood (i.e., happiness and connectedness). These findings further support the relevance of ER to adolescent mental health and wellbeing, and highlight the value of examining ER in relation to school-based PEP interventions and their outcomes. Results also highlighted the value of considering participant-specific characteristics in the evaluation of interventions more broadly (Kadzin, 2007; Shapiro, Brown, Thoresen, & Plante, 2011). In this instance, self-reported ER emerged as a consistent marker of both positive and negative psychological functioning in youth, and students' proficiency for adaptive ER on entering Year 10 was more predictive of wellbeing outcomes over time than was participation in the intervention group. This suggests that school-based wellbeing interventions including PEPs would benefit from incorporating explicit ER training into existing curricula. To manage emotions more effectively, students may be taught to observe, understand, and express emotions in situationally-appropriate ways. Students may also be encouraged to identify the physical signals of emotion in oneself and others (e.g., physiological sensations, facial expressions, body language); to understand the functional basis of unpleasant and pleasant emotional responses (e.g., fear helps one to avoid harm; contentment to build social and environmental resources); and to recognize the transient nature of emotional experiences (Gratz & Gunderson, 2006; Suveg, Sood, Comer, & Kendall, 2009). These skills are likely to help students avoid common problems of ER, such as difficulties in labeling, accepting, and tolerating

uncomfortable emotional experiences in oneself and others. Further, students should be equipped with effective techniques to modify emotional states, via the use of evidence-based, adaptive ER strategies like reappraisal, problem-solving in response to emotional stressors, and emotional acceptance (Aldao, Nolen-Hoeksema, & Schweizer, 2010). Adaptive ER strategies including reappraisal and acceptance can be cultivated via mindfulness practice (Chambers, Gullone, & Allen, 2009; Garland, Gaylord, & Fredrickson, 2011), or through more explicit training via cognitive restructuring techniques (Moskowitz, 2011). Such inclusions to PEP interventions may further enhance the benefits to student happiness and social connection observed in the current study, and also buffer students against the increase in depression and anxiety symptoms typically seen throughout the senior secondary school years.

Finally, to develop a deeper understanding of the relationship between ER and wellbeing, future research would benefit from assessing factors such as the situational context in which ER strategies are used, and the degree of flexibility with which young people implement ER strategies to meet varying environmental demands (Aldao, 2013; Aldao & Nolen-Hoeksema, 2012; Bonnano & Burton, 2015). Doing so will necessitate the development of new measures and research methods to appropriately capture the array of ER strategies used in daily life. Future research might benefit from the use of the Experience Sampling Method (ESM) to capture the real-time use of ER strategies in response to numerous ecologically valid, diverse emotional stressors, and in turn, contribute a more nuanced understanding of how ER capacity can be optimized.

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Study 3: Supplementary Information on Heart Rate Variability

Preamble

The purpose of this section is to outline the method, results, and discussion relating to HRV results for the third empirical study included in this thesis (see Chapter 5). It is intended to supplement the manuscript submitted for publication in *The Journal of Happiness Studies*, which examined the role of self-reported ER in the wellbeing outcomes of the examined PEP. Although HRV was initially included in the analysis, these data were removed following suggestions from journal reviewers.

Procedure

HRV data were collected within a two-week timeframe of the online wellbeing assessment, and involved a series of individually-conducted physiological assessments to assess resting (tonic) high-frequency heart rate variability (HRV). Participants presented to a low-stimulus experimental room at an allocated time during the school day (from 8.30am to 4pm). Details of the testing procedure were provided to students on arrival, and informed consent was sought and obtained. The collection, analysis and reporting of HRV data was undertaken in accordance with the Guidelines for Reporting Articles on Psychiatry and Heart Rate Variability (GAPH; Quintana, Alvares, & Healthers, 2016).

Materials

High Frequency Heart Rate Variability (HRV): HRV refers to the beat-to-beat variation in heart rate that occurs within the frequency band of respiration (0.15 – 0.40 Hz). Such variation results from the complex co-ordination of autonomic, respiratory, circulatory, endocrine and mechanical influences on heart rate over time (Quintana et al., 2016). HRV represents a valid, relatively stable index of parasympathetic influence on the heart, and is commonly recognized as a physiological marker of ER capacity in both adults and adolescent populations (Beauchaine & Thayer, 2015; Thayer, Ahs, Fredrikson, Sollers, & Wager, 2012). Higher resting HRV is associated with positive psychological outcomes, including social adjustment, positive affect and behavioral regulation; while lower resting HRV

is regarded as a transdiagnostic marker of mental ill-health (see reviews by Beauchaine, 2015; Beauchaine & Thayer, 2015).

To monitor HRV, researchers administered disposable electrodes approximately 1cm below the clavicle and on the lower ribcage, in a standard Lead 2 bipolar configuration (Bernston, Quigley, & Lozano, 2007). Respiration rate and rhythm were monitored via a sensor positioned on the lower abdomen. A neutral breathing pacer program, set at the recommended rate of 9 (<10) breaths per minute, was used to control for breathing rate and rhythm to yield maximum R-R interval power (Brown, Beightol, Koh, & Eckberg, 1993). Given the potential for paced breathing to contribute to stress-related changes in HRV when it is grossly misaligned with individuals' natural breathing rate, participants were instructed to "try and breathe along with this pacer, however if it feels difficult or unnatural, just breathe at a relaxed pace that feels right to you". Electrocardiography (ECG) and respiration data were then recorded by an integrated system and software package (Nexxus-10, Mind Media, 2004-2006), measured at a sampling rate of 1000Hz. Five minutes of continuous recording was obtained, as recommended for assessments of short duration (Quintana et al., 2016; Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). HRV monitoring software was concealed from the participant during the recording, to avoid potentially confounding effects such as increased sympathetic arousal, distraction, or interference of respiration or heart rate via biofeedback processes.

Data analyses

HRV data were generated and pre-processed using the Nexus software package (Mind Media, 2004-2006). The first 60-seconds of each five-minute recording was excluded from analysis to ensure participants were settled and sufficiently relaxed (Quintana et a., 2016). A time series of heart rate interbeat intervals (IBIs) was then generated. Raw IBIs were then screened for artifacts using the following criteria: (1) IBIs were between 500 and 1500 ms; and 2) IBIs differing by more than 25% from the previous IBI were considered an artifact and removed from analyses and replaced with interpolated data (IBI[n] = (IBI[n-1] + IBI)/2); Mind Media, 2004-2006). Time series with more than 10% of data loss were considered unusable and were removed from analyses (Quintana et al., 2016). Data from between 19 (pre-intervention) to 28 (6-month follow-up) individuals were removed from each time point due to data loss.

Equipment failure at the 15-month follow-up time point resulted in an unacceptably high proportion of data loss (80% of the experimental group, 84% of the control), therefore HRV data from this final time point were removed from further analyses. The mean percentage of artifact removed from each participant was between 4.10% and 5.04% (*SD* = 0.24 – 0.36) at each included time point. The remaining four minutes of HRV data were then processed in full, and HRV values (i.e., heart rate variability in the high-frequency band of 0.15 -0.40 Hz) were extracted. Due to significant skew, HRV data were then log transformed to better approximate a normal distribution and meet assumptions of linear regression (Ellis, Soller, Edelstein, & Thayer, 2008). HRV and self-reported ER and wellbeing data were entered into SPSS for all statistical analyses (version 23, IBM Chicago, IL, USA).

To analyze the relationship between psychological wellbeing variables and PEP participation over time, linear multivariate modelling (LMM) analyses were performed. LMM accounts for correlations between repeated data and maximizes power by including all available data from each time point (i.e., it is robust in the absence of complete data). LMM manages correlated data and unequal variances, and allows for the measurement of nested data. To assist interpretation of findings, HRV scores were split into three equal groups, each reflecting high, medium, and low ER capacity. Psychological wellbeing variables, participant group (PEP or comparison), time point (1, 2, 3, 4), and HRV variables at baseline were entered as fixed factors in each model. To control for its potentially confounding effect on the variables of interest, sex was included in all models as a fixed factor. Body mass index (BMI) was also controlled for in models including HRV (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). Participants (student) were treated as a random effect and a random intercept was estimated. To examine whether different patterns of wellbeing emerged over time between the PEP and control group, a time-by-group interaction was added to the model. Group-by-HRV interactions were also included to examine whether the impact of PEP participation on wellbeing outcomes differed according to students' ER capacity at baseline. Two models were estimated for each wellbeing variable examined, one examining HRV and the other examining self-reported ER. A total of 18 models were estimated, using the restricted maximum likelihood (REML) method of estimation. Visual inspection of the distribution of residuals revealed that the

assumptions of LMM, normality, and equal variances had been satisfied. All analyses were conducted using SPSS version 23, using a 95% (p = .05) confidence level.

