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Here We Go Again: A Dynamic Systems Perspective on Emotional Rigidity Across Parent–Adolescent Conflicts

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The authors used a dynamic systems theoretical approach to examine intraindividual variability in emotional responses during the transitional period of adolescence. Longitudinal diary data were collected regarding conflicts between 17 teenage girls and their mothers over a period of a year. The results revealed a reversed *u*-shaped relation between girls' emotional variability and the number of conflicts. Moreover, girls who showed limited variability in emotional states across conflict episodes tended to attach the same emotional state to divergent conflict topics. Explained as the result of a self-organizing process, emotional rigidity (i.e., a lack of variability and contextual sensitivity) possibly undermines the adaptive potential of the parent–adolescent system in times of relational transitions and developmental changes.

Keywords: parent–adolescent conflict, emotions, diary study, variability, dynamic systems

Across adolescence, typical parent–adolescent relationships can be characterized both by mutual disclosure and by interpersonal conflict. The attempts of adolescents to create space for their own identity exploration—becoming independent and developing their own ideas and beliefs or gaining autonomy (Grotevant & Cooper, 1998)—can clash with their parents' ideas and willingness to provide autonomy (Collins, 1991; Jackson, Bijstra, Oostra, & Bosma, 1998; Smetana, 1989, 1995). This clash may cause emotional arousal and conflict and can possibly trigger relational accommodations and transitions (Collins, 1995; Granic, Dishion, & Hollenstein, 2003). The majority of parent–adolescent dyads move successfully through this transitional period. For some dyads, however, this temporary period of conflict fails to be a developmental step forward and rather introduces a negative pattern of interactions that erodes the bonds formed in childhood (for a review, see Laursen & Collins, 1994).

To understand how some dyads end up in negative interaction patterns and fail to maintain and readjust their relationships, one has to concentrate on the trajectories of parent–adolescent dyads as they move through this transitional period (Granic, Hollenstein, Dishion, & Patterson, 2003). Conflicts are important "movers" of the transitional period of adolescence, and the expression of (negative) emotions forms an integral part of conflicts (Jones, 2001).[1] For that reason, emotions and emotional patterns and processes should be a major concern for those studying conflicts (Jones, 2001; Kunnen, 2006). Several studies have shown that, in addition to the content (i.e., sort of negative emotion) of an interaction, structural aspects of an interaction, such as variability and contextual sensitivity, add important information and can provide unique predictions (e.g., Granic & Lamey, 2002; Hollenstein, Granic, Stoolmiller, & Snyder, 2004). As we outline below, during periods of transitions and renegotiations, variability might be of importance in serving the adaptive ability and potential of the parent–adolescent dyad, because variability enables the dyad to explore new pathways and possibilities and to learn to adapt to the new challenges and opportunities coming up during adolescence.

Our aim in the current study was to extend existing research on emotional variability within parent–adolescent interactions by focusing on emotional variability across conflict interactions. In order to do so, we implemented a diary study in which 15-year-old girls reported on their naturally occurring conflicts with their mothers over the course of a year. These data provided information on the episode-to-episode variability in emotional states (i.e., composition of emotions) over the developmental period of 1 year. This study addressed the relationship between emotional variability and the number and nature of conflicts.

So far, research has focused on static features of parent–adolescent relationships and conflicts and has thereby neglected structural and temporal aspects, such as intraindividual variability and contextual sensitivity (Granic, Hollenstein, et al., 2003). The dynamic systems perspective opens an approach to the above process-related questions (e.g., Hollenstein, 2007) by providing a conceptual framework with which to understand the principles of developmental change, including the role and meaning of variability.

A Dynamic Systems Perspective

One of the crucial assumptions of a dynamic-systems-oriented approach is that the individual, dyad, or family (whatever is defined as the system) and its behavioral changes and trajectory over time form the basic unit of analysis (Thelen & Ulrich, 1991;

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[1] It should be noted that these assumptions about the relationship between conflict and adolescent development are based on research and literature situated in the Western culture. This study does not address the question of whether these ideas are generalizable to other cultural contexts.

van Geert, 1994). Studying the individual trajectories over time draws our attention to the role of intraindividual variability and relative stability in behavior (over time and contexts). This emphasis on the role of variability is fundamentally different from the more traditional developmental approaches, in which variability is often seen as measurement error and noise (Thelen & Smith, 1994; Thelen & Ulrich, 1991; van Geert & van Dijk, 2002).

A dynamic system is defined as a set of interconnected elements that affect each other over the course of time (Smith, Thelen, Titzer, & McLin, 1999; van Geert, 1994; van Gelder, 1998). No general rule exists about how to define a system. This choice depends on the universe of discourse and the phenomena in which the researcher is interested (van Geert, 2003). In the context of parent–adolescent conflicts, several system definitions are possible, such as the entire family, the parent–adolescent dyad, or just one of the subsystems (e.g., the mother or the daughter; see also Granic, 2000). Each system can be distinguished by several elements, such as emotions, cognitions, and behaviors involved in a conflict interaction. Also, the choice and definition of the elements depend on the phenomena and the research level in which one is interested (e.g., think of emotional patterns during a conflict as compared with hormonal or brain activity measures). Thus, the conceptualization of a system and its elements is based on a nested structure (Granic, 2000).

In the present research, the system under study was the mother–daughter dyad as it emotionally "behaves" in the context of daily conflicts. This specific system was investigated by focusing on the girl as the bearer of the context (i.e., the girl as the indicator of the ongoing dynamics). This means that we followed the complex system (parent–adolescent system) in time via one essential component (i.e., the emotions of the girl). Hence, the girl was not isolated from the system, and the system, as described through the perspective of the girl and her emotional states, revealed information about the structure of the entire mother–daughter system. The idea that a complex system is represented by and can be studied through the dynamics of one well-chosen component is borrowed from the reconstruction theorem of Takens (1981), which says that a system's dynamics can be reconstructed (i.e., described) by analyzing the time evolution of one of its components or variables.

