Emotional Variability in Mother-Adolescent Conflict Interactions and Internalizing Problems of Mothers and Adolescents: Dyadic and Individual Processes

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Abstract Emotional variability reflects the ability to flexibly switch among a broad range of positive and negative emotions from moment-to-moment during interactions. Emotional variability during mother-adolescent conflict interactions is considered to be important for healthy socio-emotional functioning of mothers and adolescents. The current observational study examined whether *dyadic* emotional variability, *maternal* emotional variability, and *adolescent* emotional variability during conflict interactions in early adolescence predicted mothers' and adolescents' internalizing problems five years later. We used data from 92 mother-adolescent dyads (*M* age T1=13.05; 65.20 % boys) who were videotaped at T1 while discussing a conflict. Emotional variability was derived from these conflict interactions and it was observed for mother-adolescent dyads, mothers and adolescents separately.

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Mothers and adolescents also completed questionnaires in early adolescence (T1) and five years later in late adolescence (T6) on mothers' internalizing problems, and adolescents' anxiety and depressive symptoms. Hierarchical regression analyses showed that less dyadic emotional variability in early adolescence predicted relative increases in mothers' internalizing problems, adolescents' depressive symptoms, and adolescents' anxiety symptoms from early to late adolescence. Less maternal emotional variability only predicted relative increases in adolescents' anxiety symptoms over time. The emotional valence (e.g., types of emotions expressed) of conflict interactions did not moderate the results. Taken together, findings highlighted the importance of considering limited emotional variability during conflict interactions in the development, prevention, and treatment of internalizing problems of mothers and adolescents.

During adolescence, mother-adolescent relationships tend to become more egalitarian, and this realignment is thought to coincide with conflict interactions (Laursen and Collins 2009). Although these conflict interactions can be unpleasant, they are considered to accommodate adolescents' development towards greater autonomy and personal choice, and enable parents and adolescents to establish a more egalitarian relationship, which is important for well-being of mothers and adolescents (Adams and Laursen 2007). Whether conflict interactions are functional and are related to healthy socio-emotional functioning depends to a certain extent on how emotions are expressed and handled during these conflicts (Adams and Laursen 2007; Branje et al. 2012; Kashdan and Rottenberg 2010).

In addition to the type of emotions expressed during mother-adolescent conflict interactions, emotional variability during mother-adolescent conflict interactions is thought to be associated with socio-emotional functioning of both interaction partners (Fogel 1993; Granic 2005). *Emotional variability* reflects the ability to flexibly switch between different emotional states from moment-to-moment during interactions, and during mother-adolescent conflict interactions it can be observed at both a dyadic and individual level (Hollenstein 2013). More emotional variability of mother-adolescent dyads during conflict interactions is thought to be a hallmark of healthy socio-emotional functioning of both mothers and adolescents. Mother-adolescent dyads with high levels of emotional variability are able to flexibly switch among a broad range of positive and negative emotions during conflicts, and as such might adequately deal with the emotional challenges of conflicts by putting across their point of view clearly and to adjust discrepant perceptions accordingly (Branje 2008; Van der Giessen et al. 2013). This could allow these dyads to adaptively deal with the relational challenges that arise during adolescence. In contrast, mother-adolescent dyads with low levels of emotional variability have a tendency to remain in very few emotions, and they are thought to have difficulties expressing, adapting, and regulating their emotions during such conflict interactions (Granic 2005). As such, these dyads seem to have troubles with adequately handling the emotional challenges of conflict interactions (Granic et al. 2003; Lichtwarck-Aschoff et al. 2009). Low levels of emotional variability of mother-adolescent dyads might therefore be indicative of a less optimal autonomy and relational development, which could be unsatisfactory for both adolescents and mothers, and less emotional variability might therefore be related to relative increases in socio-emotional problems over time (Van der Giessen et al. 2013).

Recent research (e.g., Hollenstein et al. 2004; Van der Giessen et al. 2013) has consistently shown that lower levels of emotional variability of parent–child dyads during conflict interactions are associated with higher levels of externalizing problems of children and adolescents over time. However, a key question is whether emotional variability of dyads is also longitudinally associated with an increased risk for internalizing problems during adolescence. Internalizing problems often involve difficulties in expressing emotions as well as inhibited emotional responses (Zahn-Waxler et al. 2000), and problems in the family context with expressing and handling emotions are found to represent a critical dimension of a high risk profile for internalizing problems (McMakin et al. 2011). The current observational study, therefore, aimed to extend prior research by examining whether emotional variability during conflict interactions in early adolescence predicted internalizing problems of both mothers and adolescents five years later. This study observed emotional variability at the dyadic and individual level to capture processes that reflect elevated risk for internalizing problems over time.

Emotional Variability at a Dyadic Level and Socio-Emotional Functioning

Emotional variability in conflict interactions has been examined mostly at a dyadic level, thereby focusing on the movement of mother-adolescent dyads from one dyadic emotional state to another over the course of an interaction (Hollenstein 2013). From a dynamic systems viewpoint (Granic 2005; Thelen and Smith 1994), dyads can be regarded as a system that consists of unique interconnected properties that affect each other over the course of time. During social interactions, both partners are continuously active and engaged in the communication, and each partner's emotions are continuously regulated by actions of the other partner. Individuals also dynamically alter their emotions with respect to the ongoing and anticipated emotions of their partners (Fogel 1993). Therefore, emotional expressions during conflict interactions reflect what goes on between dyad members and these emotions, thus, appear to be embedded within a relational context (Campos et al. 2011; Hinde 1997). As such, emotions during conflicts are irreducible to each individual's emotions within the dyad, and vital information about the dyadic system is missing when examining only the individuals' emotions and neglecting the other dyads member's emotions (Hollenstein et al. 2014). Thus, when examining emotional variability during mother-adolescent conflict interactions from a dynamic systems approach the dyad is the unit of analysis.

So far, research has shown that lower levels of *dyadic emotional variability* (i.e., small emotional repertoire, few switches between emotional states, and high mean durations of emotional states of dyads) during parent–child interactions were related to higher levels of concurrent and future socio-emotional problems of children and adolescents. For example, less emotional variability of parent–child dyads during a conflict interaction and a positive discussion was associated with concurrent internalizing and externalizing behavior and growth in externalizing behavior during kindergarten (Hollenstein et al. 2004), as well as with less improvement of children's aggressive behavior after treatment (Granic et al. 2007). Also, less emotional variability of parent–child dyads during a challenging puzzle task was related to more externalizing problems at age five (Lunkenheimer et al. 2011). One study that specifically examined the role of emotional variability during a conflict interaction in adolescence found that adolescents' in less emotionally variable mother-adolescent dyads showed increases in aggressive behavior across adolescence (Van der Giessen et al. 2013). Taken together, less emotional variability of parent–child dyads within different

parent–child contexts has been consistently related to more externalizing problems during childhood and adolescence. However, much less is understood about the predictive role of emotional variability of mother-adolescent dyads for subsequent internalizing problems of adolescents and mothers. Since adequately handling emotions during conflicts represents a major challenge in the lives of mothers and adolescents, which is associated with healthy relational and affective functioning of mothers and adolescent (Adams and Laursen 2007; Branje et al. 2012), the current study observes emotional variability of mother-adolescent dyads during conflict interactions. We expect that the experience of expressing and modulating different types of emotions in response to a difficult emotional conversation topic can benefit adolescents' and mothers' emotional and relational competence (Van der Giessen et al. 2013), thereby resulting in fewer internalizing problems over time.

