

Effects of Pubertal Timing on Communication Behaviors and Stress Reactivity in Young Women During Conflict Discussions with their Mothers

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Abstract Individuation, a process whereby adolescents gain autonomy from their parents while maintaining emotional relatedness, is displayed by characteristic styles of verbal exchanges. Negotiating this developmental transition is often stressful for adolescents and their parents. This study deals with the association between pubertal timing, communication behaviors, and stress reactivity assessed during young females' conflict discussions with their mothers. A sample of $N = 32$ girls (age 9–13, T1) was grouped by pubertal timing. Years later (age 17–22, T2) they were followed up and videotapes of daughter–mother conflict discussions were evaluated. Salivary alpha-amylase was used to assess the stress reactivity. Results revealed that young women who had entered puberty early were higher in striving for control and separation in interactions with their mothers, and displayed higher stress levels. These results pointed to less successful individuation in late adolescence/young adulthood compared to on-time and late maturing age mates.

Keywords Pubertal timing · Individuation · Observation study · Stress reactivity

Introduction

During puberty, parent–child relationships change (e.g., rate and intensity of family conflicts increase) and adolescents develop a sense of individuation (Hofer et al. 1993). Individuation theory, as conceptualized by Youniss and Smollar (1985) and Grotevant and Cooper (1985), provides a framework for understanding the process of restructuring parent–child relations that can be characterized by the following features. First, it involves growing personal autonomy, which is referred to *separation*. Behavioral manifestations of this process in the adolescents' behavior within family interactions are the expression of negative affect towards parents (Montemayor et al. 1993), arguments in opposition to parental opinion (Bosma et al. 1996), or heightened assertiveness and influence on the parents' opinion (Pinquart and Silbereisen 1999). Second, adolescents try to gain more regulative *control* and influence in the family (Hofer and Sassenberg 1997). Behavioral indicators observable during interactions are, for instance, frequent questions, initiatives, and suggestions (Hakim-Larson and Hobart 1987; Hofer and Sassenberg 1997). At the same time adolescents seek to maintain emotional *connectedness* to parents in spite of growing separation from their parents. During interactions within the family connectedness is indicated by openness, mutuality, verbal and nonverbal indications reflecting love, care, and interest in the other person, or warmth. Taken together, different features within family interactions seem to indicate achievements in individuation.

In close interpersonal systems, such as families, the rate and intensity of conflicts increase, particularly during adolescence when family members have to revise expectations of one other (Laursen and Collins 1994). Parents consistently suggest later ages for the achievement of

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autonomy related developmental tasks (e.g., defending own rights) than adolescents themselves (Decovic et al. 1997; Silbereisen and Schmitt-Rodermund 1996). Such discrepancies might be particularly pronounced in families of female adolescents, because parents accept the expected timetables of their daughters to a lesser extent than those of their sons, and they seem to be more protective and regulatory towards their daughters (Paikoff and Brooks-Gunn 1992). Moreover, daughters who mature during puberty faster than their age mates seem to be especially more supervised and controlled by their parents in order to prevent premature transitions or achievements of developmental tasks, e.g., having a boyfriend or becoming sexually active (see for review Weichold et al. 2003; Paikoff and Brooks-Gunn 1992). In sum, the family relationships of girls who mature earlier than their age mates particularly seem to be strained during adolescence.

