On the nature and origin of self-esteem

A complex dynamic systems perspective
of nested self-esteem phenomena

Naomi de Ruiter

The research presented in this dissertation was funded by a PhD grant from the Faculty of Behavioural and Social Sciences, University of Groningen.

Cover picture and design: Hester Nijhoff
Printed by: Gildeprint

ISBN paper version: 978-90-367-7912-8
ISBN electronic version: 978-90-367-7947-0

NUR-code: 773

university of groningen

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PhD thesis

to obtain the degree of PhD at the
University of Groningen
on the authority of the
Rector Magnificus Prof. E. Sterken
and in accordance with
the decision by the College of Deans.

This thesis will be defended in public on

Monday 8 June 2015 at 14:30 hours

By

Naomi Michelle Praise de Ruiter

born on 18 July 1986
in Trail, Canada

Supervisor

Prof. P.L.C. van Geert

Co-supervisor

Dr. E.S. Kunnen

Assessment committee

Prof. R.R. Vallacher

Prof. I. Granic

Prof. D. Draaisma

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CHAPTER 1
Introduction

Self-esteem is an exceptionally prevalent construct in modern psychology (Zeigler-Hill, 2013). So much so that it is thought to be at the root of what makes individuals (and societies at large) thrive. This can be seen at the level of the general public, evidenced by the large amount of self-esteem oriented self-help literature – such as How to Raise Your Self-Esteem (Branden, 1987) – or by initiatives such as the National Association for Self-Esteem (NASE), whose mission is to "improv[e] the human condition through the enhancement of self-esteem" (National Association for Self-Esteem, n.d.). The significance of self-esteem is also seen in the context of scientific research, where it has been found to be an important predictor for psychological variables such as well-being (Baumeister, Campbell, Krueger, & Vohs, 2003; Furnham & Cheng, 2000) and life satisfaction (Diener & Diener, 1995), for example. Perhaps what attests the most to the perspective that self-esteem is central in individuals' lives is the widely held perspective that positive self-esteem is actually a need (Allport, 1955; Epstein, 1973; James, 1890). Aside from our basic physical needs, therefore, many researchers believe that we are motivated to fulfill a need for positive self-regard (Baumeister, Tice, & Hutton, 1989; Brown, 1998; Robins, Trzesniewski, Tracy, Gosling, & Potter, 2002).

While the centrality of self-esteem in our lives seems to be both common knowledge and scientific knowledge, the field of self-esteem research is still in want of a general consensus of what self-esteem actually is (Blaschovich & Tomaka, 1991; Heine, Lehman, Markus, & Kitayama, 1999; Scheff & Fearon, 2004; Tafarodi & Ho, 2006). There are definitions of self-esteem, to be sure, varying from the extent to which people like themselves and feel that they are competent (Brown, 1998; Tafarodi & Swann, 1995) to the positive or negative view that individuals have of themselves (Rosenberg, 1979). From these definitions we can ascertain that self-esteem is not a thing that has a physical location, which we then have a mental representation of (in the same way that a bicycle physically exists and can be reflected upon; Tafarodi & Ho, 2006). Instead, researchers have concluded that self-esteem is the mental representation itself, where the positivity or negativity of self-esteem is determined by the extent to which individuals like their mental representations of themselves (Tafarodi & Ho, 2006). From this perspective, self-esteem is akin to a positive or negative conclusion that is made about the self. This raises questions such as, what remains of 'self-esteem' if a conclusion is not made, and a representation is not formed, of the self? Does self-esteem then no longer exist?

These questions bring about a more fundamental question regarding the nature of self-esteem. Namely, if self-esteem is not a physical 'thing', what then underlies the representations that individuals develop of themselves? The current thesis aims to answer this question by unveiling the underlying processes that give rise to, and that characterize, the experience of self-esteem. In order to understand these processes, a complex dynamic sys-

tems perspective is adopted (Lewis & Granic, 1999; Nowak & Vallacher, 1998; Thelen & Smith, 1994; Van Geert, 1994).

1.1 A Complex Dynamic Systems Perspective

A complex dynamic systems perspective is a meta-theory, which – based on a number of basic principles – aims to describe, explain and predict how the interactions between a collection of elements across time creates an emergent property that cannot be reduced to the characteristics of the elements themselves (Thelen & Smith, 1994). A dynamic system can be a cellular system, an individual system, a dyadic system, an economic system, and many others at various scales. Thus, the same set of principles is expected to apply to any system. In the current thesis, I apply a complex dynamic systems perspective to the self-esteem system. The core complex dynamic systems principles that I will discuss in this thesis are self-organization, emergent properties, and nested time-scales, which I shortly describe below.

Self-organization is the process by which interactions amongst lower-order elements give rise to higher-order emergent properties. The system thus organizes itself, without there being an internal agent that steers this organization (Kelso, 2000). An example of self-organization is molecules interacting to form cells (Misteli, 2001). The emergent properties are characterized – not by the elements themselves – but by the way that the elements influence each other and are organized across time, and by their ability to maintain themselves across a period of time.

This process is fundamental to any complex dynamic systems approach (Haken, 1997; Lewis, 2000), and forms the heart of our exploration of self-esteem.

Self-esteem can thus also be conceptualized as a higher-order emergent property that emerges out of interactions between its own lower-order elements, such as feelings like pride or shame, negative thoughts about the self, or behavior like assertiveness or seeking reassurance. These lower-order elements – being positive and negative experiences of the self – can be seen as the building blocks for the self-organization of self-esteem. The self-esteem system therefore refers to all levels involved in this self-organizational process, from the level of the self-experiential building blocks to the higher-order emergent characteristics of self-esteem.

Due to this self-organization out of lower-order elements into higher-order emergent properties, a dynamic system can be conceptualized as consisting out of nested levels of increasing complexity. The levels are ‘nested’ in as far as each level is the product of simpler sub-levels, and as each level emerges into existence across an increasingly larger time scale compared to the previous level.

The most common distinction between nested levels is the distinction between a micro level and a macro level. The micro level of the nested system includes the lower-order elements that form the basis for the self-organizational process. For psychological systems, these include actions and experiences that occur in the here-and-now across the time scale of seconds or minutes (Fischer & Bidell, 2006; Lichtwarck-Aschoff, Van Geert, Bosma, & Kunnen, 2008; Thelen & Smith, 1994). Micro-level elements therefore exhibit

highly variable real-time developmental trajectories, characterized by relatively low structure and predictability (Lewis, 2002; Lichtwarck-Aschoff et al., 2008; Van Geert, 1998).

The macro level of the nested system consists of the higher-order emergent characteristics. For psychological systems, these include developmental acquisitions such as psychological disorders (Cramer, Waldorp, Van der Maas, & Borsboom, 2010), intelligence (Van der Maas et al., 2006), identity (Lichtwarck-Aschoff et al., 2008), and interaction patterns (Fogel, 1993; Granic & Patterson, 2006). Macro-level psychological characteristics develop across weeks, months, or years (Lewis, 2002), such that they have the potential to develop into patterns or structures that maintain themselves across a period of time.

While the micro-level and macro-level of a dynamic system are separate, they are also intrinsically connected (Lichtwarck-Aschoff et al., 2008; Smith & Thelen, 2003). This connection is bi-directional, such that the interactions between lower-order elements give rise to higher-order emergent characteristics, which then constrain the interactions between the lower-order elements. There is thus circular causality between the levels of the nested system (Kelso, 2000). This circular causality underlies the development of the system across the long term, as well as its real-time dynamics. Therefore, the nature of a higher-order emergent characteristic cannot be understood on its own, since it is not a static structure, but one that is inherently intertwined with the interactions between its lower-order elements.

Just as molecules interacting at the micro level give way to cells at the macro level, I posit that emotions and behavior that are positive or negative in their self-experiential meaning interact at the micro level to form a self-maintaining experience of self-esteem at the macro level. As such, my general proposition is that the origin of self-esteem is the self-organizational process that begins at the micro level (i.e., with self-experiential elements), and that the nature of self-esteem is that of a higher-order emergent property. Because an emergent property is – at any given moment – continually interacting with the lower-order levels of the nested system, I will test these general propositions by examining the dynamics within and across the nested levels of self-esteem in real-time (i.e., in the here-and-now).

1.2 State and Trait Self-Esteem

In the current thesis, I expand on the more general micro-macro distinction of a nested system in order to incorporate the traditional distinction between state self-esteem and trait self-esteem. State self-esteem is typically conceptualized as the highly variable and fleeting experience of one's self-worth as positive or negative that occurs "at this moment" (DeHart & Pelham, 2007; Kernis, Cornell, Sun, Berry, & Harlow, 1993). In contrast, trait self-esteem is conceptualized as the experience of one's self-worth as positive or negative that is relatively stable across a large period of individuals' lives, i.e., across years (Harter, 1982; Robins & Trzesniewski, 2005; Rosenberg, 1979).

I propose that both state self-esteem and trait self-esteem can be conceptualized as emergent properties. However, I suggest that the two are different self-esteem phenomena because they differ in the time span across which developmental self-organization occurs.

In this thesis, I distinguish between developmental self-organization and real-time self-organization. First, developmental self-organization refers to the process of self-organization that allows the emergent phenomenon to come into existence in the first place. The time scale across which developmental self-organization occurs differs for state and trait self-esteem.

State self-esteem changes from moment to moment (Kernis, Grannemann, & Barclay, 1989; Leary & Downs, 1995; Rosenberg, 1986), suggesting that it developmentally self-organizes in the here-and-now. In contrast, trait self-esteem changes across the time span of years (Harter, 1982; Robins & Trzesniewski, 2005; Rosenberg, 1979), suggesting that it developmentally self-organizes across many months to years. Therefore, state self-esteem self-organizes in the moment out of the current self-experiential building blocks, while trait self-esteem is a relatively slow-changing emergent property, self-organizing across the larger history of the building blocks of self-esteem. Trait self-esteem is thus a higher-order construct compared to state self-esteem, making state self-esteem an intermediate meso-level, between self-experiences (i.e., micro level constructs) and trait self-esteem (i.e., macro constructs). The nested structure of the self-esteem system, as conceptualized in the current thesis, thus consists of the micro level, meso level, and macro level.

Aside from developmental self-organization, I suggest that emergent properties such as self-esteem also self-organize in real-time. In contrast to developmental self-organization, real-time self-organization is the process of self-organization that allows the emergent phenomenon to manifest itself, once it has self-organized into existence by means of developmental self-organization. Real-time self-organization thus allows state and trait self-esteem to be experienced by the individual. As experience occurs in the present moment, real-time self-organization thus also occurs in the present moment (across seconds and minutes).

Moreover, given that – from a complex dynamic systems perspective – all nested constructs of a dynamic system are dynamically intertwined at each moment, I conceptualize trait self-esteem, state self-esteem, and the self-experiential building blocks as being dynamically intertwined at every moment. As such, this thesis brings a new dynamic dimension to the concept of self-esteem. Regarding this dynamic dimension, the principles of the complex dynamic systems perspective make it possible to develop specific predictions regarding the specific nature of the dynamics between and within these levels of the self-esteem system. As the underlying dynamics of self-esteem have, to date, been largely neglected in self-esteem literature, this thesis aims to contribute to extant self-esteem literature by outlining, discussing, and empirically demonstrating these dynamics.

While complex dynamic systems thinking is not mainstream in self-esteem literature, the contributions that self-esteem researchers have made by utilizing complex dynamic systems thinking prove its value in furthering knowledge regarding the fundamental nature of self-esteem (i.e., Vallacher and colleagues, Delignières and colleagues; Delignières, Fortes, & Ninot, 2004; Fortes, Delignières, & Ninot, 2004; Ninot, Fortes, & Delignières, 2005; Nowak, Vallacher, Tesser, & Borkowski, 2000; Vallacher & Nowak, 2000;

Wong, Vallacher, & Nowak, 2014). This thesis extends this stream of work by integrating complex dynamic systems thinking more explicitly into the conceptualization of trait self-esteem, state self-esteem, and self-experiences (as nested levels of self-esteem).

1.3 Self-Esteem as an Intra-Individual Process

In order to understand the nature of a construct, it is essential to consider intra-individual variability, which focuses on differences (i.e., fluctuations) within individuals and across repeated measures (Van Geert & Van Dijk, 2002). Intra-individual variability contrasts inter-individual variability, which refers to the differences between individuals, and which is the most common focus in (developmental) research in psychology (Van Geert, 2014).

It is vital that intra-individual variability of self-esteem is considered, as self-esteem is an inherently within-individual process. According to the principle of non-ergodicity, within-individual processes can only be truly understood based on findings at the level of the individual (i.e., intra-individual variability; Molenaar, 2004, 2008; Salvatore & Valsiner, 2008).

While it is commonplace to draw conclusions regarding individual processes based on findings at the population level (i.e. population averages), this is in fact only possible under specific conditions. These conditions refer to, firstly, group homogeneity, where the main features of a statistical model – such as what is measured by each factor and what the strength between factors is – must be the same across individuals in order for a group model of a phenomenon to represent an individual model (Flyvbjerg, 2006; Molenaar & Campbell, 2009).

It has been found, however, that group homogeneity does not hold for most psychological processes (Denissen, Penke, Schmitt, & Van Aken, 2008; Molenaar, 2004; Tennen, Affleck, Armeli, & Carney, 2000). Secondly, the condition of stationarity must be met, which means that the statistical properties of data and the relationship between variables do not change across time. This, however, rarely holds for developmental processes (Molenaar & Campbell, 2009; Molenaar, 1994, 2004).

As these two conditions are hardly met for human processes (Molenaar, 2004, 2008) – such as self-esteem (Denissen et al., 2008), exploration of individual processes like self-esteem should be done at the individual level. I therefore explore the nature of self-esteem by focusing on within-individual dynamics. Based on the assumption of non-ergodicity, it cannot be assumed that all individuals will demonstrate the same specific dynamics. This, however, need not pose a problem for the scientific endeavor of unveiling the nature and origin of self-esteem based on its underlying processes (Flyvbjerg, 2006).

Rather than trying to identify specific dynamics of self-esteem that can be generalized to all individuals, I aim to identify how individual dynamics (and any possible inter-individual differences therein) can be interpreted from one underlying theoretical framework, i.e. a complex dynamic systems framework (Van Geert, 2014). I therefore aim to accomplish generalizability by demonstrating that a complex dynamic systems framework can be generalized to all individuals' self-esteem processes.

1.4 Self-Esteem as a Contextualized Process

Above, I describe how – to gain a better understanding of the nature of self-esteem – I take a complex dynamic systems perspective and focus on intra-individual variability of self-esteem. In order to unveil the origin of the dynamics of individuals' self-esteem, it is necessary to start at the beginning: with the building blocks of self-esteem. From a complex dynamic systems perspective, iterations of real-time events are the proximal engines behind development (Granic et al., 2007; Thelen & Smith, 1994). I therefore zoom in on these real-time events for self-esteem.

I suggest that the real-time building blocks of self-esteem are the positivity and negativity of behavioral and affective experiences of the self that occur in the moment, i.e., in real-time. First, behavior reflects how an individual sees or feels about him or herself (Atkinson, 1964; Leary, 2004). For self-esteem specifically, the positivity or negativity of the behavioral experience of the self is reflected in autonomy (Deci & Ryan, 1995). According to the Self-Determination Theory (SDT), autonomous actions are manifestations of a secure sense of self and a high level of true self-esteem, and positive self-worth is reflected in agency and proactivity (Deci & Ryan, 1995). In accordance with the SDT, autonomous actions are those that express agency, proactivity, free will, and ownership of behavior.

Second, emotions reflect an individual's personal reality regarding their self-worth (Cognitive-Experiential Self Theory; Epstein, 1993). Specifically, 'self-conscious' emotions are of relevance to self-esteem, which are socially-situated emotions pertaining to the self, such as pride and shame (Tangney & Fischer, 1995). These are in contrast with emotions that are not self-conscious, such as affection or anger (which reflect appraisals of the context and concerns in an immediate relationship; Frijda, 2001).

The positive and negative emotional-behavioral building blocks of self-esteem can best be examined by observing their natural emergence (Ryan & Brown, 2003; Scheff & Fearon, 2004). Rather than decontextualizing self-esteem in a laboratory setting, the current thesis focuses on self-esteem in the context of interaction with a significant other. This is an important context for self-esteem, as significant others play a vital role in the way that self-esteem emerges into a structured state (Fogel, 1993; Tangney & Fischer, 1995), while also providing a practical way to elicit the organic emergence of self-esteem dynamics (Gable, Gosnell, & Prok, 2012; Koerner & Fitzpatrick, 2006).

1.5 Outline of the Thesis

Part I

The first part of the current thesis (**Chapter 2**) considers the nature and origin of state and trait self-esteem from a theoretical perspective. In this part of the thesis we describe the proposed theoretical model regarding the dynamic and nested nature of self-esteem, called the Self-Organizing Self-Esteem (SOSE) model. The model serves as a framework for the remainder of the thesis. The aim of the SOSE model is to describe the internally generated patterns of change that give rise to, and that characterize, state and trait self-esteem phenomena; thereby examining the origin and nature of self-esteem.

The examination of the origin of self-esteem is based on the emotional-behavioral building blocks, introduced above. We describe how, based on principles of dynamics systems thinking (including self-organization, emergent properties, and nested time-scales) the building blocks of self-esteem give rise to state and trait self-esteem.

We describe that the nature of trait self-esteem can be conceptualized as a self-maintaining emergent property, and the nature of state self-esteem as a fleeting emergent property. We also describe the nature of the real-time and long-term circular relationship between the trait and state self-esteem.

Additionally, we compare the SOSE model of self-esteem to the traditional approach to self-esteem, and we discuss what the differences between the two models imply for the conceptualization of the nature of self-esteem as well as for research concerning self-esteem.

Part II

The second part of the thesis is the empirical part, including two chapters. The general aim of Part II is to validate the SOSE model. This is done by empirically examining the internally generated patterns of real-time change, for both state and trait self-esteem.

The empirical chapters in Part II focus on self-esteem in the context of adolescence. Adolescence was chosen, firstly, because it is a significant period for self-esteem development (Robins et al., 2002) and, secondly, because adolescents have been found to exhibit high intra-individual variability of self-esteem (Trzesniewski, Donnellan, & Robins, 2003), with relatively large individual differences therein (Harter & Whitesell, 2003).

In general, therefore, adolescence provides a context in which a lot is happening concerning self-esteem dynamics, and where differences between individuals allow for the understanding of how different types of dynamics emerge and what this might mean. With the chapters in Part II, as yet unexplored aspects of self-esteem variability are investigated, thereby advancing the discussion of self-esteem variability during adolescence. As mentioned above, self-esteem will be investigated in the context of interaction with a significant other. For adolescents, parents are a pivotal significant other for self-esteem development (Allen, Hauser, Bell, & O'Connor, 1994; Bulanda & Majumdar, 2008). Therefore, the dynamics of adolescent self-esteem are investigated as they occur during parent-child interaction.

Part II utilizes an innovative methodological approach to self-esteem. Traditionally, self-esteem is measured using a questionnaire approach, where participants are asked to answer questions such as "on the whole I am satisfied with myself" (Rosenberg Self-Esteem Scale; Rosenberg, 1965). This approach is not effective for studying the real-time dynamics of self-esteem, however (this will be discussed in detail in Chapter 3). To remedy this, self-esteem is measured based on the emotional-behavioral building blocks that organically emerge during parent-child interactions. To quantify the resulting observational data, I developed a coding scheme that was used to decipher the phenomenological meaning of the autonomous actions and emotional expressions that could be observed during the interactions with regard to the adolescents' self-esteem (see Coding Scheme in Appendix).

Chapter 3 focuses on the nature of self-esteem on the meso level of the self-esteem system: state self-esteem. More specifically, we explore the temporal dynamics of state self-esteem that emerge out of moment-to-moment changes of adolescents' positive and negative emotional-behavioral experiences of the self. In this chapter, the hypothesis is tested that the temporal variability of state self-esteem is an intrinsic property of the state self-esteem dynamics. This hypothesis is in contrast to what is traditionally assumed, where the temporal dynamics of state self-esteem are seen as more-or-less random and contextually based fluctuations that occur around a stable baseline level.

In **Chapter 4** we introduce an empirical approach to trait self-esteem as an emergent macro-level self-esteem construct that manifests itself in real-time. In order to demonstrate the manifestation of trait self-esteem in real-time, we investigate its real-time dynamics with state self-esteem. We test whether individual differences regarding the nature of the interactions between trait self-esteem and state self-esteem correspond with individual differences regarding the influence that parents have on the adolescents' self-esteem. In this chapter, the hypotheses regarding this correspondence are grounded in complex dynamic systems thinking.

Part III

In Part III an important conceptual distinction in self-esteem is discussed: implicit self-esteem versus explicit self-esteem. In **Chapter 5** we describe how the nature of this distinction can be conceptualized from the framework of the SOSE model. In doing so, two dominant perspectives of the implicit-explicit self-esteem relationship are integrated that have been traditionally viewed as being competitive.

The aim of Part III is more explorative than it is conclusive. My hope is that Part III of this thesis serves to begin a scientific discussion regarding the nature of implicit and explicit self-esteem from a complex dynamic systems perspective, where the SOSE model provides a framework from which this can be done.

In **Chapter 6** I will summarize and integrate the theoretical work and the empirical findings from this thesis. I will focus on the contribution that the thesis makes in conceptualizing self-esteem as a dynamic system that behaves according to the principles of the complex dynamic systems perspective, and how this conceptualization allows us to understand the nature and origin of self-esteem based on its underlying processes. I will discuss the implications that this conceptualization has for future self-esteem research, as well as the limitations of the current thesis.

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Part I

The nature and origin of state and trait self-esteem from a theoretical perspective

CHAPTER 2
A Self-Organizing Model of Self-Esteem: Trait and State Self-Esteem as Dynamically Connected Across Nested Time Scales

Abstract

The current chapter proposes a Self-Organizing Self-Esteem (SOSE) model, which provides an integrative theoretical foundation for conceptualizing and studying the dynamics of state self-esteem and trait self-esteem. The SOSE model is in contrast to the traditional approach to self-esteem, in which state and trait self-esteem are part of one construct, where state self-esteem is conceptualized as the contextual error around latent trait self-esteem. In contrast, the SOSE model posits that trait self-esteem and state self-esteem are distinct constructs that occur on two interconnected time scales. The model outlines how their nature, as well as their relationship with each other, can be conceptualized based on a primary process of bottom-up emergence, where trait self-esteem is an emergent macro-level product of state self-esteem dynamics, and state self-esteem is an emergent meso-level product of current micro-level experiences of the self. The model also outlines a secondary process, namely, that of top-down constraint, where the emergence of the higher-order construct begins a process of constraint on lower-order interactions. Together, these form a self-organizing process. The current chapter discusses the core differences between the SOSE model and the traditional approach to self-esteem and the implications that these differences have for empirical research. [1]

[1] This chapter is based on De Ruiter, N.M.P., Van Geert, P.L.C, Kunnen, E.S. (2015). *A self-organizing model of self-esteem: state and trait self-esteem as dynamically interacting across nested time scales.* Manuscript under revision.

While it is generally accepted that self-esteem is multifaceted, with a trait element and a state element (Donnellan, Kenny, Trzesniewski, Lucas, & Conger, 2012), there are relatively few explicit accounts of how these facets are ontologically interconnected, and even fewer attempts to empirically investigate this interconnection. In the current article, we delve into the nature of the trait aspect of self-esteem (typically characterized as the relatively stable valence associated with the self-concept; Harter, 1982; Rosenberg, 1979) and the state aspect of self-esteem (typically characterized as the fleeting and in-the-moment experience of the self; DeHart & Pelham, 2007; Kernis, Cornell, Sun, Berry, & Harlow, 1993; Leary & Downs, 1995; Rosenberg, 1986), as well as the relationship between the two.

Specifically, we present a comprehensive model of trait and state self-esteem and their dynamic relationship, called the *Self-Organizing Self-Esteem (SOSE)* model. As the name suggests, our model emphasizes the process of *self-organization* as a core underlying mechanism of self-esteem (Kelso, 2000; Smith & Thelen, 2003), where self-esteem is conceptualized as spatiotemporal patterns of self-experience that arise out of many nonlinear interactions between lower-order components, and where novelty is generated by the intrinsic dynamics of self-esteem itself.

The SOSE model is in contrast with the traditional top-down approach to self-esteem, which we call the *latent-construct* model. Broadly speaking the latent-construct model suggests that trait self-esteem is a latent variable that generates measurable and context-dependent experiences of the self (i.e., state self-esteem) in a top-down fashion.

With our model, we show that self-esteem can be conceptualized as a complex dynamic system, which is any system that is composed of multiple components that interact with each other in a reciprocal and iterative way over time (Thelen & Smith, 1994; Van Geert, 1994, 2008). While some researchers have theorized about the importance of dynamics and complexity in self-esteem (for example, Delignières, Fortes, & Ninot, 2004; Kernis, Cornell, Sun, Berry, & Harlow, 1993; Markus & Wurf, 1987; Morf & Mischel, 2012; Ninot, Fortes, & Delignières, 2005; Nowak, Vallacher, Tesser, & Borkowski, 2000; Scheff & Fearon, 2004; Vallacher, Nowak, Froehlich, & Rockloff, 2002), there is currently no formal model from which the specific nature of the relationship between state self-esteem and trait self-esteem can be conceptualized.

The main aim of the current chapter is to present our SOSE model as a new account of the nature of state self-esteem, trait self-esteem, and their relationship with each other, compared to the latent-construct model. We show that the fundamental differences between the models stem from a distinction in the *causality theory* that underlies the two models, where an *emergent-causality* theory contrasts a *generative-causality* theory. Our second aim is to show that the two models also complement each other, in that they predict two different empirical approaches to self-esteem and two different kinds of research questions that, together, provide comprehensive empirical coverage of the self-esteem concept.

As the two alternative models of self-esteem discussed in the current article are models of the ontological relationship between trait and state self-esteem, it is important

that we first clarify what is meant by 'self-esteem', and more specifically, its 'trait' and 'state' characteristics[2]. We begin by outlining the difference between trait and state self-esteem from the theoretical bases of the classic Jamesian distinction between me-self and I-self (James, 1890).

2.1 The Foundation of Trait and State Self-esteem

The difference between trait self-esteem and state self-esteem is often reduced to a distinction in the level of stability and context-dependency **(**Kernis et al., 1993; Leary & Downs, 1995; Rosenberg, 1986). Trait self-esteem is seen as relatively stable and context independent, while state self-esteem is seen as highly variable and context dependent. We suggest that, while this distinction is accurate, it does not quite capture the essence of the difference between trait self-esteem and state self-esteem. To appreciate the essential difference, we suggest that the distinction between trait self-esteem and state self-esteem be framed in terms of the classical distinction between *me-self* and *I-self*. This distinction was formulated by William James (1890), and is seen as classic in self-psychology (Rosenberg, 1979) with a vast legacy in modern-day psychology (e.g., Bretherton, 1991; Butterworth, 1992; Demetriou, Kazi, & Georgiou, 1999; Harter, 1999; Hermans, 1996; Kernis, 2003; McAdams, 1996; Roeser & Peck, 2009).

The Jamesian distinction between me-self and I-self is essentially a distinction in levels of self-concept. The me-self (also known as the *self-as-object*) is "an empirical aggregate of things objectively known" about the self (James, 1890, p. 400), or the "trait labels" regarding the self (James, 1890). It is an "organization" (Mead, 1934) of self-descriptions or trait labels regarding the material-me, the social-me, and the spiritual-me (James, 1890).

The I-self, otherwise referred to as the *self-as-process* (James, 1890), is not an aggregated product of what is known about the self. Instead, it is the active *knower* of the self: the continuous and ever-changing awareness and experience of one's dynamic internal states of self-related emotions, thoughts and actions (Dickstein, 1977; Hattie, 1992; James, 1890; Mead, 1934).

In the past, I-self has been viewed as being rather elusive and inaccessible (Allport, 1961), and a "metaphysical problem" (James, 1890, p. 401). At the same time, however, Mead (1934) held that the I-self can and should be studied. McAdams (1996) offers a conceptual clarification that we believe is key to making the I-self empirically tangible. According to McAdams, readers tend to misinterpret the two Jamesian 'selves' as being two entities, where the I-self is seen as an inner self that "pulls the strings", thereby eluding scientific enquiry (Allport, 1961, p. 130). We suggest (in concordance with McAdams) that this be remedied by emphasizing the nature of I-self as an active *process*, and the nature of me-self as a *product*. In accordance with this, our working definition of me-self becomes an *aggregated product pertaining to the self that consists of an organization of stable trait*

[2] In the current article we focus on *global* self-esteem and we omit *domain-specific* self-esteem.

labels; and our working definition of I-self becomes a *dynamic process of experiencing one's immediate internal states pertaining to the self.*

Moving now from a distinction in levels of self-concept to a distinction in levels of self-esteem; 'self-esteem' is an experience of an attitude, which is either a positive or negative reaction to, or association with, the self (Gawronski, 2007; Olson & Fazio, 2009). Self-esteem, in other words, is the valence of the self-concept (Harter, 1982). Consequently, this results in two levels of self-esteem: Trait self-esteem is the valence of the aggregated and relatively stable me-self (Harter, 1982; Rosenberg, 1979), and can thus be defined as *the valence of the aggregated product pertaining to the self that consists of an organization of stable trait labels*. State self-esteem, on the other hand, is the valence of the self that occurs "at this moment" (DeHart & Pelham, 2007; Kernis et al., 1993), i.e., the I-self (Hamaker, 2012), and can be defined as *the valence of the dynamic process of experiencing one's immediate internal states pertaining to the self.*

Based on the above distinction, it is clear that the difference between state self-esteem and trait self-esteem consists of more than a difference in stability and in context dependency. The two can be seen as two qualitatively different aspects of self-esteem, where trait self-esteem is the valence of an aggregated *product* and state self-esteem is the valence of the *current process* of self-experience.

Trait self-esteem and state self-esteem, and their relationship with each other, can be conceptualized in two fundamentally different ways with regards to their nature. In the following sections, we outline the distinction between *generative-causality theory* and *emergent-causality theory* (Coan, 2010; Cramer, Waldorp, Van der Maas, & Borsboom, 2010; Schmittmann et al., 2011). Afterwards, we show how the former results in the latent-construct model of self-esteem, and the latter results in our proposed SOSE model.

2.2 Generative-Causality Theory

From a generative-causality approach, the phenomenon being studied is approached as a latent trait that resides within the individual (Borsboom, Mellenbergh, & Van Heerden, 2003; Borsboom, 2005; Coan, 2010; Cramer et al., 2010; Markus & Borsboom, 2013). The latent trait is assumed to generate, i.e., be the cause of, surface phenomena called *indicators* (Borsboom et al., 2003; Coan, 2010). As the latent variable is assumed to be the cause of each indicator, the indicators are not seen as being causally interdependent (Schmittmann et al., 2011)[3]. From this causality-theory, the latent trait is approached as an entity within the individual, where the existence of that entity does not depend on indicators of the latent trait (Borsboom et al. 2003). From a generative-causality perspective, therefore, causality is unidirectional – from the top down.

Because the latent trait is approached as an unobservable entity, the measurement of the underlying entity depends on measurements of the indicators that are thought to be

[3] Causal independence should not be confused with statistical independence. Indeed, the causal independence does not preclude the possibility of statistical independence in a population. However, any statistical dependence between indicators is separate from the assumptions accompanying causal independence.

generated by the underlying entity. Therefore, this causality model implies a *reflective measurement model*, where indicators of the latent variable are thought to reflect the state of the latent variable (see Borsboom et al. 2003; Cramer, Waldorp, Van der Maas, & Borsboom, 2010; Van der Maas et al., 2006).

While the indicators are seen as a product of the underlying latent trait, they are also influenced by the current context. The current context is approached as being independent from the latent variable, however. Therefore, the influence that the context has on the indicators is seen as measurement error regarding the underlying latent trait. This conceptualization follows the basic axiom of standard psychometric theory, which posits that there is a true underlying level of a latent variable, and that this true score is subject to error, which is by definition independent from the true score (Lord & Novick, 1968). Figure 1 illustrates the generative-causality model (Borsboom et al., 2003; Coan, 2010; Markus & Borsboom, 2013)[4].

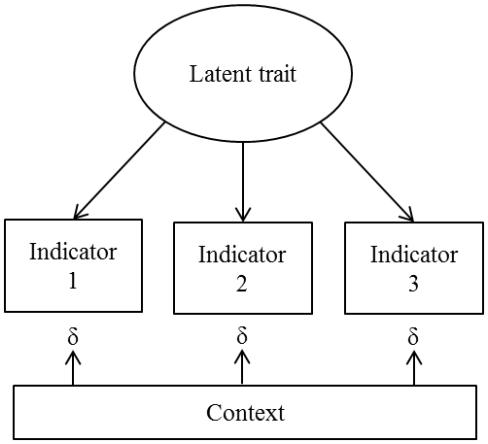

Figure 1. A generative model of causality. The downward arrows indicate the unidirectional top-down causal relationship between the latent variable and the indicators. The upward arrows indicate the influence that the current context has on the indicators. The δ symbols indicate the error caused by the context.

[4] In a typical generative-causality model, the latent variable is at the bottom while the indicators are at the top. We chose to depict the model the other way around so as to emphasize the top-down conceptualization, where the latent-variable is the cause of the indicators.

2.3 Nature of self-esteem from a generative-causality approach: latent-construct self-esteem.

A generative model of causality corresponds with the traditional way that most psychological constructs, including self-esteem, are approached (Borsboom et al., 2003; Coan, 2010), which we call the *latent-construct model* of self-esteem. From this model, the latent trait in Figure 1 is trait self-esteem, which is thought to exist as a latent variable that differs between individuals (Hamaker, Nesselroade, & Molenaar, 2007). The indicators in Figure 1 include, but are not limited to, successions of state self-esteem, which are generated by (and therefore reflect) the latent trait self-esteem (Cramer, Sluis, Noordhof, & Wichers, 2012) (e.g., Marsh, 1996; Tafarodi & Swann, 2001; Tomas & Oliver, 1999). Finally, as portrayed by the indictors in Figure 1, state self-esteem is influenced by transient contextual factors (e.g., Kernis, 2005; Leary, Tambor, Terdal, & Downs, 1995). It is clear that, from a latent-construct model of self-esteem, state self-esteem is not a separate phenomenon from trait self-esteem. Instead, it is the temporary deviation from the true level of trait self-esteem (e.g., Alessandri & Caprara, 2012; Hamaker et al., 2007; Kenny & Zautra, 1995).

This conceptualization of self-esteem is clearly problematic when attempting to consolidate it with the Jamesian framework of me-self and I-self. From a latent-construct model of self-esteem, state self-esteem and trait self-esteem are essentially the same construct, but the former is the context-dependent version. This conceptualization does not correspond with the qualitative distinction between me-self and I-self that results in two separate concepts, where the former is a product and the latter is a dynamic process (see Section 1).

The conceptualization of trait self-esteem and state self-esteem as the context-independent and context-dependent versions (respectively) of the same concept is reflected in the methodological attempts to capture state self-esteem. The typical differentiation of a state measure from a trait measure is that, for trait self-esteem, participants are instructed to respond based on their feelings “in general”, while for state self-esteem, they are instructed to respond based on their feelings “at the moment” (e.g., Heatherton & Polivy, 1991; Kernis, 2005; Zeigler-Hill & Showers, 2007). The differentiation refers only to a difference in the time-span across which the self is assessed (i.e., now, or in general). Both assessments ultimately require the *objectification* of the self as a product, and therefore, reflect the valence of the me-self (quite literally, an assessment of the *self-as-object*) (Harter, 1999; Rosenberg, 1979). State self-esteem is measured as a snapshot of the me-self, rather than as a process of current self-experience. Because of this, we argue that a typical state self-esteem measurement likely captures the me-self in the current moment, and a trait self-esteem measurement captures the me-self in general.

As a result of the dominant latent-construct model, therefore, self-esteem research has predominantly focused on self-esteem as a characteristic of the me-self (Van Halen, 2002). The consequence of essentially leaving out the I-self is that our understanding of self-esteem is one-sided (James, 1890; H Markus & Wurf, 1987; Mead, 1934), where the

dynamics of self-experience as an in-the-moment process are largely omitted. From a Jamesian standpoint, it is essential that researchers consider these process dynamics in order to study I-self. However, this is made virtually impossible in the latent-construct approach. In the section *SOSE model: Implications for research*, we describe how it is possible to assess state self-esteem as a continuous process of self-experience.

2.3.1 Latent-construct model: implications for research

In this section we outline what the concrete implications are of adopting the core underlying assumptions of the latent-construct model.

Latent-construct model: trait self-esteem research.

The first assumption of the latent-construct model (as described above) is that the latent variable, which differs between individuals, is the common within-individual cause for the production of indicators (*common causal antecendent*; see Borsboom, 2008; Reichenbach, 1956; Salmon, 1978).

This has a large implication for trait self-esteem research, namely, that differences between individuals regarding trait self-esteem (either cross-sectional differences or developmental differences) must be explained by factors *outside* of the self-esteem system (as opposed to the internal dynamics of the self-esteem system itself). This form of explanation is called *causal interventionism*, which states that if there is some formal or material intervention on – or manipulation of – a causally relevant (and usually trait-like) variable, there will be a change in the value of another variable (Woodward, 2007) [5]. For example, a change in average self-esteem level has been explained by a statistical manipulation of variables such as gender, personality, or family characteristics results (e.g., Baldwin & Hoffmann, 2002; Birkeland et al., 2012; Deihl et al., 1997). Below, we outline the two advantages of adopting a latent-construct model perspective in trait self-esteem research, both of which involve causal interventionism.

The first advantage refers to the description of *central tendencies*, which are statistical measures that identify a single score as representative of an entire distribution (most commonly, means, modes, and medians). Research that focuses on central tendencies aims to determine what is normal for a given population. This is then usually compared to what is normal for another population, so as to provide relativity. In comparing the central tendencies between two populations, causal interventionism is central, where the statistical manipulation of a factor predicts a difference in trait self-esteem between the two populations. What is statistically manipulated may be a binary difference in group membership, such as gender (where boys score slightly higher on self-esteem measures than girls on average; Kling, Hyde, Showers, & Buswell, 1999), or a continuous difference in a characteristic, such as weight (where higher weight is associated with slightly lower self-esteem on average; Miller & Downey, 1999). The latent-construct model is therefore useful for

[5] Interventionism refers to the general ability to influence another variable, and should not be confused with clinical or educational intervention.

determining population differences in trait self-esteem levels, and for predicting these differences based on differences in another population characteristic (i.e., gender, or weight).

The second advantage of the latent-construct model is related to the development of trait self-esteem, where the model allows for the quantification of changes across time with regard to central tendencies of trait self-esteem. This is done by gathering repeated measures across the long term. Depending on the amount of repeated measures, and therefore the kind of statistical analyses that are possible, linear (e.g., Wagner, Lüdtke, Jonkmann, & Trautwein, 2012; Zimmerman, Copeland, & Shope, 1997) and curvilinear development can be captured (e.g., Baldwin & Hoffmann, 2002; Birkeland et al., 2012). Therefore, the latent-construct model is also useful for providing a picture of the broad ontogeny of trait self-esteem across the lifespan (Thelen & Smith, 1994), established by findings of changes in average levels of self-esteem across time. This has been especially fruitful is revealing that trait self-esteem does in fact demonstrate change across the long term, and that it is not stable across the lifespan as researchers once thought (Erol & Orth, 2011; Harter & Whitesell, 2003; Trzesniewski, Donnellan, & Robins, 2003; Zimmerman et al., 1997).

In order to explain differences in developmental trajectories, individual differences regarding other population characteristics are explored, thereby relying on causal interventionism once again, where the statistical manipulation of a factor predicts a difference in trait self-esteem trajectories. For example, common factors that are thought to explain differences in trajectories are age (Robins, Trzesniewski, Tracy, Gosling, & Potter, 2002); although many researchers have also found that age itself does not predict differences in global self-esteem levels (Mullis, 1992; Pullmann, Allik, & Realo, 2009), and gender (Block & Robins, 1993).

Aside from the abovementioned advantages, the latent-construct model also has disadvantages with regard to self-esteem research. Generally speaking, the main disadvantage is that temporal causality of trait self-esteem cannot be explained. While the model does explain group differences in trait self-esteem and possible trajectories of development, the underlying mechanism of change itself is not addressed (Van Geert, 2014), and instead, remains latent (Schmittmann et al., 2011). Indeed, from the latent-construct perspective, causality originates with the latent construct, although the latent construct is unobservable (Salmon, 1998b). As a result, the latent-construct model cannot answer questions such as: *how* do changes in trait self-esteem actually come about across the long term?

This general disadvantage can be further explained by two more specific disadvantages of the model. First, because causality is thought to originate with the latent trait (top-down causality), and not with the 'indicators' of that trait (bottom-up causality), trait self-esteem development is not explained by *internal* processes (i.e., dynamics within the self-esteem system) (DiDonato, England, Martin, & Amazeen, 2013). This is problematic for understanding the causal mechanism of development itself as research shows that development across the long term stems from short-term variability of the surface phenomena (i.e., the 'indicators') related to the psychological construct in question (e.g., Bassano &

Van Geert, 2007; Collins, 2006; Lichtwarck-Aschoff, Hasselman, Cox, Pepler, & Granic, 2012; MacDonald, Nyberg, & Bäckman, 2006; Smith & Thelen, 2003; Van Geert & Van Dijk, 2002). Indeed, significant change across the long term requires an individual to first be able to explore new behavior across the short term (i.e., short-term variability; Thelen & Smith, 1993). Therefore, for self-esteem to develop across the long term, surely it must first show short-term variability; otherwise, how can something that itself does not change be expected to bring about change (Borsboom et al., 2003; Chakravartty, 2005)? This bottom-up process of causality, however, is not included in the latent-construct model.

The second specific disadvantage stems from the fact that the latent-construct model commonly generates studies that focus on central tendencies of populations, such as averages (Van Dijk & Van Geert, 2007). For developmental studies, this means that development is explored based on averaging individual scores together and then examining how these averages increase or decrease across time. This is disadvantageous for understanding developmental processes, as development is an inherently individual process (Van Geert, 2014). Therefore, investigations of self-esteem development should not be done at the group level. Should the condition of *ergodicity* hold, however, then group-level studies can be conducted in order to describe individual developmental processes. Ergodicity requires group homogeneity and stationarity (see Molenaar & Campbell, 2009; Molenaar, 1994, 2004), which rarely hold for human developmental processes (Molenaar, 2004, 2008). Therefore, the tendency for researchers to average individual tarjectories together in order to focus on group differences is an inherent hinderance for *understanding* the development of self-esteem.

Latent-construct model: State self-esteem research.

In this section, we refer to the following assumptions of the latent-construct model: first, that the indicators are thought to be generated by the latent trait, and therefore, that they are not thought to be causally interdependent (Schmittmann et al., 2011); second, that the indicators are also influenced by the current context.

The first implication that the above assumptions have for state self-esteem research is that state self-esteem measures are used as an indicator for the underlying trait self-esteem level. Additionally, given that the indicators are thought to be influenced by the current context, it is assumed that the influence of the context must first be eliminated in order to ensure that state self-esteem will validly reflect the trait self-esteem score (Kernis et al., 1993). As a result, studies that stem from the latent-construct model obtain repeated measures of state self-esteem across time (thereby including many different contexts). Next, the repeated measures are collapsed in order to calculate central tendencies of trait self-esteem (cancelling out the 'noise' that is caused by the changing contexts; DiDonato et al., 2013).