Emotional Variability at an Individual Level and Socio-Emotional Functioning

Prior studies tend to focus on emotional variability as a dyadic process (Granic et al. 2007; Hollenstein et al. 2004; Van der Giessen et al. 2013), with little attention to individual processes. This approach has yielded novel and important knowledge, but might limit our ability to understand how mothers and adolescents individually navigate emotional challenging conflict situations. Individual behavior, even when observed in a dyadic context, as well as dyadic behavior have both been found to provide unique information about an parent–child interaction (Moore et al. 2013). As such, the level of *emotional variability of each individual* within a dyad might also contribute to healthy socio-emotional functioning of adolescents. For example, adolescent emotional variability could be associated with adolescents' internalizing problems. Compared to children, adolescents experience greater extremes of emotion, with a bigger range between higher and lower moods than children, and adolescents' mood states tend to be less persistent and quicker to dissipate than those of children (Larson et al. 1996; Larson et al. 2002). These frequent changes in emotional states are considered to be more normative during adolescence, especially during conflict interactions, and to be related to fewer internalizing problems of adolescents (Collins and Steinberg 2006). Furthermore, mother emotional variability could also be associated with adolescents' internalizing problems. Mothers who freely display a wide range of emotions teach adolescents a variety of emotions and teach them to appropriately express, adapt, and regulate these emotions during conflicts, and this is thought to be important for adolescents' healthy affective functioning (Morris et al. 2007). Therefore, it seems rather important to reveal whether and how adolescent emotional variability as

well as maternal emotional variability contribute to the prediction of adolescents' internalizing problems.

Nevertheless, there is no research yet examining the longitudinal associations between individuals' emotional variability during mother-adolescent conflict interactions and adolescents' internalizing problems. There are studies that have shown concurrent and longitudinal links between temporal stability in individuals' emotional states during mother-child interactions and adolescents' depressive symptoms. For example, when adolescents' emotional states during parent-adolescent interactions (i.e., positive, conflict, and reminiscence discussion) showed a high degree of emotional inertia, operationalized as a high autocorrelation, this was related to higher levels of depressive symptoms (Koval et al. 2012). Adolescents' emotional inertia during a conflict interaction also predicted the emergence of clinical depression 2.5 years later, above the emotional valence of the interaction (Kuppens et al. 2012). Furthermore, longer durations of adolescents' negative emotions and of mothers' negative emotions during mother-adolescent conflict interactions as well as positive discussions have been associated with higher levels of adolescents' depressive symptoms (McMakin et al. 2011; Sheeber et al. 2000; Sheeber et al. 2009; Sheeber et al. 2012). Overall these studies, thus, showed the predictive effects of one dyad member's (i.e., mothers or adolescents) emotions during different types of parent–child interactions on adolescents' depressive symptoms. However, most studies examining the predictive effects of one dyad member's emotions tended to neglect the other dyad member's emotions as well as dyadic emotions. Even more so, these studies examined different interactions contexts and used different conceptualizations of moment-to-moment changes in individuals' emotions, such as autocorrelation or temporal stability. To capture contributions of emotional variability from both parties, the current study also examined the role of emotional variability of both mothers and adolescents specifically during conflict interactions in predicting adolescents' and mothers' internalizing problems.

The Current Study: Resolving Issues in Existing Research on Emotional Variability

Taken together, moment-to-moment changes in dyadic and individual emotions appear to be related to adolescents' socio-emotional functioning. The current observational study extends previous studies in a number of important ways. First, an important question remains whether dyadic emotional variability is longitudinally associated with an increased risk for internalizing problems over the course of adolescence. Because emotional variability is assumed and found to be important for well-being (Granic 2005; Granic et al. 2007; Hollenstein et al. 2004), we hypothesize that more dyadic

emotional variability during conflict interactions predicts subsequent fewer internalizing problems of adolescents (i.e., anxiety and depressive symptoms). In addition, prior studies tend to focus on emotional variability as a dyadic process (Hollenstein et al. 2004; Van der Giessen et al. 2013), with little attention to emotional variability as individual processes. This underscores the importance of attending to the contribution of dyadic as well as individual processes when examining the association between emotional variability and internalizing symptoms (Moore et al. 2013). The current observational study therefore examined associations of dyadic emotional variability, maternal emotional variability, and adolescent emotional variability during conflict interactions with subsequent levels of adolescents' internalizing problems.

Second, the current study not only focuses on adolescents' internalizing problems, but also on mothers' internalizing problems. Mothers have been found to report increased internalizing problems when faced with repetitive and stressful conflicts over day-to-day issues with adolescents (Steinberg 2001). Constructively engaging in conflict interactions with adolescents is also thought to be an important challenge for mothers during this age period and unsuccessful reconciliation could be experienced by mothers as personal failure (Branje et al. 2012; Silverberg and Steinberg 1990). Indeed, less emotional variability of mother-adolescent dyads during conflict interactions was found to be concurrently related to maternal depression (Connell et al. 2011). The current study contributed to this existing literature by also examining longitudinal associations of dyadic and individual emotional variability with mothers' internalizing problems. We hypothesize that more emotional variability is also associated with an decreased risk over time for internalizing problems of mothers.

Finally, the current study addressed whether the emotional valence interacted with emotional variability when predicting internalizing problems. Several studies showed that associations between moment-to-moment changes in emotions and socio-emotional functioning did not depend on average levels of negativity or positivity during conflict interactions (e.g., Kuppens et al. 2012; Van der Giessen et al. 2013). In contrast, when specifically examining the moderating effect of emotional valence Lunkenheimer et al. (2011) showed that greater parent–child emotional variability combined with greater positive affect during a cognitive challenging interaction predicted fewer externalizing problems during early childhood, suggesting that adaptive interactions during early childhood were characterized by a combination of more emotional variability and more positive affect. However, knowledge is still limited whether the emotional valence of conflict interactions moderates the longitudinal associations between emotional variability and internalizing problems of mothers and adolescents.