Results

Sample characteristics at baseline and post-intervention are presented in Table 16. A series of independent samples t-tests were conducted and determined that there were no significant between-group differences in baseline HRV. Non-significant bivariate correlations between HRV and wellbeing variables at baseline or post-intervention were found in the PEP group, but a number of significant bivariate correlations were found between HRV and well-being variables at baseline and post-intervention in the comparison group. These are presented in Table 17. Contrary to expectations, results of LMM revealed no significant main effect of HRV on any of the wellbeing variables examined, and that all three-way time-by-group-by-HRV interactions were non-significant. These results are presented in Table 16.

Table 16. Descriptive statistics for pre- and post-intervention outcomes for the adolescent sample

Variable	Pre-intervention				Post-intervention				6-months follow-up				15-month follow-up						
	PEP $n = 44$		Control $n = 36$		PEP $n = 44$		Control $n = 36$		PEP $n = 38$		Control $n = 25$		PEP $n = 38$		Control $n = 24$				
	m	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*	*m*	*SD*	d_{post}	$d_{6\ mo}$	$d_{15\ mo}$
HRV	9083	9030	9438	7383	8310	7191	9356	7587	5502	5736	7015	6226					0.06	0.42	
HRV^{log10}	3.77	0.41	3.82	0.41	3.76	0.40	3.80	0.42	3.57	0.38	3.67	0.42							
Engagement	17.85	0.66	17.85	0.66	17.21	0.57	17.16	0.72	17.82	0.59	17.19	0.94	16.23	0.67	17.19	0.65	0.16	0.02	0.16
Perseverance	17.64	0.57	17.56	0.72	17.05	0.74	16.08	0.89	17.73	0.60	16.52	0.92	16.77	0.74	16.25	0.73	0.22	0.02	0.15
Optimism	18.10	0.56	18.41	0.64	18.00	0.67	17.16	0.85	18.30	0.65	17.76	1.07	16.87	0.70	17.13	0.80	0.16	0.04	0.08
Connectedness	20.18	0.60	20.48	0.62	19.67	0.56	19.40	0.71	20.97	0.63	18.90	0.99	20.19	0.73	20.00	0.82	0.08	0.13	0.00
Happiness	19.79	0.57	19.59	0.84	19.14	0.64	18.68	0.95	20.58	0.66	19.14	1.04	18.35	0.67	19.44	0.84	0.15	0.19	0.17
Resilience	26.10	0.85	27.63	1.16	25.86	1.16	26.40	1.08	37.06	1.01	38.52	1.46	36.26	1.18	37.88	1.03	0.37	1.83	1.76
SLSS	34.54	0.65	31.11	1.15	33.31	1.06	30.64	1.29	35.15	0.93	33.14	1.51	32.65	1.13	31.25	1.39	0.15	0.21	0.11
Depression	0.90	0.15	1.78	0.22	1.71	0.22	2.12	0.33	3.39	0.21	3.67	0.35	3.61	0.25	3.75	0.39	0.32	1.58	1.66
Anxiety	1.15	0.16	1.56	0.30	1.98	0.28	1.96	0.35	3.51	0.26	3.52	0.39	3.81	0.28	3.56	0.40	0.25	1.41	1.48

SD = standard deviation; BMI = body mass index; HRV = high frequency heart rate variability; HRV^{log} = log-transformed HRV; EPOCH = EPOCH Measure of Adolescent Well-being; Resilience = Connor-Davidson Resilience Total Score; SLSS = Student Life Satisfaction Scale; PHQ-4 = Patient Health Questionnaire four-item version. p^{t*g} = time * group interaction significance levels using data across all four time points. d_{post} = Cohen's *d* effect size based on pre-treatment and post-treatment means; $d_{6\ mo}$ and $d_{15\ mo}$ show Cohen's *d* effect sizes based on pre-treatment and post-treatment (d_{post}), 6-months post-treatment ($d_{6\ mo}$), and 15-months post treatment ($d_{15\ mo}$) for the experimental group.

Table 17. Bivariate correlations of pre-treatment HRV with study outcomes at pre-treatment, post-treatment, and six-months follow-up for PEP and comparison groups

Variable	Pre-treatment	Post-treatment	6-months follow-up
PEP condition			
Engagement	-.10	.13	.02
Perseverance	.02	-.01	.03
Optimism	.11	.12	.03
Connectedness	.14	.20	.12
Happiness	.23	.20	**.38***
Resilience	.01	.13	.18
SLSS	.23	.15	.17
Depression	-.02	-.15	-.25
Anxiety	-.26	-.24	-.04
Control condition			
Engagement	-.34	**-.48***	-.34
Perseverance	-.21	-.27	-.26
Optimism	**-.42***	**-.57****	-.37
Connectedness	**-.43***	**-.50****	-.18
Happiness	**-.51***	**-.45***	-.01
Resilience	-.21	-.27	-.39
SLSS	-.24	-.31	.12
Depression	**.48***	.27	-.28
Anxiety	.40	.16	-.33

Discussion

The current study had three key aims. These included examining the relationship between HRV and change in adolescent wellbeing over the 15-month follow-up period; evaluating whether baseline HRV could differentiate students who benefitted from participation in PEP from those who did not; and determining whether HRV was improved following PEP participation compared to a wellbeing-as-usual comparison condition. Contrary to our hypotheses, participants' baseline HRV did not predict change in any of the wellbeing variables predicted. Previous research suggests that impaired HRV is implicated in lower wellbeing in maltreated children (Kim & Cicchetti, 2010), and the development and maintenance of mental ill-health in at-risk adolescent samples (see Beauchaine, 2015 for a review). Conversely, higher resting HRV has been linked to greater indices of positive functioning in adults (Kok & Fredrickson, 2010) and college students (Geisler, et al., 2010). Results of the current study did not replicate those of past research. One point of difference from previous research is that the current sample involved a school-based sample with above-average SES, a group that is likely to be exposed to fewer mental health risk factors than at-risk and maltreated youth. Furthermore, as HRV is thought to gradually decline as a result of chronic stress and associated processes of allostasis (Thayer &

Sternberg, 2006; Vijoen & Claassen, 2017), it is possible that statistically significant, inverse relationships between HRV and mental ill-health emerge later in life or, in adolescents, only in cases of extreme psychological hardship.

Higher HRV is thought to represent a greater capacity to modulate physiological systems that facilitate higher-order ER processes, including the sympathetic nervous system and neural regions involved in tasks of executive functioning (Thayer & Lane, 2000). In relation to positive psychological functioning, it is plausible that HRV represents a precursor to wellbeing, but when examined independently does not emerge as a sufficiently strong predictor of positive psychological health. In other words, HRV may play a supportive role in facilitating the use of adaptive cognitive processes that promote wellbeing (Mather & Thayer, 2018), but does not guarantee that the individual will engage in wellbeing-enhancing, top-down cognitive processes (e.g., reappraisal; Gross & John, 2003).

Examination of time-by-group-by-HRV interactions revealed that students' HRV upon entering the Year 10 program did not differentially predict change in wellbeing for students participating in the PEP versus the comparison condition. Further research is required to explicate and replicate these findings in larger and more diverse samples, for example, students from lower SES groups and from public schools.

Finally, participation in the PEP was not associated with significant change in HRV compared to the wellbeing-as-usual comparison group. One interpretation of this finding is that the current PEP does not improve students' physiological capacity for ER, and including additional, ER-specific interventions into the program would be beneficial. Activities such as biofeedback training and mindfulness practice have been found to be effective in improving HRV and the physiological capacity for ER more broadly (Lehrer & Gevirtz, 2014; Shearer, Hunt, Chowdhury, & Nicol, 2016). Alternatively, it is possible that actual improvements in physiological ER capacity brought about by the PEP were not adequately captured due to a lagged intervention effect. Specifically, HRV is considered slow to reflect change (Tarkiainen et el., 2005), and the 15-month follow-up period involved in this study may have been insufficient to detect statistically significant benefits from participating in the PEP. Incorporating longer follow-up periods that involve times of transition or increased stress (e.g., leaving school, commencing tertiary education) may further clarify this issue.

A major limitation of this research was the inclusion of a single measure of HRV taken at rest. This method provides an indication of overall (i.e., trait) ER capacity, but does not capture change in HRV in response to a stressor (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). Measuring real-time responses to emotional challenges may provide additional understanding of whether and under which circumstances PEP exposure influences physiological ER capacity, and is therefore recommended in future research. Further, a number of factors thought to influence HRV were not statistically controlled for, including caffeine, nicotine and alcohol intake, time of recording, and fitness level (Quintana et al., 2016). It is likely that variation in some of these factors was limited by the characteristics of the current sample and recording throughout the school day (e.g., alcohol and nicotine intake), however this potential limitation should be noted.

