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On the nature and origin of self-esteem

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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.

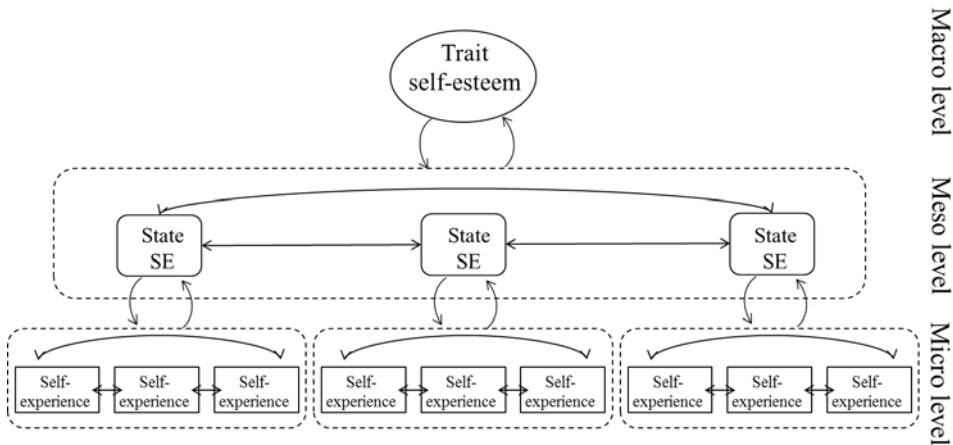


Figure 1. The Self-Organizing Self-Esteem model, consisting of three nested levels of self-esteem experience: the macro, meso, and micro levels, which are bi-directionally related to each other; from Chapter 2.

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).

¹⁵Adolescence 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 Methods¹⁶

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 non-verbal 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 3³, 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 rationale¹⁸
<i>Positive self-affect and negative self-affect</i>	Lack of trust in internal processes
<i>Positive connectedness and negative connectedness</i>	Relational inauthenticity
<i>Negative autonomy and positive self-affect</i>	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-esteem¹⁹.

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):

$$SSE_t = (SA_t + AU_t) ; \text{ if } (SA_t + AU_t > 0) \text{ and } (SEI_t = 0); \text{ otherwise, } 0$$

(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.

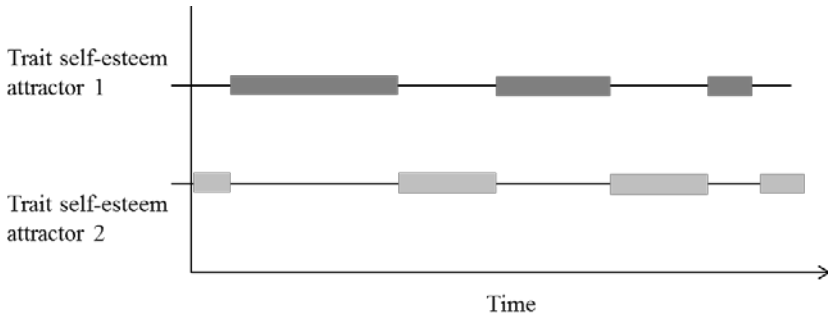


Figure 2: Simulated trait self-esteem attractor variability between trait self-esteem attractor 1 and 2 across time. The grey bars indicate the duration of time that the trait self-esteem attractors (1 and 2) are expressed.

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: $t_1 = 2, t_2 = 2, t_3 = 1, t_4 = 2$; and a hypothetical state self-esteem time series (x) with the values: $t_1 = 1, t_2 = 2, t_3 = 2, t_4 = 2$.

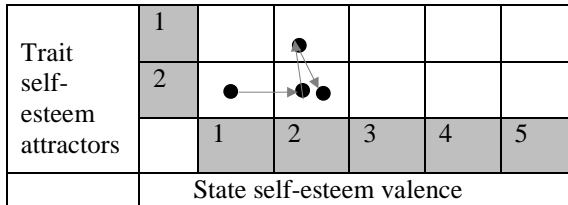


Figure 3. Illustration of a SSG depicting the first three events of a trait self-esteem time series (y) and a state self-esteem time series (x).

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.

$$Temporal\ Coherence_{absolute} = \sum_{i=1}^5 \left(\frac{x_i y_1 - x_1 y_2}{x_i y_1 + x_1 y_2} \right) \quad (2)$$

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 $y_1 =$ trait self-esteem attractor 1, and $y_2 =$ trait self-esteem attractor 2).

The total number of events in cell $x_1 y_2$ is subtracted from the total number of events in cell $x_1 y_1$ (referring to Figure 3, this would be $x_1 y_2 - x_1 y_1 = 1$). 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 $x_1 y_1 - x_1 y_2$) 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.

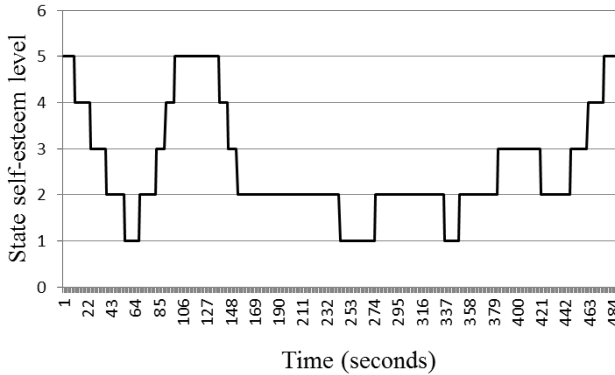


Figure 5. State self-esteem time series of one individual.