Method

Participants

Participants were 92 mother-adolescent dyads who were a subsample of a larger longitudinal research project called "Research on Adolescent Development And Relationships Young" (RADAR Young). This is an ongoing longitudinal study in the Netherlands that focuses on the development of relationships and problem behavior in adolescence. To be able to examine the role of emotional variability on relative changes in internalizing problems over a longer age period, the current longitudinal study used data of the first (T1) and sixth (T6) measurement waves with a 5-year interval. At the first wave, the mean age of the mothers was 44.87 years ($SD=$ 4.83), and the mean age of the adolescents was 13.01 years ($SD=0.52$). The sample consisted of 54 boys (58.7 %) and 38 girls (41.3 %). At the first wave, adolescents were in the first grade of junior high. Most adolescents lived in medium or high SES families (92.4 %).

Attrition in the observation sample was 18.48 % from T1 to T6. Chi-square and T-test analyses revealed no differences in gender, family SES, age, and outcome variables between participants who participated at T1 and T6 and participants who dropped out of the study. Little's (1988) Missing Completely At Random (MCAR) Test produced a normed χ^2 (χ^2/df) of 1.03 which indicates a good fit between sample scores with and without imputation (Bollen 1989). Currently, multiple imputation is highly recommended as a missing data handling technique (Baraldi and Enders 2010). Missing values were therefore imputed using Multiple Imputation (LISREL 8.7) with an EM algorithm. This resulted in a single data-set containing all data, which was used in further analyses in SPSS.

Procedure

To obtain this sample, out of all regular primary education schools in the province of Utrecht, and the cities of Amsterdam, Rotterdam, The Hague, and Almere 429 schools were randomly selected and were subsequently approached to participate. We used a two-step inclusion phase (teacher screen followed by parent interviews) to select the 497 families in the "RADAR Young" sample. First, because the aim was to include full families for a six year follow-up, and because of the complex and intensive data collection that requires a firm grasp of the Dutch language of all family members, only children identified by the teacher as being of Dutch origin were eligible for participation in the RADAR study. This resulted in including 1544 adolescents who were approached separately in the second selection phase of the study. Second, parents of 1544 adolescents were approached by phone; 463 adolescents were excluded because they did not meet

requirements for inclusion in the study (both parents present, and presence of a sibling≥10 years), and 538 actively refused to participate. Eventually, 497 parents and adolescents provided informed consent.

At the first wave, 102 mother-adolescent dyads were randomly selected from the "RADAR Young" sample to also participate in videotaped interactions tasks. Ninety-two dyads were willing to participate and provided written informed consent. The present study used this subsample of 92 mother-adolescent dyads. Non-participation in the observations was not related to the target adolescents' gender (χ^2 (1, N=102)=0.49, p=0.736), adolescents' anxiety scores (F (1,100)=2.15, p=0.146), adolescents' depressive symptoms scores (F (1,100)=0.05, p=0.824), or mothers' internalizing scores (F (1,100)=0.06, p=0.814). During home visits, mothers and adolescents filled out several questionnaires, and they were videotaped during conflict interactions. In addition to the written instructions, research assistants provided verbal instructions about conflict interaction task and the questionnaires. Families received €100 per home-visit. This study was approved by the medical ethics committee of the University Medical Center in Utrecht.

Conflict Interaction Task

In early adolescence (T1) video-taped conflict interactions were available. Mothers and adolescents were asked to choose an issue that they discussed most often during the last month. We provided the Interpersonal Conflict Questionnaire (Laursen 1995), which lists topics of frequent family conflicts (e.g., chores, school problems, curfews), as an aid to selecting topics. Mothers and adolescents had to resolve the conflict issue within 10 min (M=7.59 min; SD=2.00 min), and their discussion was videotaped. Next, each conflict interaction task was coded using a simplified version of the SPecific AFFect coding system (Gottman et al. 1996). This modified SPAFF version has been applied successfully to parent–child interactions (Hollenstein et al. 2004). SPAFF identifies the affects or emotions expressed during parent–child interactions through a combination of verbal content, voice tone, facially expression, and physical cues. Coders categorized the affects displayed using four positive codes (affection, enthusiasm, humor, interest), five negative codes (complaining, sadness, fear, anger, contempt), and a neutral code (refers to statements and information exchange that are non-emotional in content and voice tone). The 10 mutually exclusive affect codes were recorded continuously in real time for mothers and adolescents independently. Observational codes were recorded using The Observer XT 9.0 (Noldus Information Noldus Information Technology 2009). Coders were trained intensively over a 3-month period to achieve a minimum inter-observer criterion of 75 % agreement and 0.65 kappa for the total conflict interaction. Reliability was computed in The

Observer using an event-unit based comparison with a 3 s tolerance window, which is based on agreements between observers first behavior that was coded and behaviors detected in the stream of behaviors, thereby noting onset and offset times of behaviors (Bakeman et al. 2009). To maintain these criteria, weekly discussion meetings were conducted. Twenty percent of the videotaped interactions were independently coded by two coders to provide estimates of reliability. Coders were unaware which sessions were used to assess observer agreement. The average inter-observer agreement at T1 was 0.73 kappa.

Measures

Emotional variability The data of each conflict interaction were plotted on state space grids in GridWare 1.15a (Lamey et al. 2004). This program plots the real-time emotions (SPAFF codes) during the conflict interactions on state space grids (see Fig. 1). A grid represents all possible emotional combinations, and each cell on the grid represents a potential emotional state. A trajectory is plotted through the successive points on the grid in the same order that the emotions proceed in real time. In the current study, grids were created separately for sequences of emotional states of mother-adolescent dyads and sequences of emotional states of individuals, namely mothers and adolescents. While a dyadic grid reflects a real-time contingent sequence of dyadic emotions, an individual grid only reflects a single sequence of either maternal emotions or adolescent emotions (Hollenstein 2013).

For dyadic grids, the mother's coded emotions were plotted on the x-axis and the adolescent's emotions were plotted on the y-axis. During the conflict discussions, 10 possible emotions or SPAFF codes were available to both mothers and adolescents, and thus, the state space grids for dyads consisted of 100 cells (10 codes of mothers * 10 codes of adolescents). Each cell on the grid represents a dyadic emotional state. For individual grids of mothers we plotted coded emotions of mothers on both x-axis and y-axis, and for individual grids of adolescents we plotted coded emotions of adolescents on both x-axis and y-axis. Individuals (i.e., mothers or adolescents) only visit the cells along the diagonal, and each of these cells represents an individual emotional state. During the conflict discussions, 10 possible emotions or SPAFF codes were available to individuals, and thus the state space grids for individuals consisted of 10 cells (Hollenstein 2013).