In sum, the current research sought to determine whether baseline HRV at commencement of the Year 10 school year predicted change in multiple measures of wellbeing over the 15-month follow-up period; whether PEP participation led to improvements in resting HRV; and finally, if resting HRV on entering the PEP program differentiated students who displayed improvements in wellbeing from those who did not. Contrary to expectations, HRV did not predict change in any of the wellbeing variables examined, and students exposed to the PEP did not display statistically different patterns of resting HRV to the wellbeing-as-usual comparison condition post-intervention. These findings suggest that in its current format, the examined PEP has minimal impact on the resting HRV of adolescents. Incorporating evidence-based interventions to target HRV, such as HRV biofeedback training, may improve these outcomes. Additional factors that may partially explain these results, and should be explored in future research, include the inclusion of a young, healthy, and socially advantaged sample, as well as a methodological limitation that precluded the assessment of HRV during an experimentally manipulated emotional challenge. In closing, a novel contribution of this research is its assessment of the impact of a best-practice PEP on a physiological measure of ER implicated in both physical and psychological health. Results highlight the importance of assessing HRV during a stressful situation (e.g., via experimental manipulation or during the transition into post-school life) in order to further investigate the potential benefits of the PEP on ER processes.

Chapter 6: General Discussion

This research project examined the relationship of ER with adolescent wellbeing and the outcomes of a best-practice, Australian PEP. It involved one narrative literature review and three empirical studies, which together, provide preliminary support for the predictive value of ER in relation to positive psychological functioning in adolescence, and the extent to which students are most likely to benefit from participation in this PEP. The first task of this project involved conducting a literature review to define key constructs, illuminate relationships between ER and domains of adolescent psychological functioning, and provide the historical context and purpose of PEPs. A more targeted review, published in *The Journal of Happiness Studies*, was then conducted to synthesize and evaluate research on relationships between ER and the positive psychology interventions incorporated into PEPs targeting adolescents, using Seligman's (2011) PERMA model as a guiding framework.

This published review had three key aims. The first was to evaluate the relationship of ER with domains of wellbeing targeted by school-based positive psychology interventions. The second aim was to examine whether adolescents' ER capacity could be improved as a result of exposure to positive education and related programs. The final aim was to evaluate the role of ER in relation to the wellbeing outcomes typically targeted by PEPs. In sum, results showed that ER processes are compatible with, and likely implicated in, PEP interventions. Robust associations were found between processes of ER and the PERMA domains of wellbeing, including positive emotions, engagement, relationships, meaning, and health. A limited number of the studies reviewed also indicated that ER can influence the degree to which students benefit from PEP participation, with students reporting use of more adaptive ER strategies also demonstrating improvements in wellbeing over the school year (Vella-Brodrick, Rickard, & Chin, 2014). A notable gap in the literature was related to whether adolescents' ER capacity could be improved following exposure to PEPs. Due to the small and heterogeneous group of interventions examined in this review, as well as the inclusion of inconsistent ER measures, it was determined that further empirical research was required, both to clarify the role of ER in adolescent wellbeing; and to assess whether ER represents a potential mechanism contributing to improvements in wellbeing following PEP participation. By highlighting the theoretical compatibility of positive psychology interventions and the dominant ER framework (Gross, 1998), this literature review builds a compelling argument for understanding and conceptualizing positive psychology

interventions within a broader framework of ER. Doing so is likely to lead, in turn, to the development of more targeted, refined, and theoretically-driven PEP interventions.

Another valuable outcome of the literature review process was arriving at a more nuanced understanding of the ER construct. It became apparent early in the investigative process that definitions of ER were diverse and inconsistent (for detailed reviews on this topic, see Cole et al., 2004). As a consequence of considerable variation in the manner in which ER is defined and measured, establishing a clear definition of ER and a valid methodology for its measurement was a necessary step in the development of this research project. Examination of commonalities between the ER literature in the fields of neuroscience, developmental psychology and education suggested that ER was appropriately understood as a multidimensional construct, in which the effective regulation of emotion is assisted by both underlying physiological (i.e., "bottom up") processes, as well as conscious and cognitive (i.e., "top down") strategies. Therefore, to capture both physiological and cognitive ER processes, the use of multiple ER measures was deemed appropriate.

The first empirical study, involving 101 adolescents aged between 14 and 16 years, examined correlations between change in heart rate variability (HRV), a physiological ER measure, and self-reported ER strategies across two time-points, eight months apart. The aim of this study was to validate the inclusion of HRV as an objective ER measure for subsequent studies included in this thesis, as is increasingly recommended by researchers in this area (Beauchaine & Thayer, 2015). Although cross-sectional evidence suggests that HRV represents a valid physiological measure of ER in adolescents, existing literature was unclear as to whether HRV is sensitive to change in ER over time, and if HRV is associated with adaptive ER strategies above and beyond its inverse relationship with maladaptive processes of ER. The first study aimed to address these gaps in knowledge. Consistent with predictions, change in high-frequency HRV predicted change in cognitive difficulties in ER, as measured by the DERS total score. Difficulties in emotional clarity – the ability to identify, understand and differentiate emotional experiences – was the only self-reported ER dimension consistently predicted across multiple HRV measures. Contrary to predictions, HRV was not significantly related to any adaptive ER strategies examined. Overall, the findings of the first empirical study indicated that the relationships between different measures of HRV and self-reported ER are inconsistent. This suggests that HRV and self-report measures provide a unique contribution to the ER construct, and might therefore differentially predict adolescent wellbeing. This outcome supported the incorporation of multiple ER measures in studies of adolescent wellbeing.

The second empirical study, currently in press at the *International Journal of Wellbeing* sought to investigate the strength and direction of relationships between multiple measures of ER and indices of positive and negative psychological functioning in a normative sample of 119 adolescents ranging in age from 14 to 16 years. Although it is thought that ER contributes to psychological adjustment in adolescence (Steinberg, 2016), the majority of empirical support for this premise has, to date, only examined a limited subset of ER processes, primarily in relation to measures of psychological distress and dysfunction. To assess the value of incorporating ER into school-based programs that aim to promote psychological adjustment, such as PEPs, it is first necessary to determine the strength and direction of relationships between ER and the numerous domains of wellbeing targeted by such programs. This study, therefore, sought to examine the relationship of both physiological (HRV) and self-reported measures of ER with domains of both positive psychological functioning (i.e., PERMA+ domains of wellbeing and resilience) and mental distress (i.e., symptoms of depression and anxiety). After controlling for covariates thought to influence ER (i.e., age, school type as a proxy for socio-economic status), hierarchical regression analyses revealed that self-reported ER predicted resilience, perseverance, connectedness, and happiness, as well as fewer depression and anxiety symptoms. Higher HRV only significantly predicted resilience and perseverance. Results of this study provided cross-sectional support for the relevance of ER to multiple measures of positive adolescent functioning, while also confirming previously identified relationships between ER deficits and mental distress.

The third and final study, under review at *The Journal of Happiness Studies*, sought to build upon the findings of the second by exploring longitudinal relationships between ER and adolescent wellbeing over a 15-month period. It examined the relationship of two self-report measures of ER with wellbeing outcomes in 44 Year 10 adolescents following a year-long PEP compared to 36 students enrolled in a wellbeing-as-usual control condition. In addition, this third study sought to empirically examine theoretical associations between the interventions incorporated into PEPs and adolescent wellbeing, as highlighted in the narrative review included in this thesis. Specifically, this study examined whether students' ER capacity on entering the PEP influenced how much they benefitted from this program. It also sought to determine whether exposure to positive education was associated with improvements in ER, compared to the wellbeing-as-usual comparison condition. Results of linear mixed modeling revealed that irrespective of wellbeing group, students' ER capacity on entering Year 10 was significantly related to change over time in all domains of positive

psychological functioning examined (i.e., the PERMA+ domains of wellbeing and resilience), thus providing longitudinal support for the importance of ER to wellbeing and adaptive psychological functioning in adolescence. Importantly, students' baseline ER capacity was more predictive of wellbeing over time than was the nature of the program they were exposed to (i.e., positive education or wellbeing-as-usual). However, significant time-by-group-by-ER interactions revealed that adolescents in the PEP group who had a low ER capacity showed improvements in happiness and social connection post-treatment, and these benefits were sustained at least 6-months after program completion. This finding indicates that positive education is associated with higher levels of happiness and social connectedness for students with impaired ER capacity, but that benefits are negligible for students with more adept ER profiles. A key implication of this study relates to the potential use of ER to distinguish students who are more likely to benefit from PEP interventions – namely, those with a reduced capacity for ER.

The following section of this general discussion outlines the collective contribution of these studies in relation to existing positive education and ER research. Collective findings and their respective implications for theory and educational practice are summarized under five key themes: 1) the contribution of ER capacity to adolescent wellbeing; 2) the value of applying an ER framework to inform positive education programs; 3) the choice of ER measurement tools for adolescent research; 4) the value of HRV as a short- to mid-term measure of adolescent ER capacity relative to self-report; and 5) considerations for wellbeing measurement and the evaluation of PEPs. Each of these topics will be discussed in turn.