This specific system is situated within a certain developmental period of life: adolescence. Development—from a dynamic systems perspective—is conceptualized as a dynamic, multilevel, and self-organizing process (for more elaborate discussions of this claim, see Granic & Hollenstein, 2003; Lewis, 2000; Thelen & Smith, 1994; Thelen & Ulrich, 1991; van Geert, 1994). Developmental processes are often characterized by discontinuous, qualitative changes (Thelen & Ulrich, 1991; van der Maas & Molenaar, 1992; van Geert; 1998). These qualitative shifts (e.g., a shift from more hierarchical childlike patterns of interactions to more horizontal, mature types of interactions) are called phase transitions. The concept of a phase transition and the role of variability are discussed in the next section.

Adolescence as a Phase Transition and the Role of Variability

The conceptualization of adolescence as a phase transition has been introduced by a group of researchers, whose work forms the basis of the present section (for more detailed explanation, see Granic, Dishion, & Hollenstein, 2003; Granic, Hollenstein, et al., 2003). A phase transition is a discontinuous shift from one stable state to another, qualitatively different stable state of the system (Thelen & Ulrich, 1991).[2] Old and stable configurations must break down to make way for new patterns and structures (Hollenstein, 2007; Lewis, Zimmerman, Hollenstein, & Lamey, 2004; Thelen & Ulrich, 1991). Consequently, a classical indicator of a phase transition is a temporary change in the natural variability of the system, such as increased within-system variability (e.g., Thelen & Ulrich, 1991; van der Maas & Molenaar, 1992; van Geert & van Dijk, 2002).

This increased variability is needed so one can explore new pathways. Increased levels of variability are in fact the precondition for adaptation. Without variability no exploration and orientation can ever take place, and, as a consequence, the system's ability to learn and create new pathways and patterns is undermined (for a similar argument, see De Weerth & van Geert, 2002; Thelen & Smith, 1994; van Geert & van Dijk, 2002). It is the same principle as in operant conditioning or the evolutionary theory of Darwin. There is spontaneous variability, and adaptive forms of variation are being chosen by means of selection (or reinforcement): "Intraindividual variability in social behaviors is a fundamental premise of social adaptivity and thus defines the base condition of an individual's developmental potentials" (Lang, Featherman, & Nesselroade, 1997, p. 658).

Variability can be observed at the various timescales at which developmental processes are being observed (Fogel & Thelen, 1987; Granic & Hollenstein, 2003; Lewis, 1995, 2000; Thelen & Ulrich, 1991). That is, the same principles of variability and stability can be applied to processes that take place at the micro level (i.e., in real time), at the meso level (i.e., from day to day), and at the macro level (i.e., over months or years; Lewis, 2000; Lichtwarck-Aschoff, van Geert, Bosma, & Kunnen, 2008). Several longitudinal studies have shown that increased levels of variability in real time accompany phase transitions in the context of parent–child interactions (Granic, Hollenstein, et al., 2003; Granic, O'Hara, Pepler, & Lewis, 2007); motor and cognitive development (Thelen & Smith, 1994; Thelen & Ulrich, 1991); and language development (Ruhland & van Geert, 1998). Studies looking at phase transitions from a developmental time perspective (e.g., week-to-week or month-to-month fluctuations) have also found support for a temporary increase in intraindividual variability (in the context of mother–infant interactions, see De Weerth & van Geert, 2002; Lewis et al., 2004; or of language development, see Bassano & van Geert, 2007).

The current study addressed the developmental period of adolescence. Our aim was to extend existing research on real-time variability in parent–adolescent interactions by focusing on interindividual differences in the emotional variability (differences in composition of emotions) across conflict interactions. By assessing variability across several conflict episodes over the course of 1 year, we measured variability on a moderate or intermediate timescale, a timescale that describes the mesodevelopment (Lewis, 2000). Real-time studies have shown that problematic parent–child relationships are characterized by a lack of variability (Granic et al., 2007; Hollenstein et al., 2004; Hollenstein & Lewis, 2006). We thus hypothesized that con-

[2] Note that a stable state can also be a dynamically stable state (see Haken, Kelso, & Bunz, 1985).

flictual relationships are characterized by a lack of variability across conflict episodes. It might be that girls who have many conflicts with their mothers "have been frozen into a small number of [emotional] states and found it hard to shift out of these states" (Lewis et al., 2004, p. 71; note that we have replaced the original term *behavioral* with emotional). In the next section we discuss the state space metaphor as a valuable framework with which to study a system's trajectories over time.

The State Space Metaphor

Within dynamic systems approaches, the general idea is that a system is situated within a state space (Lewis, Lamey, & Douglas, 1999; van Geert, 1994; van Gelder, 1998). This space, which is composed of all the variables (i.e., dimensions) used to specify the system, describes the behavioral landscape of the system under study and contains all potential states the system can occupy. A particular state of the system at a certain point in time is defined by the geographical position in the state space. The evolution process of the system can be studied by following the spatial movements of the system across the state space (e.g., state space grids developed by Lewis et al., 1999; Karnaugh maps developed by Dumas, Lemay, & Dauwalder, 2001). The landscape is not flat but contains metaphorical hills and valleys. The shape of the landscape—that is, the valleys and hills—is based on the frequency of certain (e.g., emotional) patterns or states. A state that is frequently occupied is expressed in the form of a valley, as the system easily "falls into" this particular behavioral state. These valleys are also called attractors; these are temporarily stable states that absorb or attract the system's behavior (Granic, 2000; Haken, 1990; Hoeksma, Oosterlaan, Schipper, & Koot, 2007; Lewis et al., 1999; Thelen & Smith, 1994).

Over time, each girl develops her unique state space, which has its own content (the emotions that are occupied) and shape (the structure of the landscape, such as the amount, size, and depth of attractors). Suppose we have a girl who often has conflicts with her mother about going out. There is a party the girl wants to attend, but she already "knows" that her mother will not allow her to go and prepares herself for the conflict with an angry face. The mother, on the other hand, sees the angry face, knows what is coming next, and puts on an angry face herself. The result: the two are in the middle of an angry fight within a few seconds. Thus, the coupling of emotions, thoughts, and behaviors within each conflict interaction "increases the likelihood of their recurrence on subsequent occasions" (Lewis & Douglas, 1998, p. 172).[3] The more often a certain type of conflict pattern occurs, the more easily it is activated. A small cue—a bad look—is enough to trigger the trajectory that moves the system toward this pattern (see also the coercive cycles described by Patterson in Granic, 2000). The anger pattern described above, once it occurs frequently enough, could be called an attractor. Over time and contexts, this particular dyad is being pulled toward this form of conflict interaction and engages in an angry fight within a few seconds.