Two distinct measures of emotional variability (i.e., transitions and dispersion) were derived from GridWare for mother-adolescent dyads, for mothers, and for adolescents separately. This means that our measures of emotional variability of dyads, mothers, and adolescents were derived from the same emotional interactions. First, *transitions* assess the number of changes or movements per minute between cells on the state

space grid (see Fig. 1), which refers to the amount of emotional flexibility. The number of transitions was divided by the total duration in minutes of the interaction to correct for differences in total duration of the interactions. Higher values indicate more frequent changes per minute between emotional states and therefore more emotional variability (*M* dyads T1= 5.17, *SD*=2.59; *M* mothers T1=3.09, *SD*=1.79; *M* adolescents T1=2.16, *SD*=1.81). Second, *dispersion* assesses the spread of emotional states on the state space grid (see Fig. 1), which refers to the range of the emotional repertoire. Specifically, dispersion is calculated as the sum of the squared proportional duration across all cells adjusted for the total number of cells in the grid. Dispersion ranges from 0 to 1, with values close to one indicating that behavior was equally distributed across cells and values of zero indicating that behavior was in only one cell. The formula that was used by GridWare to calculate dispersion is: $1- [(n\Sigma (di/D)^2) - 1]/[n - 1]$. *D* refers to the total duration of the interaction, *di* is the duration in cell *i* on the grid, and *n* indicates the total number of possible cells on the grid. Higher values indicate a broader emotional repertoire and thus more emotional variability (*M* dyads T1=0.34, *SD*=0.17; *M* mothers T1=0.25, *SD*=0.16; *M* adolescents T1=0.19, *SD*=0.14). Both measures of emotional variability have been shown to exhibit good reliability and predictive validity (Granic et al. 2007; Hollenstein et al. 2004). Furthermore, these measures can be used as both individual and dyadic indices of emotional variability.

The correlations between transitions and dispersion were quite high; 0.80 (*p*<0.001) for dyads, 0.65 (*p*<0.001) for mothers, and 0.88 (*p*<0.001) for adolescents. Therefore, an *emotional variability* construct was created for dyads, mothers, and adolescents separately. Each emotional variability construct combined the *Z*-scores of transitions and dispersion, thereby reflecting two different aspects of emotional variability, namely emotional flexibility and the emotional repertoire. This resulted in one measure of emotional variability at a dyadic level and two measures of emotional variability at an individual level, namely emotional variability of mothers and adolescents. Higher scores indicate higher levels of emotional variability.

Emotional valence To capture the overall emotional valence of the interactions, we calculated the ratio of positive and negative affect dyads expressed during the interaction. Affect ratios have been found to be good predictors of individuals' well-being during adolescence and adulthood (Fredrickson and Losada 2005; Silk et al. 2011). We first derived from GridWare the total duration in seconds of positive affect and negative affect of mother-adolescent dyads. The grids were divided into two distinct regions, based on whether positive or negative affect was expressed during the interaction. Positive affect included the SPAFF codes affection, enthusiasm, humor, and interest. Negative affect included the SPAFF codes complain, sadness, fear, complain, anger, and contempt. Next, to correct for differences in interaction duration, the duration of positive and negative affect of dyads was each divided by the total duration of the interaction and then multiplied with 100 ((e.g., duration negative affect/duration total interaction) *100)). This way, the duration of positive affect and the duration of negative affect of dyads represented the percentage of positive and negative affect as a function of the total duration of the interaction. Finally, these corrected measures of positive and negative affect were used to calculate an emotional valence. This ratio represents the proportion of positive versus negative affect of dyads during an interaction (negative affect/(positive affect+negative affect)). Higher scores indicated that dyads showed more negative affect than positive affect during interactions.
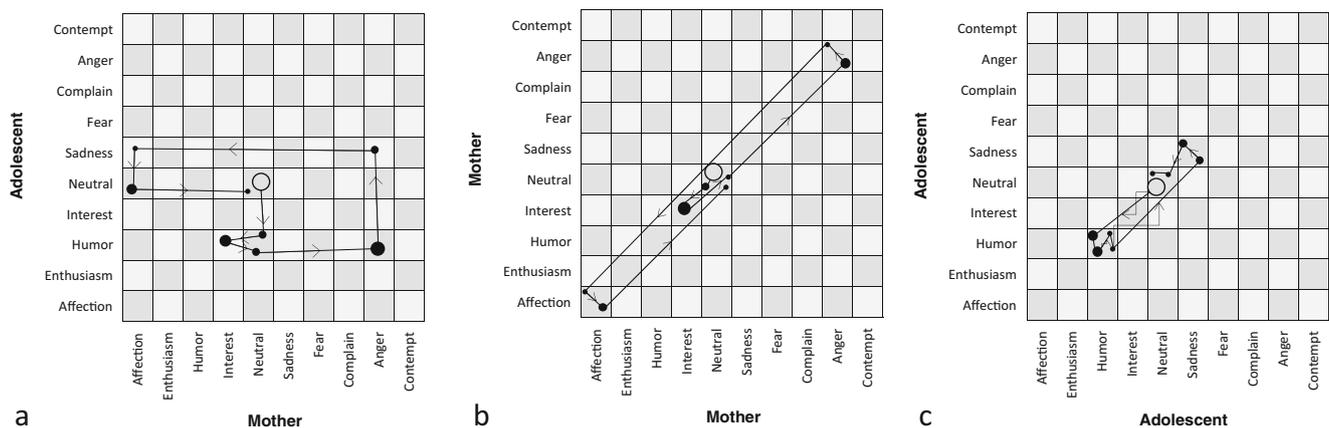
Fig. 1 Three examples of state space grids depicting sequences of emotions or (**a**) the mother-adolescent dyad, (**b**) the mother, and (**c**) the adolescent. Each cell on the grid represents a potential emotion, and a trajectory is plotted through the successive points on the grid in the same order as the emotions proceed in real time. The size of the circles is proportional to the duration of time each emotion is expressed and the arrows reflect the changes or transitions between emotions

Mothers' internalizing problems The Adult Self-Report (ASR; Achenbach and Rescorla 2003) was available at T1 and T6 to assess *mothers' internalizing problems*. Mothers completed all 39 items of the internalizing problems scale, which measured the following concepts; "Withdrawn" (e.g., I am fearful or anxious), "Somatic Complaints" (e.g., heart pounding) and "Anxious/Depressed" (e.g., I keep from getting involved with others). Good reliability and validity have been demonstrated for the ASR (Achenbach and Rescorla 2003). Items were rated on a three-point scale ranging from 0 (not true) to 2 (often true). The ASR prevented us from assessing anxiety symptoms and depressive symptoms separately, therefore all 39 items were averaged to compute a global mean score for mothers' internalizing problems. Higher mean scores indicating higher levels of internalizing problems. Cronbach's alpha was 0.90 at T1 and 0.90 at T6 in the current study.

Adolescents' internalizing problems To assess adolescents' internalizing problems separate questionnaires for depressive symptoms and anxiety symptoms were available at T1 and T6. The Reynolds Adolescent Depression Scale 2nd edition (RADS-2 Reynolds 2004) measured *adolescents' depressive symptoms*. This is a self-report measure designed as a clinical tool for the identification of depression in adolescents. This measure contained three subscales 'Dysphoric Mood' (8 items; "I feel like crying"), 'Negative Self-Evaluation' (8 items; "I feel I am bad") and 'Somatic Complaints' (7 items; "I am tired"). Items were rated on a four-point scale ranging from 1 (almost never) to 4 (most of the time). We computed an overall mean score for depressive symptoms, averaging all items of the RADS-2. Higher mean scores indicated higher levels of depressive symptoms. Internal consistency, test-retest reliability, and validity all have been strongly established (Reynolds 2004). The RADS-2 was translated to Dutch using the procedure described by Varni et al. (1999), including forward and backward translation, and pilot testing. Cronbach's alpha was 0.94 at T1 and 0.95 at T6 in the current study.