Emotion Regulation Contributes to Positive Psychological Functioning in Adolescents

A key aim of this thesis was to examine the relationship of multiple measures of ER with adolescent wellbeing. In this context, novel contributions of this research were: i) the examination of ER measures that, when taken together, capture both the conscious use of putatively adaptive and maladaptive ER strategies, as well as underlying physiological processes; and ii) the inclusion of a broad suite of markers of positive and negative psychological functioning to reflect the complete state of wellbeing (Keyes, 2005). Self-reported ER was consistently found to predict indices of positive psychological functioning in both cross-sectional (Study 2) and longitudinal research (study 3). These results extend previous research that has focused almost exclusively on mental distress and dysfunction, by showing that fewer ER difficulties and a greater use of reappraisal contribute to the

prediction of positive aspects of psychological functioning. Results thus provide an important addition to the existing ER literature by demonstrating the importance of adolescents' ER capacity to the full spectrum of mental health, which includes the presence of wellbeing above and beyond the absence of mental ill-health (Suldo & Shaffer, 2008).

Results were less consistent in relation to HRV, the physiological ER measure used throughout. The second empirical study involved a cross-sectional sample of 119 adolescents and revealed that HRV only predicted two aspects of positive psychological functioning - resilience and perseverance. HRV is thought to contribute to ER capacity by facilitating a flexible allocation of physical resources in response to environmental demands (Appelhans & Leucken, 2006), a process likely implicated in resilience (i.e., the individual's capacity for adaptive functioning following stress or adversity; Campbell-Sills & Stein, 2007), and perseverance (i.e., tenacity in the face of challenges; Kern et al., 2016). However, a follow-up study (Study 3) of 101 adolescents that examined longitudinal relationships over a two-year period revealed non-significant relationships between HRV and all wellbeing variables. Differential relationships between physiological and cognitive ER measures and student wellbeing highlight the importance of appropriately matching one's choice of ER measure with the specific research questions and study design at hand. For example, it has been suggested that HRV provides a relatively stable measure of ER (Tarkiainen et al., 2005; but see Kok et al., 2013), and it is possible that the 15-month period examined in this thesis was insufficient to capture change in HRV over time. Alternatively, it is possible that the relationship between HRV and positive psychological health becomes more apparent with increasing age. It is likely that the effects of health-related behaviors and cognitive patterns that influence HRV (e.g., physical activity level, diet, characteristic responses to perceived stress) are cumulative, and contribute to greater between-person variation physiological markers of health, such as HRV, among older age groups (Kemp & Quintana, 2013; Thayer & Sternberg, 2006). Further, it is possible that improving the physiological component of ER, as reflected by HRV, may be more effectively targeted by interventions that involve a physiological component, such as the incorporation of biofeedback training (e.g., McCraty & Zayas, 2014; Ratanasiripong, Sverduk, Hayashino & Prince, 2010). Ongoing research is required to clarify some of these questions and further explore the relationship of HRV with adolescent wellbeing.

Together, results supported the importance of including a greater emphasis on ER capacity in models of positive mental health, and in particular, cognitive ER strategies that promote the ability to identify, manage, and modify emotional experiences (e.g., labelling

and describing emotions, employing techniques to shift from an unhelpful emotional state such as cognitive reappraisal). This knowledge may be used to inform health promotion policy and programs that seek to enhance adolescent health, models of positive youth development, and youth-oriented psychological services (e.g. Headspace; Orygen).

Processes of Emotion Regulation Can Inform Positive Education Programs

A key implication of the findings reported in this thesis relates to the value of incorporating explicit ER training into the current PEP model to complement and enhance current positive psychology interventions. Results of a comprehensive literature review revealed that: i) processes of ER are implicit in numerous cognitive, behavioral and positive psychology interventions conveyed by the PEP (see article titled *Emotion Regulation in Adolescent Wellbeing and Positive Education*, for an overview); ii) positive education is compatible with an established model of ER: Gross' (1998) Process Model; iii) ER strategies can be effectively taught via school and group-based training programs (Berking et al., 2008); and iv) positive psychology and cognitive behavioral interventions sharing similarities with the examined PEP can be enhanced by incorporating ER-specific training into the curriculum (e.g., Berking et al., 2008; Lü, Wang, & Liu, 2013; Weytens et al., 2014). Furthermore, results of studies two and three demonstrated the importance of ER capabilities to psychological health, Interestingly, PEP participation was not found to improve students' overall ER capacity, which was unexpected, given the bidirectional relationships between change in ER and domains of wellbeing reported elsewhere (e.g., positive affect, social connectedness; Kok et al., 2013). In sum, these findings suggest that the examined PEP does not currently capitalize on ER as a mechanism through which to enhance student wellbeing. In order to enhance the examined PEP, introducing ER-specific interventions into the school curricula is recommended. An overview of a recently developed Positive ER Intervention group program (Weytens et al., 2014), which synthesizes positive psychology interventions within an ER framework, is presented in Appendix F. In addition, PEP interventions may be discussed and practiced through reference to existing ER theory; for example, interventions such as gratitude, savoring, and activity planning can be used to allow participants to capitalize on positive experiences in the past, present, and future, respectively (see Morrish et al., 2017; Quoidbach et al., 2015 for detailed discussions). As the majority of research to date has examined the use of positive psychology interventions in relation to the up-regulation of positive affective experiences, further research is warranted to examine how such strategies

can be utilized by young people to effectively manage difficult emotional experiences commonly encountered in academic and interpersonal contexts.

In relation to person-activity fit, the outcomes of this research project indicate that self-reported ER capacity might represent a valuable indicator of which students are likely to benefit most from PEP interventions. For students with the lowest ER capacity at the commencement of the Year 10 program, PEP participation was significantly related to two domains of wellbeing, happiness and social connectedness. Importantly, these improvements in wellbeing continued to increase until at least 15 months' post-treatment, the final point of data collection. These results indicate that the improvements conveyed by program involvement were both enduring and increased incrementally, likely as students learned to master the learned skills over time. The benefits of PEP participation for students lacking adaptive ER capacity suggest that PEP may be particularly beneficial when applied to at-risk groups, who often display the poorest ER profiles. This might include young people from socially disadvantaged backgrounds, maltreated adolescents, or youth with mental ill-health conditions (Brunzell, Stokes, & Waters, 2016; Curtis & Cicchetti, 2007; Kim & Cicchetti, 2010). Further research applying positive education to a broader range of young people, particularly those with poorer ER capacity, may further clarify the potential benefits of this program.

Self-Report and Physiological Measures Capture Related but Distinct Components of Emotion Regulation

Across the ER literature there has been increasing emphasis on the need to incorporate physiological measures in research designs (Beauchaine, 2015). A review of the literature identified HRV as an increasingly popular measure of physiological ER capacity. Despite such claims, during the first year of the current research project there was a paucity of empirical research to directly support this claim. Although it is evident that HRV was related to ER in a theoretically consistent manner, no published studies could be identified that had directly examined the claim that HRV represents a physiological index of ER. Given this gap, the first proposed empirical paper sought to establish the degree of covariance between HRV and self-reported ER. In 2015, one year into this PhD candidature, two cross-sectional studies were published that demonstrated that HRV and ER were indeed significantly related (Nardelli et al., 2015; Williams et al., 2015). In order to build upon these findings, the first study included in this thesis aimed to examine the strength, stability and direction of longitudinal relationships between HRV and self-reported ER strategies at two time points

over the academic year. This was deemed an important precursor to the following studies, which would investigate change in ER over the intervention and follow-up period. Further, as the two published studies examined self-reported deficits of ER, it was also valuable to explore how HRV related to the adaptive ER strategies of acceptance, positive reappraisal and positive refocusing. Results of this first study revealed a small, significant and inverse relationship between HRV and total self-reported difficulties in ER, accounting for just 5.1% of the variance in DERS scores. There was no significant correspondence between change in HRV and adaptive ER, as measured by the CERQ. Similarly, the second study revealed that the covariance between HRV and both total ER difficulties and positive reappraisal was negligible. These findings appear to call into question the assumption that HRV and self-report measure the same ER construct, particularly given that the experience and regulation of emotion is thought to involve coordinated responses across subjective, cognitive, behavioral, and physiological measures (Marsh, Beauchaine & Williams, 2008). However, further investigation revealed that low covariance between experiential and physiological measures of emotional processes is common (Bonnano & Keltner, 2004; Evers et al., 2014), particularly in the absence of intense emotional experiences or specific contexts (Crowell et al., 2014; Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005). Based on these considerations, the weak to negligible association between HRV and self-reported ER in the current research does not necessarily indicate an absence of construct validity. Instead, it suggests that each measure captures distinct processes of ER and that caution should be taken when comparing outcomes of empirical studies that have used different measures of ER (for discussions of this topic, see Cole et al., 2004; Naragon-Gainey et al., 2017). A related issue, outlined previously, is the need to carefully consider which ER measure will be most appropriate given the research aims in question.