Specifically, two central tendencies of trait self-esteem are often calculated based on repeated measures of state self-esteem. The first is the mean level of state self-esteem, which is thought to reflect the true level of trait self-esteem (e.g., DeHart & Pelham, 2007). The second is the standard deviation of the repeated measures, which is thought to reflect

the level of *self-esteem stability* (Kernis et al., 1993), which is conceptualized as a between-individual disposition related to trait self-esteem, where a larger standard deviation implies a higher level of instability (e.g., Franck & De Raedt, 2007; Kernis et al., 1993, 1989; Oosterwegel, Field, Hart, & Anderson, 2001). This does not imply that such studies are not valuable. Indeed, studies regarding self-esteem stability have been fruitful in revealing that there are important between-individual differences with regard to the level of self-esteem stability. For example, low self-esteem stability (i.e., high standard deviation of state self-esteem) is associated with negative characteristics, such as paranoia (Thewissen et al., 2007) and anger arousal and hostility (Kernis et al., 1989).

The second implication of the latent-construct model is that resulting studies emphasize the predictive role that different contexts have on state self-esteem change. This is because the model assumes that state self-esteem is predominantly generated by latent trait self-esteem, and that a *change* from one state self-esteem experience to the next is attributed to the context that caused the change. State self-esteem at t_n is thought to be connected to state self-esteem at t_{n+1} because they reflect the same underlying level of trait self-esteem, or that they – with the presence of contextual forces – reflect deviations from the same underlying trait self-esteem. (De Ruiter, Den Hartigh, Cox, Van Geert, & Kunnen, 2014).

This is illustrated by the dominant theory of state self-esteem: the Sociometer Theory of self-esteem, where trait self-esteem is viewed as the resting state of self-esteem in the absence of contextual information, and where state self-esteem fluctuates around this resting level of self-esteem as a function of the contextual cues (Leary & Downs, 1995; Leary, Haupt, Strausser, & Chokel, 1998; Leary, 1999). In line with this perspective, extant studies most commonly study the role of the context on state self-esteem change by adopting a test-retest design, where the change in state self-esteem level from one moment to the next is explained by an experimental manipulation of the immediate context (e.g., Baccus, Baldwin, & Packer, 2004; DeHart & Pelham, 2007; Grumm, Nestler, & Von Collani, 2009; Guay, Delisle, Fernet, Julien, & Cal, 2008).

The above implications are disadvantageous because they negates the ontological nature of state self-esteem as a process in and of itself, where a process is defined by its *iterative* nature, such that a state is both the function of the previous state (i.e., t_{i-1}) and the input for the next state (i.e., t_{i+1}) (Van Geert & Steenbeek, 2005). This ontological nature has been demonstrated for state self-esteem as a process developing in the current moment (De Ruiter et al., 2014) and as a long-term process (Delignières et al., 2004; Fortes, Delignières, & Ninot, 2004). However, the latent-construct model conceptualizes change in state self-esteem as a function of the immediate context, which contradicts the (empirically supported) notion that state self-esteem is an iterative process that demonstrates intrinsic change. The latent-construct model therefore does not *explain* temporal changes in state self-esteem (Van Geert, 2014), but instead, it predicts them based on external (i.e., contextual) factors. Moreover, in negating the nature of state self-esteem as a process, the concep-

tualization of state self-esteem from a latent-construct model does not reflect the conceptualization of I-self from the Jamesian perspective, which is of a dynamic (iterative) *process*.

In summary, any studies that utilize state self-esteem measures do so in order to obtain indicators of trait self-esteem or to gain information regarding the effect of the context on state self-esteem. This results in a gap regarding studies of self-esteem development: developmental studies focus on the development of trait self-esteem, and not state self-esteem. We suggest that this gap is not inherent to the study of self-esteem, but instead, that its presence is indicative of the need for additional – currently absent – theory regarding state self-esteem dynamics.

In the following section we introduce the SOSE model, which is based on an emergent-causality perspective and a complex dynamic systems perspective. We show that this new model of self-esteem is capable of explaining temporal causality of both trait self-esteem and state self-esteem, which (as described above) cannot be explained from the latent-construct model. In doing so, we also show that the SOSE model allows the gap to be filled regarding studies about state self-esteem development.

2.4 Emergent-Causality Theory

The conceptual counterpart of a generative-causality approach is an *emergent-causality approach* (Coan, 2010; Schmittmann et al., 2011). From this perspective causality is bi-directional, rather than unidirectional. In the emergent-causality approach, causality begins as a bottom-up process. As a result, *temporal* causality is self-generational as opposed to external (as is the case in the latent-construct model), such that temporal causality is explained by the intrinsic dynamics of a phenomenon (Coan, 2010; Markus & Borsboom, 2013), which we will explain in this section.

Bottom-up causality means that surface phenomena (which were referred to as 'indicators' in the previously described latent-construct model) interact with each other to form a coherent network, and from this network an emergent *construct variable* is created[6] (which was referred to as a 'latent variable' in the latent-construct model) (Howe & Lewis, 2005; Lewis & Granic, 1999; Smith & Thelen, 2003). The emergent-causality approach is portrayed in Figure 2 (Borsboom et al., 2003; Coan, 2010; Markus & Borsboom, 2013). In the figure, three intrinsic processes are distinguished (A, B, and C), which we will describe in succession below. When discussing an emergent-causality perspective, we will refer to the surface phenomena as 'lower-order components' and to the construct variable as a 'higher-order' construct variable.

[6] In the current chapter, the term "construct" in the context of the emergent-causality theory is used to refer to psychological phenomena that are emergent by nature.

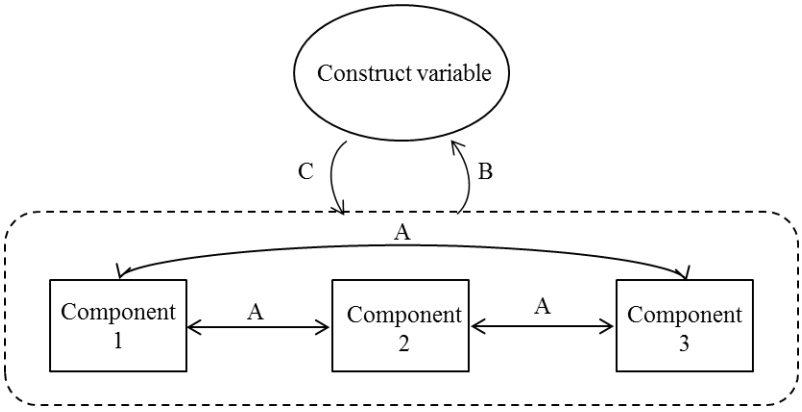

Figure 2. An emergent-causality model. Feedback loops between components (A) result in the emergence (B) and maintenance (C) of a construct variable.

In the emergent-causality approach, the interactions between components are central to explaining the existence of the construct variable and individual differences thereof. The underlying mechanism is *feedback loops*, where each component influences and is influenced by other components within the system until they become linked (Lewis, 1997; Van Geert, 1994). Feedback loops within a system means that the system's output feeds back into the system, becoming the new input for the system. The system's behavior is thus dependent on its own output, creating intrinsic dynamics.

Feedback loops can be either *self-amplifying* or *self-stabilizing*[7], and these processes can occur between lower-order components, as well as between lower-order components and higher-order constructs. Feedback loops between lower-order components are portrayed in Figure 2 as "A" processes. We describe these here before describing the feedback loops between levels at a later moment (portrayed as "B" and "C" in Figure 2).

Self-amplifying feedback loops are the mechanism by which the interactions between components enhance particular changes. For example, a change in Component A triggers change in Component B, which then triggers more change in Component A, etc. This feedback process allows the system to adapt and to change, for example in response to changes in the environment (Granic & Patterson, 2006). In this way, self-amplifying feedback loops reflect a system's progressive tendency, as change is promoted. Specifically, these feedback loops allow for the introduction of novelty into the system; novelty that "prepares and establishes a future state of development" (Van Geert, 1998, p. 637).

Micro-level feedback loops are consistently found in areas of perception (Haken, 2006), neural networks in the brain (Bullmore & Sporns, 2009) and in movement (Kelso et al., 1981; Thelen, Ulrich, & Wolff, 1991). Additionally, Carver and Scheier (2002) describe

[7] Note that 'self-amplifying feedback loops' are commonly referred to as *positive* feedback loops, and 'self-stabilizing' feedback loops are commonly referred to as *negative* feedback loops.

how numerous everyday processes, from actions to shifts between goals, can be explained by a similar process, where one action influences another until a qualitatively distinct outcome arises that was unintended. Carver and Scheier's descriptions are consistent with the empirically validated occurrence of *perception-action loops*, where perceptions of the external world continuously influence an individual's actions as he or she moves, and where such loops explain the emergence of novel behavior (Thelen, 1990). Self-amplifying feedback loops are also found at the micro level between individuals. For example, these feedback loops can be seen in the one-upmanship that occurs during deviant talk within antisocial dyads (Dishion, Spracklen, Andrews, & Patterson, 1996), and it has been argued that they underlie the coercive cycle involving cognitions, emotions, and behavior between parents and their children (Granic & Patterson, 2006).

Self-amplifying feedback loops can enhance either similar or dissimilar connections between components. For similar connections, change (increase or decrease) in a component results in the same type of change (increase or decrease) in the component itself or another component. As this cycle continues, the network of components transforms from a collection of differentiated components to a congruent and integrated network (Lewis & Junyk, 1997). For example, in Figure 2, Component 1 changes positively, which leads to positive change in Component 2 and 3, which then leads to more positive change in Component 1, etc.; resulting in a coherently positive state self-esteem. In contrast, for dissimilar connections, change in a component results in the opposite change in the component itself or another component. This can trigger a cycle in which the components become increasingly disparate in their values, resulting in an incongruent network of components with regard to their values.

In contrast to self-amplifying feedback loops, self-stabilizing feedback loops are the mechanism by which the interactions between components minimize deviations and changes, leading to conservation of their stable states (Van Geert, 1998). In Figure 2, for example, the activation of Component 1 decreases change in Component 2 and 3, and the dampening of Component 2 and 3 subsequently reduces the change in Component 1. The result is that change is generally constrained, so that the components are brought back to their initial states preceding the self-stabilizing feedback loops.

Examples of such inhibitory cycles are frequently found in circuits in the brain. For example, excitatory pathways from the frontal cortex trigger inhibitory effect on the striatum, the globus pallidus, and the thalamus (Masterman & Cummings, 1997). Moreover, it is suggested that self-stabilizing feedback loops underlie self-regulatory behavior such as autonomic regulation, attention regulation, and affective regulation, and that the self-stabilizing feedback loops allow for the interruption of ongoing behavior and the redeployment of resources to other tasks (Thayer & Lane, 2000, p. 214). This highlights the protective function of self-stabilizing feedback loops in the face of negative experiences, a stance that is further described by Kappas (2011) regarding the self-termination of negative emotions. Furthermore, Carver and Scheier (1990), suggest that micro-level self-stabilizing feedback loops occur at the behavioral level, where they underlie the steps that are taken

during conscious self-regulation needed to decrease the discrepancy between where individuals are with respect to a (continuous-action) goal and the achievement of that goal, i.e., goal pursuit (Carver, 2006).

The next process described in the emergent-causality model, portrayed in Figure 2 as the "B" process, is triggered through self-amplifying feedback loops specifically. This process refers to the emergence of a higher-order state, called the *construct variable*. The construct variable spontaneously emerges as a result of the self-organization of lower-order components. It is important to emphasize that it is the dynamics between the components, and the self-amplifying reactions that emerge, that give rise to the higher-order construct variable (Nowak, Vallacher, & Zochowski, 2005). The construct variable is thus not the result of an exogenous driving force, nor is it the result of the individual components themselves (Thelen & Smith, 1994; Van Geert & Steenbeek, 2005). This process is often seen in human systems, such as the emergence of coordinated inter-limb movement (Kelso et al., 1981), visual pattern recognition (Haken, 2006), and self-evaluation (Vallacher & Nowak, 2000). All of these examples are of higher-order constructs that emerge out of interactions between lower order components (i.e., movement, perception, and self-narratives, respectively).

Once a construct variable emerges, it sets off self-stabilizing feedbacks loops between itself and the network of lower-order components. Through these inter-level self-stabilizing feedback loops, the construct variable *constrains* the network of lower-order components through a process of non-rigid top-down fixation (Haken, 2006), thereby triggering self-stabilizing feedback loops between the lower-order components and decreasing the possibility of further change at the lower level. This process is portrayed in Figure 2 as the "C" process. An example of higher-order construct variables constraining the variability of lower-order input is the acquisition of native language in infants. The emergence of native language (L1) acquisition (i.e., the higher-order variable) has a constraining effect on children's ability to discriminate phonetic contrasts between languages (i.e., lower-order components). Before L1 acquisition, infants' speech-perception abilities are broad, and this ability eventually becomes constrained by the infants' L1 acquisition (Best, 1991).

Similarly, the process of higher-order constraint also explains *fossilization* in second language acquisition (L2). The initial misperception of unfamiliar sounds becomes entrenched in individuals' L2 speech through frequent repetition, decreasing the variability of pronunciation in L2 speech and making it difficult for the individual to correct mispronunciations in L2 (De Bot, Lowie, & Verspoor, 2007).

Due to the interaction between self-amplifying and self-stabilizing feedback loops (Figure 2, see A, B, and C), the emergent construct variable is constituted as *softly assembled*. This means that it is not a static aggregate variable that, once formed, is no longer ontologically dependent on its lower-order components. Instead, it is a dynamic, local, and temporal phenomenon, which has no existence independent from its lower-order components (Thelen & Smith, 1996). For example, if the self-stabilizing feedback loops between lower-order components (Figure 2, see A) are perturbed beyond their self-stabilizing limits,

the composition of the components in the lower-order network will be changed, resulting in the emergence of a qualitatively *new* construct variable. For example, referring back to our language-acquisition illustration above, although adults demonstrate far less of an ability to perceive phonetic organization of unfamiliar speech, this ability remains somewhat open – allowing for L2 acquisition in adulthood; demonstrating that the constraining effect of language acquisition is not absolute, nor permanent (Best, 1991). Instead, a bi-directional effect continues even after the higher-order construct (language, in this case) has emerged.

2.5 Nature of self-esteem from an emergent-causality approach: Self-Organizing Self-Esteem (SOSE) model.

The fundamental characteristics of the emergent-causality approach (see above) have previously been theorized as fundamental to the self, where the self has been conceptualized as a system of global self-properties that spontaneously self-organize out of basic components (Nowak et al., 2000). Our proposed Self-Organizing Self-Esteem (SOSE) model complements this basic conceptualization, but further specifies how the dynamic interaction between processes of bottom-up emergence and top-down constraint underlie the specific nature of state self-esteem and trait self-esteem, and their relationship with each other.

The first general proposition made in the SOSE model is that the underlying the nature of state and trait self-esteem is similar: they are both conceptualized as softly-assembled constructs that emerge from a network of lower-order components, stemming from an emergent-causality approach (Cramer et al., 2012; Thelen & Smith, 1994). Both state self-esteem and trait self-esteem are thus conceptualized as higher-order constructs.

We suggest that the two are *nested* high-order constructs, however, such that trait self-esteem is of a higher order than state self-esteem. The highest-order self-esteem construct is called the *macro-level* construct, which is trait self-esteem[8]. Next, state self-esteem is nested within trait self-esteem, and it is called the *meso-level* construct. Finally, at the very lowest level are the building blocks for subsequent levels of self-esteem: the discrete positive and negative self-related experiences ("self-experiences"). We call these the *micro-level* constructs. Each self-esteem level is thus an emergent product of the previous sub-levels.

The distinction between the three levels stems from a distinction in the time span across which developmental self-organization occurs. We distinguish between *developmental self-organization* and *real-time self-organization*. The former refers to the process of self-organization that allows the emergent phenomenon to come into existence in the first place. The time scale across which developmental self-organization occurs differs for state and trait self-esteem (see below). Real-time self-organization, on the other hand, is the self-organization that allows the emergent phenomenon to manifest itself and be experienced by

[8] For the sake of simplicity, we first describe the SOSE model in its most basic form, in terms of there being just one trait self-esteem construct variable. In the section *Dynamic inter-level coupling: Circular causality between state and trait self-esteem* we incorporate the possibility of multiple self-esteem constructs into the model.

the individual, once it has developmentally self-organized. As experience occurs in the present moment, real-time self-organization thus occurs in the present moment (across seconds and minutes) for both state self-esteem and trait self-esteem.

Regarding the time span of developmental self-organization, trait self-esteem (i.e., the macro level) self-organizes out of iterations of state self-esteem that span a longer period of time (e.g., in developmental psychology, weeks, months, or years). State self-esteem (i.e., meso level) self-organizes out of the momentary network of self-experiences that span real-time (e.g., the present moment, across seconds and minutes). Self-experiences (i.e., micro level) also emerge in real-time. However, they are distinct from state self-esteem because they strictly refer to the discrete experiences themselves (e.g., an emotion, or a thought) that emerge in reaction to current experiences, rather to the entire network of experiences or an emergent property.

While trait and state self-esteem develop across different time scales, both are manifested in the present moment, i.e., in real-time. The micro-, meso-, and macro-level thus all have the potential to self-organize into experience in real-time. Because of the distinction in time scales regarding developmental self-organization, the two higher-order properties (i.e., state and trait self-esteem) differ in their level of complexity and stability, and therefore, in the nature of their manifestation in real-time.

The second proposition made in the SOSE model is that the three levels of self-esteem dynamically interact via processes of bottom-up emergence and top-down constraint, also stemming from an emergent-causality approach. The macro-, meso-, and micro-levels of self-esteem are thus bi-directionally connected, creating a larger self-esteem system. While trait self-esteem emerges out of iterations of state self-esteem, it therefore also constrains current and future iterations of state self-esteem. Likewise, while state self-esteem emerges out of the current network of self-experiences, it also constrains current and future iterations of self-experiences. The basic SOSE model, including the three levels of self-esteem and the bi-directional relationships between them, is portrayed in Figure 3. In the following sections, we outline self-organizational processes that give way to state self-esteem and to trait self-esteem.

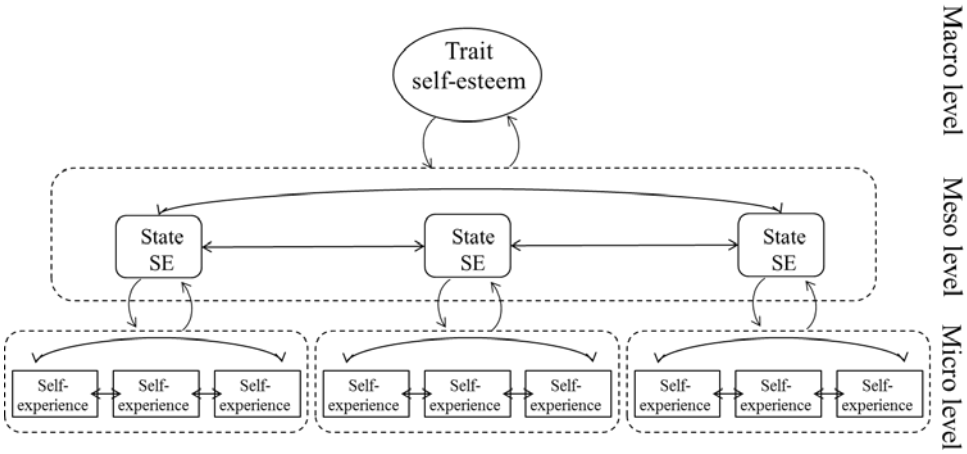

Figure 3. The Self-Organizing Self-Esteem model. Trait self-esteem, state self-esteem (SE), and positive or negative self-experiences form the macro, meso, and micro levels of self-esteem, respectively. The three nested levels are bi-directionally connected.

2.5.1 Self-experiences emerge into state self-esteem.

State self-esteem develops across real-time, where the lower-order input includes the fleeting self-related experiences. We suggest that these include self-directed feelings, autonomous (and heteronomous) behavior, and self-directed thoughts (Epstein & Morling, 1995; Marks-Tarlow, 1999; Nowak et al., 2000; Scheff & Fearon, 2004; Stipek, Recchia, Mcclintic, & Lewis, 1992; Vallacher et al., 2002). As the SOSE model posits that self-experiences are the first level of lower-level input, feelings, behavior, and thoughts pertaining to the self can be thought of as the basic ingredients for the emergence of meso-level, and therefore, also macro-level self-esteem constructs.

It is no surprise that self-directed affect is central for self-esteem, as global self-esteem has even been referred to as an "affective construct consisting of self-related emotions", and as "the way that people feel about themselves" (Kernis, 2003), "feelings of affection for oneself" (Brown & Marshall, 2001; Brown, 1993; Dutton & Brown, 1997) and "a general fondness and love for oneself" (Brown & Marshall, 2001).

While self-affect may be an integral aspect of self-esteem, the two concepts are not the same (Heatherton & Polivy, 1991; Heppner et al., 2008; Nezlek, 2005). Global self-esteem is richer and more complex than just self-affect. Indeed, aside from an individual's emotional experience of him- or herself, his or her behavioral experiences of him- or herself are also central to self-esteem (Allen, Hauser, Bell, & O'Connor, 1994; Deci & Ryan, 1995; Savin-Williams & Jaquish, 1981). The behavioral experience of the self is reflected in autonomy, which includes having confidence in one's decisions and goals, perceiving that one has control and responsibility for one's own goals, and believing that one is capable of

making decisions and goals (Noom, Dekovic, & Meeus, 2001). Autonomy has been found to be strongly connected to daily self-esteem (Heppner et al., 2008).

The last family of self-experiences that are included as lower-order input for state self-esteem are self-related cognitions. Cognitions are the most commonly utilized components of self-esteem in research, reflected by the nature of questions used in self-esteem questionnaires, such as "I am able to do things as well as most other people", or "I take a positive attitude toward myself", used to capture self-esteem (Rosenberg, 1989).

In accordance with an emergent-causality approach, the SOSE model posits that self-experiences that occur in real-time influence each other, such that they are reciprocally interconnected. If these experiences continue to influence each other, the components enter feedback loops. As described in the previous section, these feedback loops can be self-amplifying or self-stabilizing. The SOSE model suggests that the type of feedback loops that arise determine whether a higher-order self-esteem construct emerges at the meso level (i.e., state self-esteem). *Self-amplifying* feedback loops specifically prepare and establish the future state of development by stimulating the emergence of a higher-order construct variable (Van Geert, 1998). Self-amplifying feedback loops are therefore the mechanism that explains how an individual's momentary experience of self can change from a dispersion of emotional, cognitive, and/or behavior experiences pertaining to the self to a full-blown positive or negative experience of the self in that moment.

It is important to highlight that this process is suggested to be more than a simple accumulation of self-experiences. Rather than the self-experiences occurring simultaneously, or independently from each other, it is pivotal that these experiences are conceptualized as influencing each other. A change (or the initial emergence) of one self-experience thus brings about change in another self-experience. When these iterative changes enter a cycle, a feedback loop is said to occur. The self-experiences thus form a complex dynamic system at the micro level, such that the components interact with each other, resulting in an emergent property at the meso level (i.e. state self-esteem).

In contrast to self-amplifying feedback loops, self-stabilizing feedback loops do not trigger current self-experiential components to enter a cycle of continuous change, and thus, to the emergence of a higher-order construct that is state self-esteem. Instead, self-stabilizing feedback loops conserve the quality of each self-experiential component, resulting in the inhibition of state self-esteem emergence. For example, the emergence of an emotion (e.g., pride) dampens a self-experiential behavior (e.g., self-assertion) or inhibits it from emerging in the first place, which then dampens the emotional experience of pride, etc., thus preventing the emergence of a higher-order state self-esteem experience. In summary, while self-amplifying feedback loops amongst self-experiences trigger the emergence of state self-esteem, self-stabilizing feedback loops hinder the emergence of state self-esteem.

Given the occurrence of self-amplifying feedback loops, the type of connections (i.e., similar or dissimilar) between the self-experiential components will determine the nature of the emergent state self-esteem as *internally coherent* or *internally incoherent*.

When similar connections between components of self-experience are self-amplified, the emergent state self-esteem will reflect a coherent state of self-evaluative experience. For example, an emotional experience of the self (e.g., pride) triggers a consistent behavioral expression (e.g., being proactive), which then amplifies the experience of pride and triggers a positive thought regarding the self (e.g., "I'm happy with myself right now"). During self-amplifying feedback loops involving similar connections, one experience regarding the self therefore generates a similar experience regarding the self with regards to the positivity or negativity of the experience. Lewis (1995) suggests that a similar process of micro-level self-organization explains how individuals develop real-time appraisals of situations. He argues that conceptions of external situations, resulting emotions, and attention, continuously interact, fueling each other through self-amplifying feedback loops, finally giving rise to a coherent appraisal of the situation (Lewis & Junyk, 1997; Lewis, 1995).

As components of self-experience can be either positive or negative in *valence* (e.g., pride versus shame, respectively), coherent state self-esteem will also be characterized as either positive or negative with regard to its valence, where the former is a positive experience of the self and the latter is a negative experience of the self.

In contrast to the self-amplification of similar connections between components, feedback loops can also amplify dissimilar connections between self-experiences. This would result in incoherent state self-esteem where the valence of self-experiences oppose each other. For example, a positive behavioral experience (e.g., offering to be team captain) triggers a negative emotional experience (e.g., shame), which then amplifies the behavioral component (i.e., suggesting a new name for the team as well), thereby amplifying the negative emotional experience (i.e., self-contempt). The cycle that emerges creates a higher-order experience of the self in that moment that is characterized as both positive *and* negative.

While the self-amplification of dissimilar connections between self-experiences is theoretically possible, it is likely that these processes will be quickly corrected for in most situations and for most individuals, given the well-established need for internal consistency (Festinger, 1957). Correction involves the perturbation of the current network by introducing a new internal factor into the network, which corrects for the opposing self-experience. For example, returning to the illustration above where an individual has a positive behavioral experience while feeling shame, the individual may perturb the feedback loops between the dissimilar connections by convincing him or herself that the emotional experience of shame is not justified (e.g., a thought such as "I deserve to behave like a leader"). As a result, self-amplifying feedback loops will allow the self-experiential network to adapt to the newly introduced component, thereby starting a new self-amplifying feedback loop between the coherently positive components, and causing the incoherent component (i.e., shame) to die out. This is in accordance with Nowak et al.'s (2000) model of self-structure, in which a 'press for integration' is assumed, implying that self-amplifying feedback loops involving similar connections between components of a given network are dominant.

2.5.2 State self-esteem emerges into trait self-esteem.

The SOSE model posits that trait self-esteem is an emergent property of iterations of state self-esteem. State self-esteem therefore has a primary role in the nature of trait self-esteem in our proposed model. This is in contrast to the traditional latent-construct approach in which state self-esteem has an incidental role, as the variability around the baseline level of trait self-esteem.

A pivotal assumption in the SOSE model therefore is that temporal changes of state self-esteem are iterative by nature, which – as mentioned earlier – has been empirically validated both across real-time (De Ruiter et al., 2014) and across the long-term (Delignières et al., 2004). At the meso level, therefore, state self-esteem output feeds forward, so that it becomes the input for the following state self-esteem iterations.

Based on the iterative development of state self-esteem, the SOSE model suggests that preferred higher-order structures of self-experience self-organize, i.e., trait self-esteem. Studies have shown that iterations of state self-esteem across the long term do indeed result in the emergence of predictable macro-level patterns (Delignières et al., 2004; Fortes et al., 2004; Ninot et al., 2005). These studies have found that the macro-level patters are characterized by a balance between self-preservation and adaptation (Fortes et al., 2004), and by fractal properties (Delignières et al., 2004). Without going into the details of what these properties entail, the studies demonstrate that structure emerges across the entire time series of states self-esteem measures and that this structure is recursive. Furthermore, the idea that trait self-esteem emerges out of iterations of state self-esteem is in sync with James' (1890) perspective that the I-self is responsible for the emergence of the me-self.

Some self-esteem researchers have argued that global trait self-esteem is an emergent property of aggregated domain-specific self-esteem across *domains*, instead of global state self-esteem iterations across *time* (e.g., Marsh, 1993a; Pelham & Swann, 1989; Shavelson & Bolus, 1982). We suggest that global self-esteem does not emerge exclusively from domain-specific self-esteem across contexts. In support of this, we refer to Harter's (1982) discussion of the meaning of *general self-worth*, in which she states that “judgments concerning one's overall self-worth are not inferred from the summation of responses to items tapping a wide array of specific abilities and attributes” (Harter, 1982, p. 88). At the same time, the emergence of trait self-esteem from iterations of state self-esteem across time does not exclude the possibility that this emergence can occur both across and within different contexts. The important distinction, therefore, is simply that emergence occurs across *time*.

Next, just as emergent state self-esteem at the meso level triggers self-stabilizing feedback loops that constrain the changes that occur between self-experiences at the micro level (i.e., top-down constraint), the SOSE model suggests that the emergence of trait self-esteem activates top-down self-stabilizing feedback loops between the macro level and the meso level. The bottom-up emergence of trait self-esteem therefore triggers a circular loop of causality, where the top-down constraint from trait self-esteem to state self-esteem feeds back up into trait self-esteem through self-stabilizing feedback loops. In this way, trait self-

esteem emerges and is maintained through bottom-up and top-down feedback loops between the meso level and the macro level.

In the following section we elaborate on the nature of the trait self-esteem construct as posited in the SOSE model. Our conceptualization of the nature of trait self-esteem stems from a complex dynamic systems perspective (Thelen & Smith, 1994; Van Geert, 1994, 2008). Based on the principles of this perspective, we suggest that trait self-esteem is much more than a static variable that characterizes how 'high' or 'low' an individual's self-esteem is. Instead, it is a complex structure that is dynamically interconnected with its lower-order components (i.e., with state self-esteem), and that this interconnection characterizes trait self-esteem. In our elaboration, we introduce the possibility of multiple trait self-esteem construct variables into the SOSE model.

2.5.3 Dynamic inter-level coupling: circular causality between state and trait self-esteem.

From a complex dynamic systems perspective trait self-esteem can be conceptualized as an *attractor state.* An attractor state is a highly absorbing state to which a system frequently returns, and for which a small amount of energy is required in order to maintain that position (Kunnen & Van Geert, 2012; Thelen & Smith, 1994). It can be compared to a pattern to which a system is drawn (Van Geert, 1998), though the attractor state need not be 'attractive'. In other fields of psychology developmental acquisitions such as a depression (Cramer et al., 2010) extraversion (Cramer et al., 2012), emotional habits (Lewis, 2000), an interaction styles between two individuals (Fogel, 1993; Granic & Patterson, 2006), strong beliefs regarding morality (Kim & Sankey, 2009), or the general intelligence factor (Van der Maas et al., 2006) are conceptualized as attractor states[9]. In order to stress that trait self-esteem can best be conceptualized as a highly absorbing state to which a system frequently returns, we will hereafter refer to trait self-esteem as a *trait self-esteem attractor*. The proposition that a property of self demonstrates attractor-state behavior has received empirical support, albeit for properties of self that are related to, but not the same as, trait self-esteem (Vallacher et al., 2002).

The conceptualization of trait self-esteem as an attractor state underlies the distinction between the manifestation of state self-esteem and trait self-esteem yet further. Specifically, while state self-esteem and trait self-esteem are both conceptualized as being higher-order emergent properties that self-organize out of lower-order interactions, the nature of these higher-order constructs is not the same. As is described in this section, only trait self-esteem is conceptualized as an attractor state. Attractor states describe developmental acquisitions that require a larger period of time for developmental self-organization (i.e., months or years), thereby developing the propensity to self-maintain across a large period of time (Thelen & Smith, 1994). Attractor states thus result in continuity across time. Trait

[9] This list of "attractor" conceptualizations in psychology is by no means exhaustive. In the dynamic systems literature, the amount of trait-like concepts that are conceptualized as "attractors" is much more extensive than what we mention here, but such an exhaustive list is beyond the scope of our illustrative list.

self-esteem is such a developmental acquisition. Trait self-esteem is traditionally thought to be relatively stable (Harter, 1982; Rosenberg, 1979). From the proposed perspective, the 'stability' of trait self-esteem can be referred to as 'continuity', which we suggest is a function of the self-maintaining attractor states that are frequently experienced across time.

In contrast, state self-esteem is not an attractor state. Instead, it is a fleeting emergent property. State self-esteem itself cannot be an attractor state because state self-esteem requires only seconds and minutes for developmental self-organization. State self-esteem is thus the higher-order construct that developmentally self-organizes *at the current moment* (DeHart & Pelham, 2007; Kernis et al., 1993), rather than across a larger period of time. Each succession of state self-esteem – as an emergent phenomenon itself – is thus a new iteration based on the previous iterations of the entire process. The different iterations are not the same phenomena, however. While the same *trait* self-esteem attractor is thus repeatedly revisited across time, *state* self-esteem at t_x is not revisited at t_{x+n}. State self-esteem at t_x and t_{x+n} may be similar in quality to each other (due to the fact that they are iterations of previous successions of state self-esteem, and due to the constraint that trait self-esteem has on the direction of state self-esteem development), but they are not the same phenomenon.

Continuing from the complex dynamic systems conceptualization, self-organizing systems have the potential to develop multiple attractor states. Together, these attractor states form the larger *attractor landscape* that characterizes the potential tendencies of an individual relevant to a phenomenon. This means that individuals are characterized by multistability (Granic, O'Hara, Pepler, & Lewis, 2007; Hollenstein & Lewis, 2006; S. Kunnen & Van Geert, 2012; Lewis, 2000; Thelen & Smith, 1994; Van Geert, 1994).

In accordance with this principle, the SOSE model suggests that individuals have the potential to develop multiple trait self-esteem attractors. Each one is thus a distinct high-order quality of trait self-esteem. From this perspective therefore, high and low trait self-esteem are not necessarily mutually exclusive within individuals. The SOSE model thus expands on the traditional conceptualization of trait self-esteem as a single baseline level, by introducing the possibility that trait self-esteem is multi-stable. While individuals may have one (positive or negative) trait self-esteem attractor (as was demonstrated by Vallacher and Nowak, 2000), individuals have the potential to develop more than one trait self-esteem tendency. This possibility has been suggested earlier by theorists with respect to properties of the self (Marks-Tarlow, 1999; Nowak et al., 2000; Vallacher et al., 2002).

Each trait self-esteem attractor is the result of a distinct quality of state self-esteem iterations across time. For example, while an individual may repeatedly experience positive state self-esteem, thereby developing a predominantly positive trait self-esteem attractor, the same individual may also repeatedly experience negative state self-esteem, thereby developing another distinct negative trait self-esteem attractor.

Adopting the 'attractor' terminology in describing trait self-esteem from the SOSE model does more than simply replace the traditional self-esteem terms with new ones. This is because the behavior and development of attractors, and the larger attractor landscape

that they form, can be predicted by *basin of attractor* dynamics (Van Geert, 1994). In order to illustrate these dynamics, an epigenetic landscape is helpful, portrayed in Figure 4 (Haken, 1997; Kunnen & Van Geert, 2011a; Lichtwarck-Aschoff & Van Geert, 2004; Vallacher & Nowak, 2000; Van Geert, 1994). The epigenetic landscape portrayed in Figure 4 consists of valleys and a moving ball. The valleys represent various trait self-esteem attractors and the ball represents state self-esteem.

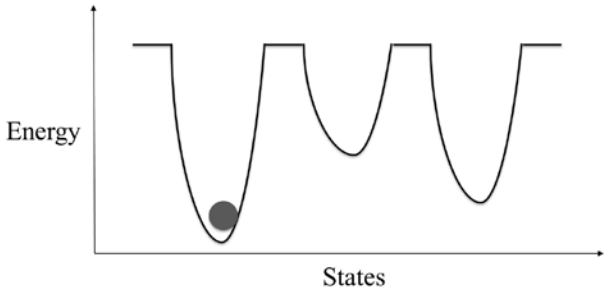

Figure 4. An attractor landscape of coexisting attractor states depicted as a landscape of valleys. Each valley illustrates a trait self-esteem attractor, while the ball illustrates the trajectory of state self-esteem.

In Figure 4, it is important to note that neither the ball nor the landscape is static. The ball moves through the landscape, and the movement of the ball slowly shapes the landscape. The *y*-axis is the depth of the attractor states. The depth refers to the amount of energy needed for the ball to move from one position to another, where higher points require more energy. When in a valley, the ball will remain at the bottom of the valley until it is perturbed. Thus deeper valleys require larger perturbations in order to move the ball out of the valley. The *x*-axis of the landscape is the width of the attractor states. The wider the valley, the larger the range of initial conditions that will lead to that specific attractor, such that the ball is more likely to roll into a wider valley (*basin of attractor* dynamics; Van Geert, 1994). Each valley refers to a qualitatively distinct trait self-esteem attractor (e.g., differing in valence).

The dimensions of the valleys govern the movement of the ball. These principles explain both the real-time behavior of trait self-esteem and state self-esteem, and their long-term development. We begin by describing the dynamics that dictate the real-time relationship between the micro, meso, and macro level of state self-esteem (self-experiences, state self-esteem, and trait self-esteem, respectively).

First, the dimensions of the valleys dictate how the trait self-esteem attractors will manifest themselves and be experienced in real-time in relation to state self-esteem. To illustrate this, consider an individual with two trait self-esteem attractor states, such that the individual's attractor landscape includes two valleys that differ in their width, where the wider valley is characterized by negative valence and the narrower valley is characterized

by positive valence. As the negative trait self-esteem attractor is wider, there are more initial conditions that will lead to its self-organization in real-time, meaning that many negative self-experiences will trigger self-amplifying feedback loops between the micro, meso, and macro level.

Imagine that the individual is doing a performance and experiences a negative thought such as "I'm making a fool of myself". This will then trigger the beginning of a self-organizational process of the negative trait self-esteem attractor. This starts with self-amplifying feedback loops at the micro level, where additional negative self-experiences will be triggered, such as embarrassment. As the micro-level feedback loop continues from second to second, a full-blown higher-order state self-esteem will emerge that is characterized by negative valence – the ball in Figure 4 is set into motion, as it were. As self-amplifying feedback loops between levels continue, the emergence of negative state self-esteem activates the existing negative trait self-esteem attractor – the ball in Figure 4 rolls into the valley that corresponds with negative trait self-esteem.

The activation of the negative trait self-esteem attractor (i.e., the ball rolling into a specific valley) then triggers a top-down process of self-stabilization. As a result, the individual cannot easily break the negative state self-esteem experience. Small perturbations introduced by the individual, for example adjustments of body posture that create a more assertive stance, are corrected for by the self-stabilizing feedback loops, such that the higher-order negative state self-esteem experience is not disturbed. In other words, the ball in Figure 4 can roll up onto the inside edge of the attractor, but if this effort is too small it will be in vain, as the ball rolls back to the deepest point of the attractor. Only when a sufficiently strong perturbation occurs (e.g., applause from the audience) will the self-stabilizing inter-level feedback loops be broken. This then frees the ball from the valley, allowing a new process of self-amplifying feedback loops to begin at the micro level. For example, if the individual then experiences a positive emotion pertaining to the self, such as pride, this will then amplify other positive self-experiences until the positive trait self-esteem attractor is triggered, thereby constraining further changes of self-experiences, and maintaining the positive state self-esteem experience. The above bi-directional relationship between trait self-esteem and its lower-order components explains how macro-level trait self-esteem attractors can self-organize in real-time, resulting in their real-time manifestation and experience.

Next, regarding the long-term development of trait self-esteem, in Figure 4 the landscape is rigid yet malleable, such that the movements of the ball have a formative effect on the structure of the landscape. A valley can be created across the long-term if the ball rolls to that particular position of the landscape frequently enough. A valley becomes deeper each time that the ball revisits that position. Given that the ball rolls to the position that requires the least amount of energy, valleys that become more entrenched increase the likeliness that the ball will roll into that valley. The developmental outcome of the valley (i.e., the attractor states) therefore constrains future real-time outcomes (Granic & Patterson, 2006). This illustrates, first, the process of iterative development of state self-esteem that

results in long-term development at the macro level (described in the previous section regarding the SOSE model). This metaphor also illustrates, the self-stabilizing feedback loops between the macro level and meso level, in which the macro level inhibits the long-term development of new trait self-esteem attractor states (or the further development of existing, yet small, attractors). If a specific quality of state self-esteem is infrequently experienced, this constrains the development of a new trait self-esteem attractor.

2.5.4 SOSE model: Implications for research.

A growing number of researchers have begun to acknowledge the need to expand on the current static understanding of self-esteem and its development (Delignières et al., 2004; Fortes et al., 2004; Ninot et al., 2005; Ram, Morelli, Lindenberg, & Cartensen, 2008; Scheff & Fearon, 2004; Vallacher et al., 2002; Vallacher & Nowak, 2000). However, while this need has been clearly acknowledged, it has – as yet – not been accompanied with a comprehensive model specific to trait self-esteem and state self-esteem from which to work from. In this section, we outline how the processes described in the SOSE model can be translated to empirical research. We hope that, in doing so, we will provide researchers with a range of theory-driven directions for research aimed to increase our understanding of the dynamics of self-esteem.

Here we discuss the empirical implications of two basic principles of the SOSE model.

The first principle is that self-esteem development is *not* viewed as a sequence of discrete events (as is the case from the latent-construct model), but as a dynamic process in which a continuous process of change is the cause of subsequent continual processes of change (Thelen & Smith, 1994; Van Geert & Steenbeek, 2005). The second principle is that, if change is seen as a continuous process of causality, this process occurs *within* the phenomenon itself rather than solely by means of external influences, as is assumed in the latent-construct model, where the focus is on causal interventionism (see *Latent construct model: Implications for research*). Change, therefore, is a function of intrinsic dynamics (Vallacher & Nowak, 1997). This does not exclude the importance of the immediate environment, however. From a complex dynamic systems perspective, a system is in constant interaction with its immediate environment (Van Geert, 1994). What is important here, is that the intrinsic dynamics – i.e. the internally generated patterns of change; Vallacher, Van Geert, & Nowak, 2015 – are central to understanding self-esteem change, and development at large (Van Geert, 2014).

At the most general level, the above principles of the SOSE model accommodate the goal of understanding the mechanisms underlying phenomena, given that the causal interactions within the phenomenon itself (i.e., within self-esteem) are the focus (Salmon, 1998b). Therefore, the SOSE model provides a framework for studies that aim to understand, one, the *nature* of state and trait self-esteem, two, how *development* of state and trait self-esteem comes about (change from t_n to t_{n+1}), and three, the dynamic relationship between state self-esteem and trait self-esteem, which are discussed below.

SOSE model: State self-esteem research.

The nature of state self-esteem.