The Dutch version of the original 38-item Screen for Child Anxiety Related Emotional Disorders SCARED (Birmaher et al. 1997) measured *adolescents' anxiety symptoms*. The SCARED is a self-report questionnaire that assesses the occurrence of adolescent anxiety symptoms on a three point Likert scale: 0 (almost never), 1 (sometimes), or 2 (often). Adolescents completed the subscales "Panic Disorder symptoms" (e.g., I'm afraid of having anxiety or panic attacks), "Generalized Anxiety Disorder symptoms" (e.g., I worry if others will like me), "Separation Anxiety Disorder symptoms" (e.g., I worry something bad might happen to my parents), "Social Phobia symptoms" (e.g., I feel shy with people I don't know well), and "School Anxiety symptoms" (e.g., I worry about going to school). The 38 items were averaged to

compute an overall anxiety symptoms mean score, with higher mean scores indicating higher levels of anxiety symptoms. Psychometric properties of the SCARED have shown to be good in several studies (Hale et al. 2011). In the current study, Cronbach's alpha was 0.91 a T1 and 0.94 at T6.

Strategy of Analyses

We used hierarchical regression analyses to examine whether emotional variability at T1 predicted mothers' internalizing problems at T6, adolescents' depressive symptoms at T6, and adolescents' anxiety symptoms at T6. We conducted analyses separately for each measure of internalizing problems. Because emotional variability of dyads is comprised of mothers' emotional variability and adolescents' emotional variability, it is not possible to include both dyadic emotional variability and individual emotional variability as predictors in the same hierarchical regression model. Therefore, the first set of analyses used emotional variability of dyads as a predictor and the second set of analyses used emotional variability of individuals (i.e., mothers and adolescents) as predictor.

In the first step of all analyses we controlled for gender, internalizing problems at T1, and the emotional valence at T1. In the second step of all analyses, emotional variability was added as a predictor. To be able to compare across different models whether contributions of dyadic, maternal, and adolescents emotional variability were of different strength, we inspected whether the unstandardized parameter estimate of one emotional variability measure fell within the confidence intervals of unstandardized parameter estimates of the other measures of emotional variability. These comparisons can be made between models that include exactly the same predictors in step 1 of the analyses. In case the unstandardized parameter estimate did not fall within the confidence intervals, effects are considered to be of different strength (Belia et al. 2005; Schenker and Gentleman 2001). Finally, to examine whether associations between emotional variability at T1 and internalizing problems at T6 were moderated by the proportion of negative and positive affect expressed at T1, statistical interactions between emotional variability and the emotional valence were entered as a final step in all analyses. Variables were centered before creating the interaction terms.

Results

Descriptive Statistics

Table 1 shows the descriptive statistics of all study variables and the zero-order correlations between all study variables. It is noteworthy that emotional variability of mothers and emotional variability of adolescents were only moderately

Table 1 Zero-order correlations between emotional variability, internalizing problems, and the emotional valence

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Emotional variability dyads T1	–									
2. Emotional variability mothers T1	0.84**	–								
3. Emotional variability adolescents T1	0.74**	0.35**	–							
4. Mothers' internalizing problems T1	−0.10	−0.13	−0.03	–						
5. Adolescents' depressive symptoms T1	0.01	−0.09	−0.07	0.14	–					
6. Adolescents' anxiety symptoms T1	−0.06	−0.20	0.05	0.15	0.66***	–				
7. Mothers' internalizing problems T6	−0.24*	−0.29**	−0.11	0.47**	0.14	0.15	–			
8. Adolescents' depressive symptoms T6	−0.14	−0.26**	−0.08	0.15	0.26*	0.50***	0.15	–		
9. Adolescents' anxiety symptoms T6	−0.16	−0.30**	−0.06	0.15	0.44**	0.41***	0.16	0.79***	–	
10. Emotional valence T1	0.11	−0.05	0.33**	0.06	−0.03	0.09	0.23*	0.02	0.19	–
M	0.00	0.00	0.00	0.19	1.60	1.35	0.16	1.57	1.26	56.31
SD	0.96	0.91	0.97	0.17	0.51	0.35	0.17	0.62	0.29	24.66

Note. The emotional variability construct combined the Z-scores of transitions per minute and dispersion, and therefore the mean score represented here is zero. For the raw mean score of transitions per minute and dispersion, the reader is referred to the description of the measures in the method section on page 13 and 14

$*=p<0.05$, $**=p<0.01$, $**=p<0.001$

correlated ($r=0.35$), in particular compared to correlations of both emotional variability of mothers and adolescents with emotional variability of dyads. Using the Fisher r-to-z transformation the significance of the difference between correlation coefficients of emotional variability of dyads and emotional variability of mothers ($r=0.84$) and emotional variability of dyads and emotional variability of adolescents ($r=0.74$) was calculated. The analysis showed no significant differences between these correlations ($Z=1.81$, $p<0.01$).

Emotional Variability at a Dyadic Level and Internalizing Problems

In Table 2, Standardized beta coefficients, R-squares, and changes in R-squares are reported for each step of the three hierarchical regression analyses. [1] In three separate hierarchical regression analyses mothers' internalizing problems at T6, adolescents' depressive symptoms at T6, and adolescents' anxiety symptoms at T6 were regressed on *emotional variability of dyads* at T1. Results of these three analyses showed that predictors of *the first step* significantly predicted these outcome measures (see Table 2). Higher levels of mothers' internalizing problems at T1 and of the emotional valence at T1 significantly predicted higher levels of mothers' internalizing problems at T6. Also, adolescent girls had significantly higher levels of depressive symptoms and

anxiety symptoms at T6 than adolescent boys. Higher levels of adolescents' depressive symptoms at T1 significantly predicted higher levels of adolescents' depressive symptoms at T6, and higher levels of adolescents' anxiety symptoms at T1 significantly predicted higher levels of adolescents' anxiety symptoms at T6. Furthermore, in all three analyses, results of the *second step* revealed that after controlling for gender, internalizing problems at T1, and the emotional valence, emotional variability of dyads at T1 significantly predicted mothers' internalizing problems at T6, adolescents' depressive symptoms at T6, and adolescents' anxiety symptoms at T6. This indicates that when mother-adolescent dyads showed less emotional variability at T1, mothers showed a relative increase in internalizing problems from T1 to T6, and adolescents showed a relative increase in depressive symptoms and anxiety symptoms from T1 to T6. Finally, in all three analyses, results of the *third step* showed that the two-way interaction between emotional variability of dyads and the emotional valence did not contribute significantly to the prediction of the outcome measures. Emotional variability of dyads at T1 accounted for 5 % of the variance in mothers' internalizing problems at T6 ($F (4, 87)=10.07$, $p<0.001$), for 3 % of the variance in adolescents' depressive symptoms at T6 ($F (4, 87)=14.56$, $p<0.001$), and for 4 % of the variance in adolescents' anxiety symptoms at T6 ($F (4, 87)=9.47$, $p<0.001$).