Heart Rate Variability may not Adequately Capture Adaptive ER Capacity in Healthy, Adolescent Samples

HRV is increasingly recognized as a marker of ER dysregulation in adolescents (see Beauchaine, 2015, for a review), with lower HRV reflecting an impaired capacity to engage in adaptive ER processes. A key aim of this thesis was to determine how HRV relates to markers of adaptive ER, such as the characteristic use of adaptive ER processes or the existence of fewer ER deficits. With the exception of the significant associations between HRV and resilience and perseverance found in the second study, no significant relationships between HRV and wellbeing were found. It is therefore conceivable that HRV more closely

reflects a general pattern of dysregulated ER than an index of adaptive ER (Beauchaine & Thayer, 2015). For example, lower HRV represents an impaired capacity to modulate the sympathetic nervous system and neural regions responsible for executive functioning, structures that together facilitate higher-order ER processes (Thayer & Lane, 2000). If ER capacity is impaired at a physiological level, this is likely to also impair an individual's capacity to effectively engage higher-order cognitive functions, such as choosing and implementing adaptive 'top-down' ER strategies (Thayer et al., 2012). Based on this logic, the presence of an appropriately responsive ANS is likely to facilitate the ability to engage in appropriate, cognitive ER strategies, but is not enough to guarantee that the individual decides to implement such strategies. In other words, compared to those with lower resting HRV, adolescents displaying higher HRV are likely to have more success in using cognitive ER strategies (e.g., cognitive reappraisal) *if and when they choose to do so*. HRV may therefore be considered an important precursor or facilitator of adaptive ER, however, other processes will influence whether ER processes are engaged, such as a person's motivation to regulate emotion, their level of insight into emotional processes, or their degree of emotional literacy.

Results of this research project also revealed that compared to self-reported ER, weaker associations existed between HRV and measures of wellbeing and mental distress. This finding, although unanticipated, may be explained in terms of the younger age and health status of the adolescent sample examined. In addition to ER capacity, HRV is used as a proxy measure for overall psychological or physical health, due to its relationship with allostatic processes. It is believed that chronic stress gradually erodes the capacity of the prefrontal cortex to regulate physiological and cognitive responses to emotion-eliciting events, which results in poorer vagal regulation of heart rate and the sympathetic nervous system. Impaired vagal tone is indexed by lower resting HRV. As the impact of chronic stress on HRV occurs gradually, it is perhaps unlikely that the negative physiological effects of stress exposure have yet resulted in a statistically significant degree of impairment in HRV in a normative sample of adolescents (Mandler, 1984). In support of this hypothesis, the majority of research has examined the relationship between impaired HRV and physical health in older or chronically unwell samples. Further, significant negative relationships between HRV and mental ill-health in adolescent samples have almost exclusively involved clinical samples or otherwise at-risk youth (e.g., maltreated children; same-sex attracted and self-harming youth) – adolescents who have likely endured elevated levels of stress for extended periods, compared to non-clinical, community-based youth (Blom et al., 2010; Kim

& Cicchetti, 2006). Replicating the current research in a less advantaged social group may evaluate this hypothesis, and shed further light on the various relationships between HRV and both positive and negative psychological functioning in adolescents.

Considerations for the Evaluation of School-Based Wellbeing Programs

The final theme to emerge from this project relates to the evaluation of school-based programs such as positive education. Two main considerations have been identified: the challenges of assessing wellbeing longitudinally, and the importance of closely monitoring the content of respective wellbeing programs in cross-school comparison studies. Each of these issues will now be discussed in turn.

Contrary to prediction, the examined positive education program did not lead to measurable improvements in student wellbeing. To understand this finding, it is important to consider some challenges of measuring change in wellbeing over time. Cultivating wellbeing and resilience is a long-term investment, and it is possible that the benefits of positive education will not emerge until later in life, or during periods of challenge and change. The absence of measureable improvements does not necessarily indicate that the program did not equip students with valuable psychological strategies or life skills, but that the method of measurement was insufficiently sensitive to detect potentially nuanced and subtle indicators of change. Similarly, declines in wellbeing are commonly observed across adolescence and the final years of secondary school, thus it is possible that the stability of wellbeing observed across these years in the current study itself indicates a degree of program efficacy, by providing a buffering effect against deteriorating mental health. It is possible that longer follow-up periods, for example, that include the transition from secondary school to employment or tertiary education, may further clarify program benefits. Regarding the measurement of wellbeing and resilience, a pertinent limitation of the current (ecological research) design relates to the difficulty in capturing valid change in these domains over time. Due to both practical and ethical reasons, it was not possible to design and implement an experimentally-controlled, stressful situation in which to test student's use of positive psychological strategies and coping. Such an experimental approach could provide greater control of the type and strength of the emotion elicited; involve multiple data collection techniques (e.g., self-report, physiological responses, observational reports); and reduce the influence of potential confounds, including recall-bias, impaired motivation, and limited metacognitive capacity or insight (Seeley, Garcia, & Mennin, 2015). An experimental approach such as this could provide a more valid and sensitive indication of any program

benefits than student self-report batteries completed across a regular school day. As outlined by Anderson and Fraillon (2009), a key challenge to measuring non-academic school outcomes is providing appropriate and sufficiently challenging opportunities for students to demonstrate cognitive and behavioral change. Given this, further research with a larger, randomly-selected sample of students is recommended, involving challenging situations within a carefully controlled environment to advance current understandings of PEP efficacy.

A second factor that is likely to have contributed to the detection of only marginal between-group differences in wellbeing is the increasing overlap in the content of the examined wellbeing-as-usual and the target positive education programs over time. Initial assessment of the participating control schools prior to the commencement of this research in February, 2014, revealed that the content of their wellbeing programs shared few similarities with the PEP experimental school, and were therefore considered to represent an appropriate, wellbeing-as-usual control condition. Yet, as the two-year evaluation period progressed, the wellbeing curriculum of each of the comparison schools increasingly incorporated positive education-related interventions, narrowing the gap between the wellbeing-as-usual control schools and the PEP intervention school. This pattern reflects a broader trend in which an increasing number of wellbeing frameworks and programs are being tailored to the school setting, many of which share considerable overlap with positive education. The use of different terms and labels to conceptualize and target wellbeing also poses a distinct challenge for researchers seeking to maintain clear distinctions between positive education and wellbeing-as-usual program content. In the current study, the gradual incorporation of positive education into the comparison school programs was not clearly identified by wellbeing educators or students, with both groups reporting no exposure to positive education throughout this research. Nevertheless, post-hoc comparisons of each schools' wellbeing intervention identified a number of similarities, which are summarized and presented in Appendix A. This evolution of the control schools' wellbeing program to more closely reflect positive education was a natural occurrence that could not be prevented by researchers for ethical reasons. The increasing emphasis on including wellbeing education into the school curriculum amongst independent schools is reflective of a broader, state-wide approach that seeks to promote wellbeing, social and emotional development, resilience, and respectful relationships within government school communities (e.g., the Victorian Government Department of Education & Training's Student Wellbeing Hub initiative). Thus, similarities between the program content of the experimental and comparison schools must be considered when interpreting this unanticipated outcome.

Challenges, Limitations, and Future Directions

Despite careful consideration in the design, implementation, and evaluation of this research, it is also subject to a number of limitations. First, the small sample size of this research resulted in insufficient power to examine or control for individual difference factors that may have influenced ER and wellbeing variables (e.g., medication use, sleep quality, family structure), or to reliably explore within-group measures of change in ER. These limitations were most notable in Study Three, which involved multiple data points as well as between-group comparisons. The use of a linear mixed model in statistical analyses partially addressed concerns surrounding missing data, but it cannot completely address the relatively low power. Factors that contributed to the small sample size included lost or unusable self-reported wellbeing data, which resulted from difficulties matching student identification codes across data from different time points. Equipment malfunction during the collection of physiological data was another limiting factor, resulting in a proportion of invalid or unusable HRV data. While rates of attrition were relatively low, numbers were further compromised by students who were absent for one or more of the days during testing.

Another challenge relates to the potentially limited generalizability of our findings due to sample characteristics. The current research involved a higher number of male students and limited inclusion of government-funded schools, producing a SES distribution that is higher than the Victorian average. A related limitation was the self-selection of schools involved in this evaluation, which could have led to a self-selection bias that favored schools with a greater interest and commitment to student wellbeing, which is likely to be significantly lower in less-engaged schools.

The measurement of ER strategies used by students throughout this research project was also limited by the relatively small range of ER measures validated for use with adolescents (see pp. 30 – 33 for a detailed description of each). The DERS and CERQ were chosen in part due to the comparatively broad range of ER strategies each captured (e.g., Gross and John's (2003) ERQ measures just two – reappraisal and emotional suppression). Nonetheless, it must be acknowledged that both the CERQ and DERS assess ER strategies used in response to *negative* affective experiences, rather than those used to enhance or prolong *positive* affect. Capturing a greater range of adaptive ER strategies, and in particular those that are used in response to positive affect, will likely provide an enhanced understanding of ER strategy use in the context of positive education. Given the limited range of putatively adaptive strategies measured by existing, psychometrically sound ER-specific

measures, it may be useful to draw upon questionnaires from research domains conceptually similar to ER, for example the field of coping.