In the section *Self-experiences emerge into state self-esteem*, the first characteristic of state self-esteem emergence that was outlined concerned whether feedback loops between lower-order self-experiences are self-amplifying or self-stabilizing, and as a result, whether state self-esteem will emerge or not. The second characteristic that was outlined concerned whether self-amplifying feedback loops enhanced similar connections or dissimilar connections between self-experiences, where the self-amplification of similar connections indicates a 'press for integration' that results in coherent state self-esteem as opposed to incoherent state self-esteem. These characteristics can be assessed by observing the valence of each self-experience that is expressed in real-time relative to other self-experiences that occur simultaneously. We demonstrate how these characteristics can be assessed in empirical research in Chapter 3.

The above characteristics are not just theoretically relevant for understanding the nature of state self-esteem, but also in terms of the growing literature regarding what it means to have high self-esteem, and more specifically, whether high self-esteem is generally beneficial. A growing proposition is that high self-esteem is only really 'optimal' if it is genuine, and not if it is contingent on self- or other-regard (Deci & Ryan, 1995; Kernis, 2003; Ryan & Brown, 2003). This perspective stems from the Self Determination Theory (SDT; Deci & Ryan, 1995). From this perspective 'genuine' high self-esteem is the result of acting in accordance with one's own interests and values (Ryan & Brown, 2003). If one is acting in accordance with his/her own interests, the resulting actions are said to be *self-determined*.

To date, the above characteristic has only been explored in terms of trait self-esteem (Kernis, 2003). It has been suggested that self-esteem is not genuine when an individual misrepresents his or her self-feeling (a discrepancy between privately experienced self-feelings and expressed self-feelings), and that genuine self-esteem occurs when an individual represents his or her self-feelings in a honest way (no discrepancy between privately experienced self-feelings and expressed self-feelings; Kernis & Paradise, 2002). Given that, in the SOSE model, self-amplifying interactions between self-experiences give way to state self-esteem emergence, the type of connections that are self-amplified can indicate whether the emergent state self-esteem experience is genuine or contingent. Specifically, the emergent state self-esteem experience is likely to be genuine given coherence amongst the lower-order components (i.e., self-experiences are simultaneously similar in valence), and it is likely to be contingent given incoherence amongst the lower-order components. We demonstrate this distinction in our operationalization of state self-esteem in Chapter 3.

Developmental processes.

The SOSE model provides a framework for studying the dynamics of state self-esteem development across real-time. This framework stems from the basic assumption that state self-esteem develops iteratively, and that temporal causality at the micro level is a

function of the continuous moment-to-moment interactions between lower-order components. From this framework, a number of empirical guidelines can be outlined. First, it is important that repeated measures of state self-esteem across time are not averaged together. In averaging repeated measures together it is possible to calculate central tendencies, but it is impossible to map the iterative changes that occur from moment-to-moment. In order to investigate temporal characteristics of state self-esteem, it is therefore necessary to keep the 'time' aspect of repeated measures intact so that the resulting *time series* can be further analyzed (see Delignières et al., 2004; Fortes et al., 2004; Ninot, Fortes, & Delignières, 2001).

Second, the SOSE model suggests that the lowest level of self-esteem, i.e., the micro-level, develops in the here-and-now. Therefore, state self-esteem is optimally measured at a high density across the here-and-now so that change can be captured as it occurs. For state self-esteem, measures should span seconds if the goal is to capture this variability. Moreover, according to the SOSE model, self-organization of state self-esteem does not occur between one moment and the following moment, but in an iterative manner across many moments. Therefore, a high frequency of state self-esteem measures is needed in order to investigate microgenetic development.

While experience-sampling methods have been used to study repeated measures of state self-esteem, the historicity of state self-esteem change is often lost as change is only analyzed between two consecutive state self-esteem measures, where each state is predicted by the previous state (Savin-Williams & Demo, 1983; Thewissen, Bentall, Lecomte, van Os, & Myin-Germeys, 2008; Udachina, Varese, Oorschot, Myin-Germeys, & Bentall, 2012), rather than by a longer process of iterations of state self-esteem (with a few exceptions, i.e., Delignières et al. (2004; 2006); Fortes et al. (2004)). It is important that the time series spans a sufficient amount of within-individual variability across time in order to capture the development that arises out of said variability (DiDonato et al., 2013).

Fourth, given that development is a continuous process of causality, state self-esteem measures should be captured indirectly, rather than by repeatedly interrupting the state self-esteem process. If the continuous process is measured by interrupting said process (as is done in the experience-sampling method), the continuity of the process cannot be measured. This is because each interruption can potentially be a perturbation to the network of self-organizing self-experiences (Cox, Hasselman, & Seevinck, 2011; Van Orden et al., 2010). If the current self-stabilizing feedback loops cannot sustain the perturbation caused by the researcher's interruption, a re-organization of the network will occur (Granic & Lamey, 2002). As a result, the state self-esteem network that is measured after the self-report is likely to be distinct from the state self-esteem network before the perturbation occurred. State self-esteem, therefore, will not be captured as a continuous process, but as discrete states separated by the external perturbations. For this reason, researchers should avoid the use of repeated self-report measures when the goal is to assess micro-level development. The above suggestions are incorporated, and thus demonstrated, in Chapter 3.

SOSE model: Trait self-esteem research.

An important contribution that the SOSE model can make to the study of the nature of trait self-esteem refers to the conceptualization that trait self-esteem self-organizes into action in real-time out of occurrences at the lower-levels of self-esteem. This thus refers to the self-amplifying feedback loops that occur in real-time between the macro level and the lower-order levels.

Broadly speaking, there are two possibilities for empirically approaching this bottom-up emergence. First, bottom-up emergence can be studied from the level of state self-esteem to trait self-esteem. This possibility requires one high-frequency time series of state self-esteem across real-time. Time-series analyses can then be used to identify trait self-esteem attractors by determining which levels of state self-esteem valence are, one, most frequently experienced, and two, experienced for the longest duration (e.g., Vallacher et al., 2002). Together, these characteristics distinguish stronger attractor states from weaker attractor states (Thelen & Smith, 1994; Van Geert, 1994).

A second way in which the emergence of trait self-esteem can be studied is by examining the processes of bottom-up emergence from the lowest level, i.e., self-experiences. This approach would require multiple time series of separate self-experiential components (e.g., one time series for emotional self-experience, another for behavioral self-experience, etc.). As above, it would be necessary to capture the continuous changes of self-experience as they occur in real-time. Observational data would lend itself to this approach, as various different qualities of self-experience (i.e., emotional, behavioral, etc.) could be subsequently quantified by, for example, coding them on a moment-to-moment basis.

As yet, the emergence of trait-like structure has only been conducted based on iterations of state self-esteem as a single time series (Delignieres et al., 2006; Fortes et al., 2004; Ninot et al., 2005), and not of multiple time series of lower-order self-experiences in real-time. Moreover, extant research has focused on the emergence of single fixed-point attractor states of self-properties (Vallacher et al., 2002), rather than multiple attractor states and the temporal structure that characterizes the moment-to-moment transitions from one attractor to another. In Chapter 4, we demonstrate how the emergence of multiple trait self-esteem attractor states can be studied, how this can be done based on multivariate micro-level data, and how variability from one attractor state to another can be captured.

Once emergent trait self-esteem attractors are measured, it is then possible to determine the characteristics of the individual attractor states and of the attractor landscape that they form. First, the strength of individual trait self-esteem attractors can be determined based on their ability to constrain lower-order variability. This thus refers to the self-stabilizing feedback loops that occur between the macro level and the meso level. Relatively strong trait self-esteem attractors can thus be identified by a relatively high level of top-down constraint on state self-esteem. Given the presence of strong trait self-esteem attractors, state self-esteem is only free to exhibit variability across real-time when it is not being constrained by an activated attractor state, or in other words, during a real-time transition from one trait self-esteem attractor to another. This is demonstrated in Chapter 4.

2.6 Discussion

The proposed Self-Organizing Self-Esteem model integrates both classical theory and new research paradigms in order to provide a framework for understanding the underlying dynamics and complexity of self-esteem and its trait and state components. Specifically, the SOSE model states that state self-esteem and trait self-esteem are distinct softly-assembled constructs that self-organize as separate self-esteem constructs, as a meso-level construct and a macro-level construct, respectively. In the SOSE model, self-organization includes the primary process of bottom-up emergence, where trait self-esteem is an emergent macro-level product of state self-esteem dynamics, and state self-esteem is an emergent meso-level product of self-experiences. Self-experiences are thus the lowest-order of self-esteem. As such, they form the micro-level of self-esteem. In general, therefore, causality originates at the level of the lower-order components.

A secondary process of self-organization in the SOSE model is that of top-down constraint, where the emergence of a higher-order construct begins a process of constraint on lower-order interactions – from the macro level to the meso level, and from the meso level to the micro level. The SOSE model thus suggests that the various levels of self-esteem are bi-directionally related.

This conceptualization is in contrast with the traditional approach to state and trait self-esteem, which we refer to as the latent-construct model. In the latent-construct model, state and trait self-esteem are seen as parts of one concept. Specifically, state self-esteem is seen as the contextual error around a latent level of trait self-esteem, making state self-esteem a primarily top-down product of trait self-esteem plus incidental and temporally independent contextual factors. From this perspective causality originates at the level of the underlying latent trait, and the relationship between trait self-esteem and state self-esteem is uni-directional.

In the current article we outlined how the SOSE model and the latent-construct model result in two opposing conceptualizations of the nature of state self-esteem, trait self-esteem, and the state-trait relationship. We interpret these conceptualizations from the classical Jamesian distinction between I-self and Me-self. We argue that, while the Jamesian distinction is widely accepted as the foundation for the study of self and self-esteem in particular, it is essentially omitted when a traditional latent-construct model of self-esteem is adopted. We argue that, from the latent-construct perspective, any study of I-self becomes a study of me-self, and we demonstrate this based on extant studies. From this vantage point, we suggest that the study of self-esteem will remain fundamentally one-sided given a reliance on only the latent-construct model.

Aside from the implications for the Jamesian distinction, we go further by outlining the specific implications that the two models have for self-esteem research in general. We showed that the latent construct model is well suited for identifying central tendencies of trait self-esteem as well as external causal factors of variations and development regarding state self-esteem and trait self-esteem. We also showed that this model is less suited for

understanding the dynamics and underlying (internal) mechanisms behind the nature of state self-esteem and trait self-esteem or their development.

We showed that our proposed SOSE model is specifically well suited for studying the dynamics and underlying internal mechanisms of both state self-esteem and trait self-esteem, as well as their relationship with each other. We suggest that, because of this, the SOSE model provides a framework for studying I-self in addition to me-self, and that it therefore remedies the one-sidedness that stems from the latent-construct model. We suggest that our SOSE model complements the traditional latent-construct approach to self-esteem by providing the theoretical means to understand and study the dynamics of self-esteem that cannot be explained or studied based on the traditional model. We pave the road for future researchers interested in carrying out research consistent with the SOSE model by outlining areas for future empirical research.

The current article opens the door to new empirical questions regarding the emergence of both state and trait self-esteem as real-time processes, the long-term process of state and trait self-esteem development, and the relationship between state self-esteem and trait self-esteem in real-time and across the long term. Our SOSE model, therefore, can be incorporated in the growing research paradigm in which the temporal dynamics of self-esteem are examined, thereby expanding on the current state of self-esteem research.

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Part II

Empirical studies regarding the internally generated patterns of real-time change of state self-esteem and trait self-esteem

CHAPTER 3
The Temporal Nature of State Self-Esteem as a Real-Time Process

Abstract

Research regarding the variability of state self-esteem commonly focuses on the *magnitude* of variability. In the current article we provide the first empirical test of the *temporal structure* of state self-esteem as a real-time process during parent-adolescent interactions. We adopt a qualitative phenomenological approach, whereby moment-to-moment emotional and behavioral indicators of state self-esteem are measured as they emerged during the interactions, resulting in state self-esteem time series. We conducted Detrended Fluctuation Analyses (DFA) on the state self-esteem time series and found that they exhibited a form of structured variability, called *pink noise.* The mean DFA exponent differed significantly from that of randomized surrogate data ($p < 0.01$), which revealed uncorrelated random variability, called *white noise.* This finding shows that the temporal structure of state self-esteem variability exhibits self-similarity and is not random. Additionally, a weak positive relationship was found between the DFA and context-independent autonomy levels. [10]

[10] This chapter is based on De Ruiter, N. M. P., Den Hartigh, R. J. R., Cox, R. F. A., Van Geert, P. L. C., & Kunnen, E. S. (2014). The temporal structure of state self-esteem variability during parent–adolescent interactions: more than random fluctuations. *Self and Identity*, (December 2014), 1–20. doi:10.1080/15298868.2014.994026

Self-esteem is conceptualized as having both a trait element (characterized as relatively stable and predictable across time), as well as a state element (characterized by fluctuations from moment to moment and a high level of variability) (Donnellan et al., 2012). While the number of theoretical and empirical studies focusing on state self-esteem is increasingly growing, these studies tend to focus on the magnitude of state self-esteem variability (e.g., Leary & Downs, 1995). To date, very little theoretical or empirical research has been done concerning the nature of the moment-to-moment fluctuations that occur in state self-esteem, which we refer to as the temporal *structure* of state self-esteem variability.

The current article provides the first test of the temporal structure of state self-esteem as a moment-to-moment (i.e., real-time) process. We begin by exploring the implicit assumptions held regarding state self-esteem variability and its temporal structure, and how these assumptions may be at the root of why the temporal structure of state self-esteem variability has remained outside of the limelight. Next, we suggest that the temporal structure of state self-esteem exhibits more meaningful dynamics than is commonly attributed to it, and more specifically, that state self-esteem can be conceptualized as a process that exhibits *fractal* characteristics. We test whether this is indeed the case for adolescents during parent-adolescent interactions, and we explore how the temporal structure of state self-esteem is related to a pivotal indicator of healthy adolescent development, namely, autonomy.

3.1 Implicit Assumptions Regarding the Temporal Structure of State Self-esteem Variability

The common conceptualization of state self-esteem stems from the notion that state self-esteem is the "barometric" element of self-esteem, which is variable across time and contexts and fluctuates around the relatively stable "baseline" level of self-esteem (Rosenberg, 1986). This conceptualization is consistent with the basic axiom of standard psychometric theory, which posits that there is a true underlying level of a latent variable, and that this true level is expressed by a score (measured by an instrument) that is subject to error. Therefore, the observed score is equal to the true score plus error, where the error is by definition independent from the true score (Lord & Novick, 1968; Van Geert & Van Dijk, 2002). For self-esteem specifically, state self-esteem is commonly approached as the "error" around (and independent from) – what is thought to be – a more meaningful baseline level that is trait self-esteem, where the "error" is contextually-based error. Indeed, according to a prevailing theory in self-esteem research – the Sociometer Theory (Leary, 2005) – trait self-esteem is viewed as the resting level of self-esteem in the absence of contextual information, and state self-esteem is thought to fluctuate around this resting level of self-esteem as a function of social cues in the immediate context (Leary, 1999). Therefore, the underlying assumption is that, without the presence of contextual events, state self-esteem is expected to be equal to the baseline level of trait self-esteem.

Empirical research has primarily approached state self-esteem *variability* as a function of external factors, as a reaction to the immediate context. Studies therefore often focused on the magnitude of the reaction to external cues, either by measuring the test-

retest level of state self-esteem before and after an experimental contextual cue (e.g., Heatherton & Polivy, 1991; Leary & Downs, 1995; Murray, Griffin, Rose, & Bellavia, 2003; Thomaes et al., 2010), or by measuring between-individual differences in the level of *self-esteem stability* (Kernis et al., 1993, 1989), conceptualized as a dispositional quality of how reactive an individual is to daily events (e.g., Franck & De Raedt, 2007; Jordan, Whitfield, & Zeigler-Hill, 2007; Kernis et al., 1989; Koole, Dijksterhuis, & Van Knippenberg, 2001; Oosterwegel, Field, Hart, & Anderson, 2001; Savin-Williams & Demo, 1983).

Regarding the temporal *structure* of state self-esteem variability, self-esteem researchers who build upon the above assumptions have yet to explicitly describe – theoretically or empirically – what the temporal nature of state self-esteem dynamics is. Generally speaking, however, the standard psychometric theory that underlies the baseline approach (see above) indicates that the variability around the true score is symmetrically distributed, due to the fact that the variability is assumed to be the cause of independent and randomly varying contextual factors (Van Geert & Van Dijk, 2002). Following this basic theory, state self-esteem represents a short-lived experience, which – given the absence of a new contextual cue – will return back to the baseline level (Alessandri & Caprara, 2012). Given this conceptualization, the variability of state self-esteem should resemble *white noise* (Diniz et al., 2011; Gilden, 2001; Stadnitski, 2012; Van Orden, Holden, & Turvey, 2003, 2005), which is temporally random variability that is created when there is no carry-over effect from one state to the next (see Figure 1a).

This implicit assumption is directly implied by the common methodological approaches to repeated measures of state self-esteem, which focus on central tendencies of self-esteem (i.e., measures at the aggregate level). Firstly, repeated measures are often averaged in order to gain a measure of the true level of self-esteem (i.e., of trait self-esteem) (DeHart & Pelham, 2007); a technique that depends on the assumption that there is a meaningful average level that state self-esteem fluctuates around. Secondly, repeated measures are often utilized in order to determine the standard deviation of state self-esteem (i.e., self-esteem stability, see above), which implies that the noise (i.e., variability) around the baseline level produces a temporally stable level of variability (DiDonato, England, Martin, & Amazeen, 2013; Van Orden et al., 2003). Together, these methodological approaches imply that state self-esteem is a stationary signal with a constant mean and standard deviation, i.e., central characteristics of white noise.

3.2 State Self-esteem Variability as a Fractal Process

We question the assumption that state self-esteem variability is purely a function of exogenous events, as well as the assumption that the temporal structure of the resulting variability is random (i.e., white noise). Alternatively, we posit that each state self-esteem event is in itself a process, and that this process interacts with neighboring (i.e., future) state self-esteem processes. These dynamics are defined as *interaction-dominant* dynamics, where the coordination of the process at large is a function of the internal dynamics, which occur within a context, but which are not a function of the context alone (Van Orden et al.,

2003). From this conceptualization, state self-esteem exhibits both short-term and long-term carry-over effects. We suggest, therefore, that state self-esteem is a self-coordinating process, rather than a passively reactive (i.e., stimulus-response like) and random process.

Many human processes, such as word naming (Van Orden et al., 2003; Wijnants, Hasselman, Cox, Bosman, & Van Orden, 2012), finger tapping (Gilden, Thornton, Mallon, 1995), walking (Hausdorff, Peng, Ladin, Wei, & Goldberger, 1995), standing (Duarte & Zatsiorsky, 2000), rhythmical aiming (Wijnants, Cox, Hasselman, Bosman, & Van Orden, 2012), neuromagnetic activity (Linkenkaer-Hansen et al., 2005) and mental-rotation tasks (Gilden & Hancock, 2007) have recently been conceptualized as depending on interaction-dominant dynamics have been found to exhibit *pink noise* (see Figure 1b). Pink noise is structured variability characterized by correlated activity across many time scales (Van Orden et al., 2003; Wijnants, Cox, Hasselman, Bosman & Van Orden, 2012).

Pink noise is significant for a number of reasons. Firstly, it is indicative of a fractal process. Fractals are characterized by their self-similarity, which can refer to spatial or temporal self-similarity. Spatial fractals occur "when the same object replicates itself on successively smaller scales" (Segev, Soljačić, & Dudley, 2012, p. 209), which is (statistically) true for many geometrical objects in nature, such as the Romanescu broccoli. The current article concerns temporal fractals, where variability is statistically similar across multiple time scales (seconds, minutes, etc.). Any point in a fractal process, therefore, possesses the "dynamic memory" of all preceding points of the process and is therefore embedded in the historical context of the system (Delignières et al., 2004; Diniz et al., 2011). The presence of pink noise is also significant in that it indicates a balance between order and chaos (Wijnants, 2014), which characterizes healthy and well-coordinated systems (Herman, Giladi, Gurevich, & Hausdorff, 2005; Wijnants, Hasselman, Cox, Bosman, & Van Orden, 2012). Indeed, pink noise lies on a continuum between *white noise* and *Brown noise* (see Figure 1), which we will describe below.

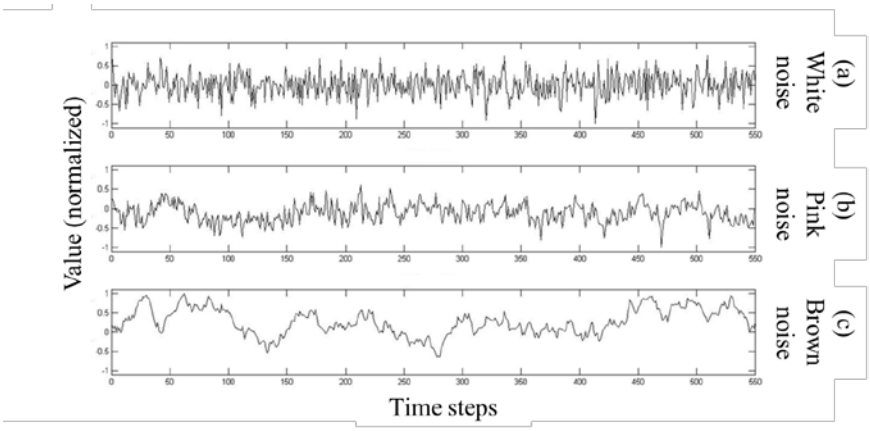

Figure 1. Three simulated types of noise patterns: White noise (a), pink noise (b), and Brown noise (c).

White noise is random and temporally uncorrelated noise distributed symmetrically around an average level (Figure 1a), referred to above regarding the traditional "barometer" view of state self-esteem. White noise is considered maladaptive because it reflects excessive flexibility to the extent that the system is unstable and does not demonstrate any memory of the previous state (Hausdorff, 2009). Processes approaching white noise have indeed been found to indicate abnormalities; for example, the temporal variability in trial-by-trial word-naming tasks in young dyslexic readers (compared to non-dyslexic readers) (Wijnants et al., 2012). At the other end of the spectrum, Brown noise is highly rigid and overly determined, such that the next state of a process is equal to the previous state plus a random influence (Figure 1c). Brown noise is considered unhealthy because it indicates that the system does not adapt effectively to the current context and is therefore "stuck" in the previous meaningful state (Gilden & Hancock, 2007). Processes approaching Brown noise have indeed been found to indicate abnormalities; for example, the temporal variability of reaction times of a mental rotation task in adults with Attention Deficit Hyperactivity Disorder (ADHD) (compared to individuals without ADHD) (Gilden & Hancock, 2007).

While the fractal properties of state self-esteem across real time have not been examined to date, there is an abundance of evidence that real-time cognitive and motor processes reveal pink noise (for a review, see Wijnants, 2014). Moreover, there is rising evidence that pink noise is also displayed in socio-emotional processes, such as trial-by-trial reaction times in racial-bias tasks (Correll, 2008), short conversational storytelling sessions (Butner, Pasupathi, & Vallejos, 2008), and mood across the long term (from 1 to 2.5 years) (Gottschalk, Bauer, & Peter, 1995). Closely related to self-esteem, Vallacher and colleagues have shown that verbal self-reflection (regarding trait-like properties) expresses interaction-dominant dynamics, where self-reflection converges onto relatively coherent regions of positivity or negativity (Vallacher et al., 2002) and exhibits pinks noise (Wong, Vallacher, & Nowak, 2014). Finally, Ninot and colleagues (Fortes et al., 2004; Ninot et al., 2005) measured state self-esteem as a long-term process (i.e., approximately a year and a half), where the smallest time interval between successive state self-esteem measurements was approximately 12 hours. While Ninot and colleagues did not examine *real-time* variability of state self-esteem, they showed that the dynamics of state self-esteem are a function of intrinsic dynamics (described by a moving-average model), and that state self-esteem exhibits pink noise (Delignières et al., 2004).

The above findings regarding self-evaluation processes as characterized as interaction dominant, and as exhibiting pinks noise, supports our hypothesis that the real-time process of state self-esteem will demonstrate pink noise. Given that state self-esteem fluctuations are conceptualized as occurring in the here-and-now (e.g., Kernis et al., 1993, 1989; Leary & Downs, 1995; Rosenberg, 1986b), it is important that the temporal structure of state self-esteem is also investigated across real time, as is done in the current study.

3.3 A Qualitative Phenomenological Account of State Self-Esteem.

To date, researchers interested in variability of state self-esteem have used the *experience sampling method* (e.g., Delignières et al., 2004; Oosterwegel, Field, Hart, &

Anderson, 2001). While this method is highly suitable for capturing daily fluctuations of state self-esteem, it is not ideal for capturing state self-esteem as a real-time process (with fluctuations occuring from moment-to-moment). This is because the very act of reporting on the momentary self-experience of one's self would disrupt the organic process of state self-esteem and would not capture the *continuous* state self-esteem process. To remedy this, we suggest that it is helpful to collect qualitative data that is phenomenological by nature, based on naturally emerging positive and negative self-experiences.

Cognitions of self-evaluation are traditionally measured as characteristics of (both state and trait) self-esteem. However, when investigating the phenomenological experience of self-esteem, it is important that researchers move toward a more holistic approach, where emotions and behavior are considered (Ryan & Brown, 2003; Scheff & Fearon, 2004). For state self-esteem specifically, it is even more imperative that cognitions are not relied upon as the sole source of information, as it is likely that self-evaluation will first occur without conscious monitoring, and therefore, not as cognitions (Cunningham & Zelazo, 2007; Ryan & Brown, 2003).

In the current chapter, we focus on the positivity and negativity of *behavioral* and *affective* experiences of the self. These self-experiences can be conceptualized as lower-order components of state self-esteem that, by means of intrinsic dynamics, emerge into a higher-order experience of the self, i.e., state self-esteem (see Chapter 2), where all lower-order components are conceptualized as having equal weight in the process of emergence. State self-esteem is therefore the general level of positivity or negativity regarding the self at that moment, and the separate emotional and behavioral experiences of the self are indicators of that general level.

[11]The reason for including behavioral indicators of state self-esteem is that behavior reflects how an individual sees or feels about him or herself (Atkinson, 1964; Leary, 2004). For self-esteem, the positivity or negativity of the behavioral experience of the self is reflected in autonomy (Deci & Ryan, 1995), where real-time expressions of autonomy are thus relevant for real-time self-esteem (i.e., state self-esteem). According to the Self-Determination Theory (SDT), autonomous actions are manifestations of a secure sense of self and a high level of true self-esteem, and self-worth is reflected in agency and proactivity (Deci & Ryan, 1995). In our study, autonomous actions need not indicate separation and individuation from the parent (Kroger, 1998), as is often adopted when considering autonomy. Instead, in accordance with the SDT, autonomous actions are those that express agency, proactivity, free-will, and ownership of behavior.

We included emotions as an indicator of state self-esteem as emotions reflect an individual's personal reality regarding their self-worth (Cognitive-Experiential Self Theory; Epstein, 1993). Specifically, 'self-conscious' emotions are of relevance to state self-esteem,

[11] The following information regarding the behavioral and emotional indicators of state self-esteem is identical to the information given in Section 1.4. It is included here for the sake of completeness in the current chapter.

which are socially-situated emotions pertaining to the self, such as pride and shame (Tangney & Fischer, 1995). These are in contrast with emotions that are not self-conscious, such as affection or anger (which reflect appraisals of the context and concerns in an immediate relationship, Frijda, 2001).

When considering the phenomenological experience of state self-esteem, it is necessary to distinguish between those expressions of positive state self-esteem that are genuine, and those that are not. This perspective stems from the SDT (Deci & Ryan, 1995), where 'genuine' high self-esteem is the result of *self-determined* actions, i.e., acting in accordance with one's own interests and values, rather than trying to gain self- or other-regard (Ryan & Brown, 2003).Researchers have suggested that positive self-esteem expressions are not genuine when an individual misrepresents his or her self-feeling (i.e., a discrepancy between privately experienced self-feelings and expressed self-feelings), and that positive self-esteem expressions are genuine when an individual represents his or her self-feelings in a honest way (i.e., no discrepancy between privately experienced self-feelings and expressed self-feelings) (Kernis & Paradise, 2002).

In the current study, we incorporate this distinction (and its identification according to Kernis and Paradise, 2002) into our measurement of state self-esteem. This is done by conceptualizing *positive* state self-esteem as expressions of positive self-experience that do *not* entail or coincide with a discrepancy of valence between simultaneously expressed emotions or autonomous behavior. Discrepancies of valence occur when one experience is positive by nature and the other (simultaneously expressed experience) is negative by nature (e.g., verbally expressing pride while non-verbally expressing embarrassment). Moreover, discrepancies include both experiences of the *self* as well as experiences of the *significant other* with which the individual is interacting. It is important that discrepancies regarding experiences of the significant other are also included, as one can only experience genuine self-esteem if one is not simultaneously being 'fake' in immediate relationships with significant others (Kernis, 2003).

3.4 The Current Study

Our study provides the first account of a qualitative phenomenological approach to state self-esteem across real time, where positive and negative emotional and behavioral self-experiences that are expressed during interaction with a significant other are observed. We aim to investigate the temporal structure of state self-esteem variability as a real-time process. The current study focuses specifically on adolescents, as adolescence is a significant period for self-esteem development (Harter & Whitesell, 2003; Robins, Trzesniewski, Tracy, Gosling, & Potter, 2002). We hypothesize that the temporal structure of state self-esteem variability will be structured, rather than random, thereby resulting in long-range correlations as indicated by the presence of pink noise (*Hypothesis 1*).

Moreover, we examine the relationship between the temporal structure of adolescents' state self-esteem variability and the static (i.e., non-temporal) and self-reported levels of adolescent trait and state self-esteem. This is useful in order to ascertain how the temporal measure of structure relates to the more traditional measures of self-esteem levels. We

hypothesize that the temporal *structure* of state self-esteem is a distinct concept from the *level* of self-esteem. We therefore expect there to be no significant correlations between the temporal structure of state self-esteem and the static measures of self-esteem levels (*hypothesis 2*).

Finally, we examine the relationship between the temporal structure of adolescents' state self-esteem variability and a theoretically relevant psychological variable during adolescence, so that the meaning of the temporal structure can be grounded in psychological theory related to adolescence. We examine the association with adolescents' levels of self-reported context-independent autonomy, as this is an indicator of positive psychosocial adjustment during adolescence (Noom, Dekovic, & Meeus, 1999)[12]. Considering that – firstly – higher autonomy levels indicate healthy adjustment in adolescents (Noom et al., 1999), and that – secondly – fractal characteristics indicate healthy human processes (Herman et al., 2005), we hypothesize that fractal characteristics in adolescent state self-esteem and autonomy levels of adolescents will be positively related (*hypothesis 3*).

3.5 Method

3.5.1 Participants

Participants were thirteen adolescents (3 boys, 10 girls) and their parents (1 male, 12 females). The mean adolescent age was 13.30 years (*SD* = 0.90). The parent-adolescent dyads that took part in this research responded to recruitment flyers that were handed out in various local community centers and schools. The participants had no indication of clinical diagnoses and were of average socioeconomic status. The majority of the dyads were Dutch, with one American-Dutch dyad and one British dyad. Participation was voluntary, and children were rewarded after the video-recordings took place with a five Euro gift-voucher.

3.5.2 Procedure

Before the video-recordings took place, adolescents filled out a questionnaire regarding their trait self-esteem and their autonomy. Later, each dyad was video-recorded in their home environment during a semi-naturalistic interaction by the first author. The dyads were given three consecutive topics to discuss. The nature of each topic was such that the parent and child would try to come to a mutual agreement. The first discussion topic was neutral (for example: If you could have one super power, which would you have?). The second was a conflict topic relevant to each dyad at that moment (for example: cleaning up your room). The last discussion topic was a new neutral topic comparable to the first (i.e., A-B-A design, Granic et al., 2003). In assigning both neutral and conflict topics, a range of emotions and behavior were potentially elicited (Granic et al., 2003; Hollenstein & Lewis, 2006). Dyads were told that they could move on to the next topic when they felt they were finished with the previous one, keeping in mind that they should take about five minutes for each topic. Dyads were also assured that there are no 'right' or 'wrong' things to say or do, and that we (the researchers) are simply interested in their natural responses to each other.

[12] Note that this refers to general autonomy levels as measured with questionnaires, and not to autonomous behavior expressed during the parent-adolescent interactions.

The dyads were given no further instructions and were left alone in a room of their choice for the duration of the video-recorded interaction. After the filming was finished, the participants were asked to immediately fill in a self-report measure of state self-esteem. The observational videos were subsequently coded.

3.5.3 Coding Procedure

Based on the video-recorded interactions, theoretically important emotional (Epstein & Morling, 1995; Scheff & Fearon, 2004; Stipek et al., 1992) and behavioral (Allen et al., 1994; Deci & Ryan, 1991; Noom et al., 2001) measures were collected that, together, indicate the participants' phenomenological state self-esteem (see Measures, below).

Coding of emotions was largely based on the SPAFF coding system (Coan & Gottman, 2007). Adaptions were made in order to distinguish between self-directed affect and other-directed affect, and were data-driven (in accordance with the Grounded Theory; Glaser & Strauss, 1967). Coding of behavior was largely based on Noom et al. (2001)'s framework of emotional, functional, and cognitive autonomy during adolescence, in combination with Savin-Williams and Jaquish's behavior checklist for self-esteem (Savin-Williams & Jaquish, 1981).

Coding was done in the program The Observer XT 10.5. Each utterance and action observed in the video-recorded interaction was coded, based on a combination of the adolescents' facial expressions, body posture, intonation, and verbalizations.

Coders were extensively trained until 75% agreement between the trainee and the trainer was reached based on the unaggregated time series for each measure. Average between-observer reliability based on explained variance between the two time series was R^2 = .79 for behavior and R^2 = .81 for affect.

3.5.4 Measures

Phenomenological state self-esteem indicators.

The following measures were obtained by means of coding:

Self-affect is self-directed affect. Both positive self-affect and negative self-affect were scored. Positive self-affect was scored on a scale of 0 to 3, which includes 0 = neutral, 1 = self-interest (e.g. adolescent speaks enthusiastically about an idea she/he has), 2 = humor (e.g. adolescent laughs in self-assured manner while speaking/behaving), 3 = pride (e.g. adolescent compliments him-/herself). Negative self-affect was scored on a scale of 0 to -3, which includes 0 = neutral, -1 = embarrassment (e.g. adolescent speaks with eyes cast down), -2 = anxiety (e.g. adolescent fidgets and avoids eye contact while opposing parent), -3 = shame (e.g. adolescent speaks in sad and serious tone during self-invalidation). Conflicting self-affect could be coded (i.e., simultaneous positive and negative scores) when verbal and nonverbal expressions of self-affect conflicted, for example, if an individual verbally expressed positive self-affect by complimenting himself (e.g. "I'm always right") while nonverbally expressing embarrassment (i.e., looking downwards and speaking in a soft voice). Positive or negative *self*-affect could be distinguished from positive or negative emotional experiences of the parent or the general interaction based on the timing of the

action or utterance. For example, if a child said something and then smiled directly afterwards, this was coded as self-affect because it is clear that the smile is directly related to something that the *child* said/did. If, on the other hand, the child smiled after the *parent* said something, this was not coded as positive self-affect.

Autonomy was scored on an ordinal scale of -2 to 3[13], where -2 = submission (e.g. adolescent changes opinion in accordance with what parent thinks without being offered counter arguments), -1 = attitudinal heteronomy (e.g. adolescent expresses not knowing the answer to a question that does not require specific knowledge), 0 = neutral, 1 = attitudinal autonomy (e.g. adolescent contributes an idea), 2 = agency (e.g. adolescent initiates a change in discussion topic), 3 = self-assertion/confrontation (e.g. adolescent rejects accusation made by the parent).

Self-Experiential Incoherence was scored after coding took place for each moment during the interaction that was coded. Self-Experiential Incoherence is taken into consideration in the calculation of state self-esteem, alongside Self-affect and Autonomy (see State self-esteem calculation, below) in order to ensure that expressions of positive state self-esteem are genuine (Kernis, 2003; Ryan & Brown, 2003) (see Introduction). Self-Experiential Incoherence was scored on a scale of 0 to 3, and is equal to the sum of instances at t_x in which self-experiences contradict themselves (based on the coded measures above), and in which other-directed affect contradicts itself. In order to determine whether other-directed affect contradicts itself, positive and negative measures of *Connectedness* were included as a third observational measure (see below). In Table 1 the three possible instances of Self-Experiential Incoherence at t_x are outlined, based on the rationale outlined by Kernis (2003).

Connectedness is other-directed affect, which was scored for the adolescent during or directly following the *parent's* utterance or action. Both positive and negative connectedness were scored. Positive connectedness was scored on a scale of 0 to 3, which includes 0 = neutral, 1 = other-interest (e.g. adolescent smiles while parent speaks), 2 = other-joy (e.g. adolescent laughs while/after parent speaks/acts), 3 = affection (e.g. adolescent hugs parent). Negative connectedness was scored on a scale of 0 to -3, where 0 = neutral, -1 = other-disinterest (e.g. adolescent looks away and turns body away while parent speaks), -2 = other-frustration (e.g. adolescent responds to parent with whining tone), -3 = contempt (e.g. adolescent expresses hurtful comment in sarcastic tone). Positive and negative connectedness could be simultaneously scored if verbal and nonverbal expressions conflicted. An example of this is if an adolescent verbally expresses connectedness by laughing when the parent tells a joke, while expressing a hurtful comment in a sarcastic tone.

Table 1
Possible instances of Self-Experiential Incoherence

[13] The autonomy scale is not symmetrical as there were more categories for autonomous behavior compared to heteronomous behavior.

Mismatch of simultaneous codes	Theoretical rationale
Positive self-affect and negative self-affect	Lack of trust in internal processes
Positive connectedness and negative connectedness	Not being genuine in relationships
Negative autonomy and positive self-affect	Dissonance between behavioral expression and internal processes

Note: The Self-Experiential Incoherence score is a sum of the number of instances of Self-Experiential Incoherence simultaneously present at t_x

Self-report self-esteem measures.

Self-report state self-esteem was collected as a static score of the individuals' state self-esteem directly after the video-recorded interaction took place. After reading the question "How do you feel at this moment", adolescents were asked to answer by responding to the statement "In general I like myself". The degree to which the adolescent agreed with this statement was indicated by marking an X on a horizontal line where 0.0 = "I disagree" and 8.5 = "I agree" (see Ninot, Fortes, & Delignières, 2001).

Self-report trait self-esteem was measured (before the video-recorded interaction took place) using the Rosenberg (1979) self-esteem scale, including 10 questions regarding individuals' feelings toward themselves in general (e.g., "I take a positive attitude toward myself"). Trait self-esteem was measured on a Likert scale from 1 to 5 (1 = very true, 5 = not at all true).

Self-report autonomy was measured (before the video-recorded interaction took place) using a questionnaire that measured three categories of subjective and context-independent autonomy: Attitudinal autonomy (one's ability to make decisions, and define opinions and goals), emotional autonomy (a feeling of confidence in one's own choices and goals), and functional autonomy (the ability to develop a strategy to achieve one's goals; Noom et al., 2001). The three categories of autonomy were measured on a Likert scale from 1 to 5 (1 = never true, 5 = almost always true). The general level of autonomy is equal to the average of the three categories.

3.5.5 Analysis Plan

State self-esteem calculation.

State self-esteem (SSE_t) was calculated as the sum of the behavioral and affective expressions of self-experience at t_x (i.e., Autonomy and Self-affect) on an ordinal scale of -5 to 6. SSE was calculated for every second of the interaction. When no scores were given for either Self-affect or Autonomy, $SSE_t = 0$ (i.e., neutral). This was the case for moments in which the adolescents did not say or do anything. A positive SSE_t score was only given if the simultaneous score for Self-Experiential Incoherence = 0. This is in accordance with our focus on *genuine* expressions of positive state self-esteem (see Introduction). The calcu-

lation for SSE_t was conducted in Microsoft Excel (Version 2010), and is described by the following formula (1):

$$SSE_t = \begin{matrix} (SA_t + AU_t)\ ;\ if\ (SA_t + AU_t > 0)\ and\ (SEI_t = 0); otherwise, \\ 0 \end{matrix} \quad (1)$$

Where SA_t is Self-affect, AU_t is Autonomy, and SEI_t is Self-Experiential Incoherence at t_x.

The additive model reflects the dynamic nature of self-experience (see Introduction), as well as our conceptualization that autonomous and emotional self-experiences carry equal weight in the emergence of state self-esteem.

Hypothesis 1: analysis of temporal structure of state self-esteem.

Detrended fluctuation analysis (DFA; Peng, Havlin, Stanley, & Goldberger, 1995) was applied to each state self-esteem time series. This technique is especially useful for testing the temporal structure of variability when time series are non-stationary and/or relatively short (< 1024 data points). In our sample, the length of the time series ranged from 487 data points to 1708 data points.

The DFA reveals a relation between different window sizes of data and the average fluctuation of the windowed data. More specifically, state self-esteem time series were divided into non-overlapping windows of equal length. The best fitting trend line was then determined, and the root mean square residual (average fluctuation) was calculated. This was repeatedly done for windows of different sizes (from 4 data points to ¼ of the length of the entire time series). This means that for each time scale (i.e., window size), the average fluctuation was determined. By examining the relationship between window sizes and their respective level of fluctuations, the temporal structure of the fluctuations can be determined. This relationship (the average fluctuation against increasing window-sizes) can be plotted on a log-log plot, whereby the slope indicates a DFA exponent. A DFA of 0.5 reflects Gaussian white noise (i.e., a highly random structure), a DFA of 1.5 reflects Brown noise (i.e., a highly rigid structure), and a DFA of 1.0 reflects pink noise (i.e., long-range correlations and fractal scaling; Hasselman, 2013; Wijnants et al., 2012).

To statistically test whether the empirical state self-esteem time series are characterized by a fractal structure rather than by a random structure, we tested whether the DFA dimensions obtained from the original state self-esteem time series were significantly different from the DFA dimensions obtained from surrogate time series that function as a control group (Hausdorff et al., 1995), using a paired-sample t-test. The surrogate time series were created by shuffling the order of data points within each observed state self-esteem time series (i.e., within individuals) with a random permutation. A new time series is thus created that contains the same data points, but in a random order. The shuffled time series therefore have the same mean and SD as the observed time series, but there is no

carry-over effect from one moment to the next, simulating state self-esteem variability that is likely to exhibit white noise.

Hypothesis 2: association between temporal structure of state self-esteem and self-reported self-esteem measures.

To explore the relationship between the temporal structure of state self-esteem variability and the traditional measures of state self-esteem level, we calculated the Pearson correlation between DFA and self-reported state self-esteem and trait self-esteem.

Hypothesis 3: association between temporal structure of state self-esteem and context-independent autonomy.

To explore the relationship between the temporal structure of state self-esteem variability and the adolescents' context-independent autonomy levels, we calculated the Pearson correlation between DFA and autonomy (on average as well as for the three categories of autonomy separately).

3.6 Results

3.6.1 Analysis of Temporal Structure of State Self-esteem

The average SSE level across all individuals was M = .49 (SD = 0.98), based on all seconds in the time series. The length of the time series was M = 911.46 seconds (SD = 322.67). Figure 2 below shows a representative example of a SSE time series.