Post hoc, we explored whether adolescents' gender moderated associations between dyadic emotional variability at T1 and internalizing problems at T6. The statistical interaction between gender and emotional variability, instead of the

[1] We checked whether results were the same when using the duration of positive affect and the duration of negative affect instead of the emotional valence and similar results were found. In order to reduce the number of variables in our analysis we decided to retain the emotional valence in current analyses.

Table 2 Longitudinal hierarchical regression analyses predicting mothers' internalizing problems and adolescents' depressive and anxiety symptoms at T6 as a function of emotional variability of dyads at T1

	Mothers' internalizing problems T6				Adolescents' depressive Symptoms T6				Adolescents' anxiety symptoms T6			
	R^2	R^2 change	β	95% CI B	R^2	R^2 change	β	95% CI B	R^2	R^2 change	β	95% CI B
Step 1	0.27	0.27***			0.37	0.37***			0.27	0.27***		
Gender			0.01	−0.067, 0.070			0.23*	0.057, 0.518			0.31**	0.052, 0.278
Internalizing problems T1			0.46***	0.282, 0.650			0.53***	0.431, 0.849			0.30**	0.112, 0.530
Emotional valence T1			.21*	0.000, 003			−0.05	−0.006, 0.003			0.06	−0.002, 0.003
Step 2	0.32	0.05*			0.41	0.04*			0.31	0.04*		
Gender			0.04	−0.054, 0.080			0.25**	0.089, 0.546			0.34**	0.073, 0.296
Internalizing problems T1			0.44***	0.259, 0.619			0.52***	0.429, 0.841			0.27**	0.087, 0.499
Emotional valence T1			0.22*	0.000, 003			−0.04	−0.005, 0.003			0.07	−0.001, 0.003
Emotional variability Dyad T1			−0.23*	−0.075,−0.008			−0.18*	−0.225,−0.005			−0.20*	−0.11,−0.005
Step 3	0.32	0.00			0.41	0.00			0.31	0.00		
Gender			0.03	−0.056, 0.080			0.25*	0.085, 0.546			0.34**	0.070, 0.297
Internalizing problems T1			0.43***	0.254, 0.618			0.52***	0.426, 0.841			0.28**	0.086, 0.504
Emotional valence T1			0.22*	0.000, 003			−0.04	−0.006, 0.003			0.07	−0.001, 0.003
Emotional variability Dyad T1			−0.24*	−0.075,−0.008			−0.18*	−0.236,−0.002			−0.20*	−0.112,−0.003
Emotional variability Dyad* Emotional valence T1			0.03	−0.002, 0.003			0.02	−0.007, 0.009			0.02	−0.004. 0.004

Note. Gender: 0=male, 1=female. R^2 =squared multiple correlation, β=standardized regression coefficient. *95% CI B*=95 % confidence interval unstandardized regression coefficient. *=$p<0.05$, **=$p<0.01$, **=$p<0.001$

interaction between emotional valence and emotional variability, was entered in the third step of all three analyses. Results[2] showed that this interaction did not contribute significantly to the prediction of the outcome measures, indicating that the negative association between dyadic emotional variability at T1 and mothers' and adolescents' internalizing problems at T6 did not differ for boys and girls.

In sum, in line with our expectations we consistently found that less emotional variability of dyads at T1 significantly predicted a relative increase in mothers' internalizing problems, adolescents' depressive symptoms, and adolescents' anxiety symptoms from T1 to T6. These longitudinal predictive effects of emotional variability at a dyadic level were of considerable strength, also considering that we controlled for gender, previous levels of internalizing problems, and the overall emotional valence of the interaction.

Individual Emotional Variability and Internalizing Problems

In Table 3, standardized beta coefficients, R-squares, and changes in R-squares are reported for each step of the three hierarchical regression analyses. In three separate hierarchical regression analyses, mothers' internalizing problems at T6, adolescents' depressive symptoms at T6, and adolescents' anxiety symptoms at T6 were regressed on *emotional variability of mothers and emotional variability of adolescents* at T1. The results of the first step were the same as with the analyses at the dyadic level. Results of the second step showed that, after controlling for gender, internalizing problems at T1, and the emotional valence, emotional variability of mothers at T1 significantly predicted adolescents' anxiety symptoms at T6. These results indicated that when mothers showed less emotional variability at T1 adolescents showed a relative increase anxiety symptoms from T1 to T6. Emotional variability of mothers and adolescents at T1 accounted for 5 % of the variance in adolescents' anxiety symptoms at T6 ($F (2, 86)=3.42$, $p=0.037$). Despite significant increases in the

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[2] Results of these analyses can be obtained from the first author upon request.

Table 3 Longitudinal hierarchical regression analyses predicting mothers' internalizing problems and adolescents' depressive and anxiety symptoms at T6 as a function of emotional variability of mothers and adolescents at T1

	Mothers' internalizing problems T6				Adolescents' depressive Symptoms T6				Adolescents' anxiety symptoms T6			
	R^2	R^2 change	β	95% CI B	R^2	R^2 change	β	95% CI B	R^2	R^2 change	β	95% CI B
Step 1	0.27	0.27***			0.37	0.37***			0.27	0.27***		
Gender			0.01	−0.067, 0.070			0.23*	0.057, 0.518			0.31**	0.052, 0.278
Internalizing problems T1			0.46***	0.282, 0.650			0.53***	0.431, 0.849			0.30**	0.112, 0.530
Emotional valence T1			0.21*	0.000, 003			−0.05	−0.006, 0.003			0.06	−0.002, 0.003
Step 2	0.33	0.06*			0.42	0.04*			0.32	0.05*		
Gender			0.05	−0.055, 0.088			0.25*	0.075, 0.554			0.32**	0.056, 0.290
Internalizing problems T1			0.43***	0.256, 0.616			0.51***	0.416, 0.827			0.25*	0.061, 0.475
Emotional valence T1			0.23*	0.000, 0.003			−0.04	−0.006, 0.004			0.05	−0.002, 0.003
Emotional variability Mother T1			−0.16	−0.069, 0.006			−0.18	−0.247, 0.002			−0.24*	−0.129, −0.011
Emotional variability Adolescent T1			−0.14	−0.064, 0.014			−0.07	−,175, 0.084			−0.01	−0.062, 0.059
Step 3	0.34	0.01			0.42	0.00			0.32	0.00		
Gender			0.07	−0.048, 0.095			0.24*	0.062, 0.552			0.31**	0.048, 0.289
Internalizing problems T1			0.46***	0.283, 0.652			0.52***	0.419, 0.836			0.25*	0.058, 0.485
Emotional valence T1			0.26*	0.000, 0.003			−0.05	−0.006, 0.004			0.04	−0.002, 0.003
Emotional variability Mother T1			−0.13	−0.064, 0.013			0.18	−0.254, 0.005			−0.24*	−0.132, −0.011
Emotional variability Adolescent T1			−0.18	−0.074, 0.008			−0.06	−0.172, 0.100			0.01	−0.060, 0.067
Emotional variability Mother* Emotional valence T1			−0.16	−0.006, 0.001			0.03	−0.010, 0.014			0.05	−0.004, 0.007
Emotional variability Adolescent* Emotional valence T1			0.16	−0.001, 0.005			−0.05	−0.012, 0.007			−0.07	−0.006, 0.003