A final challenge relates to the difficulties in maintaining an active comparison condition over a two-year period, particularly given the increasing, state-wide emphasis on developing wellbeing programs similar to positive education across schools. Each of these factors makes it difficult to gauge whether findings would be replicated in other samples, for instance those with a lower SES or less interest in positive education initiatives.

The use of technology to capture real-time ER processes in naturalistic settings may address some of these limitations, and is a recommended direction for future research. For example, cognitive ER processes may be captured via the use of ecological momentary assessment methods, which allow participants to record specific emotional triggers and the choice and effectiveness of different ER strategies as they occur. Physiological ER processes may also be recorded with the use of transportable and increasingly cost-effective monitoring devices (e.g. wireless sensors, mobile ECG devices, smartphone technology) to capture emotion-generated physiological dynamics in naturalistic settings (Seeley et al., 2015). The use of such methods can capture a variety of ER processes while minimizing reporting biases. Given the rich and detailed data provided by such methods, the problem of missing data may also be minimized. Importantly, capturing real-time ER data allows for examination of how different emotional triggers are regulated; how emotions of different valence are regulated; whether differences exist in the manner in which pleasant and unpleasant emotions are regulated; and can provide insight into individual differences or trait characteristics that influence ER success. In sum, the application of recent technological advancements will contribute to a more nuanced understanding of the complex relationships between emotional experiences, regulatory efforts, and wellbeing.

Notwithstanding these limitations and challenges, the current research also has numerous strengths. It offers a meaningful contribution to theoretical literature by presenting a novel integration of two fields of research relevant to adolescent mental health – ER and positive education, a popular early intervention framework. To date, ER has remained largely under-researched in the context of positive education, despite its important contribution to the domains of wellbeing targeted by PEPs. The findings of the current research demonstrate that a young person's ER capacity predicts all five domains of wellbeing thought to predict flourishing in adulthood (Kern et al, 2016), including engagement, perseverance, optimism, connectedness, and happiness. Results also revealed that ER can be used to determine person-activity fit; that is, those students for whom positive education may be most beneficial.

Further, by building upon recent theoretical developments that position positive psychology interventions as a specific subset of ER intervention (see Quoidbach et al., 2015), the current research provides promising, theoretically-driven directions for future research. Specifically, understanding positive psychology interventions from an ER perspective (that is, techniques that enhance wellbeing by optimizing positive emotional experiences before, during, and after emotion-eliciting events) provides a valuable framework from which to develop new positive psychology interventions.

An important contribution of the current research is the application of a positive ER framework specifically to adolescent samples, and in the context of school-based wellbeing programs. In relation to methodological strengths, this research applied a best-practice, multi-method approach to the measurement of ER (Cole, 2004; Compare et al., 2014; Quintana & Heathers, 2014) to capture both perceived ER efforts as well as objective, underlying physiological processes contributing to ER success. The majority of previous ER research with adolescent samples has used a single methodological approach (Adrian et al., 2013), which prohibited an examination of the relative contribution of different components of ER. By examining both HRV and self-reported ER, this research revealed that in this healthy adolescent sample, self-report is more strongly associated with domains of wellbeing than HRV, which has been largely examined in relation to mental ill-health. This study also involved a relatively long follow-up period, which facilitated the evaluation of the sustainability of outcomes over time and allowed for any lagged effects. Finally, the current research examined a variety of measures of positive and negative psychological functioning, which permitted the examination of ER in relation to the full spectrum of psychological wellbeing (Keyes, 2005).

Summary and Conclusions

In sum, this research project was intended to advance the science of wellbeing and positive psychology by examining variables thought to contribute to optimal psychological functioning in young people. Three key messages were broadly conveyed by this research: first, ER is an important marker of adolescent wellbeing, above and beyond its relationship with mental ill-health; second, positive education appears to improve levels of happiness and social connectedness in students with an impaired ER capacity; and third, models of positive education should consider ER as a guiding framework through which to conceptualize program interventions and understand mechanisms of change. Considerations for future

research include developing and trialing a school-based wellbeing intervention that combines positive psychology interventions with explicit, evidence-based ER interventions; assessing the outcomes of positive education under controlled conditions that elicit specific emotional challenges; and the use of ecological momentary assessment methods to capture real-time emotional experience and ER efforts in naturalistic settings. These developments may advance our understanding of the complex relationships between ER and adolescent wellbeing; improve adolescent-focused wellbeing interventions; and in turn, contribute to flourishing in adolescent populations.

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Appendix A

Summary of Wellbeing Program Content Delivered via PEP and Comparison Schools

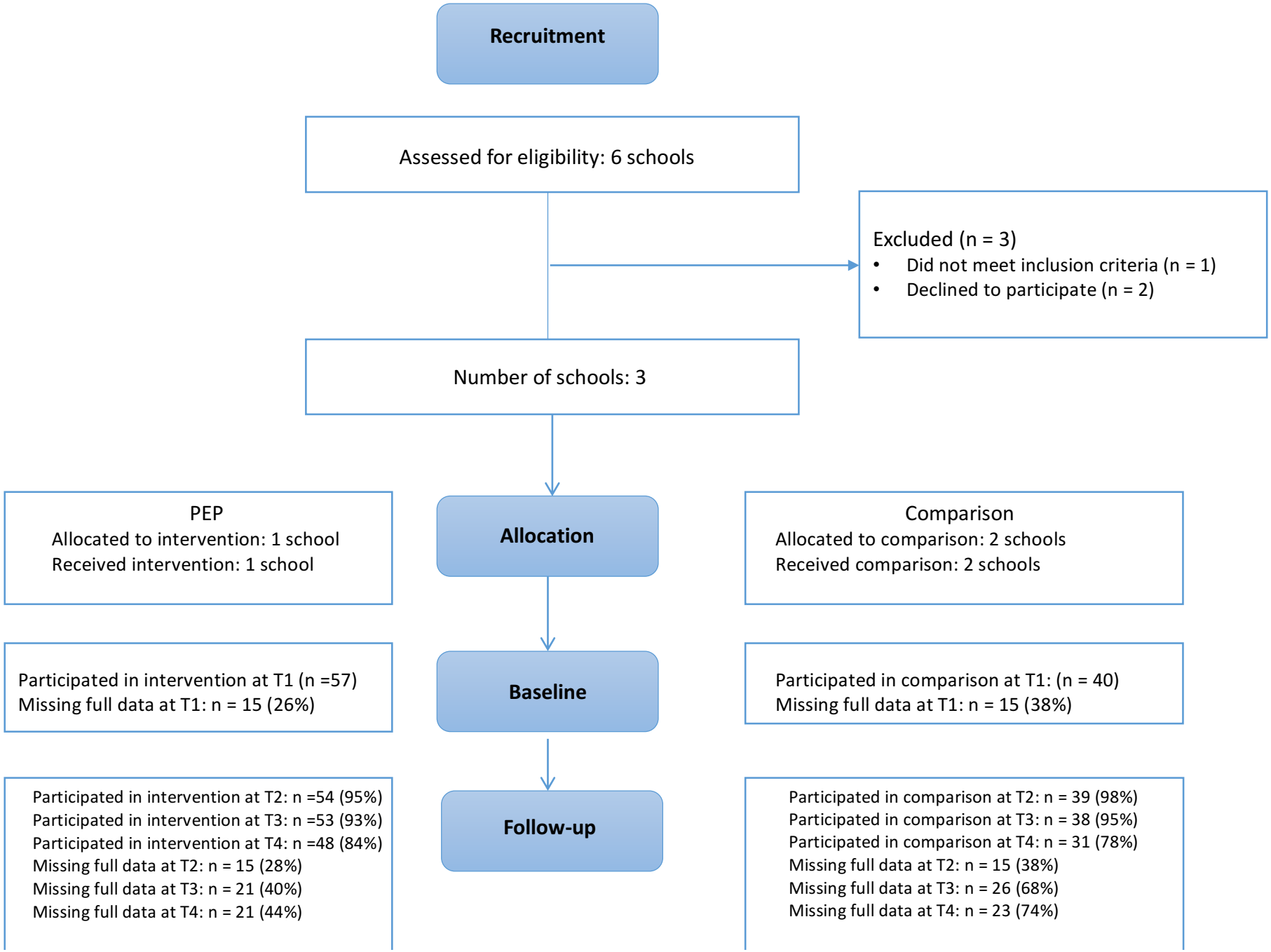
	PEP	Comparison School 1	Comparison School 2
Wellbeing framework	**Geelong Grammar School Model for Positive Education (PERMA)** • Positive emotions • Positive engagement • Positive purpose • Positive relationships • Positive accomplishment • Positive health	**PROSPER** • Positivity • Engagement • Purpose • Relationships • Outcomes • Strengths • Resilience **Leadership Program:** Communication; conflict resolution; ethical leadership; teamwork; attitude; meaningful life **Positive Coaching:** Tutor sessions	**Five Domains of Positive Functioning** • Attention & awareness • Comprehension & coping • Emotions • Goals & habits • Virtues & relationships
Program commencement	2011	2015	2015
Frequency of lessons	Weekly	Weekly	Fortnightly
Duration of lessons	90 minutes	60 minutes	50 minutes
Program topics	What is flourishing?	Flourishing	Exploring flourishing from the PERMA perspective and Keyes' mental health & mental ill-health continuum
	Exploring character strengths	PROSPER – Character strengths	Character strengths (mentor groups)
	Using your strengths	Signature strengths	Using your strengths (mentor groups)
	Spotting character strengths	Identifying top 5 and supporting strengths	Spotting strengths (mentor groups)
	Developing a growth mindset	Developing a growth mindset (tutor groups including years 9 to 12)	