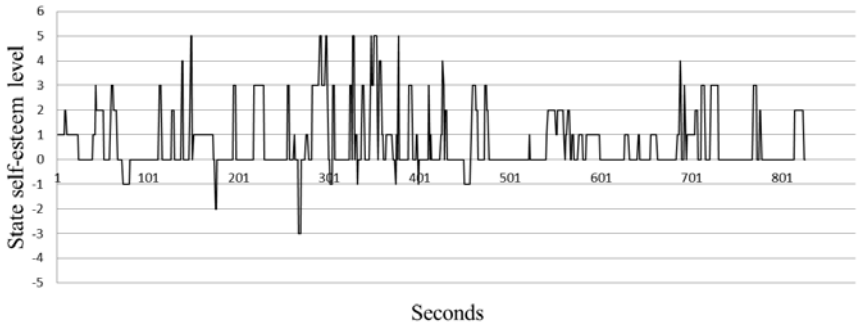

Figure 2: Example of a SSE time series based on the empirical data.

Figure 3 shows a log-log plot of the relationship between the log of the average fluctuation (Q) and the log of the window size (points in subset). The straight line indicates that there is a linear relationship, such that fluctuations in smaller windows are related to fluctuations in larger windows in a power-law fashion. The slope of the line indicates the scaling exponent, i.e., DFA = 0.89.

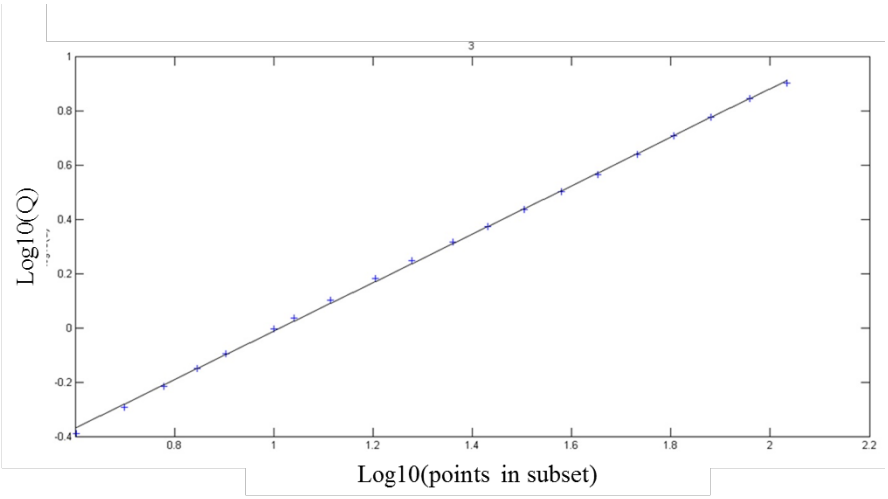

Figure 3: Example of a log-log plot of average fluctuation (Q) versus window size (points in subset) based on the empirical data. Slope (DFA exponent) = 0.89.

On average, the DFA exponent of the empirical state self-esteem time series was M = 0.81 (SD = 0.05). The lowest DFA score was 0.74, while the highest was 0.90. The temporal structure of state self-esteem variability is therefore close to pink noise, i.e., DFA ~ 1.0. The DFA values were weakly correlated with the standard deviations of the SSE time series (r = .14), indicating that the nature of the temporal variability of state self-esteem (i.e., DFA) is distinct from the magnitude of variability of state self-esteem (i.e., SD).

The average DFA exponent for the participants' shuffled SSE time series was M = 0.49 (SD = 0.03), indicating uncorrelated randomness very close to white noise, i.e., DFA ~ 0.5 (see Figure 4 for an example of a shuffled SSE time series).

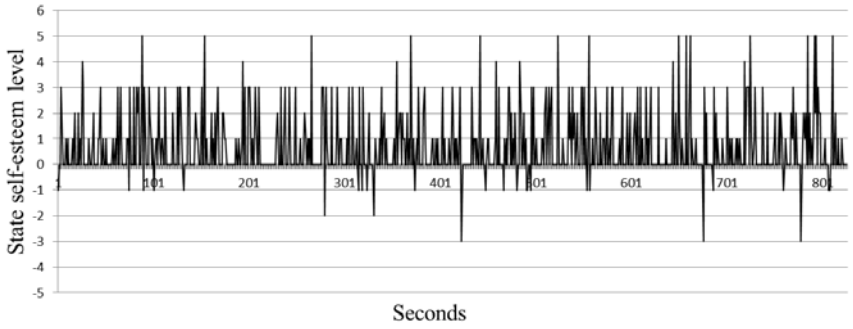

Figure 4: Example of a SSE time series based on the shuffled data.

The mean DFA scores of state self-esteem for the empirical (non-shuffled) time series and the surrogate (shuffled) time series are shown in Figure 5. The 95% confidence

intervals (CI) shown in Figure 5 indicate that the DFA level indicating white noise (i.e., DFA ~ 0.5) falls within the CIs of the shuffled time series, but that this is not the case for the CIs of the empirical time series.

The difference between the mean DFA score for the shuffled and empirical time series was $M = 0.32$, which was significant ($t(12) = 17.29$, $p < 0.001$). We can therefore conclude that the observed SSE time series are closer to pink noise than would be expected if the time series were random, which supports *hypothesis 1*.

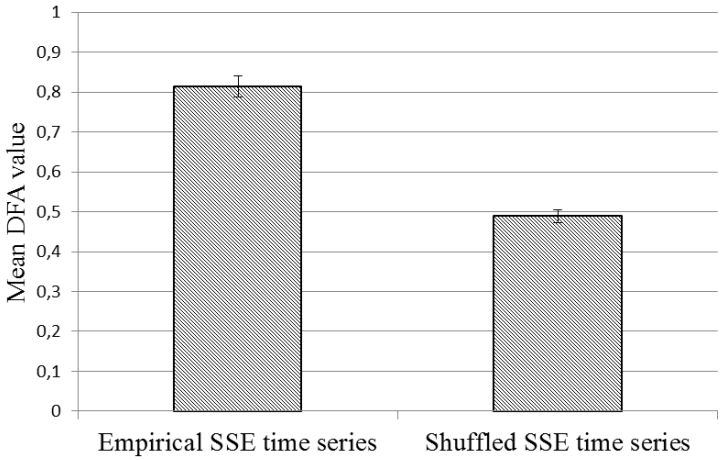

Figure 5: Mean DFA scores and 95% confidence intervals for state self-esteem (SSE) for empirical time series and for random (shuffled) time series. DFA ~ 0.5 = white noise and DFA ~ 1.0 = pink noise

3.6.2 Association between Temporal Structure of State Self-esteem (DFA) and Context-Independent Self-reported Autonomy Measures

Self-esteem.

The average self-report state self-esteem score was $M = 5.94$ ($SD = 1.65$), and the average self-report trait self-esteem score was $M = 4.03$ ($SD = 0.57$). The two measures of self-esteem were moderately correlated ($r = 0.36$). Neither of the static measures of self-esteem correlated significantly with the DFA values. For trait self-esteem, the correlation with DFA was $r = -.52$ ($p = 0.07$), and for state self-esteem the correlation with DFA was $r = -.06$ ($p = 0.86$). The lack of significant correlations between DFA and static self-esteem measures indicates that the temporal structure of state self-esteem variability is a distinct concept from the static levels of self-esteem, which is in support of *hypothesis 2*.

Autonomy levels.

Table 2 presents the means and standard deviations of the self-reported autonomy levels of adolescents, as well as their correlation with the DFA scores.

Table 2
Means and Standard Deviations (SD) for self-report autonomy levels, and their correlation with the DFA values for the SSE time series

Autonomy variable	Mean	SD	Correlation with DFA
Child autonomy (average)	3.43	0.57	0.25
Child attitudinal autonomy	3.43	0.74	0.16
Child emotional autonomy	3.45	0.71	0.30
Child functional autonomy	3.41	0.57	0.16

The relationship between DFA scores and autonomy measures was positive, indicating that the higher the DFA values (i.e., the closer to pink noise), the higher the levels of autonomy. Correlations were small to moderate, however, and were not significant ($p > .05$), which is partly in support of *hypothesis 3.*

3.7 Discussion

In the current article, we argued that the common assumption regarding state self-esteem (as contextually-based error around a baseline level of trait self-esteem) does not fully reflect the temporal nature of state self-esteem variability. We suggest that the coordination of state self-esteem is predominantly determined by its own interaction dynamics, thereby producing structured and meaningful temporal variability across real time. Our argument is based on the fact that other human processes that are determined by such dynamics are ubiquitously found to exhibit structured noise, i.e., pink noise (Stanley et al., 1993).

We found that the variability of state self-esteem across real time must indeed be characterized as (approaching) pink noise. Moreover, we show that this structure of variability is significantly different from the structure of variability that would be exhibited if state self-esteem was characterized by random fluctuations with no carry-over effect from one moment to the next, i.e., white noise. This was in support of our main hypothesis (*hypothesis 1*). In addition, we found that the temporal structure of state self-esteem is a distinct concept from the valence level of (state and trait) self-esteem, which was in support of *hypothesis 2*.

For hypothesis 1, we explicitly tested the specific assumption that there is no carry-over effect from one moment to the next, which – if true – should result in random variability of state self-esteem (i.e., white noise). Although it seems clear that the commonly adopted 'barometer' approach to state self-esteem corresponds with a white noise hypothesis, one may argue that this interpretation of the underlying assumption is too strict. Specifically, it may be argued that the 'barometer' approach allows for the assumption that there is short-term carry-over effect across state self-esteem, due to – for example – continuity in

the immediate context. In this case, the time series would exhibit only short-term correlations that rapidly decay across time; or in other words, Brown noise (see Figure 1c). Although we did not explicitly test this alternative hypothesis, our finding was that state self-esteem variability was close to pink noise, where the small deviations from pink noise were in the direction of white noise, and *not* in the direction of Brown noise (recall that Brown noise is at the opposite end of the noise spectrum from white noise, where pink noise lies between the two). It is therefore highly unlikely that there are only short-term carry-over effects across our state self-esteem time-series.

The above results have significant theoretical and methodological implications. We show that the nature of state self-esteem variability is less straightforward than was perhaps formerly assumed. Specifically, the presence of pink noise is indicative of a fractal process, which has underlying interaction-dominant dynamics. An important implication of this is that state self-esteem is active, rather than passive, in that it self-coordinates by balancing between self-maintained stability and flexible adaptations to external influences.

Furthermore, the presence of pink noise in state self-esteem fundamentally questions the appropriateness of single-scale measures of state self-esteem. Such measures are static by nature, as they are limited to the measurement of state self-esteem *levels* (Scheff & Fearon, 2004). However, if high-level psychometric concepts that are central to psychological theory – such as self-esteem – have a *dynamic* nature, this suggests that "behavior cannot be adequately measured with statistics based simply on mean and variance" (Lipsitz, 1992, p. 1807), and that measures are needed that also capture the level of 'complexity' of these concepts, that is, the extent to which they reveal coupling of multiple components or of time scales. This is not to say that measures of mean and standard deviation are not of value. Instead, our results call for a broader methodological approach to state self-esteem, where both the magnitude *and* structure of state self-esteem variability are meaningful, but distinct, characteristics to be studied.

In our study, all individuals' state self-esteem time series approached pink noise. Moreover, the participants in our study were all psychologically healthy and well-adapted adolescents. This corresponds with the notion that pink noise is a signature of healthy, efficient, and well-coordinated behavior. Furthermore, our results showed that the level of pink noise was associated (albeit weakly) with adolescents' context-independent autonomy levels (a pivotal indicator of positive psychosocial adjustment during adolescence; Noom et al., 1999). Specifically, higher DFA scores (i.e., closer to pure pink noise) were associated with higher emotional, attitudinal, and functional autonomy scores, although the correlation was not significant. This was partially in support of *hypothesis* 3. Future research is needed to explore which psychological concepts are highly associated with the temporal structure of variability in order to provide more clarification regarding its psychological meaning.

A few important limitations of the current study warrant noting. First, as there were no large deviations from pink noise in our sample, it is only possible for us to speculate about what deviations from pink noise might mean for state self-esteem. Previous research shows that deviations toward white or Brown noise indicate unhealthy systems (e.g.,

Gilden & Hancock, 2007). Therefore, it is likely that deviations in the context of state self-esteem would be indicative of maladaptive self-esteem; where deviations toward white noise indicate overly flexible state self-esteem and deviations toward brown noise indicate overly rigid state self-esteem. While past research has focused on maladaptive self-esteem as being low (e.g., Robson, 1988), unstable (based on the magnitude of the standard deviations; e.g., Kernis, 2005), and fragile (e.g., Zeigler-Hill, 2006), it is plausible that the temporal structure of state self-esteem may also be an important tool for identifying individuals with maladaptive state self-esteem. To explore this possibility, future research is needed regarding the temporal structure of state self-esteem in more heterogeneous samples, or in clinical samples.

A second limitation of the current study is that our sample does not include age groups other than adolescents, which means that it may not be possible to generalize our findings to other age groups. The adolescent period can been characterized as 'unstable' regarding self-esteem, where adolescents demonstrate a dip in the average valence of self-esteem (Robins et al., 2002) as well as relatively low test-retest correlations of self-esteem (Trzesniewski et al., 2003). Future research is therefore necessary in order to investigate whether state self-esteem variability is more structured (i.e., with smaller deviations from pink noise) in adults compared to adolescents, and more generally, whether the temporal structure of state self-esteem differs on average across the life span.

Third, it was beyond the scope of the current article to explore the temporal dynamics that occur in the interaction between the parent and the child, and how these dynamics relate to the temporal dynamics of state self-esteem. Future research is needed in order to investigate how the two are related.

In summary, while the general level of state self-esteem variability is regarded as meaningful (Kernis et al., 1993), our findings show that the temporal *structure* of state self-esteem variability has been unnecessarily disregarded (as 'random') in empirical studies of state self-esteem. Our results bring the passive and random nature of state self-esteem into question, and provide evidence that state self-esteem, as a real-time process, might be better conceptualized as an intrinsically dynamic and active process. This is an important shift in the theoretical conceptualization of the nature of state self-esteem. Based on our findings, we call for a broader methodological approach to state self-esteem, where measures of complexity are combined with measures of central tendencies (standard deviations and means). We hope that these theoretical and empirical implications will be further explored in future research.

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CHAPTER 4
The Real-Time Phenomenology of Trait Self-Esteem: Testing the Dynamic Interaction Between Trait and State Self-Esteem

Abstract

The current study investigates the real-time nature of trait self-esteem phenomenology during adolescence (N = 13, M (age) = 13.6). We posit that this phenomenology can be best conceptualized from a Self-Organizing Self-Esteem (SOSE) model. The SOSE model suggests that trait self-esteem consists of trait self-esteem *attractor states*, conceptualized as emergent idiosyncratic networks of positive and negative emotional and behavioral self-experiences that repeatedly recur across real-time. State self-esteem is conceptualized as the fleeting valence of concurrent self-experiences, which is distinct from, yet dynamically interconnected with, trait self-esteem attractor states. We validate this conceptualization by testing whether trait self-esteem demonstrates two pivotal characteristics of attractor states. First, we show that trait self-esteem attractor states fall into two profiles, relatively strong and relatively weak ($p < 0.01$), differentiated by their level of real-time constraint on state self-esteem variability in real-time. Second, we show that the stronger trait self-esteem attractor states protect state self-esteem variability from real-time external perturbations more than weaker trait self-esteem attractor states ($p < 0.05$).[14]

[14] This chapter is based on De Ruiter, N.M.P., Hollenstein, T., Van Geert, P.L.C. & Kunnen, E.S. (2015). *The real-time phenomenology of trait self-esteem: testing the dynamic interaction between trait and state self-esteem.* Manuscript submitted for publication.

How is trait self-esteem manifested in daily life as an experience? This question, while seemingly central for the psychological understanding of self-esteem (Reis, 2012; Scheff & Fearon, 2004), is largely unexplored, which can be explained by the traditional approach to trait self-esteem. Trait self-esteem (i.e., the relatively stable valence associated with the self-concept; Harter, 1982; Rosenberg, 1979) is traditionally conceptualized as the context-*independent* level of self-esteem. Therefore, trait self-esteem is not usually associated with an in-the-moment (i.e. *real-time*) experience of self-esteem.

Instead, a real-time self-esteem experience is attributed to state self-esteem (i.e., the fleeting and in-the-moment experience of the self as positive or negative (DeHart & Pelham, 2007; Kernis et al., 1993; Leary & Downs, 1995; Rosenberg, 1986). This is because the relationship between trait and state self-esteem is approached in accordance with the basic axiom of standard psychometric theory, where a variable is thought to have a true score plus error (Lord & Novick, 1968). From this perspective, trait self-esteem is approached as the true score and state self-esteem as the contextually-based error (e.g., Donnellan, Kenny, Trzesniewski, Lucas, & Conger, 2012; Kernis et al., 1993). A classical approach to trait self-esteem therefore makes the real-time manifestation of trait self-esteem inconsequential; as this experience is conceptualized as being equal to a momentary deviation from the true score. As a result, empirical studies mainly focus on trait self-esteem as a predictor variable, an outcome variable, or a mediating variable based on an aggregated score (Brown & Marshall, 2001; Scheff & Fearon, 2004), or on the long-term development of trait self-esteem (Robins & Trzesniewski, 2005). To date, therefore, trait self-esteem is empirically understood either in relation to other variables or as a demonstration of long-term change, but not in terms of the phenomenology of trait self-esteem itself.

In the current paper, we suggest that trait self-esteem is more than an average valence associated with the self that is characteristic for an individual. It is a dynamic structure that individuals experience in their daily lives through its relationship with state self-esteem. This is a key point in our Self-Organizing Self-Esteem (SOSE) model (presented in Chapter 2), which describes the underlying dynamics of trait self-esteem and state self-esteem, as well as their relationship with each other, from a complex dynamic systems perspective (Hollenstein, Lichtwarck-Aschoff, & Potworowski, 2013; Thelen & Smith, 1994; Van Geert, 1994). We begin by shortly describing the core attributes of the SOSE model.

The SOSE model suggests that self-esteem is a system consisting of nested levels of self-esteem experiences. At each level, a separate self-esteem construct occurs. We distinguish between three levels of self-esteem: the micro level, the meso level, and the macro level. Trait self-esteem occurs on the macro level, state self-esteem occurs on the meso level, and distinct positive or negative experiences pertaining to the self (e.g., pride, or being self-assertive) occur on the micro level. The self-esteem constructs at each level develop across different time scales, and they all emerge from the self-esteem experiences at lower levels. Because of this, self-esteem at each level is a higher-order construct compared to the previous levels, with increasing levels of stability and complexity. Moreover, each

higher-order construct constrains the degrees of freedom of the lower-order constructs, resulting in a bi-directional causal relationship between higher- and lower-order constructs. The nested levels of the self-esteem system are figuratively portrayed in Figure 1.

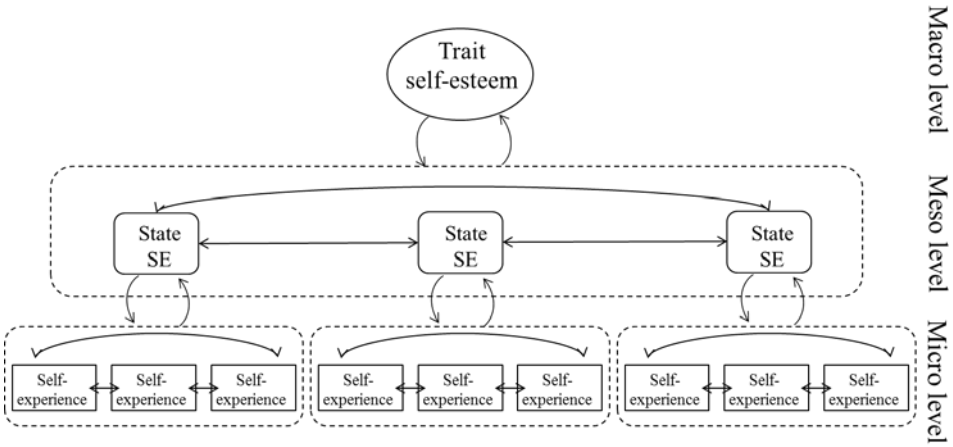

Figure 1. The Self-Organizing Self-Esteem model, consisting of three nested levels of self-esteem experience: the macro, meso, and micro levels, which are bi-directionally related to each other; from Chapter 2.

First, individuals experience emotional and behavioral experiences of the self that change across the time scale of seconds. These are the micro-level experiences of self-esteem, which form the building blocks for succeeding levels of self-esteem. Micro-level self-experiences interact across the time scale of minutes, resulting in the self-organization of fleeting networks of experiences that are relatively more stable than the micro-level experiences themselves. These networks give rise to an overall experience of the self at that moment, which is the meso-level construct of state self-esteem.

Next, state self-esteem develops iteratively (De Ruiter et al., 2014), which gives rise to the development of patterns of self-esteem across the long term (i.e., weeks, months, years). These patterns are the macro-level trait self-esteem constructs. Moreover, the SOSE model asserts that different qualities of state self-esteem (e.g., positive versus negative) develop into distinct trait self-esteem constructs (for the sake of simplicity, only one trait self-esteem construct is portrayed in Figure 1). Therefore, much like individuals can have multiple self-concepts (Harter, 1982; Markus & Nurius, 1986), or multiple qualities of personality traits (Nowak et al., 2005), the SOSE model suggests that trait self-esteem is also multi-stable, with a small number of dominant patterns of self-esteem, rather than one baseline level of self-esteem.

These macro-level trait self-esteem constructs are defined as *attractor states*. Attractor states are constellations of components that form equilibrium points for the system, where a small amount of energy is required in order to maintain those positions compared

to the amount of energy required to change them (Kunnen & Van Geert, 2012; Nowak et al., 2005; Thelen & Smith, 1994). Because of this, the system is drawn to those particular constellations of components (Van Geert, 1998). The multiple attractor states that develop across the long term form an *attractor landscape*. Each attractor state within the landscape is experienced at the present moment, where only one attractor state can be experienced at a time. From this vantage point, trait self-esteem is an attractor landscape consisting of multiple trait self-esteem attractor states, each of which is a qualitatively different habit of self-experience that is stable in the sense that it is dominant and recurring in an individual's behavioral/emotional/cognitive repertoire (Lewis, 2002). As each trait self-esteem attractor state within the landscape is a separate equilibrium point for the system, together, they form the potential for the system's current and future behavior.

Although the various self-esteem constructs of the SOSE model (i.e., micro, meso, macro) develop across different time scales, the model suggests that all of the self-esteem constructs are in constant interaction with each other (i.e., bi-directional causality), and are thus simultaneously experienced in real-time. This conceptualization makes it possible to investigate the real-time nature of trait self-esteem as a separate (but interconnected) construct from state self-esteem, and therefore, to come to an understanding of its phenomenology. This would not be possible from the traditional approach, where the real-time experience of trait self-esteem cannot be distinguished from the real-time experience of state self-esteem.

From the SOSE perspective of trait self-esteem, the variability of trait self-esteem is more complex than just the slow and steady developmental changes that occur across the long term. More specifically, the SOSE model suggests that trait self-esteem exhibits underlying dynamics; an assertion that has been empirically demonstrated (Delignières et al., 2004). We posit that these underlying dynamics stem from the successive real-time transitions between various trait self-esteem attractor states within the trait self-esteem landscape, as well as the interaction between each trait self-esteem attractor and lower-order self-esteem constructs. We describe the characteristics of this interaction in more detail below (see Hypotheses). We suggest that it is the underlying dynamics of trait self-esteem that characterize the phenomenology of trait self-esteem. We test the validity of this assertion by examining whether the dynamics demonstrated by trait self-esteem and the lower-order self-esteem constructs can be predicted based complex dynamic systems principles (i.e., basin of attraction dynamics; Nowak & Vallacher, 1998; Thelen & Smith, 1994; Van Geert, 1994).

4.1 The Current Study and Hypotheses

The current chapter is the first explicit test of the nested relationship between state self-esteem and trait self-esteem, as proposed by the SOSE model. In testing this relationship, we explore the general hypothesis posed in this chapter that the phenomenology of trait self-esteem is characterized by the underlying dynamics between trait self-esteem and its lower-order self-esteem constructs. In order to do this, it is necessary to map the simultaneous dynamics of trait self-esteem and lower-order self-esteem constructs.

4.1.1 Methodological approach.

To map the dynamics between trait self-esteem and state self-esteem, we developed a new methodological approach to state self-esteem and trait self-esteem, where participants are not required to report on their level of self-worth in a reflective manner. Instead, an observational approach is adopted, where we focus on the observable and spontaneous emotional and behavioral expressions of self-esteem called *self-experiences* (i.e. such as pride, or expressing one's opinions). We conceptualize these emotional and behavioral self-experiences as the micro level of self-esteem, i.e., the lowest level of self-esteem, from which higher-order state and trait self-esteem can be identified.

Next, based on the observed self-experiences described above, we identify the moment-to-moment valence of meso-level state self-esteem, as the overall valence of concurrent self-experiences. We limit our conceptualization of 'positive' state self-esteem to an experience of 'genuine' positive state self-esteem, where *all* simultaneous verbal and non-verbal micro-level self-experiences at that moment are positive. This is in accordance with Kernis' (2003) suggestion that a discrepancy between expressed and experienced self-worth indicates that self-esteem is contingent on self- and other-based approval, and with Deci & Ryan's(1995) assertion that contingent self-esteem is in fact not true positive self-esteem. Therefore, we adopt a definition of genuine state self-esteem as a state self-esteem experience for which there is no discrepancy in valence between concurrent self-experiences. The current approach to micro-level (i.e. self-experiences) and meso-level (i.e. state self-esteem) self-esteem has been empirically demonstrated in Chapter 3 of this thesis, where more information regarding the empirical approach can be found. As in Chapter 3, the current study also focuses on self-esteem processes within the developmental context of adolescence, and in the dyadic context of parent-child interactions (see Chapter 1 for more information).

Finally, based on the observed micro-level self-experiences, we identify existing trait self-esteem attractors that have previously developed and that are currently experienced one at a time alongside the micro- and meso-levels of self-esteem. Each trait self-esteem attractor is identified as a network of self-experiences that repeatedly recurs across real-time. In accordance with a complex dynamic systems perspective therefore, each network is a separate equilibrium point that the individual is drawn to (Nowak et al., 2005; Van Geert, 1998). The current study is the first to empirically investigate the moment-to-moment (and within-individual) transitions between multiple trait self-esteem attractors.

The current study examines the observed expressions of micro-level self-experiences in the context of interactions with significant others during adolescence. A context of dyadic interaction is adopted, firstly, as it provides a practical way to elicit relevant self-experiential processes (Gable, Gosnell, & Prok, 2012), and secondly, because it is theoretically important to do so given that significant others play an important role in the momentary valence of self-esteem (the Sociometer Theory of self-esteem; Leary & Baumeister, 2000) and in the way that self-esteem emerges into a structured state (Fogel, 1993; Tangney & Fischer, 1995).

[15]Adolescence was chosen as the developmental context given that it is a significant period for self-esteem development (Robins et al., 2002). Moreover, adolescents have been found to exhibit important individual differences regarding levels of self-esteem variability and fluctuations (Harter & Whitesell, 2003). With the current study, we investigate an – as yet – unexplored aspect of the concept of self-esteem variability during adolescence. Regarding the context of interaction with a significant other, for adolescents, parents are a pivotal significant other for self-esteem development (Allen et al., 1994; Bulanda & Majumdar, 2008). Therefore, we specifically investigate the dyadic interaction between adolescents and their parents.

4.1.2 Hypotheses.

We test two hypotheses central to the SOSE model that refer to the underlying dynamics of trait self-esteem. The first hypothesis refers specifically to the endogenous dynamics of the self-esteem system, and the second refers to the dynamics between the self-esteem system and exogenous processes.

Hypothesis 1

Hypothesis 1 focuses on the operationalization of trait self-esteem as attractor states. From a complex dynamic systems perspective, when an attractor state from the attractor landscape is expressed, it will constrain the lower-order levels by limiting the amount of variability that is possible. This can be compared to a ball rolling into a basin, where the ball is the lower-order variability and the basin is the expressed attractor state. The ball's movement is thus restricted by the confinements of the basin (Nowak et al., 2005; Van Geert, 1994). Additionally, given that different attractor states in an individual's attractor landscape correspond to qualitatively different emotional/behavioral/cognitive repertoires (Lewis, 2002), each attractor state will have a different set of constraints on lower-levels. The nature of these different trait self-esteem attractors is idiosyncratic.

According to the SOSE model, the valence of state self-esteem is thus expected to remain relatively stable for the duration of time that one trait self-esteem attractor is expressed (i.e. the corresponding attractor). Additionally, each trait self-esteem attractor is expected to have a unique constraint on state self-esteem variability. For example, for individual A, one trait self-esteem attractor may constrain state self-esteem variability within the negative-valence range, while another trait self-esteem attractor may constrain state self-esteem variability within the positive-valence range. Therefore, each individual's state self-esteem is expected to be constrained in multiple ways, demonstrating the multi-stable nature of trait self-esteem in real-time. Furthermore, from a complex dynamic systems perspective, systems (i.e. individuals) will differ in the strength of their attractor states (defined as the depth and width of the basin of attraction, Van Geert, 1994). Therefore, while we expect each individual's trait self-esteem attractor states to demonstrate temporal

[15] The following information regarding adolescence as the developmental context for the current study is identical to the information given in Section 1.5. It is included here for the sake of completeness in the current chapter.

recurrence across the dyadic interaction, we do not expect all individuals to demonstrate characteristics of *strong* trait self-esteem attractors.

In sum, we aim to capture the temporal recurrence of idiosyncratic trait self-esteem attractor states, alongside the idiosyncratic temporal variability of state self-esteem. We hypothesize that adolescents' trait self-esteem attractors will exhibit constraint on concurrent state self-esteem variability, where state self-esteem variability is limited for the duration that the corresponding trait self-esteem attractor is expressed. Additionally, we expect that there will be individual differences in the amount of constraint that trait self-esteem attractors have on state self-esteem variability.

Hypothesis 2

Hypothesis 2 focuses on the construct validity of trait self-esteem. Specifically, if trait self-esteem can indeed be conceptualized as a collection of attractor states that are capable of constraining within-individual variability of state self-esteem at the meso level, then trait self-esteem should also demonstrate other pivotal characteristics of attractor states. An important characteristic of attractor states is that – because of their constraint on their meso level counterparts – they result in a high level of resistance to current external perturbations; where higher attractor strength (i.e. a deeper basin of attraction) corresponds to more resistance to perturbations (Van Geert, 1994). We hypothesize, therefore, that there will be a negative within-individual relationship between trait self-esteem attractor strength (as identified in our test of Hypothesis 1) and the influence that external perturbations have on state self-esteem. Therefore, the individuals whose trait self-esteem attractors have *more* constraint on their state self-esteem variability (i.e. stronger attractor strength) will also be the individuals whose state self-esteem variability is *less* perturbed by external perturbations. Likewise, individuals whose trait self-esteem attractors exhibit *less* constraint on their state self-esteem variability (i.e. weaker attractor strength) should also be the individuals whose state self-esteem variability is *more* affected by external perturbations.

Perturbations take the form of any changes (such as changes in context, goals, or demands) that result in a shift in state or pattern, where the exact nature of the perturbation differs according to the time scale at which the perturbation occurs (Hollenstein et al., 2013). Since we will be examining changes that occur across real time, we are interested in perturbations that occur across real time as well. These are moment-to-moment changes that bring about respective changes in the valence of state self-esteem. As the current study explored the dynamics of adolescent self-esteem in the immediate context of parent-child interaction, we will investigate the perturbing effects of qualitative changes in the parents' emotional-behavioral interaction style during the interaction with their child.

4.2 Methods[16]

4.2.1 Participants

Participants were thirteen adolescents (3 boys, 10 girls) and their parents (1 male, 12 females). The mean adolescent age was 13.6 (ranging from 12 – 15). The parent-child dyads were representative of the average population. The majority of the dyads were Dutch-speaking, with the exception of two English-speaking dyads (one American-Dutch dyad and one British dyad). Participation was voluntary, and children were rewarded after the interaction task was completed with a 5 Euro gift-voucher.

4.2.2 Procedure

Each dyad was video recorded in their own home during an interaction task. Each interaction was structured around three discussion topics in which the aim of the discussion was to come to a mutual decision. The first discussion topic was a positive discussion topic (for example: If you could have one super power, which would you have?). The second was a conflict topic relevant to each specific dyad at that moment, where the dyad was instructed to try to come up with a solution to their problem. The last discussion topic was a new positive topic comparable to the first (i.e., A-B-A design, Granic et al., 2003; Hollenstein & Lewis, 2006). In assigning both neutral and conflict topics, a range of emotions and behavior are potentially elicited (Granic et al., 2003; Hollenstein & Lewis, 2006). After clarifying the three discussion topics, dyads were told that they could move on to the next topic when they felt they were finished, keeping in mind that they should take about five minutes for each topic. The dyads were reassured that there was no 'right' or 'wrong' thing to say or do, and that we – the researchers – were interested in their natural responses to each other. The researcher then left the dyads alone in a room of their choice for the duration of the filming. Afterwards, the observational videos were coded for their emotional and behavioral content.

4.2.3 Coding Procedure

Based on the video-recorded interactions, theoretically important emotional (Epstein & Morling, 1995; Scheff & Fearon, 2004; Stipek et al., 1992) and behavioral (Allen et al., 1994; Deci & Ryan, 1991; Noom et al., 2001) measures were collected that, together, indicate the participants' phenomenological state self-esteem (see Measures, below).

Coding was done in the program The Observer XT 10.5. Each utterance and action observed in the video-recorded interaction was coded, based on a combination of the adolescents' facial expressions, body posture, intonation, and verbalizations.

Coding of emotions was largely based on the SPAFF coding system (Coan & Gottman, 2007). Adaptions were made in order to distinguish between self-directed affect and other-directed affect, and were data-driven (in accordance with the Grounded Theory; Glaser & Strauss, 1967). Coding of behavior was largely based on Noom et al. (2001)'s framework of emotional, functional, and cognitive autonomy during adolescence, in com-

[16] The following information regarding the participants, procedure, and coding procedure is identical to the information given in Section 3.5.1 – 3.5.3. It is included here for the sake of completeness in the current chapter.

bination with Savin-Williams and Jaquish's behavior checklist for self-esteem (Savin-Williams & Jaquish, 1981). See the Appendix of the current thesis for more information regarding the coding scheme.

Coders were extensively trained until 75% agreement between the trainee and the trainer was reached based on the unaggregated time series for each measure. Average between-observer reliability based on explained variance between the two time series was R^2 = .79 for behavior and R^2 = .81 for affect.

4.2.4 Measures

We coded measures that indicated the adolescents' micro-level of self-esteem (for Hypothesis 1), and measures that indicated the parental emotional-behavioral interaction-style (for Hypothesis 2). These are described separately below.

***Micro-level self-esteem measures*[17].**

The measures *Self-affect* and *Autonomy* were coded for each verbal and/or nonverbal action expressed by the adolescent. Based on the coded measures, Self-Experiential Incoherence was scored (described below).

Self-affect is self-directed affect. Both positive self-affect and negative self-affect were scored. Positive self-affect was scored on a scale of 0 to 3, which includes 0 = neutral, 1 = self-interest (e.g. adolescent speaks enthusiastically about an idea she/he has), 2 = humor (e.g. adolescent laughs in self-assured manner while speaking/behaving), 3 = pride (e.g. adolescent compliments him-/herself). Negative self-affect was scored on a scale of 0 to -3, which includes 0 = neutral, -1 = embarrassment (e.g. adolescent speaks with eyes cast down), -2 = anxiety (e.g. adolescent fidgets and avoids eye contact while opposing parent), -3 = shame (e.g. adolescent speaks in sad and serious tone during self-invalidation). Conflicting self-affect could be coded (i.e., simultaneous positive and negative scores) when verbal and nonverbal expressions of self-affect conflicted, for example, if an individual verbally expressed positive self-affect by complimenting himself (e.g. "I'm always right") while nonverbally expressing embarrassment (i.e., looking downwards and speaking in a soft voice). Positive or negative *self*-affect could be distinguished from positive or negative emotional experiences of the parent or the general interaction based on the timing of the action or utterance, where self-affect was only coded when an individual expressed emotional during or directly after he/she spoke or acted.

Autonomy was scored on an ordinal scale of -2 to 3[3], where -2 = submission (e.g. adolescent changes opinion in accordance with what parent thinks without being offered counter arguments), -1 = attitudinal heteronomy (e.g. adolescent expresses not knowing the answer to a question that does not require specific knowledge), 0 = neutral, 1 = attitudinal autonomy (e.g. adolescent contributes an idea), 2 = agency (e.g. adolescent initiates a change in discussion topic), 3 = self-assertion/confrontation (e.g. adolescent rejects accusation made by the parent).

[17] The following information regarding the micro-level self-esteem measures is identical to the information given in Section 3.5.4. It is included here for the sake of completeness in the current chapter.

Self-Experiential Incoherence was scored after coding took place for each moment during the interaction that was coded. Self-Experiential Incoherence is taken into consideration in the calculation of state self-esteem, alongside Self-affect and Autonomy (see State self-esteem calculation, below) in order to ensure that expressions of positive state self-esteem are genuine (Kernis, 2003; Ryan & Brown, 2003; see Introduction). Self-Experiential Incoherence was scored on a scale of 0 to 3, and is equal to the sum of instances at t_x in which the valence of self-experiences are opposite (i.e., simultaneously positive and negative), and in which the valence of expressions of other-directed affect are opposite (i.e., the individual is being disingenuous in the current interaction; Kernis, 2003). In order to determine whether other-directed affect contradicts itself, the adolescents' moment-to-moment level of *Connectedness* toward the parent was included as a third observational measure (see below). Table 1 outlines the three possible instances of Self-Experiential Incoherence that can be scored at t_x, based on the rationale outlined by Deci and Ryan (1995) and Kernis (2003).

Connectedness is other-directed affect, which was scored for the adolescent during or directly following the *parent's* utterance or action. Both positive and negative connectedness were scored. Positive connectedness was scored on a scale of 0 to 3, which includes 0 = neutral, 1 = other-interest (e.g. adolescent smiles while parent speaks), 2 = other-joy (e.g. adolescent laughs while/after parent speaks/acts), 3 = affection (e.g. adolescent hugs parent). Negative connectedness was scored on a scale of 0 to -3, where 0 = neutral, -1 = other-disinterest (e.g. adolescent looks away and turns body away while parent speaks), -2 = other-frustration (e.g. adolescent responds to parent with whining tone), -3 = contempt (e.g. adolescent expresses hurtful comment in sarcastic tone). Positive and negative connectedness could be simultaneously scored if verbal and nonverbal expressions conflicted. An example of this is if an adolescent verbally expresses connectedness by laughing when the parent tells a joke, while expressing a hurtful comment in a sarcastic tone.

Table 1
Possible instances of Self-Experiential Incoherence

Mismatch of simultaneous codes	**Theoretical rationale**[18]
Positive self-affect and negative self-affect	Lack of trust in internal processes
Positive connectedness and negative connectedness	Relational inauthenticity
Negative autonomy and positive self-affect	Dissonance between behavioral expression and internal processes

[18] The theoretical rationale stems from the perspective of self-determined and authentic self-esteem from Deci and Ryan (1995) and Kernis (2003).

Note: The Self-Experiential Incoherence score is a sum of the number of instances of Self-Experiential Incoherence simultaneously present at each second of the interaction.

Parental-interaction measures.

The measures *Parent self-affect*, *Parent connectedness* and *Autonomy management* were coded for each verbal and/or nonverbal action expressed by the parent. Based on the coded measures, Parent Self-Experiential Incoherence was scored.

Parent self-affect was scored on an ordinal scale of -3 to 3. See *Self-affect* described above (*Micro-level self-esteem measures*) for details.

Parent connectedness was scored on an ordinal scale of -3 to 3, where positive scores reflect positive emotions directed at the child such as affection, and negative scores reflect negative emotions directed at the child such as contempt. See *Connectedness* described above (*Micro-level self-esteem measures* above) for details.

Autonomy management was scored on an ordinal scale of -2 to 3, where positive scores reflect the support of the child's autonomy, such as validating the child's actions, and negative scores reflect challenging the child's autonomy, such as invalidating the child's actions.

Parent Self-Experiential Incoherence was calculated (on an ordinal scale of 0 to 3) based on calculations of the above measures from the observational videos. See *Self-Experiential Incoherence* above (*Micro-level self-esteem measures*) for details.

4.2.5 Analysis Plan

Calculating state self-esteem[19].

State self-esteem (SSE_t) was calculated as the sum of the behavioral and affective expressions of self-experience at t_x (i.e., Autonomy and Self-affect). SSE was calculated for every second of the interaction. When no scores were given for either Self-affect or Autonomy, $SSE_t = 0$ (i.e., neutral). This was the case for moments in which the adolescents did not say or do anything. A positive SSE_t score was only given if the simultaneous score for Self-Experiential Incoherence = 0. This is in accordance with our focus on *genuine* expressions of positive state self-esteem (see Introduction). The calculation for SSE_t was conducted in Microsoft Excel (Version 2010), and is described by the following formula (1):

$$SSE_t = \begin{cases} (SA_t + AU_t)\,; \; if\; (SA_t + AU_t > 0)\; and\; (SEI_t = 0); otherwise, \\ 0 \end{cases} \quad (1)$$

Where SA_t is Self-affect, AU_t is Autonomy, and SEI_t is Self-Experiential Incoherence at t_x.

[19] The following information regarding the calculation of state self-esteem is identical to the information given in Section 3.5.5. It is included here for the sake of completeness in the current chapter.

Data preparation.

For the following analysis, the raw data for the measures obtained from the videotaped interactions were smoothed idiosyncratically (i.e. intra-individually). This was done with a LOESS smoothing technique (Cleveland & Devlin, 1988), which conducts a local regression around each score of the time series, within a window of 20% of the data, where the window is sequentially moved across the scores in the time series (i.e., a *moving window*). The values within the moving window are weighted on the score at that second. This form of smoothing protects the patterns of change in the data by using an iterative process (Chen et al., 2004).

Smoothing was done for the SSE time series for each individual (after calculations were conducted based on the raw data). Afterwards, the scaling of the time series was transformed from continuous to ordinal, with five categories: 1 = very low, 2 = low, 3 = medium, 4 = high, 5 = very high. This re-scaling was done because the SSG analyses requires ordinal data (Hollenstein, 2007). Smoothing was also done for all lower-order self-esteem measures (Autonomy, Self-Affect, Self-experiential incoherence), post SSE calculation. This was done in order to estimate missing data points in the time series based on local scores, which was necessary for further analyses involving Kohonen's Self-Organizing Maps (see below).

Testing hypothesis 1.

In order to test Hypothesis 1, it was necessary to capture the moment-to-moment variability of trait self-esteem attractors, and to measure the level of constraint that this moment-to-moment variability had on the simultaneous variability of state self-esteem.

Capturing the variability of adolescent trait self-esteem attractors.