Pubertal Timing and Family Relationships in Female Adolescents

Based on the above summarized observations and insights, the present study links behavioral manifestations of individuation in parent–daughter communication in late adolescence/young adulthood to the daughter's pubertal timing, i.e., whether a certain pubertal stage was reached at an earlier, same, or later age compared to same-aged and same-sex peers (Dubas and Petersen 1993). In the following, we review prior research on the relationship between pubertal timing and family relationships in female adolescents. According to questionnaire data, families of early maturing girls are characterized by longer and more intensive periods of heightened conflicts and disagreement (Coakley et al. 2002; Holmbeck and Hill 1991; Sagrestano et al. 1999; Steinberg 1988), by more negative communication (Güre et al. 2006), by more interpersonal problems (Ruiselová 1998), and less successful individuation (Büttig et al. 2007) than other families. This might be due to the fact that early maturing girls experience developmental transitions (i.e., going out into discos, being in love) earlier in life compared to their age mates (Silbereisen et al. 1992) and strive for behavioral separation at an earlier age. Parents react toward this seemingly age-inappropriate behavior by being restrictive and by increasing control over their daughter (Hill and Holmbeck 1987). Concerning qualitative changes in interaction behavior within parent–adolescent relationships, observational data suggest that early maturing girls argue more often in favor of their own positions and are able to state their opinions clearly, which is one of the most important features of behavioral separation (Hauser et al. 1985). Furthermore, early maturing girls are higher in striving for control during conflict

discussions with their mothers compared to other adolescent girls (Weichold and Silbereisen 2000). In sum, early maturing girls experience more conflicts associated with higher levels of striving for separation within parent–adolescent interactions during early and middle adolescence.

Long-term Consequences of Pubertal Timing on Family Relationships

Although the process of individuation is a central issue during puberty and adolescence, establishing and maintaining a healthy sense of individuation is a lifelong concern (Reis et al. 2003). Nevertheless, long-term consequences of females' pubertal timing on parent–child relations have attracted little consideration to date (see review: Weichold et al. 2003). Existing studies suggest that early maturers report reduced relationship quality with family and friends, as well as decreased social support networks at age 24 (Graber et al. 2004). Furthermore, early maturing young women meet their parents less frequently and trust their parents less when getting into difficult situations in early adulthood (Stattin and Magnusson 1990). In sum, there is some indication for a less successful individuation of early maturing females in young adulthood compared to their age mates, but this is primarily based on a few samples from the US and Sweden. Moreover, these findings on long-term consequences regarding family relationships are limited to self-reported questionnaire data. Further, there is no empirical evidence concerning the micro-level of family interactions (e.g., nonverbal behavior assessed within observational studies) pointing to accomplishments of the individuation process during young adulthood.

Stress During Family Interactions

Successful individuation (i.e., healthy separation from parents while maintaining emotional connectedness, resulting in a more balanced power distribution in the relationship) may not only be revealed through particularities of communication during conflicts, but also by the relative lack of stress, such a conflict situation may trigger in the communication partners. Indeed, prior research showed that negotiating the developmental transition toward individuation within the family system is often stressful for adolescents (Güre et al. 2006) and their parents (Steinberg 2001). In particular, daily conflicts can be a significant source of distress (Savin-Williams and Small 1986; Silverberg and Steinberg 1990). To assess this aspect, besides behavioral measures, most recent studies include biological markers to focus not only on behavioral

but also on physiological reactions within potentially stressful social interactions (Susman 2007).

The main two components of the human stress system are (1) the activation of the hypothalamic–pituitary–adrenal (HPA) axis and (2) the faster-acting activation of the sympathetic nervous system (SNS) (Chrousos and Gold 1992). Whereas the assessment of free cortisol as a marker for activity of the HPA is well established in human stress research (Kirschbaum 1991), the identification of a suitable marker of the SNS activity is a new field of research (Stegeren et al. 2006). Some studies suggest that salivary alpha amylase (A-A), an enzyme produced in the oral mucosa by the salivary glands (Granger et al. 2006), is a useful index of SNS activity (Chatterton et al. 1996; Granger et al. 2006; Nater et al. 2005) and, thus, a reliable indicator for physiological stress reactions. Physiological stress parameters are typically assessed by analyzing saliva samples. This procedure is preferred over others (e.g. using blood samples) because of its practicality and non-invasiveness (Granger et al. 2006). In lab settings, researchers have consistently reported increases in salivary A-A in response to psychological stress (Granger et al. 2006; Nater et al. 2005, 2006). Moreover, associations between A-A reactivity and pubertal development were studied, but only during puberty and not in late adolescence or young adulthood. For instance, Susman (2007) showed a significant increase in A-A during the standardized Trier Social Stress Test (TSST), indicating that social interactions like interpersonal conflict cause increases in stress levels as compared to baseline physiological arousal. Moreover, she found an interaction between A-A and pubertal timing (only for boys) at age 13, whereby high A-A was characteristic for early maturing boys. In sum, salivary A-A seems to be an adequate and practical procedure to capture stress reactivity during social interactions, and this measure has already been used in recent studies on puberty. Nevertheless, no study to date has focused on the association between pubertal development (e.g., pubertal timing) and stress reactivity (A-A) in social situations during late adolescence and early adulthood.