	Training your brain		
	Exploring resilience	PROSPER - Resilience	Modified version of PENN Resilience Program and ACT-based resilience program
	Thinking flexibly Building strong relationships in good & bad times	PROSPER – Relationships	Social relationships
	Igniting your passion		
	Exploring meaning & purpose in life	PROSPER - Purpose	
	Understanding positivity	PROSPER – Positive emotions	
	Encouraging gratitude		
	Nurturing hope & optimism	Leadership: Leading in life	Goal-setting activities (tutor sessions)

**Note: Although the comparison schools stated that Positive Education was not explicitly taught to Year 10 students in 2014, there was similar content and/or learning objectives subsequently identified in their well-being-as-usual program, including flourishing, character strengths, relationships, and resilience.*

Appendix B

Recruitment & Participation Flowchart



Appendix C

2014 Geelong Grammar School Positive Education Program Overview

<table>
<tr><th colspan="6">Geelong Grammar School Year 10 Positive Education Program (2014)</th></tr>
<tr><th colspan="2">Term 1</th><th>Term 2</th><th>Term 3</th><th colspan="2">Term 4</th></tr>
<tr><td>W1</td><td>Positive relationships
Positive communities</td><td>Mindfulness</td><td></td><td colspan="2">Wellbeing App Project</td></tr>
<tr><td>W2</td><td>What is Flourishing</td><td rowspan="3">Cultivating Positivity
- Broaden & Build Theory
- Defining & using mindfulness
- Mindfulness practice</td><td>Character Strengths
- Research & activities</td><td colspan="2">Purpose – Making a Difference</td></tr>
<tr><td>W3</td><td rowspan="3">Fostering Relationships
- Importance of r’ships
- Acts of Kindness
- Active Constructive responding
- Blessing journal</td><td>Character Strengths
- My VIA strengths & activities</td><td colspan="2">Purpose – Community Activity</td></tr>
<tr><td>W4</td><td>Expressing Gratitude
- Appreciation & gratitude
- Gratitude poster & letter</td><td>Character Strengths at the Movies</td><td colspan="2">Relationships – Empathy</td></tr>
<tr><td>W5</td><td rowspan="2">Neuroplasticity
- Mindsets – fixed vs growth
- Neuroplasticity in action: juggling</td><td>Character Strengths
- Nurturing a strength</td><td colspan="2">Relationships - Forgiveness</td></tr>
<tr><td>W6</td><td>Positive Emotions Experience</td><td>Purpose in Life</td><td colspan="2">Creativity – create a movie</td></tr>
<tr><td>W7</td><td rowspan="2">Building resilience
- Overview
- Problem-solving
- Post-traumatic growth</td><td></td><td>Mental Health
- Understanding mental ill-health</td><td colspan="2">Creativity – present a movie</td></tr>
<tr><td>W8</td><td>Neuroscience – Expert overview</td><td>Mental Health Personal Insight</td><td colspan="2">Skills review</td></tr>
<tr><td>W9</td><td></td><td>Skills review</td><td>Positive Health - Nutrition</td><td></td><td></td></tr>
<tr><td>W10</td><td></td><td></td><td>Positive Health – Sleep & Exercise</td><td colspan="2"></td></tr>
</table>

Appendix D

Emotion Regulation Questionnaire

Dealing with your emotions

---

1) What is your participant ID? (e.g. 055)

___ ___ ___

2) How relaxed do you currently feel?

Not at all relaxed	Slightly relaxed	Fairly relaxed	Quite relaxed	Very relaxed
☐	☐	☐	☐	☐

3) How often do the following statements apply to you?

	Almost never	Sometimes	About half the time	Most of the time	Almost always
I am clear about my feelings	☐	☐	☐	☐	☐
I pay attention to how I feel	☐	☐	☐	☐	☐
I experience my emotions as overwhelming and out of control	☐	☐	☐	☐	☐
I have no idea how I am feeling	☐	☐	☐	☐	☐
I have difficulty making sense out of my feelings	☐	☐	☐	☐	☐
I am attentive to my feelings	☐	☐	☐	☐	☐
I know exactly how I am feeling	☐	☐	☐	☐	☐
I care about what I am feeling	☐	☐	☐	☐	☐
I am confused about how I feel	☐	☐	☐	☐	☐

4) When I'm upset.....

	Almost never	Sometimes	About half the time	Most of the time	Almost always
I acknowledge my emotions	☐	☐	☐	☐	☐
I become angry with myself for feeling that way	☐	☐	☐	☐	☐
I become embarrassed for feeling that way	☐	☐	☐	☐	☐
I have difficulty getting work done	☐	☐	☐	☐	☐
I become out of control	☐	☐	☐	☐	☐
I believe that I will remain that way for a long time	☐	☐	☐	☐	☐
I believe that I'll end up feeling very depressed	☐	☐	☐	☐	☐
I believe that my feelings are valid and important	☐	☐	☐	☐	☐
I have difficulty focusing on other things	☐	☐	☐	☐	☐
I feel out of control	☐	☐	☐	☐	☐
I can still get things done	☐	☐	☐	☐	☐
I feel ashamed with myself for feeling that way	☐	☐	☐	☐	☐
I know that I can find a way to eventually feel better	☐	☐	☐	☐	☐
I feel like I am weak	☐	☐	☐	☐	☐

5) When I'm upset.....

	Almost never	Sometimes	About half the time	Most of the time	Almost always
I feel like I can remain in control of my behaviours	☐	☐	☐	☐	☐
I feel guilty for feeling that way	☐	☐ Text	☐	☐	☐
I have difficulty concentrating	☐	☐	☐	☐	☐
I have difficulty controlling my behaviours	☐	☐	☐	☐	☐
I believe there is nothing I can do to make myself feel better	☐	☐	☐	☐	☐
I become irritated with myself for feeling that way	☐	☐	☐	☐	☐
I start to feel very bad about myself	☐	☐	☐	☐	☐
I believe that wallowing in it is all I can do	☐	☐	☐	☐	☐
I lose control over my behaviours	☐	☐	☐	☐	☐
I have difficulty thinking about anything else	☐	☐	☐	☐	☐
I take time to figure out what I'm really feeling	☐	☐	☐	☐	☐
it takes me a long time to feel better	☐	☐	☐	☐	☐
my emotions feel overwhelming	☐	☐	☐	☐	☐

6) Everyone gets confronted with negative or unpleasant events now and then and everyone responds to them in his or her own way. With the following questions, you are asked to indicate how you generally think, when you experience negative or unpleasant events.

	(Almost) never	Sometimes	Regularly	Often	(Almost) always
I feel that I am the one who is responsible for what has happened	☐	☐	☐	☐	☐
I think that basically the cause must lie within myself	☐	☐	☐	☐	☐
I think that I have to accept that this has happened	☐	☐	☐	☐	☐
I think that I have to accept the situation	☐	☐	☐	☐	☐
I often think about how I feel about what I have experienced	☐	☐	☐	☐	☐
I am preoccupied with what I think and feel about what I have experienced	☐	☐	☐	☐	☐
I think of pleasant things that have nothing to do with it	☐	☐	☐	☐	☐
I think of something nice instead of what has happened	☐	☐	☐	☐	☐

I think about how to change the situation	☐	☐	☐	☐	☐
I think about a plan of what I can do best	☐	☐	☐	☐	☐
I think I can learn something from the situation	☐	☐	☐	☐	☐
I think that I can become a stronger person as a result of what has happened	☐	☐	☐	☐	☐
I think that it hasn't been too bad compared to other things	☐	☐	☐	☐	☐
I tell myself that there are worse things in life	☐	☐	☐	☐	☐
I keep thinking about how terrible it is what I have experienced	☐	☐	☐	☐	☐
I continually think how horrible the situation has been	☐	☐	☐	☐	☐
I feel that others are responsible for what has happened	☐	☐	☐	☐	☐
I feel that basically the cause lies with others	☐	☐	☐	☐	☐

Thank You!

Thank you for completing this survey. Your response is very important to us.

Appendix E

Online Wellbeing Survey (Relevant Scales)

How are you?