In the current study, we have applied the idea of emotional state spaces to entire conflict episodes (i.e., to the emotional states [composition of emotions] and variations herein across conflict episodes). In this way, information can be obtained about the structural shape of the emotional landscape (Granic & Hollenstein, 2003). Are there any emotional states that are occurring over and over again? A lack of variability in emotional states—with dyads often falling into the same emotional state across conflict episodes—can be seen as an indicator of an attractor (Lewis et al., 1999).[4]

The second important criterion of an attractor is resistance to environmental changes or environmental forces (Granic, 2000; Hollenstein et al., 2004; Thelen & Ulrich, 1991). That is, despite contextual variations, the system's behavior remains in the same position. Continuing with the example: Does the girl feel angry only during conflicts about going out, or does she show the same emotional response during any type of conflict she has with her mother? The latter would be a sign of emotional rigidity. The role of contextual variation in distinguishing between stability and rigidity is the subject of the next section.

Contextual Sensitivity and the Difference Between Stability and Rigidity

A system's context or environment contains everything that does not belong to the system but interacts with it (van Geert, 2003). Context definitions can vary from distal contexts (e.g., socioeconomic or cultural background) to more proximal contexts, such as the sort of task the system has to perform (Thelen & Ulrich, 1991), the sort of interaction the system is engaged in (Granic et al., 2007), or the interaction partner of the system (Steenbeek & van Geert, 2008). The essential point is that each context provides its own constraints and opportunities (e.g., certain child-rearing practices) and thereby contributes to the emergence of the system's behavior (Thelen & Ulrich, 1991; van Geert, 1994). That is, dynamic-systems-oriented approaches strongly emphasize that the system's behavior is the product of a temporal cooperation or interaction between the system and its context (Thelen & Smith, 1994; van Geert, 2004).

A system that has lost its contextual sensitivity can be qualified as rigid. Rigidity is different from the neutral state of stability. That is, whereas stability is defined as a lack of variability, rigidity is defined as a lack of variability and adaptability (i.e., adaptation in response to contextual variations; for a similar argument, see Hollenstein et al., 2004; Paulhus & Martin, 1988; Werner, 1946). In the current study we measured contextual variation by means of different conflict topics as reported by the girls (e.g., autonomy, unfairness). Various conflict topics differ in the underlying goals and expectancies that are threatened (Collins, 1991, 1995; Smetana, 1989) and are therefore supposed to trigger different emotions, thoughts, and behaviors (see, e.g., the work of Frijda, 2001; Roseman, Wiest & Swartz, 1994; Siemer, Mauss & Gross, 2007). Thus, the current study forms an important extension to existing research in that we have evaluated emotional variability in the light of naturally occurring contextual variations.

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[3] Note that an attractor does not have to be the result of a large number of repetitions. For example, people who meet for the first time can easily end up in an attractor (i.e., a stable form of interaction).

[4] Lewis et al. (1999) have developed various ways to detect the existence of attractors. In addition, there are mathematical ways in which to prove the existence of an attractor (see, e.g., Haken, 1990; Hoeksma et al., 2007).

The Current Study

This study represents a first explorative step toward the question of intraindvidual variability in emotional states across mother–adolescent conflict episodes and thereby provides an extension to research that deals with the role of real-time variability during the phase transition of adolescence. Furthermore, the present study was conducted in a real-life setting (i.e., the girls' perspectives on daily conflicts with the mothers were assessed by means of diaries). Diaries have the advantage of measuring real-life conflicts almost at the moment that the conflicts occur (Laurenceau & Bolger, 2005; Papp, Goeke-Morey, & Cummings, 2007; Välimäki, Vehviläinen-Julkunen, & Pietilä, 2007). Research has shown that emotional responses differ tremendously depending on whether hypothetical or real-life conflicts are being used (Johnson, 2004). Using diary data enabled us to measure naturally occurring contextual variations (i.e., the variations in conflict topics) rather than experimentally induced contextual changes. Because our focus was on the trajectories of emotional conflict patterns and their variability across episodes, we chose a sample that was followed intensively over the course of a year. Due to the labor-intensive nature of the method, the sample size was small.

The following two research questions were investigated: (a) What is the relationship between the emotional variability and the number of conflicts? We hypothesized that the emotional variability would decrease when relationships became more conflictual, with "conflictual" depending on the number of conflicts reported. (b) How is the emotional variability related to conflict type? We wanted to know if a lack of emotional variability indicates that the system has lost its sensitivity to contextual variations. To answer this question, we evaluated the emotional variability across episodes in relation to the variations in conflict type as measured by the reported conflict topics.

Method

Participants

A total of 25 adolescents was recruited from a public school in a small town in the north of the Netherlands. Participation was voluntary, and there were no selection criteria for the diary study. Of these 25 adolescents, 23 were female and 2 were male.[5] Over the course of 1 year, 4 adolescents (3 girls and 1 boy) dropped out of the study. The remaining 21 adolescents (20 girls and 1 boy) completed on average 9 weeks of daily diary writing (calculated in days, $M = 65.28$, $SD = 15.40$). Because we were interested in emotional conflict patterns and variations therein across episodes, we included only children who reported at least two conflicts across the diary episode. Of the 21 adolescents, 4 (3 girls and 1 boy) had to be excluded because they did not meet the inclusion criteria. Thus, in the present study the diaries of 17 adolescent girls were analyzed.

At the start of the study the respondents were 15 years of age ($M = 15.35$ years, $SD = 0.49$). Of the girls, 14 were living with both parents, 1 was living with the mother and the mother's new partner, and 2 girls were living with the mother only. All girls had at least one sibling ($M = 2.94$, $SD = 0.99$). All participants were Dutch citizens; 1 had parents with an Indian background, and another girl had Iranian parents. The majority of the participants (70%) were following the lower education track (prevocational secondary education), and 30% of the girls were following the higher education track (senior general secondary education).