Earlier research on individuation development showed that especially early maturing females are at risk for problematic relationships with their parents, characterized by intensive conflicts or negative communication during adolescence (Sagrestano et al. 1999; Steinberg 1988) and young adulthood (Graber et al. 2004; Stattin and Magnusson 1990). This leads to the assumption that social interactions within the family may be particularly stressful (i.e., high stress reactivity) for former early maturing girls. This stress should be reflected in a stronger increase in A-A during conflict discussions for early maturing females compared to those of late and on-time maturation.

Aims of this Study

The aim of the current study was to investigate the relationship between pubertal timing and various indicators of successful individuation within the family system. More specifically, we wanted to analyze the relation between pubertal timing, communication behaviors, and reaction to stress during young women's conflict discussions with their mothers utilizing longitudinal data of a German sample. Consequences of variation in pubertal timing have been studied with regard to various aspects of non-normative behaviors, but seldom regarding normative developmental outcomes like the individuation process (see Silbereisen and Kracke 1997; Dubas and Petersen 1993; Weichold et al. 2003 for reviews). Results showed that early maturing girls were especially likely to report problematic family relations in adolescence (e.g., Holmbeck and Hill 1991; Hauser et al. 1985) and in young adulthood (Graber et al. 2004; Stattin and Magnusson 1990). Nevertheless, empirical evidence regarding consequences on successful individuation is scarce, in particular in relation to micro processes during family interactions (i.e., communication behaviors and stress within family conflict discussions) in late adolescence/early adulthood.

By referring to individuation theory, the current investigation can add new insights into the relation of pubertal timing and family processes during late adolescence/young adulthood. In contrast to the few studies by Graber and Stattin/Magnusson, this study was based on the analysis of observational data during conflict discussions between daughters and their mothers. Thus, verbal and non-verbal interaction patterns and interpersonal processes within family relationships will be analyzed. Furthermore, we also focused on physiological stress reactions of both family members during the potentially stressful mother–daughter interactions.

Hypotheses

Concerning *communication behavior* we hypothesized that (1) young women with early pubertal timing display behaviors representing separation (i.e., assertiveness or influence on the mothers' opinion) and control/initiative (i.e., initiatives and attempts) more frequently than dyads comprised of on-time and late maturing young women and their mothers. Further we hypothesized that (2) there are no differences between daughters with different pubertal timing concerning indicators of connectedness (i.e., receptiveness, warmth), and that (3) mothers of early maturing young women display more control/initiative during conflict discussions than the other timing groups.

Concerning *stress reactivity*, we hypothesized that (4) salivary A-A increases in response to mother–daughter conflict discussions, indicating higher stress level (i.e., higher SNS activity) compared to the baseline stress level before the social stressor (i.e., conflict discussion) and that (5) young women with early pubertal timing and their mothers display higher stress reactivity (stronger increase in A-A) compared to daughters of on-time and late pubertal timing and their mothers.