Trait self-esteem attractors were measured as qualitatively different networks of lower-order self-experiential components to which the individual repeatedly returned, where each network can be characterized by a set of self-experiences and their respective valences. This was done using a data mining technique that maps the spatial and temporal emergence of structure in the time-serial data: Kohonen's Self-Organizing Maps (SOM; Kohonen, 1982). The SOM analysis was done in the data mining program Tanagra 1.4.41 (Rakotomalala, 2003). Using unsupervised learning algorithms, this technique derives a small set of qualitatively different networks ("clusters") of the input data (i.e., the smoothed multivariate data: Self Self-affect, Autonomy, and Self-experiential incoherence), that show temporal recurrence unique to each individual (Ultsch, 1999).

In the current analysis, a set of two clusters was captured for each individual: Trait self-esteem cluster 1 and 2. The same number of clusters was determined for all participants so that between-individual comparisons of attractor strength could be made. Determining two clusters was optimal, as further clustering (i.e., ≥ 3) generally revealed a division of the first two clusters found, rather than further differentiating new clusters. Because the SOM analysis maintains both the spatial and temporal structure of the emergent clusters, a unique time series can be obtained for each individual, which depicts the moment-to-moment transitions between the clusters across the entire time span of the data. Both the cluster make-up and the temporal transitions are idiosyncratic. Two examples of these time series are

portrayed below (see Figure 2a and 2b). The figures demonstrate the dynamic and self-similar nature of variability at the macro level, where each attractor repeatedly recurs across time, and where the two are interchangeably expressed.

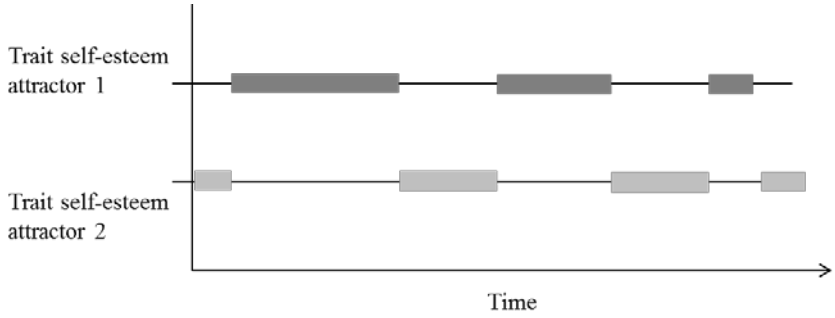

Figure 2: Simulated trait self-esteem attractor variability between trait self-esteem attractor 1 and 2 across time. The grey bars indicate the duration of time that the trait self-esteem attractors (1 and 2) are expressed.

Measuring trait self-esteem constraint on state self-esteem variability.

The level of top-down constraint, and thus the strength of the trait self-esteem attractor, can be measured as the level of *temporal coherence* between variability of trait self-esteem attractors (i.e., macro-level concept) and variability of state self-esteem (i.e., meso-level concept). The term *temporal coherence* will be used from here on. Variability of trait self-esteem attractors refers to the temporal transitions from one trait self-esteem attractor state to another, and variability of state self-esteem refers to the temporal changes in the overall valence of state self-esteem. If trait self-esteem attractor transitions occur at the same time as changes in state self-esteem valence, this is referred to as a relatively high level of temporal coherence, which is indicative of high constraint (i.e., stronger trait self-esteem attractors). If trait self-esteem attractor transitions do not occur at the same time as changes in state self-esteem valence, this is referred to as a relatively low level of temporal coherence, which is indicative of low constraint (i.e., weaker trait self-esteem attractors).

In order to measure the level of temporal coherence, State Space Grid methodology will be used (SSG; Hollenstein, 2012; Lewis, Lamey, & Douglas, 1999). Using SSGs, it is possible to map the temporal coherence of trait self-esteem variability and state self-esteem variability, as this technique portrays two-dimensional (categorical) data across time. The sequence of state self-esteem events (ranging in five levels of valence, from 'very high' to 'very low') is plotted (on the *x*-axis) against the sequence of trait self-esteem events (i.e., as either the expression of trait self-esteem attractor 1 or 2; on the *y*-axis). The time series of the set of variables (*x, y*) are thus plotted as they proceed in real time, where the whole grid represents all possible combinations for each adolescent. Whenever either of the two variables changes (i.e., is variable), a new point is plotted on the grid and a line is drawn connecting it to the previous point (Hollenstein, 2012). This is portrayed below in Figure 3,

where the first four events are illustrated of a hypothetical trait self-esteem time series (*y*) with the values: t_1 = 2, t_2 = 2, t_3 = 1, t_3 = 2; and a hypothetical state self-esteem time series (*x*) with the values: t_1 = 1, t_2 = 2, t_3 = 2; t_3 = 2.

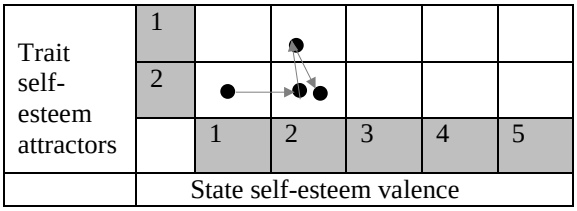

Figure 3. Illustration of a SSG depicting the first three events of a trait self-esteem time series (*y*) and a state self-esteem time series (*x*).

Based on the frequency of each possible combination of *x* and *y* values (within one adolescent across the dyadic interaction), we developed a calculation in order to determine the level of temporal coherence (TC) of variability for the state-trait relationship (*x*, *y*), see Formula 2.

$$Temporal\ Coherence_{absolute} = \sum_{i=1}^{5} \left(\frac{x_i y_1 - x_i y_2}{x_i y_1 + x_i y_2}\right) \quad (2)$$

where *x* is the number of times that state self-esteem occurred for each cell on the *x*-axis. Each cell is represented by *i* (where *i* = 1, 2, 3, 4, 5); and where *y* is the number of times that each trait self-esteem attractor state occurred for each cell on the *y*-axis (where y_2= trait self-esteem attractor 1, and y_2= trait self-esteem attractor 2).

The total number of events in cell x_1y_2 is subtracted from the total number of events in cell x_1y_1 (referring to Figure 3, this would be x_1y_2 - x_1y_1 = 1). This is done to determine whether x_1 (state self-esteem with valence = 1, for Figure 3) could be discriminated by y_1 versus y_2 (i.e., trait self-esteem attractor 1 versus 2). A large total difference (i.e., between x_1y_1 - x_1y_2) means that state self-esteem could be discriminated by the two trait self-esteem attractors. If the level of state self-esteem can be discriminated by the trait self-esteem attractors, we can deduce that *changes* in the trait self-esteem attractors must therefore correspond to *changes* in state self-esteem valence, and therefore, that the trait self-esteem attractors constrain the variability of state self-esteem. The difference between the number of events in y_1 - y_2 is calculated for each state self-esteem level (x_1, x_2, x_3, x_4, x_5) and made proportionate to the total number of events for that level. The absolute sum of these values is thus the level of temporal coherence (i.e., *TC*).

Testing hypothesis 2.

In order to test Hypothesis 2, it was necessary to capture the moment-to-moment changes in the parents' emotional-behavioral interaction styles that emerged within the interaction, to measure the perturbing effects that these moment-to-moment changes had on the simultaneous variability of state self-esteem. This was done using the same statistical techniques as for Hypothesis 1 (above), but with parental emotional and behavioral data for the *y*-axis (gathered from the video-recorded interactions) rather than the adolescents' trait self-esteem.

Capturing the changes in parental emotional-behavioral interaction styles.

Kohonen's Self-Organizing Maps technique was also conducted in order to determine qualitatively distinct emotional-behavioral parental interaction-styles that emerged across the interaction. Smoothed parental measures were used as input data in order to capture distinct idiosyncratic emotional-behavioral interaction styles. Variability from one interactional style to another refers to a perturbation, i.e. a moment-to-moment contextual change that potentially results in a shift in behavior of another system (Hollenstein et al., 2013). In the current analysis, a set of two parental interaction-styles was captured for each parent: Parental cluster 1 and 2. As with the trait self-esteem attractors (above), we limited the clusters to two per parent for practical reasons; namely, so that between-individual comparisons could be made.

Measuring the effect of parental perturbations on adolescent state self-esteem variability.

State Space Grids were utilized in order to determine the level of temporal coherence between variability of parental interaction-styles and variability of the adolescents' state self-esteem. The absolute temporal coherence (TC) was calculated using Formula 2, where y = parent-interaction styles (1 versus 2) and x = child state self-esteem valence (1, 2, 3, 4, 5).

The relationship between trait self-esteem constraint and parental perturbations.

We compared the level of TC for the trait self-esteem attractors with the level of TC for the parent-interaction styles (within individuals). This was done in order to test whether higher temporal coherence for trait self-esteem (indicating high trait self-esteem constraint) corresponded with lower temporal coherence for parental perturbations (indicating low effect of parental perturbations); and vice versa (Hypothesis 2). These differences in TC are tested with Monte Carlo analyses. This statistical technique is ideal for small sample sizes, which generally lack power in standard statistical tests, and where conditions necessary for standard statistical tests are generally not met. A Monte Carlo analysis compares the real data to permutations of the data. More specifically, the real data are subjected to random re-sampling 1000 times (i.e. sampling distribution of S=1000). With each re-sample, a specific property of the real data is compared to that in the sampling distribution, where the null hypothesis is that there is no difference.

4.3 Results

4.3.1 State Self-Esteem

The average state self-esteem level (SSE) across all individuals was *M* = 2.30 (*SD* = 0.48; on the ordinal scale of 1 to 5). The length of the time series was *M* = 847.3 seconds (*SD* = 192.2). Figure 5 below shows a representative example of a SSE time series.

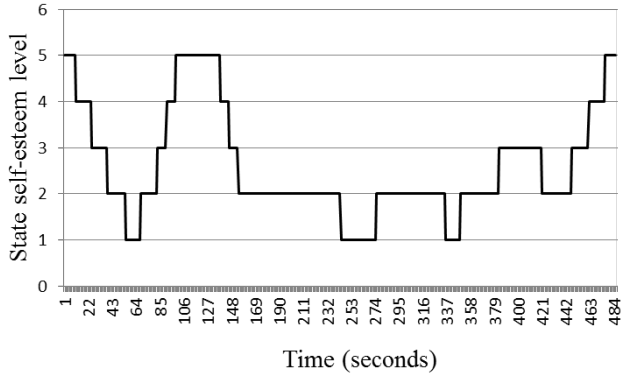

Figure 5. State self-esteem time series of one individual.

4.3.2 Testing Hypothesis 1: Trait Self-Esteem Constraining State Self-Esteem

Trait self-esteem attractors.

For each adolescent, two recurring trait self-esteem attractors were identified by the SOM technique. Recall that, while the state self-esteem time series (SSE) indicated moment-to-moment changes in the summed valence of self-experiences, the transitions from Trait self-esteem attractor 1 to Trait self-esteem attractor 2 indicated transitions to and from two distinct networks of the adolescent's self-experiences. Two empirical examples (from Individual A and Individual B) are shown below of within-individual transitions between trait self-esteem attractor 1 and 2 (Figure 6).

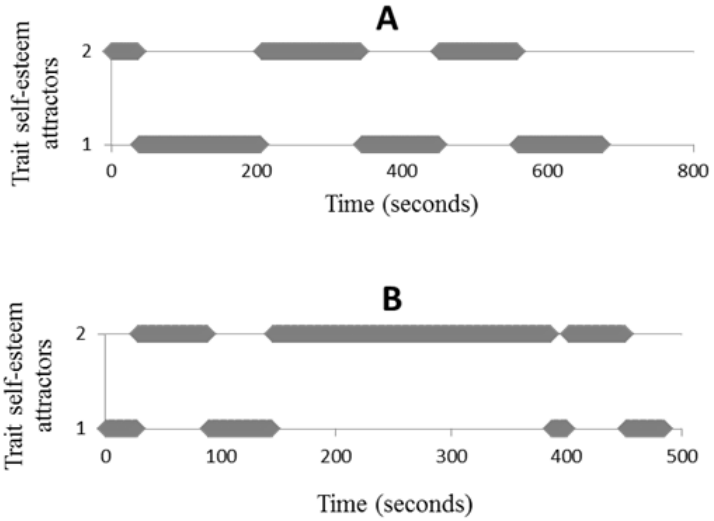

Figure 6: Examples of trait self-esteem attractor variability across the dyadic interaction for two participants (A and B). The grey bars indicate the duration of time (i.e., seconds) that the trait self-esteem attractors (1 and 2) are expressed.

Figure 6 demonstrates that the temporal pattern between Trait self-esteem attractor 1 and Trait self-esteem attractor 2 differ for each individual. Additionally, the trait self-esteem attractors differed in content, both within and between individuals, with regard to the dominance of the emotional versus behavioral experiences of self, in the coherence the self-experiences (regarding their valence), as well as the positivity or negativity of the self-experiences themselves. To illustrate, the characterization of the two trait self-esteem attractors for participants A and B (From Figure 5) are displayed in Table 2. The table shows the percentage of time during which each trait self-esteem attractor was expressed across the entire dyadic interaction for each individual. The extent to which each trait self-esteem attractor was characterized by each self-experiential variable was indicated by the *test-value*[20].

The test-value shows how much weight each self-experiential measure has in determining the expression of that specific trait self-esteem attractor, where higher absolute values indicate a higher weight. The test-value is deduced based on a statistical within-individual test of a comparison of means (the mean value across the entire time series compared to the mean value during the duration in which the specific cluster is active). For each trait self-esteem attractor, the self-experiential measure with the highest absolute test value is the self-experience that – when experienced (with the relevant valence) – is most likely to

[20] For more information, see the "Understanding the 'test value' criterion" tutorial provided by Tanagra (http://data-mining-tutorials.blogspot.nl/2009/05/understanding-test-value-criterion.html).

trigger the expression of that specific attractor. For example, for Participant A, it was likely that Attractor 1 was triggered when positive self-affect was experienced, given that self-affect had the highest absolute test-value (Test-value = 17.19), and it was likely that Attractor 2 was triggered when negative self-affect was experienced (Test-value = -17.19). For participant B, the valence of autonomous self-experiences was most pivotal (Test-value = 17.30 and -17.30 for Attractor 1 and 2, respectively).

Because we defined two attractors for each individual, the emergent attractors were triggered by opposing levels of each self-experiential component (i.e. Self-affect, Autonomy, Self-Experiential Incoherence). This can be seen in Table 2, where (within each individual) the test-values of the network characteristics for Attractor 1 were opposite in valence from those for Attractor 2. The absolute values of test-values differed between individuals, however, indicating a between-individual difference in weight regarding the various self-experiential components.

Table 2

Examples of trait self-esteem attractor characterizations for two participants (A and B)

	Participant A		Participant B	
Percentage of time expressed	Trait SE attractor 1 (58.2%)	Trait SE attractor 2 (41.8%)	Trait SE attractor 1 (27.4%)	Trait SE attractor 2 (72.6%)
	Test value network characteristics			
Self-affect	17.19	-17.19	9.14	-9.14
Autonomy	-13.47	13.47	17.30	-17.30
Self-Experiential Incoherence	-10.9	10.9	4.65	-4.65

Note. SE = self-esteem.

Measuring trait self-esteem constraint on state self-esteem variability.

The mean level of TC for trait self-esteem variability and state self-esteem variability across all participants was *TC* = .31 (*SD* = .21).

Splitting the distribution into two based on a median split of the TC for trait self-esteem attractors resulted in two profiles: Profile 1 and Profile 2. Profile 1 ($N = 6$) included participants with relatively strong trait self-esteem attractors (*M* absolute *TC* = .47, *SD* = 0.12) and Profile 2 ($N = 7$) includes the participants with relatively weak trait self-esteem attractors (*M* absolute *TC* = .12, *SD* = .09). Based on a Monte Carlo permutation test, we found that Profile 1 and 2 differed significantly in their average trait self-esteem attractor strength based on the mean absolute TC in each profile (difference-score = 0.35, $p < 0.01$).

In Figure 7a and 7b an example is given of two adolescents who display a relatively high (*TC* = .46) and low (*TC* = .11) level of temporal coherence as portrayed in state space grids (from Profile 1 and Profile 2, respectively). In Figure 7a, Trait self-esteem cluster 2 corresponds with negative state self-esteem levels (i.e., "very low" and "low"), while Trait self-esteem cluster 1 corresponds with positive state self-esteem levels (i.e., "high" and "very high"). This means that the absolute difference in the number of observations between $x_i y_1$ and $x_i y_2$ is relatively high, resulting in a high absolute TC (i.e., indicating high attractor strength). In Figure 7b both Trait self-esteem cluster 2 and Trait self-esteem cluster 1 correspond with all state self-esteem levels. This means that the absolute difference in number of observations between $x_i y_1$ and $x_i y_2$ is relatively low, resulting in a low absolute TC (i.e., indicating low attractor strength).

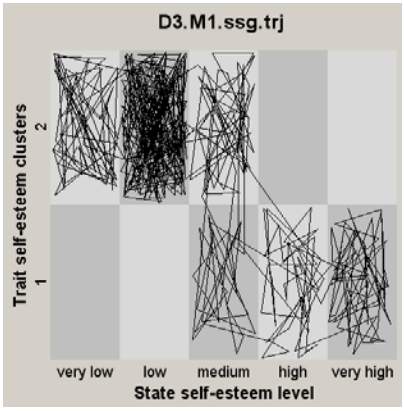

Figure 7a

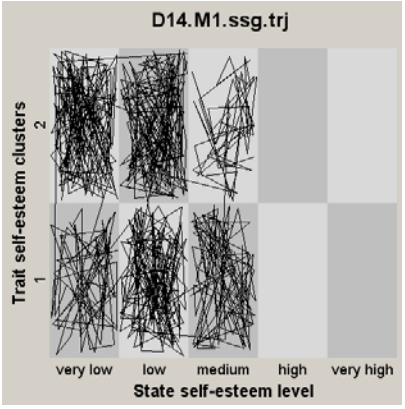

Figure 7b

Figure 7. Two examples of state space grids portraying the time series for trait self-esteem attractor expression (*y*-axis) against the time series for state self-esteem (*x*-axis). Figure 3a illustrates a high level of temporal coherence in variability between the two variables, while Figure 3b illustrates a low level of temporal coherence in variability between the two levels.

These results show that trait self-esteem attractors do indeed have dynamic constraint on the variability of state self-esteem in real-time, such that state self-esteem is constrained in a different way (e.g., within a positive valence range versus a negative valence range) when different trait self-esteem attractor states are expressed (e.g., Trait self-esteem attractor 1 versus Trait self-esteem attractor 2). Moreover, not all individuals exhibited strong trait self-esteem constraint on state self-esteem. While this was the case for about half of the adolescents (Profile 1; *N* = 7), the other half of the adolescents (Profile 2; *N* = 6) exhibited significantly less constraint on their state self-esteem variability due to trait self-esteem attractors. These findings confirm our first hypothesis.

4.3.3 Testing Hypothesis 2: The Relationship Between Trait Self-Esteem Attractor Strength and Effect of Parental Perturbations.

The mean level of TC for parental interaction-styles and state self-esteem variability across all participants was M = 0.35 (SD = 0.25). Below, the absolute TC for trait self-esteem attractors and parental interaction-styles are shown for each participant (Figure 8).

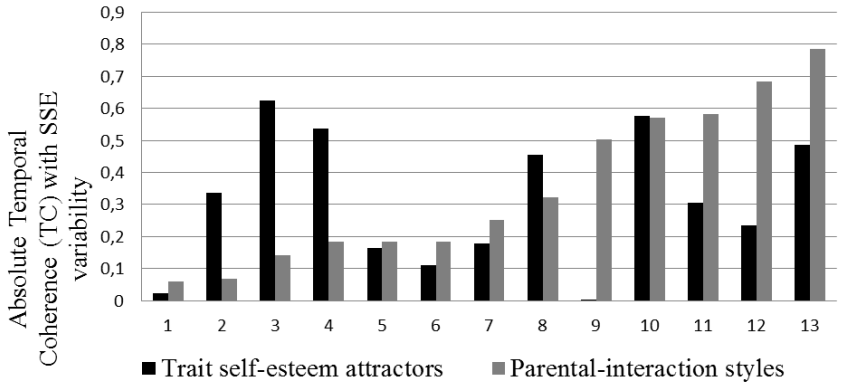

Figure 8. Absolute TC scores for adolescent trait self-esteem attractors and parental interaction-styles for each dyad.

We tested whether the level of temporal coherence for trait self-esteem was *higher* than the level of temporal coherence for parent-interaction styles in Profile 1, and whether the level of temporal coherence for trait self-esteem was *lower* than the level of temporal coherence for parent-interaction styles in Profile 2. For Profile 1 (i.e., strong attractor profile) the observed differences are in the expected direction, where the temporal coherence for the trait self-esteem attractors (TC = 0.47) is larger than the temporal coherence for the parental perturbations (TC = 0.38 (SD = 0.27)). For Profile 2 (i.e., weak attractor profile) the observed differences are also in the expected direction, where the temporal coherence for the trait self-esteem attractors (TC = 0.12) is smaller than the temporal coherence for the parental perturbations (TC = 0.31 (SD = 0.23)). These profile differences are portrayed in Figure 9. Based on a Monte Carlo analysis of the above differences, Profile 1 and Profile 2 were found to be significantly different from each other based on their respective within-profile differences between the total TC for trait self-esteem attractors and parental interaction-styles ($p < 0.05$).

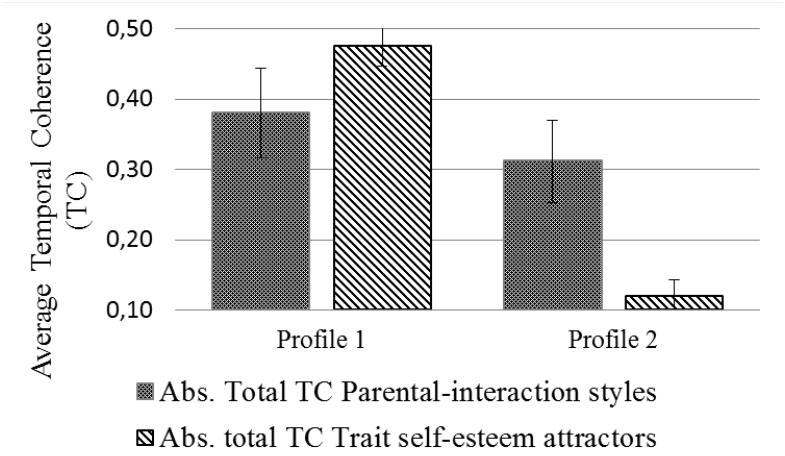

Figure 6. Group levels of absolute temporal coherence (TC) for adolescent trait self-esteem attractors and parental interaction-styles.

These findings show that adolescents who have relatively *strong* trait self-esteem attractors (as indicated by a high level of constraint on their state self-esteem variability, i.e., TC) were relatively *less* affected by parental perturbations (based on changes in the parents' emotional-behavioral interaction styles). In contrast, adolescents who have relatively *weak* trait self-esteem attractors (as indicated by a low level of constraint on their state self-esteem variability, i.e., TC) were relatively *more* affected by parental perturbations. This is in accordance with our second hypothesis.

4.4 Discussion

To date, trait self-esteem has been classically explored as a context-independent outcome variable or predictor variable. Moreover, the level of trait self-esteem stability has been investigated in terms of its long-term stability in the level of self-esteem valence. In the current chapter, we proposed that – alongside the classical empirical approach to trait self-esteem – the real-time phenomenology of trait self-esteem can and should be empirically studied.

We suggested that the phenomenology of trait self-esteem in real-time is characterized by the underlying dynamics of trait self-esteem, and we drew from the Self-Organizing Self-Esteem (SOSE) model in order to specify what these underlying dynamics are precisely. Based on the SOSE model, we posited that trait self-esteem is characterized by a landscape of idiosyncratic attractor states (i.e. trait self-esteem attractor states) to which the individual is repeatedly drawn in real-time. We operationalized each attractor state as an idiosyncratic emergent network of self-experiences that continuously recurs across a dyadic interaction.

In accordance with the complex dynamic systems perspective, the expression of an attractor state is expected to constrain the variability of the lower-order level of self-esteem. In our SOSE model, this lower-order level is state self-esteem. Therefore, we proposed that

the underlying dynamics of trait self-esteem can be best approached as the constraint that trait self-esteem attractors have on state self-esteem, where each trait self-esteem attractor state constrains the variability of state self-esteem in a different way (i.e. within a different range of state self-esteem valence).

In accordance with Hypothesis 1, we showed that idiosyncratic and recurring networks of self-experiences can be captured (i.e., trait self-esteem attractor states), and that they do indeed constrain the variability of state self-esteem. Moreover, each trait self-esteem attractor has a unique constraint on state self-esteem variability. These results provide support for the conceptualization of trait self-esteem as a collection of attractor states that constrain lower-order variability at the meso level, i.e. at the state self-esteem level. Additionally, we found that this constraint was relatively strong for approximately half of the adolescents, and relatively weak for the other half. The fact that there were significant between-individual differences in the level of constraint indicated that adolescents differed in their attractor strength.

In order to test the validity of our operationalization of trait self-esteem attractors in Hypothesis 1, we tested whether stronger trait self-esteem attractors demonstrated a pivotal characteristic of strong attractor states (and vice versa for weaker trait self-esteem attractor states). Specifically, from a complex dynamic systems perspective, we expected that adolescents with stronger trait self-esteem attractor states would be less perturbed (with regard to their state self-esteem valence) by changes in the parents' emotional-behavioral styles during the interaction (and vice versa for adolescents with weaker trait self-esteem attractor states). We found (in accordance with Hypothesis 2) that adolescents with *stronger* trait self-esteem attractors (i.e., Profile 1, identified by a higher level of constraint on their state self-esteem levels) were indeed *less* perturbed by moment-to-moment changes displayed by the parents' emotional-behavioral interaction style. In contrast, adolescents with *weaker* trait self-esteem attractors (i.e., Profile 2, identified by a lower level of constraint on their state self-esteem levels) were *more* perturbed by moment-to-moment changes displayed by the parents' emotional-behavioral interaction style. These within-individual differences were significantly different for Profile 1 compared to Profile 2.

The above results provide support for the conceptualization of trait self-esteem as a landscape of attractor states, as adolescents demonstrated the endogenous characteristics of attractor states (trait self-esteem constraint on state self-esteem variability) in combination with the corresponding interaction with the immediate environment that is expected based on complex dynamic systems principles (the level of resistance to external perturbations).

With these findings, the current article provides the first empirical account of the underlying dynamics of trait self-esteem in real-time based on the Self-Organizing Self-Esteem (SOSE) model (as proposed in Chapter 2). We demonstrated that these underlying dynamics can be conceptualized as the real-time phenomenology of trait self-esteem. This suggests that an individual experiences his or her trait self-esteem in real-time, in the sense that he or she experiences a certain level of consistency in state self-esteem while the corre-

sponding trait self-esteem attractor state is expressed. Therefore, while the adolescents' state self-esteem exhibit continuous fluctuations in response to what is currently going on in the dyadic interaction with the parent, the expression of strong trait self-esteem attractors means that these fluctuations are constrained, such that the individual's state self-esteem is not completely reactive to the parent.

This conceptualization of trait and state self-esteem is relevant for the discussion regarding the 'buffering effect' of positive self-esteem (Baccus et al., 2004; Dijksterhuis, 2004; Greenberg et al., 1992; Greenwald & Farnham, 2000), where individuals' emotional and cognitive processes are less negatively affected by aversive experiences if their trait self-esteem is positive instead of negative. While the buffering effect of self-esteem is frequently found, the mechanism underlying it is not well understood (Cast & Burke, 2002; Greenberg et al., 1992). Greenberg et al., for example, suggest that it is "important to explore the precise processes through which self-esteem acquires and produces its anxiety-buffering effects" (Greenberg et al., 1992, p. 921). Generally speaking, the buffering effect of positive self-esteem is assumed to be a cognitive process, such that self-esteem provides individuals with cognitive resources to either re-interpret, or more effectively deal with, negative experiences (Cast & Burke, 2002).

The current findings are the first to demonstrate this buffering effect 'at work'. Although it was beyond the scope of the current chapter to further distinguish between trait self-esteem attractor states as 'positive' or 'negative', trait self-esteem attractors that corresponded with relatively positive state self-esteem can be seen as 'positive' trait self-esteem attractors. In showing that strong 'positive' trait self-esteem attractor states constrained state self-esteem (i.e., restricting the degrees of freedom to positive valence) and protected state self-esteem from current perturbations from the parent, we showed that positive trait self-esteem (attractor states) buffered state self-esteem against concurrent exogenous factors. This therefore suggests that the buffering effect may not be a cognitive process, but rather, the result of the relatively high amount of energy needed for aversive experiences to perturb the system from the positively-valenced equilibrium point provided by the trait self-esteem attractor state. Recall that the basin of attraction dynamics dictates that an attractor state is strong (i.e., deep and wide) because it requires a small amount of energy to reach and maintain that position compared to the energy that is required to perturb it. From this perspective, positive trait self-esteem (or, more specifically, a strong positive trait self-esteem attractor state) protects state self-esteem because it increases the threshold of energy required by external factors to disturb it. Further research would be useful in order to further delve into the intra-individual differences between 'positive' and 'negative' trait self-esteem attractor states and their respective influences on 'aversive' versus 'pleasant' exogenous influences.

Aside from the buffering effect of trait self-esteem, our results are also informative about state self-esteem, and more specifically, regarding the nature of state self-esteem variability. The dominant existing theory of state self-esteem is that state self-esteem is a reaction to one's social cues (Sociometer Theory of state self-esteem; Leary & Baumeister,

2000). While our findings confirm this, where the adolescents' state self-esteem valence changed in reaction to the parent, we also showed that the state self-esteem reactions were constrained, and that this constraint is a function of one's trait self-esteem. Moreover, not all adolescents experienced this constraint on their state self-esteem. Individuals that experienced less constraint on their reactivity of state self-esteem to the parent had weaker trait self-esteem attractors, and as a result, their current level of state self-esteem was highly reactive to the parent's current emotional and behavioral expressions. Our results thus extend the dominant perspective of state self-esteem, by highlighting the constraining influence of trait self-esteem on state self-esteem fluctuations.

While it was beyond the scope of the current study to investigate where the abovementioned inter-individual differences came from, complex dynamic systems thinking suggests that they may be explained by whether or not individuals are currently in a phase transition. A phase transition is characterized by a period of global destabilization of patterns, during which an individual demonstrates a high level of variability (Thelen & Smith, 1994). The occurrence of a phase transition has been found to be a pivotal mechanism in bringing about significant developmental change, as it allows the individual to explore new emotional-behavioral patterns (Lichtwarck-Aschoff et al., 2012). After the occurrence of a phase transition, variability decreases and patterns re-organize as the individual settles into qualitatively new patterns. This re-organizational process can be understood as the formation of new attractor states. From this perspective, while an individual is experiencing a phase transition, it can be expected that his or her trait self-esteem attractor states will be relatively weak – therefore exhibiting less constraint on moment-to-moment variability of state self-esteem compared to individuals who are not currently experiencing a phase transition.

It has been shown that adolescents experience a developmental phase transition in the context of the parent-child relationship (Granic, Hollenstein, Dishion, & Patterson, 2003), and that significant change in self-esteem occurs during adolescence (Robins et al., 2002; Waterman, 1982). Based on these findings, it is likely that adolescents experience a developmental phase transition in their self-esteem. Therefore, in the context of our study, it may be that adolescents who were characterized by relatively weak attractor states were in such a phase transition, while those that were characterized by relatively strong attractor states were not in such a phase transition. Future studies are necessary in order to test whether this is the case or not. This can be done by combining real-time measures of trait self-esteem attractor strength with longitudinal data, which would make it possible to identify periods of increased variability that may indicate a developmental phase transition. Future studies might also profit by turning to qualitative data that tap into the adolescents' subjective experience of their development (for example, diary studies). Such an approach may provide information regarding the subjective experience of a phase transition. Moreover, it is also theoretically possible that some individuals may remain in a relatively destabilized period, such that their trait self-esteem attractor states remain weak. Future longitudi-

nal research is also necessary in order to determine whether this is the case and for whom it is the case.

Because the present research represents the first attempt to capture the simultaneous dynamics of trait self-esteem and state self-esteem, we purposefully limited the dynamics of trait self-esteem to the dynamics that occurred between two trait self-esteem attractors. These trait self-esteem attractors can be conceptualized as the two most dominant attractors. In doing so, we were able to make between-individual comparisons regarding the level of constraint that the two trait self-esteem attractors had on state self-esteem. Moreover, our current aim was not to investigate the number of intra-individual attractor states, but instead, to investigate the relative strength of individuals' trait self-esteem attractors. While there are strong theoretical reasons for investigating these between-individual differences (based on, for example, the occurrence of phase transitions), there are also reasons to examine the intra-individual differences in trait self-esteem attractor strength. This is because an individual's trait self-esteem landscape may consist of both weak *and* strong attractors (Van Geert, 1994). Future research should investigate the number of within-individual trait self-esteem attractor states alongside their relative strength. The number of attractors is likely to be an important characteristic of the nature of trait self-esteem phenomenology. For example, more attractor states would likely result in more kinds of constraint on state self-esteem as well as more transitions between these types of constraint in real-time, which may be experienced as less self-certainty (Nowak et al., 2005).

Although our novel methodological approach to real-time trait self-esteem dynamics is in an early stage of development, it promises to provide a way to investigate the real-time phenomenology of trait self-esteem based on precise predictions regarding the dynamic and temporal relationship between state self-esteem and trait self-esteem. In showing that these phenomena can be approached as dynamically intertwined processes that are manifested and experienced in real-time, we hope that we can facilitate future studies in investigating self-esteem from a complex dynamic systems perspective, as outlined by the Self-Organizing Self-Esteem (SOSE) model.

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Part III

Theoretical considerations of the relationship between implicit and explicit self-esteem from the Self-Organizing Self-Esteem model

CHAPTER 5
The Relationship Between Implicit and Explicit Self-esteem From a Self-Organizing Self-Esteem Perspective

Abstract

In this chapter we aim to develop a theoretical conceptualization of the distinction between implicit and explicit self-esteem based on the SOSE model. From this perspective, we suggest that a qualitative distinction between implicit and explicit self-esteem is different at the trait level and the state level. At the state level, we suggest that implicit and explicit self-esteem form one state self-esteem process, which changes in its quality (i.e. implicit or explicit) from moment-to-moment depending on the lower-order network at each moment. At the trait level, we suggest that implicit and explicit trait self-esteem can be conceptualized as separate trait self-esteem attractors, resulting from distinct pathways of long-term iterative development of state self-esteem. We discuss this conceptualization in the context of the two dominant (and competitive) perspectives of the implicit-explicit relationship, namely that implicit self-esteem and explicit self-esteem are *one* versus *separate* constructs. We suggest that our model unites the two traditional perspectives by incorporating the distinction between state and trait self-esteem mechanisms, and by accounting for the temporal nature of the two processes.[21]

[21] This chapter is based on De Ruiter, N.M.P., Kunnen, E.S. & Van Geert, P.L.C. *The relationship between implicit and explicit self-esteem from a Self-Organizing Self-Esteem (SOSE) perspective.* Manuscript in preparation.

This thesis has so far focused on the distinction between the micro level of self-esteem and the macro level of self-esteem, resulting in state self-esteem and trait self-esteem, respectively. We have, thus far, not made a distinction in the experiential *quality* of self-esteem as *implicit* versus *explicit*, as such a distinction is not a pivotal factor in the Self-Organizing Self-Esteem (SOSE) model (see Chapter 2). This distinction is, however, a prominent topic in mainstream self-esteem literature.

Self-esteem – as an *attitude* involving a positive or negative reaction to, or association with, the self (Gawronski & Bodenhausen, 2007; Olson & Fazio, 2009) – is thought to take the form of implicit self-esteem as well as explicit self-esteem (Greenwald & Banaji, 1995). This distinction stems from the common conceptualization of self-esteem as a cognition, and classical duality theories thereof, which hold that there are two qualities of human cognition (Epstein, 1990; Fazio, 1990; Gawronski & Bodenhausen, 2006; Greenwald & Banaji, 1995; Strack & Deutsch, 2004). The first, which corresponds to implicit self-esteem (Epstein, 2006; Peters & Gawronski, 2011), is characterized as being automatic and emotional/behavioral. Implicit self-esteem is generally referred to as the automatic association between the self and positive or negative evaluations, which the individual is unable or unwilling to report on (Buhrmester, Blanton, & Swann, 2011; Koole & DeHart, 2007). The second type of cognition, which corresponds to explicit self-esteem (Epstein, 2006; Peters & Gawronski, 2011), is characterized as being slow, analytical, and reflective. Explicit self-esteem is referred to as the evaluation of the self based on the reflective association between the self and positive or negative evaluations (Brown, 1993; Rosenberg, 1965; Tafarodi & Swann, 2001).

To date, there is much dispute regarding the nature of the relationship between implicit and explicit self-esteem, stemming from a more fundamental question regarding the origin of implicit versus explicit self-esteem. Some researchers believe that implicit and explicit self-esteem are distinct constructs or processes (Bosson, Swann, & Pennebaker, 2000; Greenwald & Banaji, 1995; Strack & Deutsch, 2004), possibly stemming from two different systems in the brain (Epstein, 2006) – although most researchers agree that it is unlikely that the two are completely independent from each other (Dijksterhuis et al., 2009; Evans, 2008; Koole & DeHart, 2007). Others believe that the two are different qualities of the same construct, where implicit self-esteem is an indirect measure and explicit self-esteem is a direct measure of that construct (Gawronski & Bodenhausen, 2007; Olson & Fazio, 2009) (for reviews, see Evans, 2008; Frankish, 2010).

5.1 Aim of the Current Chapter

In the current chapter, we discuss the nature of implicit and explicit self-esteem from the framework provided by the Self-Organizing Self-Esteem model, while drawing on existing theoretical perspectives and models regarding attitudes. We suggest that the SOSE model can contribute to the ongoing discussion regarding the relationship between implicit self-esteem and explicit self-esteem by integrating the two perspectives, i.e., of implicit and

explicit self-esteem as *separate* processes/concepts versus implicit and explicit self-esteem as *one* process/concept with two qualities.

We suggest that – from the SOSE model – the nature of the implicit-explicit distinction is different for state self-esteem and trait self-esteem. First, however, we begin by highlighting pivotal findings regarding implicit and explicit self-esteem that have emerged from extant studies to date (for reviews, see Buhrmester et al., 2011; Dijksterhuis, Albers, & Bongers, 2009; Koole & DeHart, 2007).

5.2 Implicit and Explicit Self-Esteem Research to Date

Implicit-cognition research has only relatively recently been applied to the self-esteem construct – resulting in *implicit self-esteem* – (Greenwald & Banaji, 1995). Since this marriage, studies have shown that implicit self-esteem is functionally related to explicit self-esteem, where – for example – both act as a buffer for psychological processes, such that negative experiences have a relatively smaller negative effect on processes such as motivation (Greenwald & Farnham, 2000), and emotional responses (Baccus et al., 2004; Dijksterhuis, 2004) for individuals with higher self-esteem than individuals with lower self-esteem. However, implicit and explicit self-esteem are not equal representatives of the same construct (Dijksterhuis et al., 2009). Researchers have drawn this conclusion based on the fact that the correlational association between traditional implicit and explicit measures is frequently found to be low (Klavina, Schröder-Abé, & Schütz, 2012; Krizan & Suls, 2008).

The low correlation between the two qualities of self-esteem has led many researchers to wonder what the implicit-explicit dissociation might mean (Fazio & Olson, 2003). Research has revealed that, while an implicit-explicit discrepancy may be inherent to the self-esteem construct, relatively larger implicit-explicit gaps are indicative of relatively maladaptive self-esteem. First, a large discrepancy in which an individual exhibits high explicit self-esteem in combination with low implicit self-esteem is indicative of *fragile* self-esteem (Bosson, Brown, Zeigler-Hill, & Swann, 2003; Jordan, Spencer, Zanna, Hoshino-Browne, & Correll, 2003), as opposed to *secure* self-esteem that is realistic and well-anchored (Kernis, 2003). These individuals are thought to harbor, but not reveal, negative self-feelings. As a result, their (explicit) self-esteem is thought to be relatively delicate and defensive, such that they tend to have a higher need for self-protective and self-enhancement techniques and tendencies (Bosson et al., 2003; Jordan et al., 2003). Indeed, it is this form of 'high' self-esteem that is associated (but not synonymous) with narcissism (Jordan et al., 2003; Nuttin, 1985; Zeigler-Hill, 2006).

Alternatively (and arguably less researched), a large discrepancy involving high implicit self-esteem and low explicit self-esteem is indicative of *damaged* self-esteem (Schroder-Abe, Rudolph, & Schutz, 2007). This kind of discrepancy has been found to be connected to victimization (Leeuwis, Koot, Creemers, & Van Lier, 2014), supporting the conceptualization that damaged self-esteem is largely due to the social context (Franck et al., 2007). Furthermore, damaged self-esteem is associated with depressive symptoms, suicidal ideation and loneliness (Creemers, Scholte, Engels, Prinstein, & Wiers, 2012) as

well as psychological disorders such as anxiety (Schreiber, Bohn, Aderka, Stangier, & Steil, 2012).

At the other end of the spectrum, researchers have found that factors that *decrease* the implicit-explicit discrepancy are those that are psychologically advantageous, in that they are related to self-knowledge and self-trust. For example, higher perceived validity of one's own intuition (Jordan, Whitfield, & Zeigler-Hill, 2007) attitude accessibility (LeBel, 2010), and meditation (Koole, Govorun, Cheng, & Gallucci, 2009) are associated with larger implicit-explicit correlations. Furthermore, findings show that explicit self-esteem, rather that implicit self-esteem, is associated with self-protective mechanisms such as impression management (Buhrmester et al., 2010; Greenwald & Banaji, 1995), and that it is specifically *explicit* self-esteem that is made more accurate when individuals are more self-focused (Pryor, Gibbons, Wicklund, Fazio, & Hood, 1975) and are asked to be honest (Olson, Fazio, & Hermann, 2007).

These results suggest that implicit self-esteem is – by nature – less filtered than explicit self-esteem (Dijksterhuis & Aarts, 2010; Dijksterhuis et al., 2009). However, these conclusions regarding the nature of implicit and explicit self-esteem have – as yet – not solved the debate regarding the origin of implicit versus explicit self-esteem. In self-esteem literature, therefore, the question remains: are these two types of self-esteem the same or distinct self-esteem constructs (Fazio, 1990; Gawronski & Bodenhausen, 2006)? In the following section I reason that – from the SOSE model – the two perspectives are not necessarily in opposition if a distinction is made between state self-esteem and trait self-esteem.

5.3 Applying the SOSE Model to the Conceptualization of Implicit and Explicit Self-Esteem

In this section we argue that, firstly, SOSE mechanisms at the state level result in an implicit-explicit relationship that resembles the conceptualization that the two are different qualities of the *same* process. Secondly, we argue that mechanisms at the trait level result in an implicit-explicit relationship that resembles the conceptualization that the two are *separate* processes/concepts. Based on our SOSE conceptualization of how trait and state self-esteem interact, we then also show how the two conceptualizations of the implicit-explicit relationship can form one overarching conceptualization.

5.3.1 State self-esteem: implicit and explicit as one dynamic process.

In Chapter 3 we empirically validated the SOSE conceptualization (described in Chapter 2) of state self-esteem as a continuous process of self-organization out of lower-order self-experiential components. In this section, we suggest that the distinction between implicit and explicit state self-esteem is a function of the type of lower-order components of state self-esteem at t_x.