Measures of Daily Mother–Daughter Conflicts: The Diaries

The diaries were divided into a general everyday part and a conflict part. Conflicts were defined as disagreements or oppositions between the opinion of the mother and the opinion of the daughter, not necessarily involving intense negative emotions (see also Laursen & Collins, 1994). The general questions had to be filled in every day. These were about the amount of time mother and daughter both spent at home, how close they felt that day, and whether the girl did something fun with her mother. If the girl reported no conflicts, the diary entry was terminated at this point.

Whenever there was a conflict, the girl had to describe several aspects of the conflict. The relevant measures for the present study were the conflict topic and the emotions felt during conflict. The respondents were asked to describe the conflict topic in an open-ended way. They were provided with a comprehensive list of 14 words (*angry, frustrated, disappointed, ashamed, afraid, guilty, sad, lonely, hurt, regret, hopeful, relieved, happy*, and *proud*) with which to indicate how they felt during the conflict. Because we were interested in the variations of emotional states across conflicts, we wanted to incorporate as many emotions as possible that were potentially relevant in the context of mother–daughter conflicts. The girls were allowed to choose as many emotions as they wanted in order to describe how they felt during the conflict. Additionally, the participants were allowed to add emotions if the list did not represent their feelings. Feeling "misunderstood" and "not taken seriously" emerged out of these open entries. Of the 17 girls, 16 used at least one of these emotional expressions once. In total, descriptions of 40 conflicts contained the word *misunderstood* and those of 37 conflicts contained the phrase "not taken seriously." Because of this frequent occurrence, we decided to include both entries as emotions in the state space. The resulting emotional state space representing the emotional states of the girls consisted of 16 potential state entries (e.g., 16 different emotions).

Procedure

The diaries consisted of six waves over the course of 1 year, and each wave comprised a 2-week diary episode. In between the diary episodes there was a 6-week break. The participants could choose between a booklet version and a Web-based form of the diary. Respondents were free to decide which time of the day they would fill in the diary. The booklet group received the booklets by mail prior to the start of a new diary episode. These respondents were asked to return the diary booklets after completing them. The website group was reminded via e-mail, and Anna Lichtwarck-Aschoff kept frequent e-mail contact with the group during the diary episodes.

In addition, a lot of effort was spent in building a good relationship with the respondents, such as sending Christmas cards, organizing an excursion, and making home visits. This was done to increase respondents' commitment and motivation to remain involved over the entire year. The girls received a small reward, €5, for every completed diary week at the end of the entire study.

[5] As one can see from the composition of the sample, it was not our original intention to select a female sample but it appeared to be very difficult to motivate 15-year-old boys to participate in a diary study of this kind.

Plan of Analysis

Question 1: The association between the emotional variability and the number of conflicts. In order to determine the intraindividual variability in emotional states, we developed three different kinds of measures, based on the idea of symbol dynamics (Daw, Finney, & Tracy, 2003; for a comparable approach, see the Karnaugh maps in Dumas et al., 2001). The basic rationale underlying this approach is the transformation of the system's trajectory or geographical movement in time into a sequence of specific symbols, corresponding to partitions within the state space (Dale & Spivey, 2005).

First, we computed the emotional state space for each girl, which contained all reported emotions across all her conflict episodes (i.e., across all the diary waves). Every state within the space represents how a girl felt during a particular conflict (see Table 1). Remember that the girls could choose as many emotions as they wanted to describe how they felt during the conflict. This means that we had to deal with multiple emotions that describe an emotional state during the conflict (this requirement made the emotional space space different from the state space grids developed by Lewis et al., 1999). In our calculation, an emotional state could therefore take the form of a single emotion or a combination of different emotions. That is, every emotional state was represented by a set of emotions present (1) or absent (0) (i.e., the symbols in the string that represent the emotional state). The mathematical representation of every state consisted of a particular string of ones and zeros. We computed the emotional space for every girl and counted the number of different states. States with exactly the same emotion or pattern of emotions obtained the same nominal code, and states with different emotions or combinations thereof received different codes (the codes are denoted by letters; see Table 1). The emotional variability was defined as the number of different emotional states.

The second and third measures were based on the Hamming distance (Hamming, 1950; Teşileanu & Meyer-Ortmanns, 2006). The Hamming distance is used in calculating the distance (absolute difference) between two symbolic strings (here, two emotional states). The distance between the emotional states indicates how much the emotional states differ from each other and in this sense represents the variation between the states (compare this with the intergrid distance used by Lewis et al., 1999). We computed two forms of the Hamming distance. The first, which is called the *sequential* Hamming distance (see Table 1), indicates the distance between the preceding states, that is, the distance between emotional state$_t$ and emotional state$_{t+1}$. Thus, this measure indicates how much a girl varies from one conflict to the next. The second, which we call the *overall* Hamming distance (see Table 2), specifies the distance between all pairs of states that are different, regardless of the time order. This measure represents an overall value of the emotional variability, as it describes how much all the existing states differ from each other. The calculation in both cases is based on the same principle and goes as follows: If two emotional states contained exactly the same emotions, the Hamming distance would be zero; for each emotion that differed (absent or present compared to another or preceding state), the Hamming distance would be raised by one (see Table 1 for the sequential Hamming distance and Table 2 for the overall Hamming distance). We compared the preceding states in the case of the sequential Hamming distance and computed the difference between all pairs of different states for the overall Hamming distance. The resulting Hamming distance represents the sum of the absolute differences. As one can see in Tables 1 and 2, the values of the overall Hamming distance are higher than the values of the sequential Hamming distance. Nevertheless, in both cases the lower the value of the Hamming distance, the more similar the states and the smaller the emotional variability.

Table 1
Example of a Calculation of the Emotional Codes and the Sequential Hamming Distance

Conflict episode	Angry	Sad	Hurt	Afraid	Code	Sequential Hamming distance
1	1	0	0	0	A	—
2	0	1	1	1	B	4
3	1	0	0	0	A	4
4	1	0	1	0	C	1
5	1	0	1	0	C	0
6	0	0	1	0	D	1
					No. states: 4	Sum of distances: 10

Note. This example of emotion data entry is based on 6 conflict episodes and 4 emotions. The last two columns indicate the code for the emotional state (e.g., A stands for anger alone, B stands for sad, hurt, and afraid) and the sequential Hamming distance between the preceding states.