Helpline info and assurance of anonymity

Thank you for agreeing to participate in this study. While very unlikely, it is possible that some young people may be uncomfortable in answering some of the questions in this survey. Should you feel any distress as a result of this survey, you can withdraw at any time. You may also wish to talk about your concerns with your parent/guardian/carer(s), teacher, school welfare officer, your doctor or a counselling service such as Headspace, Kid's Help Line or Lifeline:

Headspace	*Kid's Help Line*	*Lifeline Australia*
Headspace provides mental and health wellbeing support, information and services to young people and their families across Australia. www.headspace.org.au	Free 24 hour telephone counselling service for young people aged 5-18. Phone: 1800 551 800	Lifeline Australia is a 24/7 phone counselling service. Phone: 13 11 14 Website: http://www.lifeline.org.au/

This survey is an opportunity for you to tell us more about your experience. There's no right or wrong answer, and your responses are untraceable as an individual.

Anonymous ID for matching responses

Please answer the following 4 questions that will enable us to make an anonymous ID code for you.

1) What is your birth month in numbers? (e.g., write '06' for June)

__ __

2) What are the first 3 letters of your mother's maiden name? (mother surname before she was married – e.g., Smith would be 'SMI')

__ __ __

3) What are the middle 2 numbers of your postcode? (e.g., enter '15' for 3157)

__ __

4) What is your birth date? (e.g., if you were born on 17 June 1995, write '17')

__ __

---

16) Over the last 2 weeks, how often have you been bothered by the following problems? [Patient Health Questionnaire-4 (PHQ-4)]

	Not at all	Several days	More than half the days	Nearly every day
Little interest or pleasure in doing things	☐	☐	☐	☐
Feeling down, depressed, or hopeless	☐	☐	☐	☐
Feeling nervous, anxious or on edge	☐	☐	☐	☐
Not being able to stop or control worrying	☐	☐	☐	☐

26) How much do these statements apply to you? [C-D Resilience Scale]

	Not true at all	Rarely true	Sometimes true	Often true	True nearly all the time
I am able to adapt when changes occur.	☐	☐	☐	☐	☐
I can deal with whatever comes my way.	☐	☐	☐	☐	☐
I try to see the humorous side of things when I am faced with problems.	☐	☐	☐	☐	☐
Having to cope with stress can make me stronger.	☐	☐	☐	☐	☐
I tend to bounce back after illness, injury, or other hardships.	☐	☐	☐	☐	☐
I believe I can achieve my goals, even if there are obstacles.	☐	☐	☐	☐	☐
Under pressure, I stay focused and think clearly.	☐	☐	☐	☐	☐
I am not easily discouraged by failure.	☐	☐	☐	☐	☐
I think of myself as a strong person when dealing with life's challenges and difficulties.	☐	☐	☐	☐	☐
I am able to handle unpleasant or painful feelings like sadness, fear, and anger.	☐	☐	☐	☐	☐

18) How well do these statements describe you? [EPOCH]

	Almost never	Sometimes	Often	Very often	Almost always
I believe that I can do just about anything I set my mind to.	☐	☐	☐	☐	☐
When I'm reading or learning something new, I lose track of how much time passes.	☐	☐	☐	☐	☐
When I have a problem, I have someone who will be there for me.	☐	☐	☐	☐	☐
Once I make a plan to get something done, I stick to it.	☐	☐	☐	☐	☐
I love life.	☐	☐	☐	☐	☐
There are people in my life who really care about me.	☐	☐	☐	☐	☐
I wake up and really look forward to my day.	☐	☐	☐	☐	☐
I feel a sense of accomplishment from what I do.	☐	☐	☐	☐	☐
When I do an activity, I enjoy it so much that I lose track of time.	☐	☐	☐	☐	☐
I have a lot of fun.	☐	☐	☐	☐	☐
I finish whatever I begin.	☐	☐	☐	☐	☐
I think good things are going to happen to me.	☐	☐	☐	☐	☐
I am a cheerful person.	☐	☐	☐	☐	☐
I have friends that I really care about.	☐	☐	☐	☐	☐
In my classes, I concentrate so hard that time passes quickly.	☐	☐	☐	☐	☐
I keep at my schoolwork until I am done with it.	☐	☐	☐	☐	☐
I believe that I will achieve my goals.	☐	☐	☐	☐	☐
When something good happens to me, I have people in my life that I like to share the good news with.	☐	☐	☐	☐	☐
I feel happy.	☐	☐	☐	☐	☐
I get completely absorbed in what I am doing.	☐	☐	☐	☐	☐
I am a hard worker.	☐	☐	☐	☐	☐
I laugh a lot.	☐	☐	☐	☐	☐
I believe that things will work out, no matter how difficult they seem.	☐	☐	☐	☐	☐
I feel that I am loved.	☐	☐	☐	☐	☐
I feel passionate about the things I enjoy doing.	☐	☐	☐	☐	☐

About you

28) How old are you?

- ☐ 12
- ☐ 13
- ☐ 14
- ☐ 15
- ☐ 16
- ☐ 17
- ☐ 18

29) Are you male or female?

- ☐ Male
- ☐ Female

30) Which country were you born in?

_____

31) Which country is your family from?

_____

32) What is your home postcode?

__ __ __ __ __ __ __ __

33) What is your mother currently doing?

- ☐ Working full-time for pay
- ☐ Working part-time for pay
- ☐ Not working, but looking for a job
- ☐ Other (e.g., home duties, retired)

34) What is your mother's main job? (e.g., school teacher, nurse, sales manager)

_____

35) What is your father currently doing?

- ☐ Working full-time for pay
- ☐ Working part-time for pay
- ☐ Not working, but looking for a job
- ☐ Other (e.g., home duties, retired)

36) What is your father's main job? (e.g., school teacher, engineer, sales manager)

_____

Appendix F

Summary of Weytens, Luminet, Verhofstadt, & Mikolajczak's (2014) Positive Emotional Regulation Program

Session 1:	
Presentation of the Positive Emotion Regulation Program (PER) and introduction	
Presentation of the theoretical framework	
Emotion: definition and function	
The role of positive emotions in wellbeing and happiness	
Introduction to emotion regulation strategies	
Classification of emotion regulation strategies (Quoidbach et al's model, 2012)	
Happiness and positive emotion enhancing techniques	
Techniques used BEFORE an event	
B1	**Situation selection: select future situations that will make you happy**
	1. **Practice sports**
	2. **Be altruistic**
	3. **Socialize**
	4. **Take care of your needs**
Homework	
Session 2:	
B2	**Situation Modification: modify future situations to boost happiness potential**
	1. **Plan your events practically**
	2. **Optimize your events by adding pleasure**
	3. **Use job crafting**
	4. **Manage time for important domains of your life**
B3	**Attentional Deployment: mentally project yourself in future pleasant events**
	1. **List tomorrow's great things/ activities**
	2. **Practice mental time travel about positive future events**
	3. **Imagine your best future self**
Homework	
Session 3:	
B4	Cognitive Change: adapt an optimistic perspective about future events
	1. **Find positive aspects in your negative/ neutral/ positive future events**
	2. **Reduce your expectations**
B5	**Response Modulation: express your emotions about future positive events**
	1. **Diversify your means of expression**
	2. **Use different means to express your positive emotions for future events**
Techniques to use DURING an event	
D1	Situation Selection: really do what is important for your happiness, go from anticipation to action
	1. **Set goals**

	2. **Monitor your progress towards your goal**
Homework	

Session 4:

D2	**Situation Modification: modify situations to increase their positive potential**
	1. **Live your best day**
	2. **Optimize the end of an event**
	3. **Find the flow**
D3	**Attentional Deployment: fully deploy your attention to the present pleasures**
	1. **Savor a piece of food**
	2. Savor something you are doing mechanically in everyday life
	3. Be receptive to beauty or excellence
	4. **Savor something you are doing mechanically in everyday life**
	5. **Be receptive to beauty or excellence**
	6. **Pay attention to compliments you are receiving and accept them**
D4	**Cognitive Change: interpret events positively, realize your luck**
	1. **Realize why you are responsible for your success**
	2. **Practice counterfactual thinking**
	3. **Realize your luck**

Session 5:

D5	**Response Modulation: express your positive emotions**
	1. **Smile**
	2. **Make yourself smile**
	3. **Feel positive emotions in your body and express them**
	4. **Show your affection**
Techniques to use AFTER an event	
A1	Situation Selection: identify what was important, what you should remember
	1. **Identify what need was fulfilled in the past positive event to know what is important to you**
	2. **Identify memories you should preserve**
	3. **Create a memorabilia box**
A2	**Situation Modification: filter your memories and showcase the good ones**
	1. **Put together a selection of your souvenirs and showcase the good ones**
A3	**Attentional Deployment: mentally relive positive past experiences**
	1. **Practice mental time travel about positive past events**
Homework	

Session 6:

A4	**Cognitive Change: be aware of the good moments you lived**
	1. **Keep a gratitude journal**
	2. **Realize what went well in the during the last year**
	3. **Write a gratitude letter**
A5	**Response Modulation: express your positive emotions about past events**
	1. **Diversify your means of expression**
	2. **Share past positive experiences**
	3. **Celebrate your and others' achievements, capitalize on them**

4. **Do a gratitude visit**
Assess your progress
Key learnings about sustainable happiness
Identify exercises that worked best for you
Plan how to incorporate these exercises into your everyday life