Note. Gender: 0=male, 1=female. R^2 =squared multiple correlation, β=standardized regression coefficient. *95% CI B*=95 % confidence interval unstandardized regression coefficient. *=$p<0.05$, **=$p<0.01$, **=$p<0.001$

explained variance (see Table 3), emotional variability of mothers at T1 was not significantly related with adolescents' depressive symptoms and mothers' internalizing problems at T6. Results also showed that emotional variability of adolescents at T1 did not significantly predict any of the outcome measures at T6. Finally, the two-way interactions between emotional variability (of mothers and adolescents) and emotional valence did not contribute significantly to the prediction of internalizing problems of mothers and adolescents.

Post hoc, we explored whether adolescents' gender moderated associations between maternal and adolescent emotional variability at T1 and internalizing problems at T6. The statistical interaction between gender and emotional variability, instead of the interaction between emotional valence and emotional variability, was entered in the third step of all six analyses. Results[3] showed that the interaction did not contribute significantly to the prediction of the outcome measures, indicating that the negative association between maternal and adolescent emotional variability at T1 and mothers' and adolescents' internalizing problems at T6 did not differ for boys and girls.

Taken together, results showed that less emotional variability of mothers at T1 only significantly predicted a relative

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[3] Results of these analyses can be obtained from the first author upon request.

increase adolescents' anxiety symptoms from T1 to T6. This was not found for adolescents' depressive symptoms and mothers' internalizing problems. Emotional variability of adolescents at T1 also did not significantly predict mothers' internalizing problems, adolescents' depressive symptoms, and adolescents' anxiety symptoms at T6. It should be noted that regression coefficients regarding adolescent emotional variability appeared to be in the same direction as maternal emotional variability as well as dyadic emotional variability. Additionally, when taking into account that confidence intervals of unstandardized parameter estimates overlapped, we were also not able to conclude that dyadic, maternal, and adolescent emotional variability differently contributed to internalizing problems over time. Yet, dyadic emotional variability consistently showed the strongest association with to internalizing problems over time.

Discussion

How emotions are handled from moment-to-moment during mother-adolescent conflict interactions might provide important information regarding mothers' and adolescents' internalizing problems over time. The main goal of the current observational study was to examine longitudinal associations between emotional variability during mother-adolescent conflict interactions in early adolescence and mothers' and adolescents' internalizing problems five years later. This study builds upon existing studies by examining dyadic and individual processes of emotional functioning. First, findings consistently revealed that less dyadic emotional variability predicted relative increases in mothers' and adolescents' internalizing problems from early to late adolescence. Second, results showed that while less maternal emotional variability predicted relative increases in adolescents' anxiety problems, less maternal emotional variability did not predict relative increases in adolescents' depressive symptoms and mothers' internalizing problems. Also, less adolescent emotional variability did not predicted relative increases in internalizing problems of mothers and adolescents. However, it should be noted that differences between effects of dyadic, maternal, and adolescent emotional variability appeared to be rather small. Finally, associations between emotional variability and internalizing problems were not moderated by the emotional valence of the conflict interactions.

The Role of Emotional Variability for Mothers' and Adolescents' Internalizing Problems

Consistent with a dynamic systems approach (Fogel 1993; Granic 2005) and with prior research examining mostly

externalizing problems (e.g., Granic et al. 2007; Van der Giessen et al. 2013), the current study demonstrated that dyadic emotional variability was negatively related over time to mothers' internalizing problems, and adolescents' anxiety and depressive symptoms. Less emotional variability of dyads seems to associated with an increased risk for both internalizing and externalizing problems. As expected, mother-adolescent dyads that showed a tendency to remain in very few dyadic emotional states during conflict interactions in early adolescence showed relative increases in internalizing symptoms over the course of adolescence. More emotionally rigid mother-adolescent dyads might be less able to successfully handle positive and negative emotions during conflict interactions and might therefore be less equipped to deal with the various emotional challenges and relational changes that take place during adolescence (Adams and Laursen 2007; Branje 2008). As such, less emotionally variable dyads might experience less optimal autonomy and relational development (Van der Giessen et al. 2013), which could be unsatisfactory for both adolescents and mothers resulting in relative increases over time in internalizing problems as well as externalizing problems. Furthermore, less emotional variability might also reflect less open communications patterns of dyads and a context that is unsupportive of a broad range of positive and negative emotions (Van der Giessen et al. 2014). Less open communication in mother-adolescent relationships has been found in other studies to be related to internalizing and externalizing problems (e.g., Kerr and Stattin 2000; Van Dijk et al. 2014). An important direction for future research is to examine longitudinal associations between dyadic emotional variability, relational development, and internalizing and externalizing problems during adolescence.

Furthermore, our findings revealed that only less maternal emotional variability was linked to relative increases in adolescents' anxiety symptoms, indicating that less emotional variability of mothers during conflict interactions in early adolescence is associated with an increased risk for anxiety symptoms over the course of adolescence. Maternal emotional variability in early adolescence did not predict internalizing problems of mothers and depressive symptoms of adolescents over time. Also, adolescent emotional variability did not predict internalizing problems of mothers and adolescents. These findings contradicted earlier studies which showed that mothers' and adolescents' limited capacity to shift emotions was related concurrently and longitudinally to their depressive symptoms (e.g., Koval et al. 2012; McMakin et al. 2011; Sheeber et al. 2009; Sheeber et al. 2000). In line with a dynamic systems approach (Granic 2005; Granic and Patterson 2006), the consistent effects of dyadic emotional variability might indicate that during conflict interactions emergent qualities of dyadic emotional patterns are greater than the sum of the individuals' emotions expressed. During interactions emotional states are considered to be embedded

within a relational context, where emotions of individuals shape the interaction, and the interaction in turn shapes emotions of individuals (Campos et al. 2011; Hinde 1997). With respect to conflict interactions, emotional expressions reflect what goes on between individuals and changes in the emotional repertoire during conflict interactions might not be fully understood by considering emotional states of two individuals studied in isolation (Fogel 1993; Granic and Patterson 2006). While dyadic variability reflects such a real-time contingent sequence of dyadic emotions, individual variability only reflects a single sequence of emotional states; of either mothers or adolescents (Hollenstein 2013).