Intraindividual emotional variability was measured with the numbers of emotional states, as well as both Hamming distances. To explore the link between the emotional variability measures and the number of conflicts, we used the Curve procedure of the statistical program SPSS (Version 14). Two models, a linear model and a quadratic model, were fitted to the data.[6] The model that best describes the data was chosen on the basis of a comparison of the explained variances.

Question 2: The association between the emotional variability and the contextual variation. In order to measure the variation in conflict topics, we first coded the open-ended answers about the conflict topics into five distinct, relatively broad categories. All the conflicts were coded according to the perspective of the daughter. We developed the present coding scheme on the basis of existing literature (Laursen, 1995; Smetana, 1989) but also of a bottom-up analysis of the diary entries. The first category is called *autonomy* conflicts. These conflicts basically deal with the question of the girl's self-determination, such as deciding when to go to bed, when to do homework, and what to do in free time. The second category is called *dependency* conflicts. These conflicts are in fact the opposite of the previous category, and they describe conflict situations in which the daughter wanted something from the mother (e.g., help, guidance, advice). The third category of conflicts is called *unfairness.* This category entails conflicts in which the daughter felt treated unfairly. The fourth category of conflict topics is labeled *not like me.* In these conflicts the daughter felt a

[6] To avoid confusion, we wish to emphasize that the curve-fitting procedure used here is different from general growth modeling approaches (e.g., latent growth curve analysis). The data that we used to fit the linear and quadratic curves are interindividual difference measures that represent the degree of intraindividual variability (i.e., the data were aggregated across each individual's conflict episodes). Thus, we fit a model that describes the relation between the number of conflicts and the emotional variability on a group level and not a model of individual development.

Table 2
Example of a Calculation of the Overall Hamming Distance

Difference between	Overall Hamming distance
States A and B	4
States A and C	1
States A and D	2
States B and C	4
States B and D	2
States C and D	1
	Sum of distances: 14

Note. This example is based on the previous data. The overall Hamming distance neglects the time order by computing the difference between all pairs of states that are different.

discrepancy between what she conceived of herself and how she was seen and reacted to by her mother. These conflicts are about being assigned wrong attributes. The last category, called *minor-scope* conflicts, contains all the remaining conflict topics that could not be coded in the previous categories. Minor-scope conflicts constituted 7% of all conflicts and included issues such as "you are brushing my hair in a painful way" or "you again managed to lose my sandwich box."

The conflicts were coded to find out how often different categories of conflicts occurred over time. We used the test–retest reliability to determine the stability of the codes over time. We proceeded as follows. The conflict topics were coded by Anna Lichtwarck-Aschoff. A month after the coding, a random subset of 15 conflicts was drawn and again was coded by Anna Lichtwarck-Aschoff. Within this subset the first and second rounds of coding were compared according to a straight concordance method. Each conflict that was assigned the same code received a one, and disagreeing conflicts received a zero. The reliability score was then calculated as the total agreement over the total number of comparisons. The average across the 15 conflicts was computed, yielding the result of 0.93 (i.e., 14 out of 15 conflicts were coded the same).

Next, in order to indicate the amount of variation in conflict topics, we calculated the coefficient of unalikeability (Perry & Kader, 2005) for each girl's conflict topics. The coefficient of unalikeability is a measure for the variability of categorical variables. It indicates how *often* observations differ from each other (this is in contrast to how *much*, as in the case of numerical variables, where the variability is often expressed by means of the standard deviation). The advantage of the unalikeability coefficient is that it matches intuitive ways of perceiving categorical variability (Perry & Kader, 2005). The coefficient of unalikeability represents the proportion of possible comparisons that are different. The higher the value, the greater the variability. For each person, the coefficient of unalikeability was computed with the following equation:

$$Coefficient_{\text{unalikeability}} = 1 - [(p/n)^2 + (q/n)^2 + (r/n)^2 + (s/n)^2 + (t/n)^2]$$

The letters *p, q, r, s*, and *t* stand for the frequencies of the five different conflict topics (autonomy, dependency, unfairness, not like me, minor scope) and are divided by the total number of conflicts.

Finally, in order to examine the question of emotional rigidity (i.e., a lack of variability despite contextual variation), we divided the group of girls into subgroups according to the amount of repetitions of the same emotional state. This division was based on the trimodal distribution of the number of repetitions and resulted in three different subgroups. To assess the level of variation in conflict topics, we computed the individual coefficients of unalikeability. We first checked whether the three groups differed in the total amount of conflict variation by calculating the coefficients across all reported conflicts and averaging them within each group. In the second step we again calculated the coefficients but only across conflicts within the same emotional state (i.e., the variation in conflict topics across conflicts where a girl reported the same emotional state). By means of resampling techniques we compared the average unalikeability coefficients of the subgroups to determine whether they were statistically significantly different from each other. Resampling techniques, such as Monte Carlo analyses, are useful in small samples with various restrictions (for a detailed description, see Todman & Dugard, 2001). These parameter-free techniques enable performance of appropriate statistical analyses even with small samples and null hypotheses based on uncommon test statistics.

Results

The adolescent girls reported a total of 147 conflicts with their mothers ($M = 8.65$, $SD = 4.72$). On average the girls reported 2.44 emotions ($SD = 1.04$) per conflict. Conflicts about autonomy occurred most frequently (51%). The second most reported topic fell into the category not like me (20%). Thirteen percent of the conflicts dealt with dependency issues, and 9% were about unfairness. The remaining 7% were coded as minor-scope conflicts.

The Association Between the Emotional Variability and the Number of Conflicts

Here, we had predicted that girls with high numbers of conflict would have lower levels of emotional variability. Table 3 shows the averages and standard deviations of the three emotional variability measures. The results of the linear and quadratic model are given in Table 4.