Recall that lower-order elements of state self-esteem include self-experiences in the form of self-directed emotions, autonomous actions, and self-evaluative cognitions (see Chapter 2). Emotional and behavioral self-experiences can be categorized as being *experiential* (Epstein, 1990), and informative of the *feel* of an experience (Perry, 2009). In con-

trast, cognitive self-experiences can be categorized as being *reflective* (Epstein, 1990), and informative of the *content* of experience (Perry, 2009).

We suggest that experiential lower-order components give way to implicit state self-esteem, while reflective lower-order components give rise to explicit state self-esteem. The *quality* of state self-esteem thus refers to whether it is implicit or explicit, where the lower-order components of state self-esteem determine what this quality will be (which we will describe below). This conceptualization therefore extends the conceptualization outlined in Chapter 2 regarding the lower-order network of state self-esteem. In Chapter 2 we described how the nature of emergent state self-esteem depends on the positivity versus negativity of lower-order components, and on the similar versus dissimilar connections between them, where these two dimensions determine the valence of state self-esteem as well as whether or not state self-esteem is genuine or not, respectively.

According to the SOSE model, the network of lower-order state self-esteem components is volatile, such that self-experiential components of varying quality can come and go depending on how the individual thinks, feels, and acts in relation to him- or herself and in response to the current context. The central point here is that self-related cognitions may or may not be a part of the current network of lower-order components. If the real-time state self-esteem network consists of only emotional and behavioral self-related components (that is, there is a lack of *self-directed* cognitions, not of cognitions per se), the dynamic interaction between these components will give rise to the self-organization of state self-esteem at t_x that is experiential by nature, i.e., implicit.

However, if the individual's real-time self-esteem network includes (a) self-related cognitive component(s) (e.g., thinking that one is a failure), the dynamic interaction between this cognitive component and the other self-directed emotions and actions will give rise to the self-organization of state self-esteem at t_x that is reflective by nature, i.e. explicit. The phenomenology of this distinction can be understood in terms of the direction of conscious attention (Dehaene & Naccache, 2001), which we describe below.

The role of the direction of attention.

We suggest that, if a self-evaluative cognition is introduced to the network, the interaction between this component and the other self-experiential components will mean that attention is directed at those self-experiential components. As a result, the individual's emotional-behavioral self-experiential components will be reflected upon, making the individual aware of the *content* of those experiences, and resulting in the emergence of reflective state self-esteem. An introduction of a self-directed cognitive component into the lower-order network therefore results in a shift of attention, namely, toward the self. This shift in attention then causes state self-esteem to become explicit. This is in accordance with the classic conceptualization that cognitive elaboration is necessary for explicit processes (Fazio & Olson, 2003).

On the other hand, if there is an absence of self-directed cognitive components in the lower-order network, the individual – at that moment – will not be directing attention on the current self-directed emotions or autonomous actions. The emotional-behavioral self-

experiences will thus not be reflected upon, making the individual aware of only the *feel* of those experiences, resulting in the emergence of implicit state self-esteem.

The role of the direction of attention has previously been conceptualized as pivotal in determining the nature of cognition. Specifically, the Unconscious Thought Theory (UTT; Dijksterhuis & Nordgren, 2006) – which refers to thought processes in general, rather than to self-esteem – posits that the difference between unconscious and conscious thought depends on the direction of attention. For conscious thought, attention is directed at the thought-object itself. For unconscious thought, attention is directed at something peripheral to the thought-object (Dijksterhuis & Nordgren, 2006). Applying this theory to state self-esteem, the 'thought-object' becomes the experience of the self. Therefore, in accordance with the UTT, state self-esteem is conscious (i.e., explicit) when attention is directed at the current experience of the self (i.e. the current self-experiential components), and state self-esteem is unconscious (i.e., implicit) when attention is directed elsewhere (i.e., to something external, such as a conversation partner).

If the direction of attention is the mechanism that explains whether state self-esteem is experienced as implicit or explicit, then a re-direction of attention (i.e., to and from self-experiential components) will predict a transformation from one quality of state self-esteem to another, from one moment to the next moment. Therefore, implicit state self-esteem has the potential to become explicit state self-esteem (Dijksterhuis & Nordgren, 2006; Fazio & Olson, 2003; Jordan, Logel, Spencer, Zanna, & Whitfield, 2008; Olson & Fazio, 2009), given that self-experiential components become the subject of attention (Fazio, Powell, & Herr, 1983). Likewise, explicit state self-esteem will become implicit state self-esteem if attention is shifted away from the self-experiential components at that moment.

Implicit is not inaccessible.

Our conceptualization of implicit and explicit state self-esteem suggests that individuals experience (and are aware of) both implicit and explicit state self-esteem. The difference, therefore, refers to a distinction in the quality of the experience, where the quality of the experience can be transformed by means of an attentional shift.

Returning to our earlier distinction between *feel* and *content*, an awareness of implicit state self-esteem means that state self-esteem is experienced as a feeling without reflecting on the content of that feeling (Perry, 2009). Explicit state self-esteem, however, means that state self-esteem is experienced through reflective means, where the individual is aware of the content of the experience.

Our conceptualization, therefore, adopts the position that "implicit" is not synonomous with "inaccessible" (see also Fazio & Olson, 2003; Gawronski, Hofmann, & Wilbur, 2006). We conceive of implicit state self-esteem as being "implicit" only in the sense that the individual may not have had the intention of having a valenced experience of the self, and that the information processing that led to the experience is a spontaneous affective reaction that is not reflective (for a discussion, see Gawronski et al., 2006).

The temporal nature of implicit and explicit state self-esteem.

Thus far, we have discussed a static distinction between implicit and explicit state self-esteem. Here we introduce a temporal aspect, examining how the two qualities of state self-esteem form one process that changes from moment to moment.

Given the SOSE perspective of state self-esteem as a continuous process of self-organization, we suggest that the emergent nature of state self-esteem is also continuously self-organizing as implicit or explicit. With each new iteration of self-organization, state self-esteem has the potential to transition between implicit and explicit. An "iteration of self-organization" can be conceptualized as occurring whenever the network of lower-order self-experiential components changes, either because components come or because they leave. This results in a re-organization of the network, giving rise to the next iteration of emergent state self-esteem. This may occur as a result of one's own actions (in the broadest sense of the word, including emotions, behavior, cognitions, etc.) or due to the immediate context. In this way, implicit and explicit state self-esteem are part of the same temporal process.

This perspective is supported by the Iterative Reprocessing (IR) model of attitudes (Cunningham & Zelazo, 2007), which acknowledges the undeniable malleability of, and continuum between, *automatic* (i.e., experiential) and *controlled* (i.e., reflective) attitudes (Van Bavel, Xiao, & Cunningham, 2012). The IR model suggests that evaluation is dynamic and involves a series of iterative adjustments based on additional information provided by the context or of one's own experience. Like the SOSE perspective of implicit and explicit state self-esteem, the IR model suggests that implicit and explicit evaluations have a sequential relationship (forming one process), rather than a parallel one (forming two processes).

Like other models of attitudes – such as the Associative-Propositional-Evaluation (APE) model (Gawronski & Bodenhausen, 2006, 2007) – the IR model suggests that reflective evaluations are normally based on experiential ones, such that evaluations first emerge as experiential (Van Bavel et al., 2012). As the evaluative process continues, more iterations give way to the possibility of additional reflections – resulting in the emergence of a relatively reflective evaluative process. For example, a negative affective reaction toward the self can be elaborated upon with a self-evaluative thought, such as "I dislike myself" (Gawronski & Bodenhausen, 2006).

It is important to note that, while state self-esteem may iteratively change between experiential and reflective, we are not suggesting that a reflective experience *replaces* an experiential one. Rather than approaching this iterative change as a mutually exclusive transformation, we suggest that it is more accurate to approach it as an additive process. If earlier iterations are experiential by nature, further iterations may result in an additional reflective quality (which can also be removed when attention is directed elsewhere). This means that "cognitive and affective processes work in concert rather than independently" (Van Bavel et al., 2012, p. 445). Experiential processes are thus continuously engaged throughout the iterative process (Cunningham & Zelazo, 2007; Van Bavel et al., 2012). At

any given moment, therefore, it is unlikely that there will be a neat distinction between implicit and explicit state self-esteem. Instead, the state self-esteem experience lies on a continuum between predominantly experiential to predominantly reflective (Carlston, 2010).

The implicit-explicit discrepancy of valence at the state self-esteem level.

As we described at the beginning of the current chapter, many researchers have attested to the 'filtered' nature of explicit self-esteem (Dijksterhuis & Aarts, 2010; Dijksterhuis et al., 2009), where not all aspects of implicit self-esteem are necessarily made explicit – resulting in an implicit-explicit discrepancy of valence (e.g., implicit self-esteem is negative while explicit self-esteem is positive). Here we incorporate this issue into our SOSE conceptualization of state self-esteem, and we discuss how a discrepancy in valence might arise between implicit and explicit state self-esteem between t_x and t_{x+1}.

We suggest that a transformation between implicit and explicit state self-esteem can only be *discrepant in valence* if the self-directed component is of a different valence than the emotional-behavioral components in the lower-order network. This is in accordance with the SOSE perspective of state self-esteem, where the emergent valence of state self-esteem is a function of the positivity and negativity of its lower-order components (see Chapter 2).

For example, let state self-esteem at t_x be implicit and negative (i.e. negative self-directed emotional-behavioral components). If at t_{x+1} a *positive* self-directed cognition is introduced into the lower-order network, attention will be directed toward the emotional-behavioral components, making state self-esteem at t_{x+1} explicit. Moreover, because the new self-directed component is positive, we can expect that this positivity will influence the valence of state self-esteem, such that state self-esteem becomes positive at t_{x+1}. A discrepancy in valence thus arises between implicit state self-esteem at t_x (negative) and explicit state self-esteem at t_{x+1}(positive). A newly introduced self-directed cognition can therefore cause both a shift in attention toward the self (making state self-esteem explicit) while also causing a shift in valence (we will discuss what this means for the macro level of self-esteem, i.e., trait self-esteem, in the section *Integrating single-process and dual-process perspectives from the SOSE model*).

However, according to the Associative-Propositional-Evaluation (APE) model, in order for an experiential evaluation to be successfully transformed into a reflective one, the newly reflective evaluation must be endorsed by the individual; or in APE terminology, it must have a positive *truth-value* (Gawronski & Bodenhausen, 2006). Here, a truth-value is simply referred to as subjective truth, rather than objective truth. Therefore, an evaluation is said to have a positive truth-value if there is cognitive consistency between the evaluation in question and existing reflective evaluations that are momentarily considered to be relevant for the judgment at hand (Gawronski & Bodenhausen, 2006). According to the APE model, experiential evaluations need not have a positive truth-value, but reflective ones do.

Applying this notion to state self-esteem, a newly introduced self-directed cognition may have a positive or negative truth-value. A self-directed cognition has a positive

truth-value if it is consistent with existing reflective self-evaluations. Note that this does not mean that the self-directed cognition is necessarily consistent with the current emotional-behavioral self-experiences in the lower-order network, as these are not 'reflective' evaluations, as emphasized in the APE model (Gawronski & Bodenhausen, 2006). A self-directed cognition has a negative truth-value (i.e., the new cognition is subjectively false) if it is *in*consistent with existing reflective self-evaluations. We will discuss the nature of these 'existing reflective self-evaluations' and their 'consistency' with momentary self-cognitions from a SOSE perspective in the section *Integrating single-process and dual-process perspectives from the SOSE model.* At this point, suffice it to say that whether or not a new self-directed cognition results in a transformation of the *quality* of the emergent state self-esteem from one moment to the next depends on whether it has a positive or negative truth-value.

Let us consider the case in which a newly introduced self-directed component (e.g., the thought "I'm worthless") has a positive truth-value (i.e., it is consistent with existing reflective self-evaluations). If this self-directed component at t_{x+1} is of similar valence to the emotional-behavioral self-experiences at t_x (e.g., embarrassment and seeking reassurance), the implicit-explicit discrepancy in valence will be minimal form one moment to the next (i.e., it will stay negative). On the other hand, if the self-directed component at t_{x+1} is of different valence compared to the emotional-behavioral self-experiences at t_x (e.g., the thought "I'm special"), an implicit-explicit discrepancy in valence will occur from one moment to the next (i.e., state self-esteem becomes more positive). An implicit-explicit discrepancy in valence between state self-esteem at t_x and t_{x+1} therefore depends upon the self-directed component having both a different valence from the existing emotional-behavioral self-experiences and having a positive truth-value.

In contrast, a self-directed component that has a negative truth-value (i.e., is *in*consistent with existing reflective self-evaluations) can be expected to disappear quickly from the individual's experience (in accordance with cognitive-dissonance research; Martinie, Milland, & Olive, 2013), thereby having no effect on the current self-organization of state self-esteem. The individual will thus not experience a transformation of the quality of state self-esteem from t_x to t_{x+1} if the self-directed cognition has a negative truth-value, such that state self-esteem remains implicit.

5.3.2 Trait self-esteem: implicit and explicit as two distinct constructs.

Above we discussed the nature of implicit and explicit self-esteem at the *state* self-esteem level. Here we discuss what the implicit-explicit relationship is at the *trait* self-esteem level. We suggest that the nature of the implicit-explicit relationship at the trait self-esteem level is different than at the state level, due to a difference in the fundamental ontology of state and trait self-esteem. Our conceptualization of these differences is grounded in the SOSE model (see Chapter 2).

In Chapter 4 we empirically validated the SOSE conceptualization of trait self-esteem as a landscape of various trait self-esteem attractors. From this perspective, each trait self-esteem attractor is the result of self-organization out of state self-esteem iterations

(based on self-amplifying feedback loops); such that each state self-esteem experience becomes the input for the following state self-esteem experience until a pattern (i.e., attractor) emerges. The content of a trait self-esteem attractor state thus includes the self-experiences that gave way to the specific state self-esteem iterations for that attractor state. Because the development of trait self-esteem attractors occurs across the long term (i.e. weeks, months, years), there is time for an individual to experience the repetition of various qualities of state self-esteem, thereby giving way to various trait self-esteem attractor states (see Chapter 2).

Here, we suggest that the characteristics regarding the iterative development of state self-esteem into trait self-esteem attractors across the long term can also be applied to the emergence of trait self-esteem attractors as predominantly implicit versus predominantly explicit. In Chapter 2 we described how trait self-esteem attractor states emerge out of iterations of state self-esteem that are similar to each other. We therefore suggested that state self-esteem experiences that are more negative self-organize into a relatively negative trait self-esteem attractor, for example. Therefore, trait self-esteem attractors differ from each other across the dimension of *valence*, i.e., positivity or negativity. Here, we introduce a dimension of *quality*, i.e., implicit or explicit. We reason that state self-esteem experiences that are similar to each other in their implicit or explicit quality will self-organize into predominantly implicit or explicit trait self-esteem attractors, respectively. This conceptualization of separate trait self-esteem attractor states for implicit versus explicit experiences of the self is in accordance with the traditional duality-perspective, in which the self is a "conglomerate of multiple subsystems", some of which are available for self-report and others are not, where the latter function implicitly (Koole & Pelham, 2003).

Additionally, just as the valence dimension of trait self-esteem attractor states can be conceptualized as continuous, we also suggest that the quality dimension is continuous. As such, trait self-esteem attractor states need not be strictly implicit or explicit, but may be characterized by an intermediate quality, depending on the quality of their lower-order input. In general, trait self-esteem attractor states can be conceptualized as differing from each other across two dimensions: valence and quality.

Recall from Chapter 2 that a trait self-esteem attractor of a specific nature (e.g., positive versus negative, or implicit versus explicit – as introduced here) is experienced by an individual through the constraint that it has on the individual's current and future state self-esteem experiences. Therefore, an *implicit* trait self-esteem attractor increases the likelihood of current and future *implicit* state self-esteem experiences, while an *explicit* trait self-esteem attractor increases the likelihood of current and future *explicit* state self-esteem experiences. Together, these trait self-esteem attractor states provide possibilities for the direction that state self-esteem can take at any given moment. A moment-to-moment transition from one trait self-esteem attractor to another corresponds with the sequential changes that occur in the state self-esteem process (regarding valence or the implicit/explicit quality). The stronger the trait self-esteem attractor (i.e., the wider and deeper the basin of attrac-

tion), the larger the likelihood that state self-esteem will move toward, and maintain, that corresponding quality.

Additionally, recall from Chapter 2 that – while only one trait self-esteem attractor can be experienced at a time – trait self-esteem is multi-stable, in that multiple trait self-esteem attractors can simultaneously exists. An individual may therefore have multiple explicit trait self-esteem attractors as well as multiple implicit trait self-esteem attractors. A given trait self-esteem attractor state is experienced in the present moment when state self-esteem corresponds with its lower-order input. This is demonstrated in Figure 1 (an attractor landscape), where each valley represents a different trait self-esteem attractor, and where the ball represents state self-esteem.

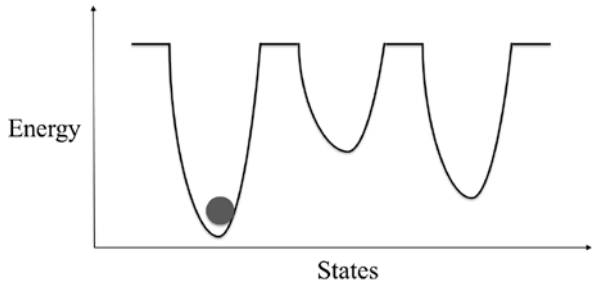

Figure 1. An attractor landscape, portraying trait self-esteem attractors as valleys and state self-esteem as a ball rolling into one valley at a time. This figure is from Chapter 2 in the current thesis.

The implicit-explicit discrepancy of valence at the trait self-esteem level.

The above conceptualization of implicit and explicit trait self-esteem corresponds with the traditional findings regarding a discrepancy between implicit and explicit trait self-esteem. As discussed earlier, a relatively large implicit-explicit discrepancy has been found to be dysfunctional (Bosson et al., 2003), where this discrepancy can be decreased by means of characteristics related to more self-knowledge (Jordan et al., 2007; Koole et al., 2009; LeBel, 2010). From the SOSE perspective, large discrepancies in valence between implicit and explicit trait self-esteem attractors indicate that there is intrinsic inconsistency within the trait self-esteem landscape.

This conceptualization is supported by Vallacher, Nowak, Froehlich and Rockloff's (2002) research based on self-narratives. Vallacher et al. found that individuals who are lower in subjective self-certainty demonstrated larger differences between positive and negative states of self-narratives. Based on this finding, a higher discrepancy in valence of attractor states can indeed be conceptualized as being less advantageous (i.e., less self-certainty) than a lower discrepancy. A discrepancy in valence between *implicit* and *explicit* trait self-esteem attractors can therefore also be expected to correspond with lower self-certainty, and therefore to be experienced as aversive. From the SOSE model perspective, a

larger discrepancy between implicit and explicit trait self-esteem attractors (and thus lower self-certainty) would be reflected in a real-time pull between largely discrepant, and inconsistent, potential experiences of state self-esteem.

While the SOSE model conceptualization of the implicit-explicit relationship at the trait level is similar to the traditional duality perspective regarding implicit and explicit self-esteem as separate constructs, there are also important differences between the two perspectives. Specifically, while traditional duality perspectives conceive of implicit versus explicit self-esteem constructs as mental representations (Strack & Deutsch, 2004), we conceive of them as attractor states. While it is possible to form representations regarding implicit or explicit attractor states, the SOSE model suggests that these representations are not the essence of implicit or explicit trait self-esteem. Forming a representation about an attractor state is possible in as far as individuals are able to form an aggregative conclusion regarding their own self-experiential history. A representation of implicit trait self-esteem is thus an aggregative conclusion regarding one's emotional-behavioral self-experiential history, while a representation of explicit trait self-esteem is an aggregative conclusion regarding one's reflective self-experiential history.

5.3.3 Integrating single-process and dual-process perspectives from the SOSE model.

While researchers tend to adopt *either* the perspective that implicit and explicit attitudes such as self-esteem are part of one process *or* that they are themselves two processes or constructs, our SOSE conceptualization allow these perspectives to be integrated. At the *state* level, implicit and explicit self-esteem are conceptualized as separate iterations in one continuous process of self-organization. At the *trait* level, implicit and explicit self-esteem are conceptualized as distinct attractor states (where individuals may differ in how many implicit or explicit attractor states they develop). Moreover, these two conceptualizations can be integrated, as trait and state self-esteem processes are highly integrated in the SOSE model.

As we discussed in Chapter 2, the self-organization of an existing trait self-esteem attractor is triggered in real time when a lower-order component of that attractor state emerges in real-time (which first results in the self-organization of state self-esteem). This is the bottom-up relationship between state self-esteem and trait self-esteem. Moreover, each time that a specific trait self-esteem attractor is triggered in real-time, it is experienced through the constraint that it has on state self-esteem, and the lower-order interactions thereof. This is the top-down relationship between trait self-esteem and state self-esteem, which also results in the strengthening of the trait self-esteem attractor state (due to the self-amplifying feedback loops between the state and trait levels; see Chapter 2). Trait self-esteem and state self-esteem are thus dynamically connected by a bi-directional relationship.

From this perspective, a real-time self-evaluative cognition (with a positive truth-value, such that explicit state self-esteem emerges) triggers and self-amplifies the corresponding explicit trait self-esteem attractor. A real-time self-directed emotion or autonomous action that is not accompanied by self-evaluative cognitions triggers and self-

amplifies the corresponding implicit trait self-esteem attractor. At the same time, the existence of an implicit trait self-esteem attractor provides state self-esteem with the potential to be experienced implicitly, and increases the likelihood that this potential will be realized. An explicit trait self-esteem attractor will provide an alternative potential, i.e., the experience of state self-esteem as reflective. In this way, implicit and explicit trait self-esteem attractors differentially predict real-time behavior. This is figuratively displayed below (Figure 2). For the sake of simplicity, the figure only portrays one implicit and one explicit attractor state (implicit trait self-esteem and explicit trait self-esteem, respectively).

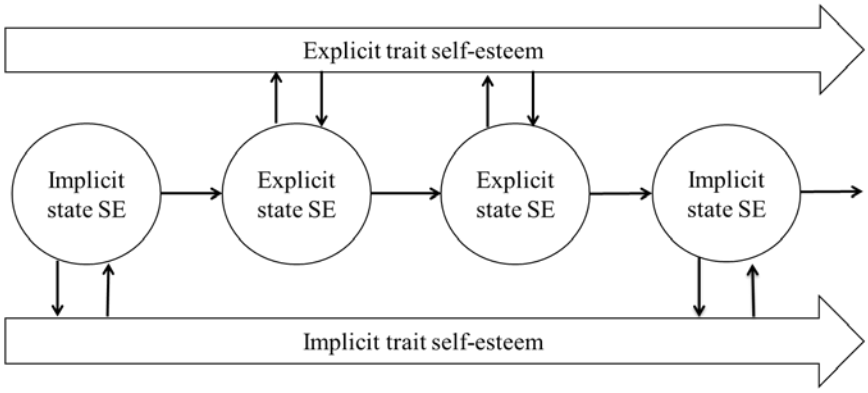

Figure 2. SOSE perspective of implicit-explicit trait self-esteem and implicit-explicit state self-esteem as one system.

We now return to the conceptualization of a *truth-value*, defined in the APE model as positive when the cognition in question is consistent with existing reflective evaluations (Gawronski & Bodenhausen, 2006). This was incorporated into our SOSE model such that implicit state self-esteem can only be transformed into explicit state self-esteem at the next moment if the newly introduced self-directed cognition has a positive truth-value. Our SOSE model provides further clarification regarding what an 'existing reflective evaluation' is, and what it means for the self-directed component to be 'consistent' with it.

From the SOSE perspective, an existing reflective evaluation can be conceptualized as an existing explicit trait self-esteem attractor. A self-directed cognition is thus consistent with an existing reflective evaluation if it is similar to the content (i.e. lower-order input) of that attractor state. If the self-directed cognition is consistent with the explicit trait self-esteem attractor state, this will trigger the explicit trait self-esteem attractor state. According to the bi-directional dynamics described in the SOSE model, this triggering will mean that the explicit trait self-esteem will constrain the state self-esteem variability – resulting in state self-esteem being momentarily constrained as 'explicit'. This thus corresponds with the notion that a positive truth-value allows the implicit state self-esteem to be transformed into explicit state self-esteem.

Although the Iterative Reprocessing (IR) model does not explicitly make a state-trait distinction, nor does it explicitly concern self-esteem, it supports our above conceptualization by making a distinction between evaluations and attitudes. In the IR model, evaluations are the *current* evaluative processes (which rapidly shift between implicit and explicit in reaction to the context). This can be compared to state self-esteem – iteratively changing between implicit and explicit – from the SOSE perspective. Alongside evaluations, the IR model posits that individuals also experience attitudes, which are stable patterns of pre-existing connections between evaluations (of which only a few are active at any point in time). These can be compared to pre-existing implicit and explicit trait self-esteem attractors from the SOSE perspective.

Moreover, like the SOSE model, the IR model also suggests that attitudes (i.e., trait self-esteem attractors) and evaluations (i.e., state self-esteem) are continuously interacting with each other, where evaluations are thought to activate existing attitudes, and attitudes are thought to guide current evaluations (Cunningham, Zelazo, Packer, & Van Bavel, 2007). This can be compared to the bi-directional relationship between trait and state self-esteem in the SOSE model. Our SOSE model builds on the IR model by explicitly describing the underlying mechanisms that determine whether self-esteem is currently experiential or reflective (i.e., based on the quality of the lower-order components), and how these mechanisms differ for state and trait self-esteem.

5.4 Summary

In this chapter, we suggest that – from the SOSE-model perspective – implicit and explicit *trait* self-esteem are *separate* constructs insofar as they are separate attractor states that have differentiated themselves from each other across the long term. The model also suggests that implicit and explicit *state* self-esteem are part of the *same* process, as they represent different qualities that sequentially emerge with each iteration of the state self-esteem process. Implicit and explicit trait self-esteem are connected to implicit and explicit state self-esteem through a bottom-up process of emergence and a top-down process of constraint. With this conceptualization, it is possible to integrate the two traditional perspectives of implicit and explicit self-esteem. The SOSE model therefore provides a framework from which an overarching conceptualization of implicit and explicit self-esteem can be developed (see Figure 2).

To date, extant research has investigated the implicit-explicit discrepancy in valence based on trait self-esteem measures of implicit and explicit self-esteem. In distinguishing how mechanisms resulting in an implicit-explicit discrepancy differ at the trait level and the state level (thereby including 'state self-esteem' in the theoretical discussion), our model also extends the mainstream discussions regarding the origin and nature of this discrepancy. Moreover, extant research has focused predominantly on the discrepancy between implicit and explicit self-esteem as static constructs, without considering how this discrepancy unfolds and fluctuates across time. The SOSE model thus also expands upon the theoretical discussions of implicit versus explicit self-esteem by offering a process per-

spective of the origin and nature of an implicit-explicit discrepancy, at both the state and trait level.

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CHAPTER 6
Conclusion and Discussion

In this final chapter I aim to summarize the theoretical formulations and empirical findings of this thesis, and to review and integrate the implications that they have. I begin by providing an overview of the context that gave rise to the questions posed in this thesis, and the global aim of the thesis (6.1). Next, I summarize the findings from Chapter 2, 3, 4, and 5 separately (6.2). This is followed by an integration of the chapters, where I focus on the theoretical and methodological developments that emerged from the thesis as a whole (6.3). Afterwards, I discuss the implications that the theoretical formulations and empirical findings have for future self-esteem research (6.4). Finally, I address the limitations of the thesis (6.5) and I provide some concluding remarks (6.6).

6.1 Research Motivation and Context

Self-esteem is one of the most investigated topics in personality and social psychology, with most studies focusing on self-esteem as a predictor variable, an outcome variable, or a mediating variable (Brown & Marshall, 2001). However, "compared to the tidal wave of empirical studies, the analytic concept of self-esteem is relatively undeveloped" (Scheff & Fearon, 2004, p. 79). Indeed, since the development of self-esteem questionnaires such as the Rosenberg Self-Esteem Scale (Rosenberg, 1979), the empirical and theoretical approach to self-esteem has remained quite stable.

Self-esteem has long been seen as the favorable or unfavorable view that people have of themselves, with deviations from this view occurring in our daily lives in response to experiences that we have (Kernis, Cornell, Sun, Berry, & Harlow, 1993). As a "view", self-esteem is commonly seen as a cognitive construct, which is connected to motivational (Kernis, 2003) and affective (Brown, 1998) processes. The emphasis in empirical research thus continues to be the *cognitive* nature of self-esteem, which is reflected in questionnaire items such as "I take a positive attitude toward myself" (Rosenberg, 1979).

The aim of this thesis was to focus on the foundation of self-esteem, and to dig deeper than the positivity or negativity of the cognitive view that people have of themselves, both in general and in response to daily experiences. I wanted to know what the nature and origin are of what lies *beneath* the view that individuals can have of themselves. I therefore aimed to unveil the underlying processes that give rise to, and that characterize, the experience of self-esteem – both as a momentary experience (i.e. *state self-esteem*) and as a recurring and continuous experience (i.e. *trait self-esteem*).

For this aim, I utilized complex dynamic systems principles in order to develop a theoretical model that describes the nature and origin of the patterns that underlie the state and trait experience of self-esteem. A complex dynamic systems perspective is one that examines how simple elements interact across time, and how this interaction creates a higher-order emergent property that cannot be characterized by the characteristics of the elements alone (Thelen & Smith, 1994). From this perspective, I reasoned that self-esteem can be seen as an emergent property that is created across time by the interactions between self-experiential elements that occur in the present moment, such as emotions regarding the self or autonomous behavior. I argued that trait self-esteem is an emergent property that is self-maintaining across time, and that state self-esteem is a fleeting emergent property, where the two develop across different time scales. My primary aim was to develop a model that outlines and elaborates on the abovementioned notions. My secondary aim was to test pivotal cruxes of the theoretical model, in order to provide a proof of existence of the underlying nature of self-esteem as proposed in this thesis.

In order to empirically examine the underlying nature of self-esteem, it was necessary to focus on the phenomenology of self-esteem as individuals experience it in the here-and-now. This involved two methodological adaptations to the study of self-esteem. Firstly, from the perspective that self-esteem is an *emergent* property – where emergence occurs across time, the role of *time* must be considered. It was therefore necessary to capture the

dynamic nature of self-esteem. Moreover, both state self-esteem and trait self-esteem (irrespective of the time scale across which they develop) are experienced in the present moment. As I was interested in the nature of the experience of self-esteem, the time span across which self-esteem needed to be considered was across seconds and minutes, i.e. real-time.

Secondly, it was necessary to adopt a more holistic empirical approach to self-esteem than has traditionally been done. Traditional self-esteem research focuses predominantly on the cognitive characteristic of self-esteem, stemming from the goal of studying the 'view' that individuals have of themselves. In order to study what underlies individuals' views of themselves, it was necessary to focus on the emotional-behavioral characteristics of self-esteem that have been theorized as important, yet not empirically considered (Brown & Marshall, 2001; Scheff & Fearon, 2004).

The present thesis incorporated these two methodological adaptations by focusing on moment-to-moment emotional-behavioral self-experiences that could be observed during dyadic interaction. Dyadic interaction was chosen as the context because it allows for the organic elicitation of emotional-behavioral self-experiences (Gable et al., 2012; Koerner & Fitzpatrick, 2006), and because such interaction plays a vital role in the way that self-esteem emerges into a structured state (Fogel, 1993; Tangney & Fischer, 1995).

Adolescence was chosen as the developmental context for studying the phenomenology of self-esteem, given that it is a period in which self-esteem has traditionally been found to demonstrate relatively high variability and developmental change (Robins & Trzesniewski, 2005; Trzesniewski et al., 2003). As a result, the parent-child relationship was chosen for the dyadic context, given that parents play an important role in adolescents' self-esteem (Bulanda & Majumdar, 2008). The empirical studies in this thesis are based on observational data gained by means of video-recordings of the parent-child dyads, which were subsequently coded in a time-serial manner, using the coding scheme in the Appendix of this thesis.

6.2 Summary of Findings

In **Chapter 2**, the Self-Organizing Self-Esteem (SOSE) model is presented. The model suggests that self-esteem is a self-organizing phenomenon that exists on various levels of complexity, resulting from development across various time scales. The model discriminates between three levels of self-esteem: the macro level, the meso level, and the micro level. We suggested that trait self-esteem (traditionally seen as the stable view of the self) is the macro-level construct of self-esteem, while state self-esteem (commonly seen as the context dependent and fluctuating view of the self) is the meso-level construct of self-esteem.

Based on complex dynamic systems principles, we suggested that both state self-esteem and trait self-esteem depend on processes of self-organization, such that they are both higher-order emergent constructs of self-esteem, separate from (yet intertwined with) each other. We suggested that state self-esteem, at any given moment, self-organizes out of a real-time network of self-related experiences on the micro level, and that trait self-esteem

self-organizes out of the iterative development of state self-esteem at the macro level. We described how both of these processes occur due to self-amplifying feedback loops. We also suggested, however, that the meso-level and macro-level of self-esteem are highly interconnected, where their relationship is bi-directional and continuous.

The model suggests that the macro level of self-esteem can be conceptualized as a landscape of attractor states, which were referred to as *trait self-esteem attractor states*. We posited that each trait self-esteem attractor state results in a unique constraint on future state self-esteem iterations by means of self-reinforcing feedback loops. Each trait self-esteem attractor provides a potential direction for state self-esteem development, such that state self-esteem is pulled toward the various potential directions of self-experience in real time.

Because state self-esteem is repeatedly drawn toward a small number of trait self-esteem attractor states, the individual experiences a continuity of self-esteem across time, and more specifically, the continuity of various qualities of self-esteem. From this perspective, trait self-esteem attractor states make trait self-esteem self-maintaining. This self-maintenance of trait self-esteem is experienced through the bi-directional relationship that trait self-esteem attractor states have with state self-esteem variability. As long as an individual's self-esteem system includes strong trait self-esteem attractor states, the individual will experience continuity of self-esteem. However, just as trait self-esteem attractor states have a propensity to change across the long term, so too does the quality of trait self-esteem that is self-maintained.

In this chapter, we described how the SOSE model corresponds with an *emergent-causality approach* (Coan, 2010; Schmittmann et al., 2011). From this perspective causality is primarily bottom-up, where concrete experiences interact with each other to form a coherent network, which then gives way to the emergence of a higher-order psychological construct. This relates to the SOSE model, where concrete emotional-behavioral self-experiences interact to form a network that emerges into state self-esteem, and where state self-esteem develops iteratively to form patterns that emerge as trait self-esteem. We described that this approach is not usually adopted in psychological research. Instead, a *generative-causality approach* is most commonly adopted, albeit implicitly. In this approach, the phenomenon being studied is approached as a latent trait that resides within the individual and is not directly observable. The latent trait is assumed to generate concrete experiences and actions in a unidirectional and top-down manner (Borsboom et al., 2003; Coan, 2010).

The generative-causality approach can be observed in mainstream self-esteem research, where trait self-esteem is most commonly seen as a latent variable that generates experiences of the self, in combination with the current context. State self-esteem is indeed commonly approached as a reflection of a latent trait self-esteem variable, plus contextual error. This conceptualization is demonstrated in the common 'baseline' and 'barometer' approach to self-esteem (Rosenberg, 1979), where trait self-esteem is seen as a stable baseline level, around which state self-esteem fluctuates in response to the environment. This conceptualization is also demonstrated in the common empirical approach to state self-

esteem, where repeated measures of state self-esteem are primarily used in order to say something about the central tendencies of trait self-esteem (i.e., mean and standard deviation; Kernis, 1993).

We showed how, aside from studying central tendencies of trait self-esteem, research that adopts a generative-causality approach focuses on factors that cause between-individual differences and long-term development of trait self-esteem. We argued that, due to the generative-causality approach adopted, traditional research is inherently less equipped to study the *intrinsic dynamics* of self-esteem, at both the trait self-esteem level and the state self-esteem level. Intrinsic dynamics are internally generated patterns of change (Vallacher, Van Geert, & Nowak, 2015). We suggested that, in order to study the dynamics of self-esteem that are intrinsically generated, an emergent-causality approach is necessary. The SOSE model is the first explicit application of an emergent-causality approach to self-esteem, where complex dynamic systems principles made it possible to expand on this model and incorporate a conceptualization of the temporal nature of self-esteem.

In **Chapter 3**, the first crux of the SOSE model is tested. The temporal structure of state self-esteem was investigated as it occurs from moment to moment in the context of dyadic interaction. This was done in order to investigate whether state self-esteem demonstrates characteristics in accordance with the 'baseline' and 'barometer' theory of self-esteem, as is traditionally assumed. We described how, from this traditional perspective, state self-esteem would be expected to fluctuate in response to the environment. Therefore, each state self-experience would be expected to be *intrinsically* independent from the previous, with any causal dependence stemming from an extrinsic dependence between environmental events. The intrinsic variability would thus resemble random temporal variability, according to the traditional perspective. Alternatively, we expected – in accordance with the SOSE model – that state self-esteem would develop iteratively, giving way to structured (rather than random) variability that stems from the intrinsic dynamics of state self-esteem.

State self-esteem time series were created for 13 adolescents, based on their emotional and behavioral self-directed expressions during parent-child interactions. State self-esteem was operationalized as the average valence of the various self-experiences that occurred at each second, where this valence changed from moment-to-moment based on the moment-to-moment changes in the concurrent self-experiences expressed. Each state self-esteem time series was studied using detrended fluctuation analysis (DFA), which analyzes the fluctuation of dynamics across time and quantifies the degree of randomness in the time series. We found that all of the time series demonstrated a form of structured variability called *pink noise*. This kind of variability indicates that there are long-range correlations in the time series, such that there is historicity (or 'memory').

The presence of long-range memory indicates that state self-esteem fluctuations are a function of intrinsic dynamics, rather than simply responses to the immediate environment. Furthermore, we found that the temporal variability demonstrated in the state self-esteem time series was significantly less random than surrogate random time series. Finally,

we also showed that the structure of variability was related to adolescents' self-report autonomy levels, albeit insignificantly, indicating that this kind of structured variability is likely related to advantageous developmental factors. Aside from validating an important premise of our SOSE model – regarding the iterative nature of state self-esteem – this study is the first to examine the temporal *structure* (rather than magnitude) of state self-esteem from moment-to-moment as a contextualized process.

In **Chapter 4**, the moment-to-moment trait-state relationship proposed in the SOSE model is empirically tested. In doing so, we investigated the real-time phenomenology of trait self-esteem, which the SOSE model suggest is the real-time constraint that trait self-esteem attractors have on state self-esteem variability, resulting in continuity of trait self-esteem properties across the time span of one interaction (i.e., the self-maintained characteristic of trait self-esteem).

Based on the SOSE model, we expected that trait self-esteem attractors would result in multiple real-time constraints on state self-esteem, such that the real-time expression of each trait self-esteem attractor would correspond with the simultaneous restriction of state self-esteem variability within a limited valence range. We argued that the level of constraint is indicative of the strength of the trait self-esteem attractors, where more constraint indicates higher strength. In order to test whether this argument is valid, we tested whether the stronger trait self-esteem attractors demonstrated a key characteristic of strong attractors, compared to the weaker trait self-esteem attractors. The key characteristic that we tested was the moment-to-moment influence that the immediate context (i.e., external events) had on state self-esteem variability. From a complex dynamic systems perspective, this external influence can result in *perturbations*, being any influence that results in a change in the systems behavior. From a complex dynamic systems perspective, perturbations from external influences have less effect on strong attractor states (due to self-reinforcing feedback loops) compared to weak attractor states. Therefore, we expected that adolescents with relatively strong trait self-esteem attractors should also demonstrate relatively smaller effects of perturbations on their state self-esteem variability.

In this study, the micro-level of self-esteem was operationalized as the valence of the adolescents' moment-to-moment self-experiences (as in Chapter 3), and the meso-level of self-esteem (i.e. state self-esteem) was operationalized as the average valence of the various self-experiences that occurred at each second (as in Chapter 3). Additionally, the macro-level of self-esteem (i.e. trait self-esteem) was operationalized as the self-organization of temporal structure, captured with Kohonen's Self-organizing Maps (SOM). This technique revealed the emergence of each individual's two strongest trait self-esteem attractors, characterized as a distinct recurring network of self-experiences. The SOM maintains the temporal structure of these networks, thereby revealing the moment-to-moment transitions that occurred between them across the entire dyadic interaction. Using the SOM, we thus obtained entirely new higher-order time series for each individual, consisting only of the transitions between trait self-esteem attractor states.

We operationalized the *strength* of the adolescents' trait self-esteem attractors as the level of constraint from trait self-esteem attractor states on state self-esteem variability. This was done using State Space Grid (SSG) analyses. This technique allowed us to track variability at the macro level (transitions from one trait self-esteem attractor to another) and the simultaneous variability at the meso level (changes in state self-esteem valence) for each individual separately based on the two separate time series. Next, we operationalized *external perturbations* as significant moment-to-moment changes in the parental emotional-behavioral interaction style during the interaction. The *effect* of these perturbations on the adolescents' state self-esteem was operationalized as the level of influence that these changes had on the adolescents' moment-to-moment state self-esteem variability. Changes in these parental emotional-behavioral interaction styles were captured using the SOM, and the level of correspondence with adolescent state self-esteem variability was measured using SSGs.

We tested whether stronger adolescent trait self-esteem attractors corresponded with smaller effects of perturbations due to changes in the parents' interaction styles. Based on a Monte Carlo analysis of individual differences, we showed that adolescents who had relatively stronger trait self-esteem attractor states (where individuals were differentiated based on a median split), were also those that were less perturbed by their parent, and vice versa for individuals with relatively weaker trait self-esteem attractor states. These results validated our SOSE-model conceptualization of trait self-esteem as consisting of attractor states, as well as our proposition that these attractor states are experienced through the real-time constraint that they have on state self-esteem variability.

In **Chapter 5**, we applied the conceptual ideas stemming from the SOSE model regarding the nature of self-esteem to the traditional distinction between implicit and explicit self-esteem. The concept of self-esteem has traditionally been seen as a reflective construct, i.e., explicit self-esteem, where the idea that self-esteem may also be implicit was introduced relatively recently (Greenwald & Banaji, 1995). The introduction of implicit self-esteem into self-esteem literature, however, has been mostly atheoretical, where implicit self-esteem research "largely has been a methodological, empirically driven enterprise" (Fazio & Olson, 2003, p.301). In this chapter, we aimed to develop a theoretical conceptualization of the distinction between implicit and explicit self-esteem based on our SOSE model. As the SOSE model distinguishes between trait self-esteem processes and state self-esteem processes, the chapter therefore integrated this trait-state distinction with the classic implicit-explicit distinction.

Based on the SOSE-model propositions, we suggested that a qualitative distinction between implicit and explicit self-esteem is different at the trait level and the state level. At the state level, state self-esteem emerges as implicit if the lower-order network consists of emotional-behavioral self-experiences, while explicit state self-esteem emerges if this network includes self-directed cognitions. We reasoned that such self-directed cognitions makes state self-esteem explicit due to the shift in attention that they cause, where con-

scious attention is directed at the emotional-behavioral self-experiences, making the individual reflect upon them.