Method

Sample

This study is based on data from 32 young women and their mothers who are participants of a longitudinal study (focusing on inter-individual differences in pubertal timing and the consequences for psychosocial adaptation in adulthood) and who took part in mother–daughter conflict discussions in late adolescence/young adulthood. At the initial assessment (T1) during early adolescence, 9–13 year-old girls ($M = 11.75$, $SD = 1.27$) were recruited via flyers distributed through schools and doctors' waiting rooms. All participants lived in a middle-sized city located in a central federal state of Germany and came from families with a middle class income (mean family net income approximately 2,000 €/month; about \$1,830). The second assessment (T2) was accomplished 8 years later when the daughters were between 17 and 22 years old. Data on communication behavior during young women's conflict discussions with their mothers were gathered in a laboratory setting. Moreover, physiological stress reactivity (A-A) was assessed during the interactions. The sample was contacted and recruited for T2 by phone. At this time, the mean age of the participants was 18.98 years ($SD = 1.15$) for the young women and 44.11 years ($SD = 3.61$) for their mothers. Families who took part in the study received 50 € (about \$45) for participation.

Measures

Pubertal Timing

To assess the status of physical development in puberty, we administered the verbal self-report measure Pubertal Development Scale (PDS; Petersen et al. 1988) during early adolescence (at T1). The scale consists of three items concerning breast development, pubic hair growth (1 = not begun to 4 = development completed), and menarcheal status (no/yes, coded as 1 = no and 4 = menarche occurred). The three ratings were averaged to form the pubertal status score (PDS-score). The internal consistency alpha of

the scale was .74 and the sample mean was 2.43 ($SD = .89$). The scale scores correlated positively with additional measurements of the girls' pubertal status taken from mothers' reports on the PDS ($r = .96$, $p < .001$) and from self-reports on height ($r = .78$, $p < .001$) and weight ($r = .87$, $p < .001$).

Timing of puberty was assessed as deviation relative to the central tendency in the status scores (Alsaker 1992; Dorn et al. 2006). To utilize a broader basis for the central tendency and deviation in assessing pubertal timing, we used data on the pubertal status of the 32 girls plus an additional sample of 25 same-aged female friends (9–13 years old, $M = 12.12$, $SD = .67$) who completed the same questionnaire on physical maturation. The enlarged sample ($N = 57$) was grouped by age into four groups (1 = 9 and 10 years, 2 = 11 years, 3 = 12 years, 4 = 13 years and older). Within each age group the pubertal development score was z -standardized (see Alsaker 1992). The normative (on-time) developmental timing within each of the age groups was defined by ± 1 standard deviation from the mean. Those girls with z -scores lower than -1 represented the late maturing adolescents and those with z -scores higher than $+1$ the early maturing adolescents. This procedure resulted in three groups of early ($n = 5$), on-time ($n = 22$), and late maturing ($n = 5$) girls in the target sample. The age of the groups did not differ significantly, $F(2, 29) = .96$, $p < .40$. See Table 1 for PDS-scores by timing groups within the four age groups in the target sample. PDS-scores increased with age and were highest in the group of early maturing girls. Comparisons with other samples regarding Pubertal Development Scale (PDS) measures revealed, first, that the PDS scores within each of the age groups of the current study are similar to those reported by Petersen et al. (1988). Second, the PDS score by pubertal timing groups is almost identical with that found by others in German samples for age groups 12–13 (Silbereisen and Schwarz 1998). In using additional samples as reference group to norm PDS scores, combined with the comparison of PDS scores to published norms of stages by age, we followed suggestions by Dorn et al. (2006) concerning adequate strategies to form pubertal timing measures based on self-reports.