Table 4 shows that for all three emotional variability measures, the quadratic relationships fit the data much better than does the linear relationship. The variance explained by the linear model for the overall Hamming distance is considerably higher than that explained by the other two emotional variability measures, but it was still below the level of explained variance of the quadratic

Table 3
The Average and Standard Deviations of the Three Emotional Variability Measures

Measure	*M*	*SD*
No. different emotional states	5.47	2.37
Sum of sequential Hamming distances	16.82	8.30
Sum of overall Hamming distances	77.82	51.88

Table 4
The Number of Conflicts Predicted by the Emotional Variability Measures With a Linear Model and a Quadratic Model

	Linear model		Quadratic model	
Measure	*F*(*dfs*)	R^2	*F*(*dfs*)	R^2
No. different emotional states	0.52 (1, 15)	.03	9.38 (2, 14)	.57**
Sum of sequential Hamming distances	0.64 (1, 15)	.04	8.27 (2, 14)	.54**
Sum of overall Hamming distances	10.44 (1, 15)	.41*	13.11 (2, 14)	.65**

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

model. All three measures of the intraindividual variability in emotional states showed a reversed *u*-shaped relationship with the number of conflicts. Figures 1, 2, and 3 display the inverted *u*-shaped relationships between the variability measures and the number of conflicts (note that the scales of the axes are different).

The reversed *u*-shaped relationship indicates that, up to a certain number of conflicts, the association between the emotional variability and the number of conflicts was positive. That is, the more conflicts the girls had, the more emotional variability they reported. Beyond a certain number of conflicts, however, the relationship flipped and the amount of emotional variability decreased. Girls with high numbers of conflicts indeed had lower levels of intraindividual emotional variability. This picture was consistent across the three variability measures.

The following objection can be made with regard to the size of the emotional space that we used in this study. Our space contains many different state terms (i.e., different emotions) that are probably not evenly distributed across the state space (i.e., some emotions are closer to each other than others). Therefore, one might wonder whether the variability measures are inflated by a difference between emotional states that are actually almost synonymous. To check for this possibility, we collapsed the 16 emotional entries into a considerably smaller number of emotional categories. Aiming at the best compromise between the similarities and differences among the categories, the reduction resulted in a collection of seven emotional categories (i.e., anger, negative internal emotions, fear, shame, guilt, feeling misunderstood, and positive emotions). On the basis of this collapsed data set, we again calculated the three emotional variability measures. First, these new collapsed emotional variability measures were correlated with the original variability measures. A very high agreement between the raw and the collapsed measures was found (Pearson correlations = .89–.93). Next, we looked at the relationship between the collapsed emotional variability measures and the number of conflicts. The results were highly comparable with the results described above, and all three measures again showed the reversed *u*-shaped relationships. It can thus be concluded that the high number of emotions or different distances between the emotions did not inflate the variability measures, and the results could also be confirmed with a collapsed data set.[7]

The Association Between the Emotional Variability and the Variation in Conflict Topics

Our aim in the second research question was to examine whether emotional stability across conflict episodes is a sign that the system has lost its sensitivity to contextual variations. In order to do this, we investigated the emotional variability in relation to the variations in conflict topic. Our hypothesis was that if emotional stability was a sign of rigidity, girls with low levels of variability would feel the same regardless of the conflict topic.

First, we counted the number of repetitions of the same emotional state (e.g., how often did a girl report the same emotion). Second, we divided the group of girls into three subgroups according to their number of repetitions (for the explanation, see *Question 2: The association between the emotional variability and the contextual variation*). The first group (7 girls) had no repeating emotional state at all. This group was called the highly flexible group. The second group consisted of 7 girls who had a low-to-moderate number of repetitions ($M = 2.86$, range = 2–5). This group was called the moderately flexible group. The last group, called the rigid group, comprised just 3 girls who had many repetitions of the same emotional state ($M = 13$, range = 9–16). The rigid group reported the highest number of conflicts, and the highly flexible group had the lowest number of conflicts (see Table 5). Remember, we first computed the unalikeability coefficient across all conflicts in order to assess whether the three groups differed in their overall level of topic variation. Then we calculated the unalikeability coefficients within the same emotional state (i.e., only across those conflicts for which a girl reported the same emotions). In both steps, the individual unalikeability coefficients were averaged within each group. The results are summarized in Table 5.

[7] Collapsing the emotions was a suitable way to demonstrate the robustness of the findings. However, an additional note has to be made with respect to the grouping of emotions. The girls in our study exploited the whole range of different emotions to describe their feelings. Sometimes the chosen emotions were a cluster of "neighboring" emotions, but sometimes there was also a combination of "distant" emotions. Emotional development is a highly idiosyncratic process; individuals develop their own unique patterning of emotions (Lewis, 1995, 1997; Magai & McFadden, 1995). In another study we performed multilevel component analyses on the same data set and found pronounced interindividual differences with respect to the intraindividual patterning of emotions (Timmerman, Ceulemans, Lichtwarck-Aschoff, & Vansteelandt, in press). Therefore, we do not think that collapsing the emotions across subjects is the best way to deal with varying distances of emotions on the state space. For discovering possible regions of neighboring emotions, we advocate an idiosyncratic approach in which the individual state spaces are analyzed first and similarities and differences between subjects are searched for afterward (see also Hamaker, Dolan, & Molenaar, 2005).

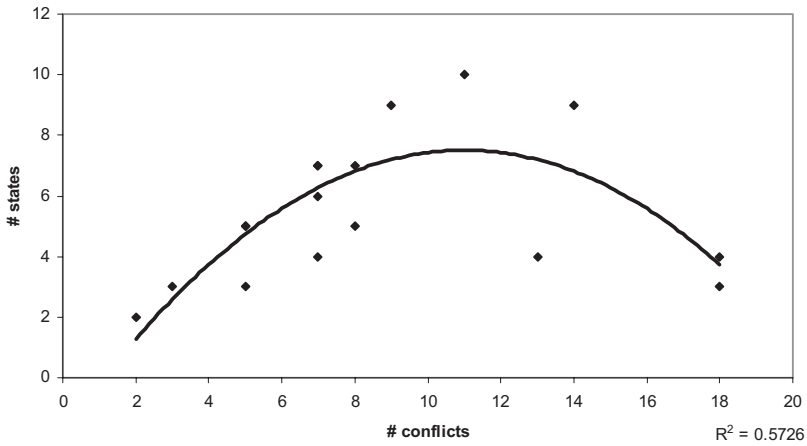

Figure 1. Curve-linear relationship between the number of different emotional states and the number of conflicts.