As the SOSE model suggests that state self-esteem develops iteratively from moment-to-moment, we suggested that each new iteration has the potential to be explicit or implicit, depending on the lower-order network at each moment. Therefore, implicit and explicit self-esteem form one state self-esteem process, which changes in its quality (i.e. implicit or explicit) from moment-to-moment depending on the presence or absence of self-directed cognitions. In this way, our perspective of implicit and explicit *state* self-esteem is similar to the commonly held theoretical perspective that the two are part of one construct (Gawronski & Bodenhausen, 2007; Olson & Fazio, 2009), although our perspective expands on the temporal nature of this construct, and explicitly refers to *state* self-esteem.

Next, we suggested that – based on the SOSE model of trait self-esteem – implicit and explicit *trait* self-esteem can be conceptualized as separate trait self-esteem attractors. *Implicit* trait self-esteem attractors are the result of long-term iterative development of *implicit* state self-esteem, while *explicit* trait self-esteem attractors emerge out of the long-term iterative development of *explicit* state self-esteem. Moreover, just as individuals can potentially develop distinct trait self-esteem attractors that correspond to a distinct valence range (see Chapter 2), individuals may also develop multiple implicit and multiple explicit trait self-esteem attractors. In this way, our perspective of implicit and explicit *trait* self-esteem resembles the commonly held theoretical perspective that the two are separate constructs (Bosson, Swann, & Pennebaker, 2000; Greenwald & Banaji, 1995; Strack & Deutsch, 2004), although our perspective is that these constructs emerge across time out of lower-order input and remain dynamic by nature.

In social cognition literature, in remains heavily debated whether implicit and explicit cognitions (including self-esteem) are *one* versus *separate* constructs (for reviews, see Evans, 2008; Frankish, 2010). Because our SOSE model integrates trait and state self-esteem processes, we argued that the conceptualization suggested in this chapter can integrate the two perspectives of the implicit-explicit relationship (as one versus separate constructs). We showed that implicit and explicit *trait* self-esteem can be conceptualized as separate constructs, while implicit and explicit *state* self-esteem can be conceptualized as part of one process. Moreover, because the SOSE model integrates state and trait dynamics, it can also integrate the two opposing perspectives held in social cognition literature.

Specifically, the separate trait self-esteem attractors all have their own constraint on state self-esteem, such that an implicit trait self-esteem attractor increases the likelihood that state self-esteem will emerge as implicit, and vice versa for an explicit trait self-esteem attractor. Moreover, we suggested that, once state self-esteem emerges as implicit versus explicit at any given moment, this will trigger – and thus reinforce – the corresponding attractor state. In this way, we showed that implicit and explicit trait self-esteem has a bi-directional relationship with implicit and explicit state self-esteem. This chapter thus contributes to existing literature regarding implicit-explicit self-esteem by grounding the distinction in the SOSE theory, thereby accounting for the temporal nature of implicit and

explicit self-esteem, making a distinction between processes at the trait level and at the state level, and integrating the two dominant perspectives of implicit-explicit self-esteem.

6.3 Integration and Emerging Developments

Self-esteem, like other psychological "trait-like" concepts – such as personality and intelligence – are commonly approached as being relatively stable qualities that reside within the individual (i.e., as *latent*; Cramer, Sluis, Noordhof, & Wichers, 2012; Van der Maas et al., 2006). These trait-like constructs are assumed to be the primary cause of momentary "state-like" expressions of the underlying construct, where the immediate context results in a momentary deviation between the latent trait level and the manifested state level (Borsboom, Mellenbergh, & Van Heerden, 2003). This common approach emphasizes the inter-individual differences (Van Geert, 2014), and does so by focusing on the association between the trait and external variables (either based on the prediction of the trait or the predictive-value of the trait).

In the current thesis, it is suggested that, while such research is of course valuable, as it sets the groundwork for understanding the relationships between variables at the level of the population, psychological research should – and can – *also* aim to understand the *intrinsic dynamics* of a trait-like construct itself by approaching it as a self-organizing construct that emerges out of lower-order interactions. Extant theoretical and empirical research regarding self-esteem, however, does not readily encourage this kind of research, due to the fundamental theoretical approach adopted. This thesis provides the first steps in empirically showing that the nested system of self-esteem (including self-experiences, state self-esteem, and trait self-esteem) *does* demonstrate meaningful intrinsic dynamics, and that these can be empirically studied in order to understand how trait-like constructs (i.e. trait self-esteem) emerge and can be characterized.

Firstly, we showed that moment-to-moment emotional-behavioral self-experiences produce a state self-esteem *process* (Chapter 3). I emphasize 'process' here, because we found that state self-esteem is a continual process of causal interaction, such that the process itself is the foundation for causality (Chakravartty, 2005; Dowe, 2000, 2010; Salmon, 1998a, 1998b). Indeed, we showed that state self-esteem is not a sequence of discrete states, each of which generated by trait self-esteem with moment-to-moment deviations in response to environmental stimuli (as is commonly assumed). Instead, the findings demonstrated that each state self-esteem experience gives way to the next state self-esteem experience – making it a continuous process. We therefore showed that state self-esteem is intrinsically dynamic, resulting in iterative development that produces long-range memory.

If state self-esteem is not passively generated by trait self-esteem, what then characterizes the relationship between state self-esteem and trait self-esteem? This thesis shows that this relationship is characterized as actively bi-directional – again, creating intrinsic dynamics (Chapter 4). Moreover, at any given moment, state self-esteem is not 'generated', but *constrained*, by trait self-esteem. While state self-esteem thus develops iteratively out of its own intrinsic dynamics, the direction of this development (for example, in the positive direction or in the explicit direction) is influenced by the potential that trait self-esteem

provides. Moreover, we showed that trait self-esteem need not be seen as one 'baseline level', but as consisting of multiple experiential equilibria (called *attractor states*). While state self-esteem moves toward these experiential equilibria from moment-to-moment, each time that an equilibrium is reached, it is also reinforced.

6.3.1 Theoretical developments

These findings encourage important theoretical developments regarding how we think about the nature and the origin of state and trait self-esteem. First, while little theoretical attention has been paid to the nature of state self-esteem development, the findings in this thesis contradict the traditional conceptualization of state self-esteem itself. This thesis develops the idea that state self-esteem is its own process, with its own intrinsic dynamics, rather than contextually-based deviations. Second, the theoretical formulations and empirical findings in this thesis develop the idea that trait self-esteem is a multi-stable emergent structure that is dynamic. Third, the relationship between trait self-esteem and state self-esteem is commonly seen as top-down, where trait self-esteem causes state self-esteem. The theoretical formulations and empirical findings in this thesis demonstrate that this relationship is likely more complex than this commonly assumed, and that the relationship can be characterized as being bi-directional, between nested self-esteem constructs. Furthermore, this relationship can be conceptualized as being dynamic and active both in real-time and across the long-term.

Finally, – and in response to my general question posed at the beginning of this thesis – the findings from this thesis help explain what the nature and origin of the underlying processes of self-esteem are. This thesis suggests that the nature of self-esteem is that of an emergent property. The time span across which this developmental emergence occurs determines the exact nature of the emergent property. As such, the nature of state self-esteem is that of an emergent property that is fleeting from moment-to-moment. The nature of trait self-esteem, on the other hand, is that of an emergent property that is self-maintaining across time. The trait self-esteem property is more specifically characterized by the equilibrium points, or attractor states, that the individual experiences through the recurring pull that these points have on current and future iterations of state self-esteem; where the strength of this pull depends on the strength – i.e., width and depth – of the attractor states that make up the trait self-esteem attractor landscape.

Regarding the origin of self-esteem, both of these emergent properties (i.e., trait and state self-esteem) originate from the self-experiential elements that occur in real-time (i.e. the present moment), and more specifically, the continuous interactions between these elements that result in the self-organizational process across the nested levels (from self-experiences, to state self-esteem, to trait self-esteem). From this perspective, the experience of self-esteem is the result of the intrinsic dynamics between the nested constructs of self-esteem. Given that this nested system is always dynamically evolving, so too is an individual's experience of self-esteem. While the historicity of self-maintained self-esteem provides individuals with experiential continuity, the nature of this continuity – as positive or negative, or as implicit or explicit – will continue to change in the future. Rather than being

a direct cause of some external influence, however, these changes will come about through the moment-to-moment variability of how individuals experience themselves in the present moment. While an individual can of course reflect on his or her continuity of self-esteem – resulting in a view of oneself as positive or negative – this reflection is not the foundation of one's experience of oneself as positive or negative. The foundation of the positivity or negativity of how individuals experience themselves, i.e., of self-esteem, consists of the processes and dynamics that give rise to the emergent properties of self-esteem.

The self-maintenance that is provided by trait self-esteem attractor states does not only refer to self-maintenance across the long term, but also to self-maintenance in the current moment (as demonstrated in Chapter 4). A trait self-esteem attractor state that is strong (i.e., deep and wide) both increases the likelihood that lower-order constructs will move toward that attractor state, and decreases the degrees of freedom of lower-order variability once the lower-order construct has done so, thereby increasing the amount of energy that is needed for external events to perturb the current state of the lower-order construct. Trait self-esteem attractor states therefore result in self-maintenance in real-time by pulling lower-order constructs (i.e., state self-esteem) toward the equilibrium point provided by the corresponding trait self-esteem attractor. In Chapter 4, we suggested that this real-time self-maintenance is the basis of the real-time phenomenology of trait self-esteem.

Aside from the intrinsic value of developing a conceptualization of the real-time phenomenology of trait self-esteem that can be tested (as was done in Chapter 4), this conceptualization of the phenomenology of trait self-esteem provides additional explanation for the traditional conceptualization that positive self-esteem is a 'need', and that it is advantageous to 'enhance' self-esteem (Baumeister, Tice, & Hutton, 1989; Brown, 1998; Robins et al., 2002). Specifically, it is commonly found that positive self-esteem is advantageous because it acts as a 'buffer' for emotional and cognitive processes against negative experiences (Baccus et al., 2004; Dijksterhuis, 2004; Greenwald & Farnham, 2000). This thesis provides information regarding what this buffer is exactly, and how it works.

Extant research has not explicitly revealed how positive self-esteem acts as a buffer, although the common assumption is that the mechanism is related to increased cognitive resources (Cast & Burke, 2002). In contrast, the SOSE model can explain the buffering effect by suggesting that the 'pull' of trait self-esteem attractors increases the amount of energy needed for external forces to sway state self-esteem from its current position. If individuals have positive trait self-esteem attractors, their state self-esteem will be pulled toward a position of positivity. The stronger the positive trait self-esteem attractor, the less likely it is that state self-esteem will be perturbed from its positive equilibrium. The SOSE model therefore outlines the mechanisms that are responsible for the buffering effect that has commonly been found (Greenberg et al., 1992).

6.3.2 Methodological developments

The empirical studies in this thesis demonstrate that a methodological shift is necessary in order to study the intrinsic dynamics of the nested structure of self-esteem. This thesis shows that, alongside self-esteem questionnaires, it can also be advantageous to

adopt new approaches to data, as well as new statistical analyses. While self-report data is advantageous when the goal is to determine the valence of individuals' view that they have of themselves, this empirical approach to self-esteem is not without its disadvantages.

Firstly, self-report methods in which individuals are asked to communicate their subjective thoughts and feeling about themselves as positive or negative will always be subject to self-protective mechanisms such as impression management (Buhrmester et al., 2010; Greenwald & Banaji, 1995; Van Halen, 2002). Secondly, these methods emphasize the cognitive element of self-evaluation at the expense of the emotional and behavioral element (Peters & Slovic, 2007; Scheff & Fearon, 2004). Thirdly, these methods are not conducive for studying the intrinsic dynamics of self-esteem. The reasons for this differ depending on whether the aim is to measure state self-esteem dynamics or trait self-esteem dynamics.

For state self-esteem, self-report measures are adapted by asking the participant to report on his/her self-thoughts or feeling *at the present moment* (e.g., Fortes, Delignières, & Ninot, 2004; Oosterwegel, Field, Hart, & Anderson, 2001). This results in a relatively intrusive measurement of the state self-esteem process, which may be problematic. Specifically, each time that a participant is asked to report on his or her self-worth at the current moment, he or she must introduce a cognitive component into the current network of self-experiences (see Chapter 5). The state self-esteem process that is studied thus adopts a new quality (i.e. state self-esteem becomes explicit), not because it organically emerged that way in the current context, but because of the measurement itself (Van Orden et al., 2010). In this way, the measurement resembles a real-time external perturbation (Hollenstein et al., 2013). Perturbations result in a re-organization of the current emotional-behavioral-cognitive system (Granic & Patterson, 2006). As such, each repeated measurement of state self-esteem will be temporally discrete, rather than part of one continuous process of state self-esteem. Therefore, unless the research aim is to study the moment-to-moment effect of the perturbation, it is not ideal to rely on self-report techniques when studying state self-esteem as a *real-time* process.

Regarding trait self-esteem, the standardized nature of self-report measures is problematic. This is because – from a SOSE model perspective – trait self-esteem is more than a score, which is how it is measured using questionnaires. A questionnaire cannot measure an idiosyncratic network of self-experiences that demonstrates temporal recurrence across time. This thesis shows that the dynamic characteristics of trait self-esteem are not so much *measured*, as they are *analyzed*. The use of Self-Organizing Maps in this thesis illustrates one possible way of analyzing – and thereby capturing – the emergence of this nature of trait self-esteem. The thesis therefore further develops earlier attempts to capture properties of self that take the form of attractor states (see, for example, Vallacher & Nowak, 2000). It advances previous work by capturing *multiple* idiosyncratic attractor states within individuals (rather than one fixed-point attractor), and doing so based on *multivariate data* (i.e. multiple forms of lower-order input, rather than one input that varies in valence – as is done in the mouse paradigm used by Vallacher and Nowak).

Finally, while self-report measures can be adapted in order to measure a trait versus state aspect of an individual's self-view, the nested and dynamic relationship between the two – at any given moment – cannot be mapped using questionnaires. This thesis shows that researchers can profit by choosing theoretically grounded forms of data. For instance, if the goal is to map the emergence of higher-order constructs like trait self-esteem based on the interactions between lower-order constructs like state self-esteem or self-experiences (as was the case in the present thesis), then the data must consist of these lower-order ingredients. Not only does this thesis demonstrate a novel approach to self-esteem data itself, but it also illustrates the use of time-series analyses for the purpose of mapping and quantifying the temporal dynamics between nested levels of constructs such as self-esteem (although it by no means provides an exhaustive demonstration, see DiDonato, England, Martin, & Amazeen, 2013; Kunnen, 2012 for methods that have not - as yet - been applied to self-esteem, but which provide the possibility to do so).

6.4. Future Research

The current thesis is inductive by nature, where the general goal was primarily theory-oriented. As such, the theoretical formulations and empirical findings from this thesis pave the way for future studies that can incorporate the theoretical and methodological developments that emerged from this thesis. Below I discuss two such areas of research. The first is based on the developments that arose from Part I of this thesis, and the second is based on the developments that arose from Part II.

6.4.1 Implications of Part I for future research

The current thesis focused on the fundamental nature of self-esteem, where the aim was to test the real-time dynamic nature of the nested constructs of self-esteem. For instance, in Chapter 4 we captured existing trait self-esteem attractor states (using Kohonen's Self-Organizing Maps) and showed that they are indeed interconnected with state self-esteem dynamics. Presumably, however, these recurring networks of self-experiences are *recurring* (i.e. demonstrating continuity) because they developed into attractor states across the long term. Having provided a proof of existence of the nature of these attractor states in real-time with the current thesis, future research is needed in order to examine how development emerges across the long term. This development may involve either changes to existing trait self-esteem attractor states (in their depth and width) or it may involve the emergence of new trait self-esteem attractor states. Either way, development of trait self-esteem attractor states will involve the restructuring of the trait self-esteem system (or, referring back to Chapter 2, to structural changes in the attractor landscape).

As of yet, trait self-esteem development has been studied in terms of its continuous (and often linear) development across the long term (e.g., Birkeland et al., 2012; Block & Robins, 1993; Erol & Orth, 2011; Orth et al., 2010; Reijntjes et al., 2011; Robins & Trzesniewski, 2005; Zimmerman et al., 1997). While long-term development does often occur slowly and continuously, it can also be characterized by non-linear and abrupt change (Van Dijk & van Geert, 2007). This kind of developmental change is preceded by a high level of short-term variability (Bassano & Van Geert, 2007; Lichtwarck-Aschoff,

Hasselman, Cox, Pepler, & Granic, 2012; Van der Maas & Molenaar, 1992). During this period of short-term variability, patterns that characterize existing attractor states are broken (Lichtwarck-Aschoff, Hasselman, Cox, Pepler, & Granic, 2012). This short-term variability is not only seen across events (e.g. from week to week), but it is also observed within events (e.g. across real-time) (Granic et al., 2003). During such a period, real-time behavior (where I refer to 'behavior' in the broadest sense of the word) is not restrained by top-down self-reinforcing feedback loops. It is during real-time that the individual is thus 'free' to explore novel behavior and new selves, as it were (Kroger, 2000; Lichtwarck-Aschoff, Van Geert, Bosma, & Kunnen, 2008). With the introduction of novel self-experiences at the lowest level, development is reinitiated and a process of re-organization can occur. This then makes it possible for qualitatively new high-order self-esteem constructs (i.e. new trait self-esteem attractors) to develop through self-amplifying feedback loops. Alongside extant studies regarding the slow developmental change that occurs across the long term, the SOSE model thus provides a framework for studying how non-linear spurts of development occur at the level of trait self-esteem based on micro-level variability of self-experiences.

Regarding adolescents specifically, studies show that long-term development of the parent-child relationship is characterized by a destabilization period (Granic et al., 2003), defined as a period of heightened real-time variability during which patterns are re-organized (Thelen & Smith, 1994). Such a period is advantageous as it allows the parent-child system to grow and to change by exploring new socio-emotional behavior during real-time interactions, given the new demands that arise during adolescence (Lichtwarck-Aschoff et al., 2012). What is not known, however, is whether a similar pattern of destabilization occurs *within* the adolescent with regard to patterns of real-time emotional-behavioral self-experiences.

Future research would therefore profit by studying, firstly, whether there is in fact a period of intra-individual destabilization of adolescents' self-esteem. It is likely that this is the case, given that adolescents are faced with the task of increasing their sense of autonomy while maintaining a sense of relatedness with parents – requiring a re-organization of patterns (Allen et al., 1994), as well as forming a self-determined identity (Erikson, 1968; Lichtwarck-Aschoff et al., 2008). Just as it is advantageous for the parent-child relationship to go through a destabilization period during adolescence, it is also likely that the occurrence of a destabilization period for self-esteem is also advantageous for adolescents, as it allows the adolescent to explore new experiences of the self. Future research is necessary, not only to determine whether such a destabilization period occurs in self-esteem during adolescence, but also to understand *how* such a period occurs based on the re-organization of trait self-esteem attractor states, and what the *function* of this period may be for adolescents' self-esteem development.

Next, in order to understand how self-esteem change happens across adolescence, it is helpful to investigate how such change is imbedded within inter-personal development (Fogel, 1993). As described above, studies have shown that a destabilization period of parent-child interactions is central to adolescents' intra-individual development (Granic et al.,

2007; Hollenstein, Granic, Stoolmiller, & Snyder, 2004; Lichtwarck-Aschoff et al., 2012; Smits et al., 2010). However, research has yet to investigate how the destabilization of parent-child interactions is coupled with the (hypothesized) destabilization of the adolescents' self-esteem, and what the characteristics of this coupling are. For example, does this coupling occur simultaneously, or sequentially – such that the destabilization of the parent-child dyad happens before that of the child's self-esteem or vice versa? This is yet another possible area for research, which would shed light on how self-experiential development during adolescence is imbedded in the development of the parent-child relationship.

6.4.2 Implications of Part II for future research

The SOSE model describes how an explicit (i.e. reflective) experience of state self-esteem is explained by the inclusion of a self-directed cognitive component (that has a positive truth value) into the momentary lower-order network of self-experiential components (Chapter 5). Due to the interactions between components, where the cognitive component is accommodated into the network, the positivity and negativity of the emotional and behavioral self-experiential components become salient to the individual as a result of the attention that is directed at them. State self-esteem – as the momentary positivity or negativity of self-worth – will thus emerge as a reflective experience. This means that the self as a whole is reflected upon, albeit momentarily.

The phenomenology of explicit state self-esteem, therefore, can be characterized as experiencing the self in the moment as an object of evaluation (i.e. *self-as-object*; Ryan & Brown, 2003). In accordance with research on *contingent self-esteem* (where an individual's self-esteem level is contingent on other-regard; Deci & Ryan, 1995; Kernis, 2003), the emergence of explicit state self-esteem may be more disadvantageous than the emergence of implicit self-esteem. This is because of the in-the-moment and context-sensitive experience of state self-esteem (DeHart & Pelham, 2007; Kernis et al., 1993; Leary & Downs, 1995; Rosenberg, 1986). Given that explicit state self-esteem results in the experience of the self-as-object (as positive or negative), a contingency arises of the worth of the self as a whole (at that moment) and the positive or negative experiences that occur within the immediate context. In contrast, the emergence of implicit state self-esteem implies that reflective attention is not directed at emotional/behavioral self-experiences, and as a result, that the self as a whole is not evaluated (i.e. *self-as-process*; Ryan & Brown, 2003).

The distinction in state self-esteem quality (as implicit versus explicit), and the implications for the experience of state self-esteem as contingent, may be a potentially important area of research given that the cognitive awareness of a contingency between the self as a *whole* (i.e. explicit state self-esteem) and contextual cues from significant others (such as parents) is a risk factor for psychological well-being (e.g., Assor, Roth, & Deci, 2004; Roth, Assor, Niemiec, Deci, & Ryan, 2009). While literature regarding contingent self-esteem typically refers to *trait* self-esteem, the SOSE model provides the framework for understanding why it may be important to examine the phenomenology of explicit *state* self-esteem as possibly more highly contingent, compared to implicit state self-esteem.

Alongside the psychological consequences of implicit versus explicit *state* self-esteem, future research is also needed in order to investigate the psychological consequences of implicit versus explicit *trait* self-esteem. From the SOSE model, implicit and explicit trait self-esteem are conceptualized as separate attractors (where an individual may have multiple implicit and multiple explicit trait self-esteem attractors; Chapter 5). In accordance with the finding that larger discrepancies in valence of potential attractor states corresponds with lower levels of self-certainty (Vallacher et al., 2002), we hypothesized that larger discrepancies in valence between implicit and explicit trait self-esteem attractors would be experienced negatively. This is because larger discrepancies would likely result in a pull between largely discrepant, and inconsistent, potential experiences of state self-esteem. Future research would profit from exploring the psychological consequences of having a trait self-esteem landscape that consists of largely discrepant (regarding valence) implicit and explicit trait self-esteem attractors.

6.5 Limitations

As mentioned earlier, the current thesis adopted a novel methodological approach, where data consisted of observations of moment-to-moment emotional and behavioral self-experiences across the time span of one parent-child interaction. While this kind of data was necessary for the explorative and dynamic-focused nature of the current thesis, it also had its disadvantages. In order to quantify the observations and create time series that could then be analyzed, it was necessary to code each verbalization, action, and emotional expression for each adolescent. It goes without saying that this is a time-intensive process, starting with the development of a reliable coding scheme (see Appendix), to the filming of the dyads, to the training of coders, and finally, to the coding of the various dyadic interactions. While the resulting data was both rich (as it was multivariate by nature) and extensive (including many data points for each individual, i.e., approximately 800), the number of dyads from which data was received was limited.

The use of appropriate analyses (i.e., Monte Carlo re-sampling techniques) meant that the limited sample size did not result in a loss of statistical power, however. As a result, the statistical significance of the findings in this thesis means that it *was* possible to generalize to one underlying theoretical explanation, thereby validating the theory developed in this thesis. However, it would be useful to increase the sample size in order to generalize the findings regarding specific dynamics and characteristics to the general population.

Another disadvantage of the time-intensive methodological approach is that it was beyond the scope of this thesis to include explicit analyses regarding the role of the parent in the adolescents' self-esteem dynamics. While the parent was included as a continuous source of perturbations on the adolescents' state self-esteem (Chapter 4), the time restrictions of this research project meant that it was not possible to move past the structural impact that the parent had (i.e., the *structure* of variability). It would have been interesting to include analyses of the *content* of parental behavior as well. Additional research is necessary in order to shed light on the content-related influence that parents have on their children's self-esteem during interactions.

Finally, the new empirical approach utilized in this thesis necessitates more validation. The aim of the empirical studies in this thesis (Chapters 3 and 4) was to empirically validate the SOSE model (Chapter 2), and not to empirically validate a new measurement of state and trait self-esteem. On the one hand, the fact that the data utilized was theory-grounded supports the construct validity of our approach. On the other hand, additional research is needed in order to systematically investigate the convergent and divergent validity.

6.6 Concluding Remarks

Altogether, the findings in this thesis support the proposed Self-Organizing Self-Esteem model. As such, this thesis shows that self-esteem is likely more dynamic and more complex than researchers previously assumed. Specifically, the chapters of this thesis show that these dynamics and the complexity of self-esteem stem from the intrinsic dynamics of the nested structure of self-esteem; from the level of concrete self-experiences, to state self-esteem iterations, to the emergence of trait self-esteem attractors. In doing so, I hope to have shed light on the nature and origin of self-esteem, based on the underlying processes that occur within and between the nested levels of self-esteem, and the intrinsic dynamics that arise from these processes.

My hope is that this theoretical model provides the framework and the language necessary for other researchers to understand and discuss the underlying ontology of self-esteem based on complex dynamic systems principles. Moreover, I hope that the methodological and empirical groundwork provided in this thesis allow and encourage self-esteem researchers – or any researchers interested in trait-like psychological constructs – to further explore the intrinsic dynamics of self-esteem. As explorative and inductive research, the purpose of the current thesis was to advance the theoretical understanding of self-esteem and to encourage self-esteem researchers to join in this voyage.

6.7 References

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APPENDICES

Coding Scheme for the Analysis of Moment-to-Moment Parent-Child Interaction

The present coding scheme was developed in order to analyze dyadic interactions between children and their parents[22]. The coding scheme focuses on both the children's and parents' emotional-behavioral experience of each other and of themselves. For the child, the self-experiences included in this coding scheme were used for the analysis of state self-esteem in the present thesis.

Coding of affect includes information from the Specific Affect (SPAFF) coding system (Coan & Gottman, 2007), which is widely used for systematically observing affective behavior during dyadic interactions. In the current coding scheme, adaptions were made in order to distinguish between self-directed affect and other-directed affect. Coding of behavior includes information from Noom et al. (2001)'s framework of emotional, functional, and cognitive autonomy during adolescence, as well as from Savin-Williams and Jaquish's behavior checklist for self-esteem (Savin-Williams & Jaquish, 1981). In accordance with the Grounded Theory (Glaser & Strauss, 1967), descriptions for categories were finalized based on what could be observed in the video-recorded interactions.

The unit of analysis for the current coding scheme is actions and/or utterances. Actions include behavioral actions, posture, and facial expressions, and utterances include verbalizations and their intonation and volume. Because the duration of the actions and utterances are of interest to for the aims in this thesis, the onset and offset of each action and utterance is coded. The coding scheme describes the codes for Self- and Other Directed Affect (Section 1) and Autonomy and Autonomy Management (Section 2). In the subsections (1.1, 1.2, 1.3 and 2.1, 2.2, 2.3 respectively), general instructions are given that apply to the respective coding categories.

[22] This coding scheme is based on the coding scheme developed in De Ruiter, N.M.P. (2010). *Real-time dynamics of global self-esteem in the context of parent-child interactions: A case study*. Master's thesis in Behavioral and Social Sciences, University of Groningen, The Netherlands.

1. Coding self- and other-directed affect

In Table 1, the emotional categories are shown, together with a description of the category, the indicators of the category, and examples of verbal indicators. Note that Figure 1(see below) should be consulted when coding an individual's laugh in response to the interaction partner. This is because a laugh, depending on the context and whether or not the laugh is genuine, can express a positive emotion as well or a way of showing disagreement and invalidation of the interaction partner.

Table 1
Emotional categories and descriptions for both parent and child. [23]

Other-directed affect	**Score**	**Description**	**Indicators[24]**	**Example of verbalizations**
Affection	3	Individual is showing Joy/Interest/Humor *with* an additional element of warmth and love.	Sitting closer / body contact; verbalize affection; while pausing: eye contact and warm smile	*I like talking to you; as long as we're together*
Pride		Individual is showing Joy/Interest/Humor/Affection *with* an additional element of expressing a high opinion/value of the other person and being openly impressed.	Person-directed compliment; responds to interaction partner with wide eyes, raised eyebrows, smile (surprised and impressed)	*You're so smart; wow, I'm impressed*
Joy	2	Individual is overtly enjoying what the other person is doing or saying.	Big smile (teeth showing, smile with whole face); (genuine) laugh	
Interest	1	Individual is expressing acceptance, understanding or interest in the other individual and when they are obviously present in the interaction with the other person.	Eye contact and small (genuine) smile	

[23] The descriptions in Table 1 were derived based on a combination of the filmed interactions themselves and the descriptions from Coan & Gottman, 2007.

[24] In this table all indicators are grouped together for each level of self- and other-directed affect. This was done for the sake of simplicity. During coding, however, a more detailed version of the coding scheme was used, which included different ways of expressing each emotion based on a specific combination of indicators. Contact Naomi de Ruiter for additional information regarding the more detailed version of the present coding scheme (n.m.p.de.ruiter-wilcox@rug.nl).

Neutral	0	Individual is not expressing any emotion while interaction partner is speaking or doing something.		
Disinterest	-1	Individual is overtly indifferent regarding the other person or what he/she is saying.	Averted gaze, turning away from interaction partner; flat tone when responding to interaction partner	
Frustration	-2	Individual is overtly and negatively aroused by the interaction partner. Individual responds with exasperation or annoyance.	Shocked (disingenuous) laugh; whining tone, emphasizing < 2 words in sentence; rubbing face; sighing; trying to end discussion abruptly	*Yeah, yeah, yeah*
Anger		Individual is overtly negatively aroused while/after being offended or wronged.	Raised voice; phony (mocking) smile; wide eyes and raised eyebrows; tense jaw and lips; eyebrows down and together	*"Tsk"*
Contempt	-3	Individual is treating the other as inferior in a hierarchical and condescending way.	Person-directed comment said with non-humorous sarcasm; forced (belittling) laugh and shaking of head; negative comment about interaction partner said in sharp tone; rolling eyes	*You don't even know what you're saying*
Self-directed affect				
Pride	3	Individual is showing joy in what they are saying/doing *and* an element of self-satisfaction is present.	Complimenting self; speaking with raised eyebrows, upright position, and possible smile	*I never get lost; I think I would make a good president*
Self-humor	2	Individual is overtly amused by something that he/she is saying/doing.	Big smile; laugh while speaking; smile or laugh when interaction partner speaks about person being coded (Note: connectedness is *also* coded in this last situation)	
Self-interest	1	Individual is overtly enjoying contributing to the interaction.	Genuine smile while speaking; speaking in excited tone	*I have an idea!*
Neutral	0	Individual is not expressing any emotion while speaking or doing something		

Embarrassment	-1	Individual is overtly showing that he/she is aware that he/she has done/said something that is socially 'unacceptable' (although not morally wrong), and this awareness is connected to a negative experience.	Eyes cast down; soft voice; forced laugh/smile; fidgeting when focus is on self; odd/spastic movement while hesitating	
Sadness	-2	Individual is overtly hurt by the actions or verbalizations of the interaction partner.	Averted eyes; soft voice; small posture; looking like about to cry	
Anxiety		Individual is overtly anticipating a negative response from the interaction partner.	Fidgeting or swaying back and forth after/during invalidation of interaction partner; alert and tense when waiting for reaction from interaction partner	
Shame	-3	Individual is overtly feeling bad after invalidating him/herself, or after acknowledging and accepting the other person's invalidation. The invalidation must refer to something inherently 'wrong' and person-directed.	Speaking in sad and serious tone after/during self-invalidation	*I know I should quit smoking, but I can't*

1. 1 Affect (general)

Within the positive and within the negative ranges, scores are mutually exclusive. For example, anger (a negative score) cannot be scored as well as frustration (also a negative score). As a rule, if two scores within a range (i.e., either positive or negative) are present, the highest score is coded. For example, if an individual expresses frustration with his/her physical posture, while expressing contempt with his/her verbalizations, contempt is coded.

Positive and negative scores, however, can be simultaneous scored for affect. For example, anger (e.g., expressed with facial expression) and affection (e.g., expressed with verbalizations) can be coded simultaneously. These moments are indicative of internal inconsistency, which is later used for the calculation of state self-esteem.

It is important that the timing of the emotional expression is considered in order to determine whether the emotional expression *self*- or *other*-directed affect. This is further described in Section 1.1 and 1.2.

1.2 Connectedness

The concept of *connectedness* stems from individuals' need to interact with, be connected to, and care for others (Ryan & Deci, 2000). Connectedness is scored when the individual being coded expresses an emotion during or directly after the *interaction partner* says or does something. This indicates that the individual's expressed emotion is a function of what the interaction partner said or did. If the individual being coded expresses an emo-

tion while he/she is doing or saying something, connectedness is not scored (as this indicates that the emotion is a function of what he/she did or said). The exception to this rule is when the individual being coded is speaking *about* the interaction partner while expressing an emotion, or asks the interaction partner a question while expressing an emotion. In this situation we can assume that the emotional expression is both self- and other-directed. Therefore, both self-affect and connectedness are scored. It is important that all other-directed affect is indeed directed at the interaction partner, and not at the general task (e.g., speaking in a whining tone when complaining about the task at hand).

1.3 Self-affect

The concept of *self-affect* is based on individuals' current experience of Self, based on how they appraise internal or external information related to the Self (Coan & Gottman, 2007). Self-affect is scored when the individual being coded expresses an emotion during or directly after *he or she* says or does something. This indicates that the individual's expressed emotion is a function of what he or she said or did. Note that (as described above) *connectedness* is scored as well if the individual says something about the interaction partner.

2.3 Overview of coding

In Table 2, the autonomy-related categories are shown, together with a description of the category, the indicators of the category, and examples of verbalizations. Note that Figure 1 (see below) should be consulted when coding an individual's laugh in response to the interaction partner.

Table 2

Autonomy-related categories and descriptions for parent and child separately. [25]

Child Autonomy	**Score**	**Description**	**Indicators**[26]	**Example of verbalizations**
Self-assertion	3	Child holds his/her ground in the face of invalidations (verbal or nonverbal) from the parent.	Rejects parent's accusation; defends own behavior; holds eye contact after being invalidated	*That's not true; I don't think it's bad that I do that*
Confrontation		Child confronts parent with on-task or off-task behavior, either verbally or non-verbally.	Confronts parent regarding something undesirable; stops parent from doing something undesirable	*You should quit smoking; You always do that*

[25] The descriptions in Table 2 were derived based on a combination of the filmed interactions themselves and the descriptions from Coan & Gottman (2007).

[26] In this table all indicators are grouped together for the sake of simplicity. During coding, different combinations of indicators were used to identify different ways of expressing a specific level of autonomy/autonomy management.

Agency	2	Child takes (momentary) control of the interaction. This level of autonomy is a step higher than attitudinal autonomy as it affects the parent as well.	Changes discussion topic; instructs parent; interrupts parent; stops what parent is doing; refuses to obey parent (regarding something trivial; otherwise *self-assertion*)	*Let's move on to the next topic; No, you get your own water*
Attitudinal autonomy	1	Child expresses his/her own attitudes, ideas, etc. within the interaction.	Asks parent a question (note: not for help); corrects parent; disagrees with parent (verbally or nonverbally); contributes idea; expresses opinion; makes decision	*I think…; We could…; No that's not right; Why?*
Neutral	0	Child is not doing or saying anything, or is speaking in neither autonomous nor heteronomous manner.		*Yeah, the next topic was…; Jenna is my best friend*
Attitudinal heteronomy	-1	Child is passive in the interaction and expects the parent to take control over the interaction.	Verbalizes not knowing (note: not relevant for factual information); shrugs; long hesitation; immediately takes back contribution	*I don't know; Oh never mind, that doesn't make sense*
Dependence		Child invites the parent to take control over the interaction at that moment.	Asks parent to take over; looks at parent expectantly instead of collaborating	*I don't know, what do you think?*
Submission	-2	Child *gives up* autonomy in response to the parents' behavior. Not a form of negotiation.	Changes opinion in agreement with parent without being 'convinced'; takes back contribution after receiving invalidating response from parent (verbal or nonverbally)	*Your idea is better; Never mind, that's stupid*
Parental Autonomy management				
Big validation	3	Parent explicitly validates or agrees with what the child says or does and shows recognition of the child's skills or positive attributes.	On-task compliment; goes along with child's idea; admits to being wrong	*I like that; Your idea is better, let's do that; You're right, I didn't think about that*

Small validation	2	Parent shows subtle respect and support for the child's contributions.	Minimal encourager (nodding, etc.); paraphrasing child[27]	*Mm hmm; So you think that we should…*
Encouraging	1	Parent encourages their child to take initiative and to explore a thought, idea, etc.	Allows child to control discussion; open on-task question (Note: not confrontational question beginning with "why?"); closed on-task question aimed at better understanding child (Note: not a challenge)	*Do you think we're finished?; Do you want to start? What do you think?; Like […] or […]?*
Neutral	0	Parent's actions neither challenge nor support the child's autonomy		*Okay, the first question was…; My favorite […] is […]*
Unresponsive	-1	Parent does not acknowledge what child said or did.	Silent after child's contribution; verbally continues after child's contribution but ignoring what he/she said	
Control		Parent steers or limits the child.	Disagrees with child; corrects child; instructs child; makes decision without collaborating with child; changes topic, interrupts child; asks leading question[28] (note: if invalidation, *confrontation*); challenges child	*Yeah, but…*[29]*; We're not doing that; We're finished; Don't you think it would be better if we…? You […] and I'll […]; No, you do that at least once a week*
Confrontation	-2	Parent expresses negative opinion about his/her child or child's behavior.	Confronts child with undesirable behavior; asks child why he/she behaves in un-desirable manner; verbal person-directed criticism	*What I don't like is…; I get annoyed when…'*
Pressure to submit		Parent pressures their child into submitting to their own plans, ideas, etc.	On-task criticism; non-verbal criticism (e.g., laughing when child did not intend to be funny; belittling smile; disgust face); manipulates child with reward	*That's a bad idea; Oh come on, don't you love me?*

[27] Minimal encouragers and paraphrasing are actions that individuals can do to help the interaction partner feel understood and secure in expressing their thoughts, emotions, etc. (Young, 2009).

[28] Young (2009)

[29] Coan & Gottman (2007)

2.1 Autonomy (general)

For autonomy scores, positive and negative scores are mutually exclusive. For example, a parent cannot be coded as both controlling (negative score) and encouraging (positive score) at the same moment. Note that inconsistencies in individuals' expressions can usually be captured by a combination of autonomy-related coding and affect-related coding. For example, a parent may express negative other-directed affect while also expressing support for the child's autonomy. Autonomy-related categories are described separately for the child (Child autonomy) and the parent (Parental autonomy-management), see Table 2.

2.2 Child Autonomy

Autonomous behavior is based on self-determination, free will, and ownership of own behavior and internal control of own behavior within the discussion. Autonomy does not necessarily imply being independent from the other person, but instead, that there is an absence of salient external control of an individual's behavior (an absence of *heteronomy)*. External control can take the form of either punishment or reward. An individual is still self-determined if external forces are *internalized* and *integrated* (Deci & Ryan, 1995). Areas in which individuals can be autonomous are (1) attitudinal, (2) emotional and (3) functional (Noom et al., 2001).

2.3 Parental autonomy-management

Parental autonomy-management refers to the extent to which the parent is supporting versus challenging the child's current autonomy. These two categories are mutually exclusive.

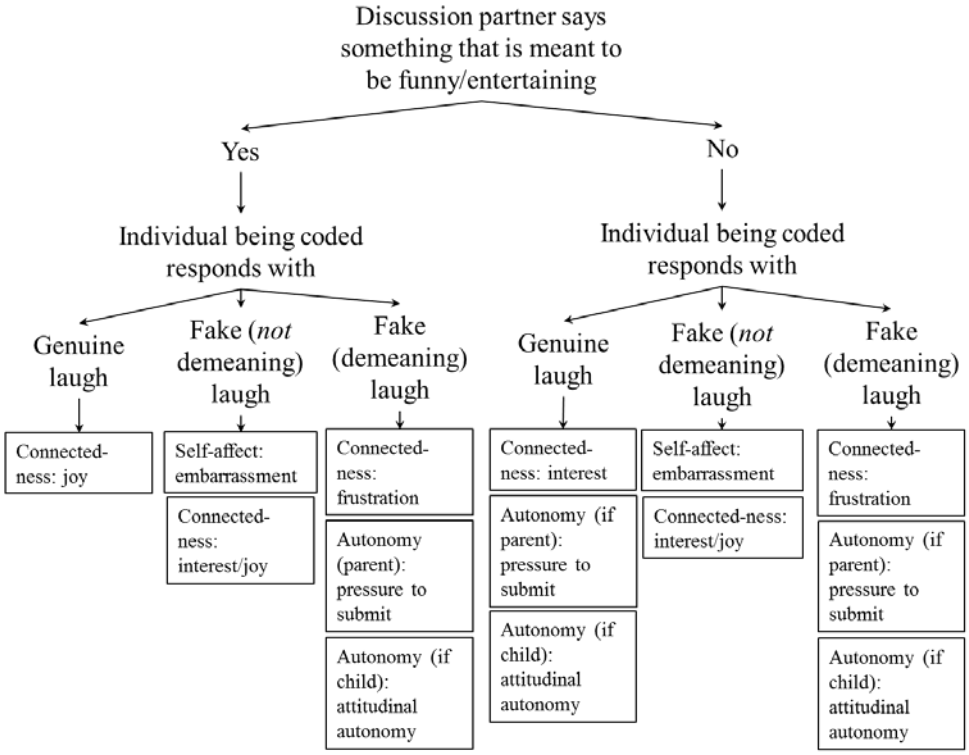

Figure 2. Outline of the affective and behavioral scores given when the discussion partner laughs during the interaction[30].

[30] Coan & Gottman (2007)

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Summary

1 Research Motivation and Context

Self-esteem has come to be a hugely important concept in modern-day psychology (Zeigler-Hill, 2013). It is often investigated as a predictor for, or an outcome of, other psychological concepts – from academic success to relationship satisfaction (Baumeister, Campbell, Krueger, & Vohs, 2003). In the vast majority of these studies, it is approached as a variable, for which individuals have a score. In psychological research, therefore, self-esteem is most commonly seen as something that distinguishes individuals or groups from each other: Person A has high self-esteem, while Person B has low self-esteem, for example. But what exactly underlies these descriptions? More specifically, what is the nature and the origin of self-esteem? The current thesis aims to answer this question.