Communication Behavior During Conflict Discussion

The girls and their mothers were videotaped at T2 (when daughters were between 17 and 22 years of age) while they discussed an everyday conflict. The discussions lasted for 10 min and were held in a laboratory setting. The topic of the discussion was chosen by the dyad before the actual interaction, and both mothers and daughters were instructed to try to solve the problem or to find a solution within

Table 1 PDS-score: means and standard deviations by pubertal timing groups and age groups in the target sample ($N = 32$)

Age groups	Early maturing		On-time maturing		Late maturing		All	
	<i>N</i>	<i>M (SD)</i>	<i>N</i>	<i>M (SD)</i>	<i>N</i>	<i>M (SD)</i>	<i>N</i>	<i>M (SD)</i>
9 and 10 years	1	1.67	2	1.33 (.00)	1	1.00	4	1.33 (.33)
11 years	1	3.67	5	2.07 (.28)	2	1.17 (.24)	8	2.04 (.81)
12 years	1	3.67	11	2.73 (.59)	2	1.33 (.00)	14	2.59 (.79)
13 years+	2	3.67 (.00)	4	3.08 (.50)	–	–	6	3.28 (.49)
All	5	3.27 (.89)	22	2.52 (.69)	5	1.20 (.18)	32	2.43 (.89)

the 10 min of discussion. To evaluate the videotapes according to the behavioral indicators drawn from the individuation theory framework, we utilized a German version of the coding manual “Family Macro-Coding Manual—March of Dimes Triadic Version” (Holmbeck et al. 1995; German translation: Srugies 1997). The coding refers to the entire sequence of exchanges in the dyad (macro-coding) rather than to separate linguistic units. The manual entails 13 behavioral categories: 11 concern the behavior of two interaction partners, and the remaining two describe the quality of dyadic interaction. The observers’ judgments (i.e., other members of the research team, blind to the hypotheses and to the pubertal timing of the girls) were given on a 5-point rating scale (behavior was displayed 1 = not at all to 5 = very much). The observers were trained by an expert over a period of approximately 2 months using video materials of other observational studies of social interactions. After the training, the inter-rater reliability on a subset of 27% of the actual material, averaged across all categories, was sufficiently high with $\kappa_w = .87$ (Weighted Kappa; Cohen 1968). The coding scheme used in this study was developed to capture qualitative features of parent–adolescent-relationships. The selection of particular behavioral categories in assessing the three aspects of individuation was based on theoretical assumptions of individuation theory (Youniss and Smollar 1985). Moreover, we validated the categories reflecting Separation, Control/Initiative, and Connectedness by the Munich Individuation Test by Walper (1997). Here we found, for instance, meaningful correlations of the categories chosen with the scale “successful individuation”.

Separation

We operationalized Separation by the categories Confidence in Stating Opinions, Rejection, and Power. Confidence was defined as speaking in a forceful and convincing manner. Rejection was indicated by disapproval of the other person and criticizing the other’s thoughts, ideas and behaviors. The category Power

measured the extent to which one person was able to influence the opinions, thoughts, or actions of the other. Verbal examples of Rejection within the discourse were “I really don’t believe it!” and “You are talking nonsense!”.

Control/Initiative

Furthermore, Control and Initiative were reflected by the behavioral categories Suggesting Input and Attempting Resolutions. Suggesting input from the other person was indicated by activities such as including the other in the exchange by asking questions. Attempted Resolution of issues was indicated by activities toward resolution of the current disagreements and differences. Examples representing Control/Initiative during the discourse were “... that’s right isn’t it? To what extent?” or “... so tidy your room at least once a week please!”.

Connectedness

Finally, the construct Connectedness was reflected by Warmth and Receptiveness. Warmth covered statements reflecting love, care, consideration for and interest in the other person. Receptiveness to statements made by the other was indicated by openness and amenableness within the mother–daughter dyad. Examples of Connectedness during the mother–daughter discussions were “You are looking lovely today!” or nonverbal activities, such as touching the other.