Table 5 shows that the three groups had almost the same amount of variation in topics across all conflicts. When we look at the topic variation within the same emotional state, however, we can see that the rigid group showed more than twice as much variation as did the moderately flexible group. By means of Monte Carlo analysis we tested the hypothesis that the rigid group had more variation in conflict topics than did the moderately flexible group. We tested against the null hypothesis that the coefficients of unalikeability were randomly distributed across the two groups (rigid vs. moderately flexible group). The analyses revealed that the rigid group indeed showed significantly higher levels of topic variation ($p = .018$). At first glance, the finding that emotionally rigid girls show higher levels of contextual variation might seem counterintuitive. But what this means is that the rigid group felt the same regardless of the conflict topic. These girls had the same emotional response to a wide range of divergent conflict topics. The moderately flexible group, in contrast, showed more similarity in conflict topics within the same emotional state. This means that, among these girls, the same emotional reaction was triggered by the same conflict topic. Thus, there was not a rigid response to all kinds of different conflict types.

Discussion and Conclusion

Our main goal in this study was to explore interindividual differences in intraindividual variability of emotions across conflict episodes within the period of adolescence. It is assumed that during transitional periods, high levels of variability enable the system to explore new pathways and patterns.

We found a reversed *u*-shaped relationship between the girls' intraindividual variability in emotional states and the absolute frequency of conflicts. The range of few-to-moderate numbers of conflicts shows a positive association between the number of conflicts and the emotional variability. As one would expect on the basis of a linear relationship, the more conflicts the girls had, the more emotional states they could occupy. But, beyond a certain number of conflicts (about two conflicts per week), girls showed a negative relationship between the number of conflicts and the

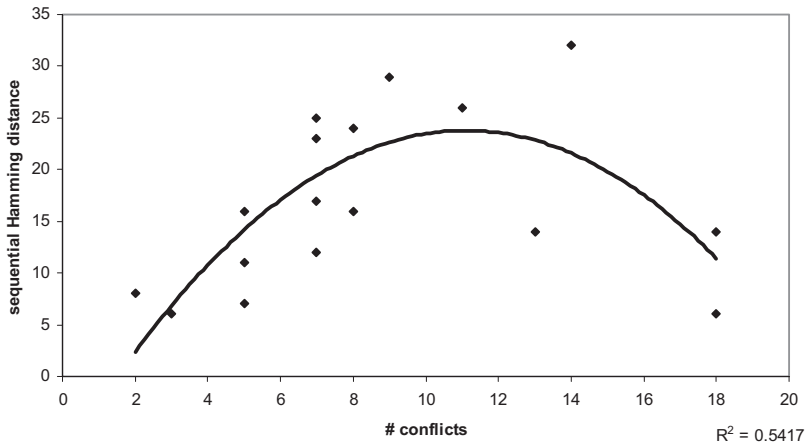

Figure 2. Curve-linear relationship between the sequential Hamming distance and the number of conflicts.

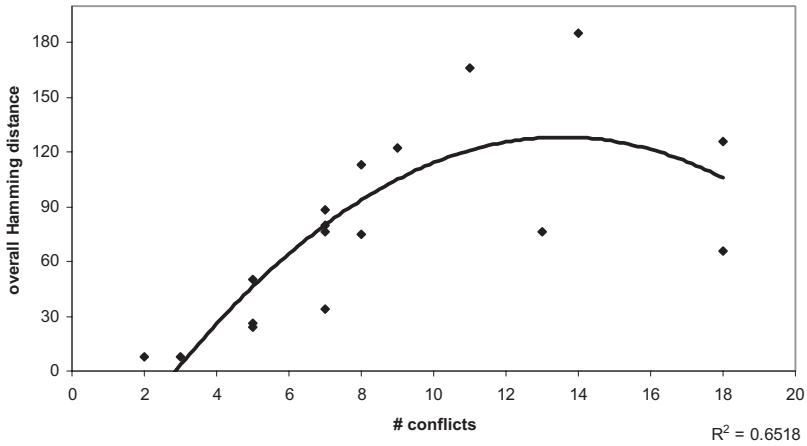

Figure 3. Curve-linear relationship between the overall Hamming distance and the number of conflicts.

measures of emotional variability. Thus, our data show that the emotional variability decreases when relationships become highly conflictual. Girls with many conflicts showed very little variation in their emotional states across conflict episodes.

Furthermore, we have argued that the system's variability should be viewed in the light of contextual variation. In other words, do these girls feel the same because they are constantly arguing about the same topic, or do they show the same emotional state in response to a range of divergent conflict types? The girls with low levels of emotional variability (the rigid group) had twice as much topic variation as did the emotionally more flexible girls (the moderately flexible group). This shows that the rigid girls brought the same emotional state to widely divergent conflict topics. For these girls, many different conflict contexts still induced the same emotional state. In other words, these girls feel the same, no matter what. Hence, the conflictual mother–daughter systems are stuck or frozen into a small number of emotional states and have lost their situational sensitivity (i.e., sensitivity and flexibility in response to different conflict topics; see also Granic at al., 2007; Lewis et al., 2004). Why is that? What is going on in these mother–daughter systems?

In dynamic systems terms, this phenomenon can be described by coupling processes and feedback cycles, which are important characteristics of a self-organizing process (see Lewis, 1995, and Lewis & Douglas, 1998, for a more elaborate discussion). Coupling processes are the "ongoing reciprocal selection or adjustment among related elements or subsystems" (Lewis, 1995, p. 78). This is the process within a conflict interaction in which certain emotions become coupled and emotions become attached to certain appraisals (Lewis, 1997; Magai & McFadden, 1995). Feedback cycles, on the other hand, imply that a current state (a set of coupled elements) is the product of accumulated previous states. That is, development is an iterative process in which the current emotional conflict state serves as the input for the next emotional conflict state. Because these feedback cycles proceed on states of coupled elements, they create stability across iterations or conflict episodes, as coupled elements moderate each other and tend to keep each other in place.