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).

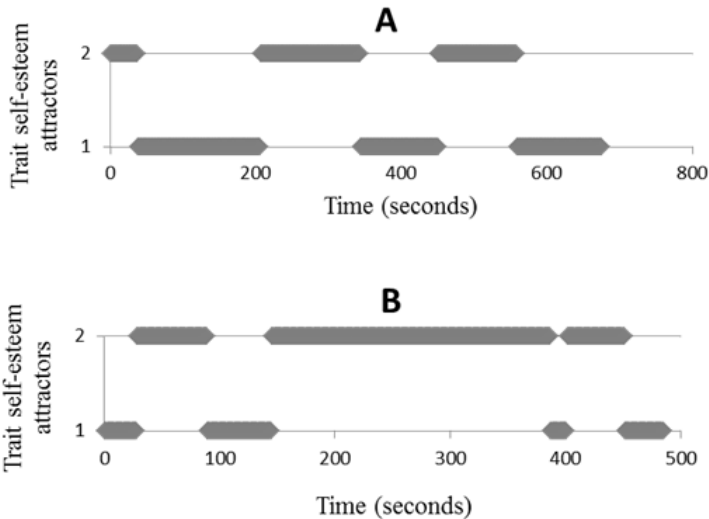


Figure 6: Examples of trait self-esteem attractor variability across the dyadic interaction for two participants (A and B). The grey bars indicate the duration of time (i.e., seconds) that the trait self-esteem attractors (1 and 2) are expressed.

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)

Percentage of time expressed	Participant A		Participant B	
	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).

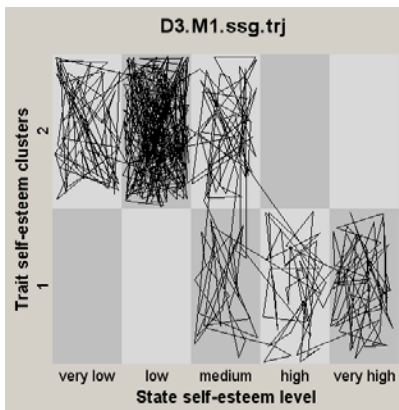


Figure 7a

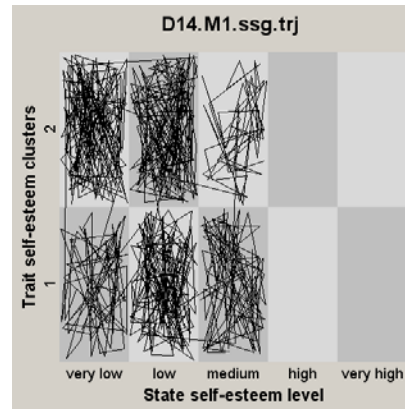


Figure 7b

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 7a illustrates a high level of temporal coherence in variability between the two variables, while Figure 7b 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).

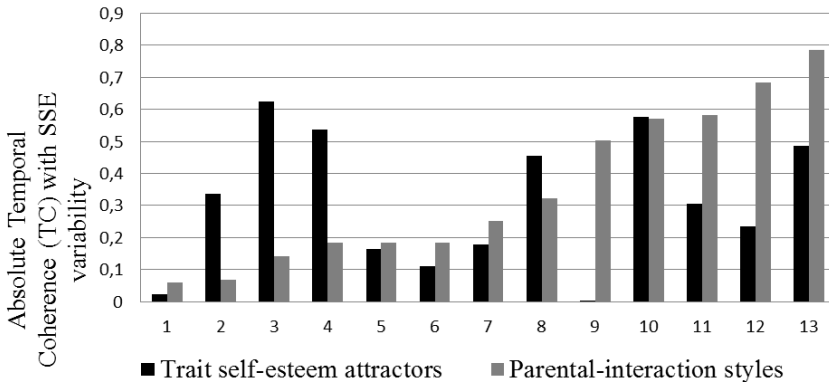


Figure 8. Absolute TC scores for adolescent trait self-esteem attractors and parental interaction-styles for each dyad.

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 ($p < 0.05$).

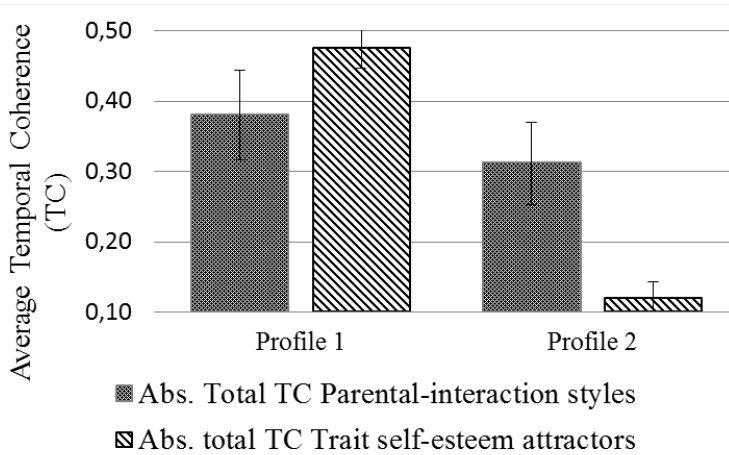


Figure 6. Group levels of absolute temporal coherence (TC) for adolescent trait self-esteem attractors and parental interaction-styles.

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