However, it should be noted that in the current study differences between regression paths of maternal, adolescent, and dyadic emotional variability appeared to be rather small. Results also showed that maternal emotional variability predicted adolescents' anxiety symptoms, and that both maternal and adolescent emotional variability were quite strongly related to dyadic emotional variability. As such, the predictive capability of individual and dyadic emotional variability might be quite comparable. Nevertheless, dyadic effects were most consistent and also slightly stronger than individual effects. As such, we think that emotional variability of individuals is not sufficient to characterize the rich complexity of emotional processes and its associations with internalizing problems, and that emotional variability might be best characterized by dyadic processes (Moore et al. 2013; Tronick 2005). Future research is needed to clarify the way in which individual and dyadic emotional processes are uniquely associated to maternal and adolescent development.

Finally, results were not moderated by the emotional valence, indicating that the association between low emotional variability and more internalizing problems did not depend on the emotional valence of the conflict interactions. These findings support propositions of emotion theorists (e.g., Campos et al. 2011; Gross 2007; Izard 2009) that all emotions, both positive and negative, are important to express for healthy development. Since conflict interactions are directly confrontational and anger provoking for dyad members (Jones 2001), mothers and adolescents who remain continuously in a mutual positive emotional state might not be adapting well to the emotional demands of this context. Some degree of negativity of mothers and adolescents during conflict interactions is appropriate and does not necessarily increase the risk for internalizing problems, as long as it is managed effectively by dyads. Being stuck in either positive or negative emotions is what is problematic, and not the average amount of either positive or negative emotions (Granic 2005). Nevertheless, depressed and anxious individuals have been found to report greater intensity of negative emotions and lower intensity of positive emotions (Sheeber et al. 2009; Suveg and Zeman 2004), which could have affected associations between emotional variability and internalizing problems. It is possible that

adaptive interactions in early adolescence are characterized by a combination of more emotional variability as well as greater intensity of positive emotions. Future studies could extend results of the current study by examining whether emotional intensity, instead of emotional valence, moderates the association between emotional variability and internalizing problems.

Altogether, we think that the most important message to be gleaned from this study is that mother-adolescent dyads that showed limited emotional variability in their emotional repertoire were at increased risk for subsequent internalizing problems. Targeting flexible emotional expressions, thereby helping to avoid emotional rigidity, may be a valuable goal for prevention of mothers' and adolescents' internalizing problems during adolescence. Nevertheless, on basis of our analyses it was not possible to infer definitive causal relationships and future research should therefore try to elucidate the temporal order between emotional variability and internalizing problems, using experimental and full longitudinal designs. A potentially useful design could be to test whether emotional rigidity predicts a first onset of a disorder among adolescents and mothers who are at high risk for internalizing problems. It would also be useful to explicitly manipulate emotional variability in order to examine whether internalizing problems decrease accordingly.

Strengths, Limitations, and Future Directions

Although the current study has a number of important strengths, such as the longitudinal and multi-method design, several limitations should also be noted. First, this study specifically examined emotional variability of mother-adolescent dyads, thereby ignoring the potential role of emotional dynamics of father-adolescent dyads. An important direction for future research is to investigate longitudinal associations between emotional variability of father-adolescent dyads and internalizing problems. Furthermore, by solely examining conflict interactions, the current study focused on moment-to-moment emotional changes that occur within one specific context or *dynamic flexibility* (Hollenstein et al. 2014). However, many of the challenges of adolescence reflect the increasing complexity of social contexts, and interpersonal and emotional demands are different across these contexts (Collins and Steinberg 2006). In some contexts, for instance during playful activities, too much emotional variability might not be adaptive because it could reflect that emotions are not well regulated and controlled by dyads. Also, mother-adolescent dyads regularly move together from one context to the next, for instance, from a playful context into an interpersonal conflict, and dyads need to adapt emotional expressions to the shifting demands of such different contexts which has been referred to as *reactive flexibility* (Hollenstein

et al. 2014). The results of this study could be extended by examining over the course of adolescence the role of emotional variability of dyads for internalizing problems both within (dynamic flexibility) and across (reactive flexibility) different interaction contexts and partners.

Second, earlier studies conceptualized emotional variability in different ways. Emotional variability has, for instance, been defined as emotional inertia, indicating the extent that one's current emotional state is predictable from one's prior emotional state during interactions (Kuppens et al. 2012). In line with earlier studies on emotional variability in parent–child interactions (Granic et al. 2003; Lunkenheimer et al. 2011), this study defined emotional variability as the amount of transitions between emotional states and the spread of emotional states. Importantly, although emotional inertia is computationally distinct from dispersion and transitions (inertia has been based on the ratio values of emotional intensity in multi-second measurements rather than the real-time categorical approach of state space grid measures), it is possible that they are related. However, it is not yet clear how and future research should examine associations among these different types of emotional variability and whether they are differentially related to internalizing problems.

Third, the current data were gathered from a community-sample of mothers and adolescents mostly from Caucasian middle-class families, which limits the generalizability of the findings. The way mothers and adolescents tend to express and share emotions during interactions is suggested to be dependent on cultural factors (Jones 2001; Ryan et al. 2005), thereby underscoring the importance of research on possible differences in emotional variability across ethnic groups. Additionally, because the current study employed a community-based sample of typically developing adolescents and mothers, our results seem to suggest that early detection of emotional rigidity might help to identify mother-adolescent dyads at risk for developing internalizing disorders. Earlier research has also supported the importance of more emotional variability in adolescents of families with high risk for maternal depression (Connell et al. 2011). Therefore, future research should continue to inform prevention and intervention efforts by examining how mothers and adolescents with subclinical levels of internalizing problems are different from those who are clinically anxious or clinically depressed with regard to levels of emotional variability in early adolescence. Finally, despite the strength of our longitudinal design; this study was nevertheless limited in that data was only available from two measurement waves with a five year interval. As such, it was not possible to see what exactly happens in between these measurements, namely between early and late adolescence. In future

research a longitudinal design that covers the entire age period of adolescence would be preferable.

Conclusion

The present study represents a novel and important contribution to the literature by examining longitudinal associations between emotional variability during mother-adolescent conflict interactions and mothers' and adolescents' internalizing problems. This study extended existing studies (e.g., Hollenstein et al. 2004; Van der Giessen et al. 2013) by showing that a rigid dyadic emotional repertoire in early adolescence predicted relative increases in mothers' and adolescents' internalizing symptoms. These findings add to the growing acknowledgment that real-time dyadic emotional processes during mother-adolescent interactions are important for understanding overall well-being. During early adolescence, adaptive conflict interactions of mother-adolescent dyads seem to be marked by the ability to flexibly switch across a wide range of positive and negative emotions. Limited emotional variability of dyads might be part of a broader risk profile for internalizing problems in late adolescence that could be targeted by prevention or early intervention efforts.

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