In the context of parent–adolescent conflicts, imagine a teenager who often gets angry at the mother and immediately thinks "my mom never gets me right" and starts to yell and slam doors. This is how it usually goes within this specific dyad, and the more often the two "fight" this way, the higher the probability that they will continue to do so in conflicts to follow. That is, the occurrence of a certain state of coupled elements increases the likelihood of its recurrence on subsequent occasions. A change in one element does not have to result in an alteration of the entire state due to the interrelations among the elements (Lewis & Douglas, 1998). Take again the teenager in the above mentioned example. Imagine that in another conflict he or she feels sad and disappointed in response to a ban imposed by the mother. As the argument proceeds, it becomes apparent that the mother is not willing to lift the ban. This

Table 5
Mean Unalikeability Coefficients by Level of Emotional Flexibility

	No. conflicts		Unalikeability coefficient across all conflicts		Unalikeability coefficient across conflicts within the same emotional state	
Groups	*M*	*SD*	*M*	*SD*	*M*	*SD*
Highly flexible ($n = 7$)	5.43	2.44	0.52	0.11		
Moderately flexible ($n = 7$)	8.57	2.99	0.59	0.19	0.28	0.26
Rigid ($n = 3$)	16.33	2.89	0.62	0.15	0.61	0.14

Note. The individual coefficients are averaged within each group.

triggers and confirms the cognition of "my mom never gets me right," and the adolescent starts to get angry again. So, here we go again: The two end up in an angry fight, the usual conflict pattern, described above. This example illustrates that although this conflict started out with a different emotional state, it still resulted in the same conflict pattern because the other elements (i.e., the cognitions, the reaction of the mother) were similar. This is how coupled elements keep each other in place.

Thus, coupling and feedback cycles are the two main forces that create stability in emotional conflict states across episodes. What we observed in the emotionally rigid girls is that their emotional reaction to conflicts was apparently so dominant (a very deep valley in the state space) that it resisted contextual perturbations. Each context (i.e., conflict topic) put unique constraints on the system's behavior. A flexible system responds to contextual variations and changes its behavior accordingly. In the rigid group, highly divergent conflict topics failed to shake the system and change its emotional state. In fact, various different contexts induced the same emotional states. Apparently, for these girls the sheer fact of again having a conflict with their mothers was enough to trigger the dominant emotional state, regardless of what the conflict was about.

In our study, we intensively followed a small sample over the course of 1 year. Because of the long time span, one of our major concerns and challenges in this study was keeping the adolescent girls motivated and involved in the study. By breaking the year into 2-week diary episodes and putting a lot of effort into building and maintaining a good relationship with the girls, we were able to keep the dropout rate at a very low level. In addition, the participants in the present study were enthusiastic about the diaries. It was an approach that suited their world and experiences, because they were allowed to describe real-life conflicts. Filling in the diaries cost relatively little effort, and the possibility of using the website offered even more efficient ways of collecting and entering data. These positive reactions and our own experience made us confident that the use of diaries offers a valuable and reliable tool for studying time-serial aspects of the emotions involved in mother–daughter conflicts in a real-life setting (Laurenceau & Bolger, 2005; Papp et al., 2007; Välimäki et al., 2007).

One important limitation of this study was the fact that participation was voluntary. On the one hand, this fact guaranteed that we had a motivated sample, but on the other hand it is highly likely that we implicitly had selected a special sample, namely, a sample that was relatively well functioning, interested, and motivated to learn more about their relationship. It is important that, in future, researchers incorporate more distressed or problematic girls, in order to find out whether these findings can be confirmed. Girls or mother–daughter dyads involved in counseling or treatment could be a possible target group. The hypothesis is that girls who have more problematic relationships with their mother will show high levels of emotional rigidity (see Granic et al., 2007). In addition, it is important to think about ways in which boys could be motivated to participate in these kinds of studies. Writing diaries is more a "girl thing" and probably does not match the boys' worlds of experiences. Research has shown that adolescent boys and girls differ in their perception of family dynamics and functioning (Vandeleur, Perrez, & Schoebi, 2007), and the challenge is to find research methods that suit boys' perspectives. However, we do believe that our findings can be seen as an estimation of what goes on in the adolescent population as a whole and that these findings are not specific to girls' development. Additionally, cultural factors have been shown to be related to the way people perceive and describe conflicts and emotions (Chentsova-Dutton et al., 2007; Tsai, Levenson, & McCoy, 2006). But our aim in this study was to uncover basic process-related characteristics, regardless of the content of the emotions or conflict topics. These insights will bring us closer to an understanding of the general dynamics and mechanisms that, we believe, can then be applied to other populations or contexts. However, there is a need for more cross-cultural studies to investigate whether the Western-rooted claim of adolescence as a "transitional" period and parent–adolescent conflicts as an important motor within that period holds for all individuals either within or between cultural groups.

Finally, in the present study we described the mother–daughter system from the perspective of the girl. By doing so, we implicitly conserved one of the system's major properties, the system's variability, without explicitly mentioning the mother as a subcomponent (see the reconstruction theorem of Takens, 1981). This approach has led to interesting results concerning interindividual differences in intraindividual variability. Given these promising results, it is important to extend this research by taking into account the mother's perspective.

This explorative diary study represents a first step toward studying intraindividual variability in emotional states across conflict episodes and interindividual differences therein. With it, we have extended existing research on emotional variability within conflict interactions—such as the Granic, Dishion, and Hollenstein (2003) study or the study of Hollenstein and Lewis (2006)—by analyzing variability across episodes and by incorporating real-life contextual variations. Adolescence is a period in which many changes and transformations are taking place. In these times, within-system variability might be a necessary precondition for adaptation and learning. A lack of emotional variability is associated with the risk of restricting and hampering the system's ability and potential to adjust to these new relational and situational demands. Given this assumption, it is reasonable to expect negative consequences for the development of the adolescent and the parent–adolescent relationship as a result of emotional rigidity. For instance, emotional rigidity in parent–child interactions has been shown to be related to externalizing as well as internalizing problem behavior (Hollenstein et al., 2004). A rich, complex, and balanced emotional profile, on the other hand, corresponds to more sophisticated levels of personality, ego, self, and identity development (Abe & Izard, 1999; Magai & McFadden, 1995; Strayer, 2002). Being stuck within a certain emotional state is probably one of the things that go "wrong" in a particular dyad, and it can eventually explain why the temporary period of conflicts fails to be a developmental step forward. However, high levels of a system's variability might enhance exploration, reorientation, and learning and thereby fulfill the necessary conditions for adapting to the rising demands, challenges, and opportunities of adolescence.

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