Rather than answering this question by approaching self-esteem as something that can be described in the form of a single score, which is then explained by various other variables, as is commonly done (Van Geert, 2014), the current thesis aims to unravel the processes that give rise to, and that characterize, the experience of self-esteem. In traditional self-esteem research, there is not just one 'self-esteem variable', however. Self-esteem can be categorized as being a *trait* or a *state* phenomenon (Kernis, Cornell, Sun, Berry, & Harlow, 1993), and as an *explicit* and an *implicit* phenomenon (Greenwald & Banaji, 1995). This thesis therefore addresses the experience of these four self-esteem constructs specifically.

In order to understand the nature and origin of self-esteem based on the processes that give rise to it, and that characterize it, a complex dynamic systems perspective is adopted. This perspective focuses on how interacting components change across time in order to form emergent complex properties (Thelen & Smith, 1994; Van Geert, 1994). In this thesis, it is suggested that self-esteem is such an emergent property. Moreover, it is posited that the self-esteem property is comprised of three distinct, yet intertwined, sub-levels. These three sub-levels are referred to as the micro-, meso-, and macro-levels of self-esteem, which are distinguished from each other by the time scale across which they are formed.

In this thesis, it is suggested that the most basic level of self-esteem is the micro-level: the positive and negative emotional-behavioral experiences that individuals have regarding themselves in the present moment. Next, at the meso level, state self-esteem occurs. Finally, at the macro level, trait self-esteem emerges. It is posited that these three levels are bi-directionally connected. It is proposed that this bi-directional relationship allows for the *self-organization* of self-esteem, which in return makes each level of self-esteem temporally dynamic, while also giving rise to the temporal self-maintenance of self-esteem.

These propositions are described in the current thesis, creating a theoretical model called the Self-Organizing Self-Esteem (SOSE) model. The model focuses on the dynamics within and between the three levels of the nested self-esteem system. Based on this model, predictions are empirically tested in an adolescent population (N = 13, M (age) = 13.6)

regarding the dynamic nature of state self-esteem and trait self-esteem. Finally, based on the theoretical propositions made in the SOSE model, a classically important distinction between self-esteem phenomena was theoretically explored: the distinction between implicit and explicit self-esteem.

2 Summary of Findings

In Chapter 2, the Self-Organizing Self-Esteem (SOSE) model is presented and further described. We showed how the SOSE model contrasts the traditional approach to self-esteem, in which state and trait self-esteem are part of one construct, and where state self-esteem is conceptualized as the contextual error around latent trait self-esteem. In contrast, the SOSE model posits that trait self-esteem and state self-esteem are distinct constructs that occur on two interconnected time scales. The model outlines how their nature, as well as their relationship with each other, can be conceptualized based on a primary process of bottom-up emergence, where trait self-esteem is an emergent macro-level product of state self-esteem dynamics, and state self-esteem is an emergent meso-level product of momentary micro-level experiences of the self. The model also outlines a secondary process, namely, that of top-down constraint, where the emergence of the higher-order construct begins a process of constraint on lower-order interactions. Together, these form a self-organizing process.

In this chapter, we described that the SOSE model corresponds with an *emergent-causality approach* (Coan, 2010; Schmittmann et al., 2011), which stresses that a higher-order construct emerges out of the interactions between lower-order components. We described that this approach is not usually adopted in psychological research. Instead, a *generative-causality approach* is most commonly adopted, albeit implicitly. In this approach, the phenomenon being studied is approached as a latent trait that generates concrete experiences and actions (Borsboom et al., 2003; Coan, 2010).

We showed that a generative-causality approach is demonstrated in most self-esteem research in either the theoretical or empirical treatment of the relationship between trait and state self-esteem. The former is demonstrated by the common ‘baseline’ and ‘barometer’ approach to self-esteem (Rosenberg, 1979), and the latter is demonstrated by the tendency to aggregate repeated measures of state self-esteem in order to say something about the central tendencies (i.e., mean and standard deviation) of trait self-esteem (e.g., Kernis, 1993). Based on the intrinsic principles of a generative-causality approach – and illustrated by the common scientific studies – we suggested that a generative-causality approach is inherently less equipped to study the intrinsic dynamics of self-esteem, at both the trait self-esteem level and the state self-esteem level. We suggested that, in order to study the dynamics of self-esteem that are intrinsically generated, an emergent-causality approach is necessary – which the SOSE model aims to make possible.

In Chapter 3, we tested the *temporal structure* of state self-esteem as a real-time process during parent-adolescent interactions. We adopted a qualitative phenomenological approach, whereby moment-to-moment emotional and behavioral indicators of adolescents’ state self-esteem are observed as they emerged during parent-child interactions, resulting in

state self-esteem time series. It was hypothesized that – in accordance with the SOSE model – state self-esteem would develop iteratively, giving way to structured variability that stems from the intrinsic dynamics of state self-esteem. Furthermore, we hypothesized that the intrinsic variability of state self-esteem across time would *not* resemble random temporal variability, as would be expected from the traditional perspective that each state self-experience is *intrinsically* independent from the previous, and where any causal dependence stems from an extrinsic dependence between environmental events.

To test this, we conducted Detrended Fluctuation Analyses (DFA) on the state self-esteem time series. We found that the time series exhibited a form of structured variability, called *pink noise*. This means that a series of measure shows long-range correlations (Wijnants, Hasselman, Cox, Bosman, & Van Orden, 2012). In this study, this means that state self-esteem at t_1 is not independent from state self-esteem at t_{1+n}. The mean DFA exponent differed significantly from that of randomized surrogate data ($p < 0.01$), which revealed uncorrelated random variability, called *white noise*. This finding showed that the temporal structure of state self-esteem variability exhibits long-range dependence and is not random. Additionally, a weak positive relationship was found between the DFA and context-independent autonomy levels. This chapter validated a central crux of the SOSE model, which was done by showing that state self-esteem develops iteratively, resulting in intrinsic dynamics at the state self-esteem level.

In Chapter 4, the real-time nature of trait self-esteem phenomenology during adolescence was tested. We posited that this phenomenology can be best conceptualized from the SOSE model, where trait self-esteem consists of trait self-esteem *attractor states* that repeatedly recur across real-time. We validated this conceptualization by testing whether trait self-esteem demonstrates two pivotal characteristics of attractor states. First, we showed that trait self-esteem attractor states fell into two profiles, relatively strong and relatively weak ($p < 0.01$), differentiated by their level of real-time constraint on state self-esteem variability in real-time. Second, we showed that the stronger trait self-esteem attractor states protected state self-esteem variability from real-time external perturbations (from the parent) more than weaker trait self-esteem attractor states ($p < 0.05$). In doing so, we validated the core propositions of the SOSE model regarding the nature of trait self-esteem and its dynamic relationship with state self-esteem.

In Chapter 5 we developed a theoretical conceptualization of the distinction between implicit and explicit self-esteem based on the SOSE model. Based on the SOSE-model propositions, we suggested that a qualitative distinction between implicit and explicit self-esteem is different at the trait level and the state level. At the state level, we suggested that each new iteration of state self-esteem has the potential to self-organize as explicit or implicit, depending on the lower-order network at each moment. State self-esteem is thus conceptualized as one continuous process of iterations, consisting of implicit and explicit moments. These moments thus occur at separate time points, but are part of the same process. Therefore, implicit and explicit self-esteem form one state self-esteem process, which changes in its quality (i.e. implicit or explicit) from moment-to-moment.

At the trait level, we suggested that implicit and explicit trait self-esteem can be conceptualized as separate trait self-esteem attractors, resulting from distinct pathways of long-term iterative development of state self-esteem. Individuals are thus expected to have implicit trait self-esteem attractors, as well as explicit trait self-esteem attractors.

We argued that the conceptualization suggested in this chapter can also integrate the two dominant (and competitive) perspectives of the implicit-explicit relationship, namely that implicit self-esteem and explicit self-esteem are one versus separate constructs. The proposed model suggests that at the state level, implicit and explicit self-esteem are one construct (i.e., one iterative process), and that at the trait level, implicit and explicit self-esteem are separate constructs (i.e., separate trait self-esteem attractor states). This chapter contributed to the understanding of the temporal nature of implicit and explicit self-esteem, and made a distinction between these processes at the trait level and at the state level.

3 Integration and Emerging Developments

This thesis provides unique information regarding the *intrinsic dynamics* of self-esteem, which is done by approaching self-esteem as a self-organizing construct that emerges out of lower-order interactions. Together, the chapters if this thesis show that *state* self-esteem exhibits intrinsic dynamics that result in long-range correlations across the real-time, and that the *trait* self-esteem constrains the degrees of freedom of state self-esteem by means of multiple attractor states. These results support the conceptualization held in this thesis that the intrinsic dynamics of self-esteem at the state level, at the trait level, and *between* the state and trait level, determine the real-time behavior of self-esteem. While an individual's self-esteem is of course in constant interaction with his or her environment, self-esteem is first and foremost a dynamic and complex construct that demonstrates its *own* intrinsic dynamic.

The above findings contradict the traditional approach to self-esteem and its state and trait constructs. While state self-esteem is commonly approached as passive contextually-based error (e.g., Kernis et al., 1993; Leary & Baumeister, 2000), this thesis shows that state self-esteem has its own intrinsic dynamics. Moreover, while trait self-esteem is commonly approached as a latent trait that generates real-time indicators (i.e. state self-esteem) in a unidirectional manner (e.g., Heatherton & Polivy, 1991), this thesis shows that trait self-esteem can potentially be multi-stable, and that the manifestation of trait self-esteem is a function of a bidirectional and continuously dynamic relationship with state self-esteem.

Finally, – and in response to my general question posed at the beginning of this thesis – the findings from this thesis help explain what the nature and origin of the underlying processes of self-esteem are. This thesis suggests that the nature of self-esteem is that of an emergent property. The time span across which this developmental emergence occurs determines the exact nature of the emergent property. As such, the nature of state self-esteem is that of an emergent property that is fleeting from moment-to-moment. The nature of trait self-esteem, on the other hand, is that of an emergent property that is self-maintaining across time. The trait self-esteem property is more specifically characterized by the equilibrium points, or attractor states, that the individual experiences through the recur-

ring pull that these points have on current and future iterations of state self-esteem; where the strength of this pull depends on the strength – i.e., width and depth – of the attractor states that make up the trait self-esteem attractor landscape.

Both of these emergent properties (i.e., trait and state self-esteem) originate from the self-experiential elements that occur in real-time (i.e. the present moment), and more specifically, the continuous interactions between these elements that result in the self-organizational process across the nested levels (from self-experiences, to state self-esteem, to trait self-esteem). From this perspective, the experience of self-esteem is the result of the intrinsic dynamics between the nested constructs of self-esteem. Given that this nested system is always dynamically evolving, so too is an individual's experience of self-esteem. While the historicity of self-maintained self-esteem provides individuals with experiential continuity, the nature of this continuity – as positive or negative, or as implicit or explicit – will continue to change in the future. Rather than being a direct cause of some external influence, these changes will come about through the moment-to-moment variability of how individuals experience themselves in the present moment. While individuals can of course reflect on their continuity of self-esteem – resulting in a view of themselves as positive or negative – this reflection is not the foundation of their experience of themselves as positive or negative. The foundation of the positivity or negativity of how individuals experience themselves, i.e., of self-esteem, consists of the processes and dynamics that give rise to the self-organization of emergent properties of self-esteem.

Aside from the theoretical advancements made in this thesis, the empirical studies in this thesis demonstrate that a methodological shift is necessary in order to study the intrinsic dynamics of the nested structure of self-esteem. This thesis shows that, alongside self-esteem questionnaires, it can also be advantageous to adopt new approaches to data, as well as new statistical analyses. Firstly, the observational methods used in this thesis demonstrate a novel way of approaching state self-esteem as an emotional-behavioral process of positive and negative self-experience in real-time. Secondly, the operationalization of trait self-esteem as a collection of idiosyncratic attractor states advances previous work (see, for example, Vallacher & Nowak, 2000) by capturing multiple idiosyncratic attractor states within individuals (rather than a fixed-point attractor), and doing so based on multivariate data (i.e. multiple forms of lower-order input, rather than one input that varies in valence). Thirdly, this thesis demonstrates the first attempt to analyze the concurrent dynamics of state self-esteem and trait self-esteem as separate processes. More generally, the methodological approach illustrates and emphasizes the advantageous of keeping 'time' intact in self-esteem data, and by analyzing the *within-individual* dynamics of self-esteem.

The current thesis is inductive by nature, where the general goal was primarily theory-oriented. As such, the theoretical formulations and empirical findings from this thesis pave the way for future studies that can incorporate the theoretical and methodological developments that emerged from this thesis.

4 Limitations

The observational nature of the data used in this thesis meant that transforming the filmed interactions between adolescents and their parents into multivariate and time-serial data was time intensive. As a result, the sample used for empirical studies was relatively small. Despite this, the empirical findings in this thesis were statistically significant, which made it possible to generalize from the data to the theoretical formulations made, thereby validating the *theory* developed in this thesis. However, whether the validated mechanisms from the proposed theory also apply to all adolescents outside of the current sample is unknown. It would therefore be useful to increase the sample size in order to generalize the current findings to the *general population*.

While the influence that parents had on their children's self-esteem was analyzed with regard to the *structural dynamics* involved, it was beyond the scope of the thesis to analyze the influence that parents had on their children's self-esteem with regard to *interaction content*. Additional research is necessary in order to shed light on the content-related influence that parents have on their children's self-esteem during interactions.

Finally, the new empirical approach utilized in this thesis necessitates more validation. The aim of the empirical studies in this thesis was to empirically validate the SOSE model, and not to empirically validate a new measurement of state and trait self-esteem. On the one hand, the data used in the current thesis was theory-grounded, which supports the construct validity of the approach. On the other hand, additional research is needed in order to systematically investigate the convergent and divergent validity of the approach utilized in this thesis.

5 Concluding Remarks

Altogether, the findings in this thesis support the Self-Organizing Self-Esteem model. As such, this thesis shows that self-esteem is likely more dynamic and more complex than researchers previously assumed[31]. Specifically, the chapters in this thesis show that these dynamics and complexity stem from the intrinsic dynamics of the nested structure of self-esteem; from the level of concrete self-experiences, to state self-esteem iterations, to the emergence of trait self-esteem attractors. In doing so, I hope to have shed light on the nature and origin of self-esteem as emergent properties of self-experience that are created by self-organizational processes across time.

[31] With the term "complex", I am referring to the complex dynamic systems approach to this term, where elements of a system interact, and where these interactions create emergent properties. The term complex should not be confused with the term "complicated", where a large amount of linear and deterministic associations between variables are included in one conceptual model.

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Samenvatting

1 Onderzoeksmotivatie en Context

Self-esteem (eigenwaarde) wordt gezien als een zeer belangrijk concept in de hedendaagse psychologie (Zeigler-Hill, 2013). Het wordt vaak onderzocht als een voorspeller voor, of een uitkomst van, andere psychologische concepten – van academisch succes tot het hebben van plezierige relaties (Baumeister, Campbell, Krueger, & Vohs, 2003). In de meeste studies wordt self-esteem benaderd als een variabele, waarbij individuen een bepaalde score voor self-esteem hebben. In psychologisch onderzoek wordt self-esteem dus vaak gezien als iets dat onderscheid maakt tussen individuen of groepen: Persoon A heeft een hoog self-esteem, terwijl Persoon B een lager self-esteem heeft. Maar wat zit hier precies achter? Met andere woorden, hoe onstaat self-esteem, en wat zijn de eigenschappen van self-esteem? Dit proefschrift probeert deze vraag te beantwoorden.

Deze vraag wordt niet beantwoord door self-esteem te benaderen als iets dat gerepresenteerd kan worden door een score, en dat verklaard kan worden op basis van een aantal andere variabelen, wat de gangbare methode is (Van Geert, 2014). In plaats daarvan is de doelstelling van dit proefschrift om de onderliggende processen te ontrafelen die ten grondslag liggen aan het ontstaan van self-esteem, en waardoor self-esteem wordt gekenmerkt. In het traditionele onderzoek naar self-esteem wordt echter meer dan één 'self-esteem variabele' geconceptualiseerd. Self-esteem wordt gecategoriseerd als een *state* en een *trait* fenomeen (Kernis, Cornell, Sun, Berry, & Harlow, 1993), en als een expliciet en een impliciet fenomeen (Greenwald & Banaji, 1995). In dit proefschrift wordt de ervaring van deze vier constructen van self-esteem behandeld.

Om self-esteem te begrijpen op basis van de processen die ten grondslag liggen aan het ontstaan van self-esteem en self-esteem karakteriseren, wordt een complexe dynamische systemen benadering toegepast. Deze benadering bekijkt hoe de interactie tussen componenten verandert over de tijd en naar de manier waarop eigenschappen ontstaan (emergeren) in deze interactie (Thelen & Smith, 1994; Van Geert, 1994). In dit proefschrift wordt gesteld dat self-esteem een emergente eigenschap is, en dat self-esteem drie aparte, maar ook verstrengelde, subniveaus bevat, namelijk het micro-, meso- en macroniveau. Deze niveaus worden gekenmerkt door de verschillende tijdsschalen waarin zij worden gevormd.

In dit proefschrift wordt gesteld dat het meest basale niveau van self-esteem het microniveau is. Dit betreft de positieve en negatieve emotionele- en gedragservaringen die mensen hebben ten opzichte van zichzelf. Vervolgens wordt op meso niveau het state self-esteem gevormd. Tenslotte emergeert trait self-esteem op macroniveau. In dit proefschrift wordt gesteld dat de drie niveaus een bidirectionele relatie met elkaar hebben. Verder wordt gesteld dat deze bidirectionele relatie ten grondslag ligt aan de zelforganisatie van self-esteem, waardoor elk niveau van self-esteem temporeel dynamisch is, en waardoor self-esteem ook zichzelf in stand houdt.

Deze beweringen worden in dit proefschrift uitgelegd, en ze vormen de basis van een theoretisch model, het Self-Organizing Self-Esteem (SOSE) model. Dit model heeft als

kernpunt de dynamiek binnen en tussen de drie niveaus van het gehele self-esteem-systeem. Op basis van dit model worden voorspellingen over de dynamische aarde van state en trait self-esteem binnen een adolescente populatie (N = 13, gemiddelde leeftijd = 13.6) getoetst. Tenslotte wordt, op basis van de beweringen die gemaakt worden in het SOSE model, een klassiek onderscheid van self-esteem fenomenen geëxploreerd: het onderscheid tussen impliciet en expliciet self-esteem.

2 Samenvatting van Bevindingen

In Hoofdstuk 2 wordt het Self-Organizing Self-Esteem (SOSE) model gepresenteerd en verder uitgelegd. Wij laten zien hoe het SOSE model in tegenstelling staat tot de traditionele benadering van self-esteem, waarin state en trait self-esteem als delen van één construct worden gezien, en waarbij state self-esteem geconceptualiseerd wordt als de ruis vanuit de context rond latente trait self-esteem. In tegenstelling daarmee stelt het SOSE model dat trait self-esteem en state self-esteem afzonderlijke constructen zijn op twee onderling verbonden tijdsschalen. Het model schetst hoe de aard van beide constructen, en ook de relatie ertussen, geconceptualiseerd kunnen worden op basis van een primaire bottom-up proces, waarbij trait self-esteem een emergent macroniveau-product is van state self-esteem dynamiek, en waarbij state self-esteem ontstaat op meso niveau als product van microniveauervaringen van het zelf op dat moment. Het model beschrijft ook een tweede proces, namelijk *top-down constraint*, waar het ontstaan van een hogere-order construct resulteert in een beperking van de mogelijkheden van lagere-order interacties. Samen vormen deze processen een zelf-organiserend systeem.

In dit hoofdstuk beschrijven wij hoe het SOSE-model overeenkomt met een *emergent-causality* benadering(Coan, 2010; Schmittmann et al., 2011), dat stelt dat een hoger-order construct ontstaat uit de interacties tussen lagere-order componenten. Wij laten zien dat deze benadering niet gangbaar is in psychologisch onderzoek. In plaats daarvan wordt meestal een *'generative-causality' benadering* gebruikt, zij het impliciet. In deze benadering wordt het bestudeerde fenomeen gezien als een latente trait die ervaringen en acties veroorzaakt (Borsboom et al., 2003; Coan, 2010).

Wij lieten zien dat een generative-causality benadering in de meeste self-esteem-onderzoeken wordt gebruikt in óf de theoretische óf de empirische aanpak van de relatie tussen trait en state self-esteem. Het gebruik van een generative-causality benadering in de theoretische aanpak is te zien in de gebruikelijke *baseline* en *barometer* benadering van self-esteem (Rosenberg, 1979), en in de empirische aanpak is het te zien in de tendens om uit te gaan van het gemiddelde van herhaalde metingen van state self-esteem om iets te kunnen zeggen over de algemene kenmerken (bijvoorbeeld, gemiddelde en standaard deviatie) van trait self-esteem (bijvoorbeeld, Kernis, 1993). Op basis van de intrinsieke principes van een generative-causality benadering - en geïllustreerd door de gangbare studies - stellen wij dat een generative-causality benadering inherent minder geschikt is om de intrinsieke dynamiek van self-esteem te bestuderen. Wij stellen dat een emergent-causality benadering nodig is om de dynamiek van self-esteem te bestuderen die intrinsiek gegenereerd is. Het SOSE model probeert dit mogelijk te maken.

In Hoofdstuk 3 hebben we de temporele structuur van state self-esteem getoetst als een real-time proces dat plaatsvindt tijdens ouder-kind interacties. Wij hebben een kwalitatieve en fenomenologische benadering gekozen, waarbij momentane emotionele- en gedragsmatige indicatoren van state self-esteem van adolescenten geobserveerd werden in ouder-kind interacties. Dit resulteerde in tijdseries van state self-esteem. Verondersteld werd dat – in overeenkomst met het SOSE model – state self-esteem zich ontwikkelt als een iteratief proces, en resulteert in gestructureerde variabiliteit die voortkomt uit de intrinsieke dynamiek van state self-esteem. Verder veronderstelden we dat de intrinsieke variabiliteit van state self-esteem over tijd *geen* willekeurige temporele variabiliteit zou vertonen. Dit zou te verwachten zijn geweest vanuit de traditionele benadering dat elke state self-esteem intrinsiek onafhankelijk is van de vorige, en waarbij eventuele causale afhankelijkheid voortkomt uit extrinsieke afhankelijkheid tussen contextuele gebeurtenissen.

Om dit te toetsen, hebben we *Detrended Fluctuation Analyses* (DFA) gedaan op de tijdseries van state self-esteem, en we vonden dat de tijdseries gestructureerde variabiliteit vertoonden, genaamd *pink noise.* Dit betekent dat een serie metingen lange-termijn afhankelijk is (Wijnants, Hasselman, Cox, Bosman, & Van Orden, 2012). In deze studie zou dat bijvoorbeeld betekenen dat state self-esteem op t_1 niet onafhankelijk is van state self-esteem op t_{1+n}. De gemiddelde DFA exponent was significant anders dan de DFA van gerandomiseerd gesimuleerde data ($p < 0.01$). Deze bevinding laat zien dat de temporele structuur van state self-esteem-variabiliteit lange-termijn afhankelijkheid vertoont en dus niet willekeurig is. Verder hebben we een zwakke positieve relatie gevonden tussen de DFA en context-onafhankelijke autonomieniveaus. In dit hoofdstuk hebben we een belangrijke eigenschap van het SOSE model gevalideerd door te laten zien dat state self-esteem zich iteratief ontwikkelt, en dat dat leidt tot intrinsieke dynamiek op het niveau van state self-esteem.

In Hoofdstuk 4 zijn de real-time kenmerken van trait self-esteem getoetst tijdens ouder-kind interacties. Wij stellen dat deze fenomenologie het beste kan worden geconceptualiseerd vanuit het SOSE model, waarin trait self-esteem bestaat uit attractoren die verschillende keren terugkomen over tijd. Wij hebben deze conceptualisatie gevalideerd door te toetsen of trait self-esteem twee belangrijke eigenschappen van attractoren vertoont. Eerst hebben we aangetoond dat de trait self-esteem-attractoren kunnen worden onderscheiden in twee soorten: sterke en zwakke attractoren ($p < 0.01$). We maakten dit onderscheid op basis van de mate waarin de attractor de state self-esteem-variabiliteit in real-time beperkte. Vervolgens hebben wij aangetoond dat, vergeleken met de zwakkere attractoren, de sterkere trait self-esteem-attractoren samen hingen met geringere variabiliteit van state self-esteem bij externe verstoringen (van de ouder) ($p < 0.05$). Hierdoor hebben we één van de kernprincipes van het SOSE model kunnen valideren, namelijk de aard van trait self-esteem als attractoren die op dynamische wijze in wisselwerking staan met state self-esteem.

In Hoofdstuk 5 presenteren we een theoretische conceptualisatie van het onderscheid tussen impliciet en expliciet self-esteem, gebaseerd op het SOSE model. Op

basis van de stellingen in het SOSE model stellen we dat het kwalitatieve onderscheid tussen impliciet en expliciet self-esteem anders is op het trait niveau dan op het state niveau. Op het state niveau stellen wij dat elke nieuwe iteratie van state self-esteem de potentie heeft om te zelforganiseren als expliciet of als impliciet. State self-esteem is dus geconceptualiseerd als een continue proces van iteraties met impliciete en expliciete momenten. Deze vinden dus plaats op verschillende momenten, maar zijn deel van hetzelfde proces. Momenten van impliciet en expliciet self-esteem vormen dus één state self-esteem-proces, en dat proces verandert met betrekking tot de kwaliteit (dat wil zeggen, impliciet of expliciet) van een moment naar de volgende moment.

Op het trait niveau stelden wij dat impliciet en expliciet trait self-esteem geconceptualiseerd kunnen worden als aparte attractoren, die voortkomen uit aparte trajecten van de langetermijn-ontwikkeling van state self-esteem. Er wordt dus gesteld dat individuen zowel impliciet trait self-esteem-attractoren als expliciet trait self-esteem-attractoren hebben.

Wij betogen dat de conceptualisatie zoals in dit hoofdstuk beschreven wordt ook de twee dominante (en tegenovergestelde) perspectieven van de relatie tussen impliciet- en expliciet self-esteem kan integreren. Deze twee perspectieven zijn dat impliciet self-esteem en expliciet self-esteem één dan wel twee constructen zijn. Het gestelde model betoogt dat, op het state niveau, impliciet en expliciet self-esteem één construct zijn (één iteratief proces), en dat, op het trait niveau, impliciet en expliciet self-esteem aparte constructen zijn (aparte trait self-esteem-attractoren). Dit hoofdstuk draagt bij aan inzichten over de temporele eigenschappen van impliciet en expliciet self-esteem, en aan inzichten in hoe deze eigenschappen onderscheiden kan worden op het state- en op het trait-niveau.

3 Integratie en Nieuwe Ontwikkelingen

Dit proefschrift levert unieke informatie op ten opzichte van de *intrinsieke dynamiek* van self-esteem. Dit wordt gedaan door self-esteem te benaderen als een zelf-organiserend construct dat ontstaat uit lagere-orde interacties. Samen tonen de hoofdstukken van dit proefschrift aan dat *state self-esteem* intrinsieke dynamiek laat zien. Dit heeft tot gevolg dat metingen van state self-esteem lange-termijn afhankelijk zijn, en dat *trait self-esteem* de vrijheidsgraden van state self-esteem kan beperken. Deze bevindingen steunen de conceptualisatie dat de intrinsieke dynamiek van self-esteem op het state niveau, op het trait niveau, en tussen het state en trait niveau, het real-time gedrag van self-esteem (als geheel) veroorzaakt. Terwijl het self-esteem van een individu natuurlijk altijd in interactie is met zijn of haar omgeving, is self-esteem in de eerste plaats een dynamische en complexe construct dat zijn eigen intrinsieke dynamiek heeft.

De bovenstaande bevindingen zijn in tegenspraak met de gangbare benadering van self-esteem, met name van state- en trait self-esteem. Terwijl state self-esteem vaak benaderd wordt als passieve ruis vanuit de context (e.g., Kernis et al., 1993; Leary & Baumeister, 2000), laat dit proefschrift zien dat state self-esteem een eigen intrinsieke dynamiek heeft. Terwijl trait self-esteem vaak benaderd wordt als een latente variabele dat de real-time indicatoren (dat wil zeggen, state self-esteem) genereert op een unidirectionele

manier (e.g., Heatherton & Polivy, 1991), laat dit proefschrift zien dat trait self-esteem multi-stabiel is, en dat de manifestatie van trait self-esteem een functie is van een bi-directionele en doorgaande dynamiek met state self-esteem.

Ten slotte, - en als reactie op de algemene vraag die gesteld wordt in dit proefschrift - kunnen de bevindingen van dit proefschrift het onstaan van en de eigenschappen van de onderliggende processen van self-esteem verklaren. Dit proefschrift stelt dat de self-esteem gekarakteriseerd kan worden als een emergente eigenschap. De tijdspanne waarbinnen deze ontwikkelingsemergentie plaatsvindt bepaalt de precieze aard van de emergente eigenschap. Daaruit volgt dat de state self-esteem gekarakteriseerd kan worden als een emergente eigenschap die vluchtig is van moment-tot-moment. Trait self-esteem wordt echter gekarakteriseerd als een emergente eigenschap die stabiel is over de tijd. De trait self-esteem kan worden gekarakteriseerd als de herhaling die een individu ervaart, omdat state-self esteem herhaaldelijk naar dit punt terugkeert. De sterkte van deze aantrekkingskracht is afhankelijk van de sterkte (dat wil zeggen, de breedte en diepte) van de attractoren in het trait self-esteem landschap.

Beide emergente eigenschappen (trait- en state self-esteem) komen voort uit elementen van ervaringen van het zelf die plaatsvinden in het hier-en-nu (emoties, cognities, acties), en meer specifiek uit de voortdurende interacties tussen deze elementen, en het proces van zelforganisatie van alle verzamelde niveaus (van ervaringen van het zelf, tot state self-esteem, tot trait self-esteem). De ervaring van self-esteem ligt daarmee ten grondslag aan de intrinsieke dynamiek tussen de verschillende aspecten van self-esteem. Gegeven het idee dat dit systeem zich voortdurend ontwikkelt, kan de ervaring van een individu van zichzelf zich ook voortdurend ontwikkelen. Terwijl de herhaling van self-esteem een zeker niveau van experientiele continuïteit kan bieden, verandert de aard van deze continuïteit - positief of negatief, impliciet of expliciet - voortdurend. Deze veranderingen worden niet direct veroorzaakt door externe factoren, maar door de real-time variabiliteit in de manier waarop een individu zich zelf in het hier-en-nu ervaart. Terwijl individuen natuurlijk kunnen reflecteren op hun herhaling van zelf-ervaring - wat leidt tot een positief of negatief beeld van zichzelf - is dit beeld zelf niet het fundament van hun positieve of negatieve ervaringen van zichzelf. Het fundament van de postieve of negatieve ervaringen van zichzelf bestaat uit de zelforganiserende en emergente dynamiek van de verzamelde niveaus van self-esteem.

Behalve de theoretische ontwikkelingen die beschreven worden in dit proefschrift, laten de empirische studies in dit proefschrift ook zien dat een methodologische verandering nodig is om de intrinsieke dynamiek van de verzamelde structuur van self-esteem te kunnen bestuderen. Dit proefschrift laat zien dat, naast het gebruik van vragenlijsten, het ook goed kan zijn om nieuwe vormen van dataverzameling en nieuwe statistische analyses te ontwikkelen. Ten eerste vormt de observationele methode die gebruikt wordt in dit proefschrift een nieuwe benadering van state self-esteem, namelijk als positieve en negatieve emotionele- en gedragsprocessen die plaatsvinden in real-time. Ten tweede bouwt de operationalisatie van trait self-esteem, als een collectie van

idiosyncratische attractoren, voort op voorgaand empirisch werk (bijvoorbeeld, Vallacher & Nowak, 2000). In deze aanpak worden meerdere idiosyncratische attractoren gemeten binnen individuen (in plaats van één fixed-point attractor), en er wordt gebruik gemaakt van multivariate data (dat wil zeggen, meerdere vormen van lagere orde input in plaats van één variabele die positief of negatief is). Ten derde beschrijft dit proefschrift de eerste poging om de gelijktijdige dynamiek van zowel state- als trait self-esteem als aparte processen te analyseren. In de brede zin illustreert de methodologische aanpak van dit proefschrift dat het gunstig kan zijn om 'tijd' intact te houden voor self-esteem-data, en om de intra-individuele dynamiek van self-esteem te analyseren.

Dit proefschrift is inductief van aard, waardoor het algemene doel primair theorie-georiënteerd was. Zo hebben de theoretische formuleringen en empirische bevindingen van dit proefschrift de weg bereid voor toekomstige studies die op de theoretische en methodologische ontwikkelingen in dit proefschrift willen voortbouwen.

4 Beperkingen

De observationele data die gebruikt werd voor dit proefschrift leidden ertoe dat het vertalen van deze gefilmde interacties naar multivariate en tijdseriële data een tijds-intensief proces was. Hierdoor was de steekproef die gebruikt werd voor de empirische studies relatief klein. Ondanks de kleine steekproef zijn de empirische bevindingen in dit proefschrift statistisch significant, waardoor het mogelijk is om te generaliseren van de data naar de theoretische formuleringen, waardoor de *theorie* die in dit proefschrift is ontwikkeld gevalideerd kon worden. Echter, het blijft onbekend of de bevindingen gegeneraliseerd kunnen worden naar alle adolescenten buiten onze steekproef. Daarom zou het nuttig zijn om de steekproef te vergroten om de bevindingen van dit proefschrift te kunnen generaliseren naar de *algemene populatie*.

Terwijl de invloed van de ouders op de adolescenten werd geanalyseerd wat betreft de structurele dynamiek, viel de invloed van de ouders op de adolescenten wat betreft de *inhoud* van de interacties buiten de scope van dit proefschrift. Verder onderzoek is nodig om inzicht te geven in de inhoudelijke invloed die ouders hebben op de self-esteem van hun kinderen tijdens interacties.

Ten slotte vereisen de nieuwe empirische benaderingen van self-esteem die ontwikkeld werden in dit proefschrift meer validatie. Het doel van de empirische studies binnen dit proefschrift was om het SOSE-model te valideren, en niet om de nieuwe metingen van state- en trait self-esteem te valideren. Er is dus meer onderzoek nodig om de convergente en divergente validiteit van deze benadering te valideren.

5 Concluderende opmerkingen

Samengevat steunen de bevindingen van dit proefschrift het Self-Organizing Self-Esteem model. Dit proefschrift laat daarmee zien dat self-esteem meer dynamisch en meer complex is dan onderzoekers vaak denken[32]. De hoofdstukken in dit proefschrift laten zien

[32]Met de term "complex" refereer ik naar de complex dynamische systemen benadering van deze term, waarbij componenten van een systeem in wisselwerking gaan,

dat deze dynamiek en complexiteit voortkomen uit de intrinsieke dynamiek van de gehele structuur van self-esteem; van het niveau van ervaringen van het zelf, via iteraties van state self-esteem, tot het ontstaan van trait self-esteem-attractoren. Hierdoor hoop ik inzicht te hebben gegeven in de eigenschappen en het ontstaan van self-esteem als emergente eigenschap van ervaringen van het zelf die gecreëerd wordt door zelf-organiserende processen over tijd.

en waarbij deze wisselwerking tot emergente eigenschappen leidt. De term "complex" moet niet worden verward met "gecompliceerd", waarbij een groot aantal lineaire en deterministische associaties tussen variabelen opgenomen wordt in één conceptueel model.

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About the author

Naomi de Ruiter was born in Canada (1986) and moved to the Netherlands in 2002, where she finished the International Baccalaureate program at the International School in Haren. In 2005 she began studying Psychology at the University of Groningen, majoring in clinical psychology. In 2010 she graduated cum laude in the Research Master Behavioral and Social Sciences, in which she followed the education and developmental psychology program. Immediately afterwards, she started her PhD in the developmental processes research group at the University of Groningen, funded by a doctoral fellowship awarded by the Faculty of Behavioral and Social Sciences. During her PhD, she organized and chaired two symposia abroad on the theoretical and methodological applications of complex dynamic systems principles to developmental psychology. She presented her research at many national conferences as well as international conferences in Turkey, USA (Texas and Florida), Switzerland, Greece, and Italy. In her final years of her PhD she travelled to Florida Atlantic University (USA) and Queen's University (Canada) for two-week and two-month research visits, respectively. She received three travel grants to fund her research visits and presentations, from the Jacobs Foundation, Nicolaas Mulerius Foundation, and the Stichting Groninger Universiteitsfonds. Since 2010 Naomi has supervised bachelor and master students and taught several seminar courses in the Psychology Bachelor program. Since 2012 she has coordinated and taught the undergraduate course Developmental Psychology in the English-language Psychology Bachelor program. Naomi currently works as a researcher and lecturer at the University of Groningen, where she is applying the complex dynamic systems perspective to new areas of child and adult development in the domain of academics and performance arts, both in the context of dyadic interaction. Alongside her academic activities, she is an actor in the improvisational-comedy organization *Stranger Things Have Happened*, performing weekly and monthly improvised shows. She also teaches improvisational comedy at the student cultural center in Groningen (USVA) and trains an improvisational-comedy student team.

Acknowledgements

Doing a PhD isn't normally referred to as a walk in the park. However, I can honestly say that these past four years have been some of the most enjoyable and stimulating years of my life. This wouldn't be the case if it weren't for so many special people, whom I would like to acknowledge here.

First, I would like to thank my (co-)promoters, Prof. Paul van Geert and Dr. Saskia Kunnen. Paul, you've been a source of inspiration throughout the various stages of my academic trajectory. You sparked my initial interest in the complex dynamic systems perspective, and have continued to inspire ever since. Your creative approach to science, your talent as an artist, and your jovial character are remarkable to say the least. I feel honored to have had you as my promoter and mentor. Thank you for teaching me how to approach research creatively, for giving me so many opportunities to develop as a researcher and lecturer, and for giving me the room to find my own questions and answers. Saskia, you were (and are) such a source of support throughout my entire PhD trajectory. You were always there to help me brainstorm about practical issues, from designing my study and coding scheme to simple advice on a personal level. Thank you for helping me find and follow my academic interests, and for being such an enthusiastic and warm-hearted supervisor. Paul and Saskia, you have shaped my idea of what a researcher should be and taught me to approach each new step in the research process with curiosity and open-mindedness.

I'm very grateful to my assessment committee. Prof. Robin Vallacher, Prof. Isabel Granic, and Prof. Douwe Draaisma, thank you for putting the time and effort into reading my work and casting a critical eye. Robin, thank you for opening up your home to my colleagues and me for the two weeks that we stayed with you in Boca Raton and for your helpful, critical feedback. Isabel, I've enjoyed our talks at the multiple conferences that we've both attended, and appreciate your encouragement. Robin and Isabel, you have both set examples of how to successfully apply complex dynamic systems principles to social and developmental psychology, respectively, and I have always enjoyed and been inspired by your work.

My colleagues from the developmental psychology department, thank you for being such a supportive and talented group of researchers. I've very much enjoyed working with you, and I'm looking forward to continuing to do so. Thank you for your ideas and critical questions during research meetings, and for numerous discussions about research, teaching, and finding a suitable work-life balance. Some of the highlights of these past years were during national and international conferences that I attended with some of you. These trips were always both fun and intellectually stimulating. Mandy, Wieke, Ruud, Steffie (and Gloria – my colleague from abroad), you made the trips to Greece, Turkey, and America both hilarious (in retrospect!) and productive – what more could you ask for? Dankjulliewel!

Some colleagues deserve special mention of course. My office mates for the past years, Mandy and Marlenny, thank you for all of the practical, intellectual, and – above all

– emotional support. Sharing laughter, tears, and moments of craziness in our overly green room has been such a privilege. Steffie, you've been a part of my whole academic trajectory in the most varied and constant way, from my student assistant job, to co-teaching Developmental Psychology for two years; you've always been so supportive and helpful, and I'm very grateful for that. Finally, to my colleagues who were also co-authors, Paul, Saskia, Steffie, Ruud, and Ralf, thank you for your critical thoughts and collaboration.

Dr. Tom Hollenstein, my time in Kingston was a great privilege. I loved being a part of your Adolescent Dynamics Lab. Thank you for all of the stimulating conversations, for your mentoring, for your critical comments on (various) manuscripts, and for collaborating with me. I very much hope we will find another reason to collaborate in the future.

Colleagues from other departments of the RuG – clinical and social psychology as well as pedagogy, thank you for your kindness and your support. I loved being able to catch up or vent frustrations when bumping into each other in the faculty kitchen or in the hallway.

Moving away now from the academic circles, Joyce and Rob, my mother and stepfather, thank you for supporting me throughout my studies and my PhD, and for listening to my insecurities and anxieties.

I know this is going back a while, but it was at the International School in Haren that my interest in learning was ignited, and where my potential as a student started to develop. The transition from high school in Canada to the International School was pivotal in setting the path that eventually led to me doing a PhD. Mike Weston, thank you for helping me recruit participants from the school for my research. I owe special thanks to Allan Wilcox. Allan, your English and Theory of Knowledge lessons were always highly analytical. It was during your classes that I realized that I love writing and working through intellectual problems – interests that have helped me throughout my PhD.

Helen and Allan, my parents-in-law, thank you both for your continued support throughout my studies and my PhD. Helen, you've been a great source of inspiration as a highly respected female academic. I still do not know how you manage to be so academically successful without compromising on your multiple creative talents and your warm and caring disposition. You've set a very high standard for living a full and rounded life, which is both daunting and inspiring. Thank you as well for all of your comforting advice regarding teaching, writing (and defending) my PhD, and proofreading application letters.

All of my friends in Groningen, thank you for keeping my life balanced and for your love and support. While there are too many people to thank individually, I would like to acknowledge the following people especially:

Fellow members of Stranger Things Have Happened (old and present members), you have been a source of, and outlet for, creativity. My time with you during rehearsals and performances, touring and just socializing has kept me from being swallowed up in academic life and stress. Doing improv comedy with you has taught me how to give in to the unknown, to let go of the need to always plan, and it has allowed me to get used to

stepping outside of my comfort zone. Thank you for the past 6 years of weekly enjoyment and laughter.

Johanna, my fellow psychology student and close friend, thank you for all of your support in absolutely every part of my life.

Jeroen, Elger, and Kees, thank you for training me as an actor - Jeroen and Elger as directors of my favorite theater plays, Kees as our trainer of improv comedy.

Finally, I owe the most to Tom – my husband and best friend. Thank you for believing in me throughout our years together. I wouldn't be where I am now if it wasn't for you. You kept me going when I thought I couldn't or lacked the motivation, you pushed me when I needed to be pushed, and you convinced me of my talents when I needed convincing; for that I am very grateful. Thank you for being unfailingly patient with me coming home from work too late, and with my moments of anxious rumination about my PhD and academic life. Thank you for being a soundboard when I was working through theoretical puzzles, for proofreading endless applications, grant proposals, articles, and Dutch e-mails before I could properly speak Dutch. I am grateful to have you in my life as my improv buddy, my travel companion, and my partner in life. Thank you for inspiring me, and for filling my life with love and adventure.

To all of you, and to many more people who I didn't specifically mention here, I feel very grateful for your friendship and your support.

Thank you, dankjewel!

Naomi de Ruiter
April 26, 2015