Stress Reactivity During Conflict Discussions

Two A-A saliva samples were obtained immediately before, and again immediately after, the conflict discussion. All discussions were conducted at about the same time of the day (at 6:00 p.m.). Salivary A-A was collected using salivette (Sarstedt, Nuembrecht, Germany) collection devices without chemical stimulants. The salivettes were stored at -20°C

after completion of the session until biochemical analysis. All samples were transported frozen to the Laboratory Chemistry Department of the University Hospital, Jena (Germany). After thawing, the samples were centrifuged at 3,000 rpm for 5 min to remove mucins. Samples were assessed for A-A using a commercially available kinetic reaction assay (Abbot Architect, Wiesbaden, Germany). The assay employs a chromagenic substrate (i.e., 2-chloro-*p*-nitrophenol) which can be spectrophotometrically measured at 405 nm using a standard laboratory plate reader. The amount of A-A activity present in the sample is directly proportional to the increase (over a 2 min period) in absorbance at 405 nm. Results are computed in U/ml of A-A using the formula: [Absorbance difference per minute \times total assay volume (328 ml) \times dilution factor (200)]/[millimolar absorptivity of 2-chloro-*p*-nitrophenol (12.9) \times sample volume (.008 ml) \times light path (.97)]. Inter- and intra-assay variance was below 2%.

Data Analysis

We conducted MANOVAs in order to test whether differences in daughters' and mothers' communication behavior and stress reactivity were dependent on the pubertal timing of the daughters (SPSS, Norusius 1993). If the overall multivariate test was significant, we examined univariate *F*-tests per observation variable. To compare the mean ratings across the pubertal timing groups, we used simple a priori contrasts (early maturing versus on-time and late maturing girls) regarding the behavioral categories (hypotheses 1, 2 and 3) and stress reactivity (hypothesis 5). As we assumed no differences between the three timing groups in connectedness, the significance level was adjusted to $p < .20$ as suggested by Bortz (2005). To answer our fourth hypothesis concerning change in A-A between the two measurement points (immediately before and after conflict discussion), we conducted ANOVAs with repeated measurements. In order to control for the effects of the daughter's age on the outcome variables, age was partialled out.

Results

Features of Conflict Discussions

Prior to testing the hypotheses, we looked at the topics of the discussions and the initiator of the conflict topic chosen for discussion (mother or daughter). The most common topics of the discussions between the young women and their mothers concerned household tasks (daily duties, e.g., washing dishes) and finances (consumer

behavior). None of the topics was directly related to issues of puberty or adolescence. There were no significant associations between the pubertal timing of the daughters and the topic of discussion ($\chi^2(14, 32) = 11.44, p < .70$, see Table 2), or the initiator of the conflict topic ($\chi^2(4, 32) = 1.53, p < .85$). Thus, possible differences in communication behavior or physiological stress reactions seem to be independent of the topic and the initiator of the conflicts.

Communication Behavior

We conducted two MANOVAs, one for daughters' and one for mothers' behavioral categories by daughters' pubertal timing, controlled for age of the young women. The *F*-tests revealed significant effects of pubertal timing on the daughters' communication behaviors ($F(22, 40) = 1.97, p < .05$) but not on those of the mothers ($F(22, 40) = .79, p < .75$).

Concerning the communication behavior of the daughters, in line with our first hypothesis, univariate analysis with simple contrasts revealed significant differences between the pubertal timing groups for one indicator of Separation, namely, Rejection during conflict discussion ($F(2, 28) = 3.99, p < .05$, see Table 3). Early maturing girls rejected their mothers' opinion more frequently than daughters showing on-time ($p < .05$) or late maturation ($p < .01$). Also in line with our first hypothesis, we found significant differences between the timing groups concerning Control/Initiative, namely in Suggesting Input ($F(2, 28) = 4.30, p < .05$). Early maturing girls suggested more input from their mothers by asking questions compared to on-time ($p < .01$) or late maturing daughters ($p < .05$). Finally, in support of our second hypothesis, indicators of Connectedness in the daughters, i.e., Warmth ($p < .35$) and Receptiveness ($p < .30$), did not differ for the three pubertal timing groups.

Stress Reactivity

Prior to our main analysis, we compared the baseline pre-discussion A-A levels between the timing groups. Results showed that young women with early, on-time, and late pubertal timing did not differ in their baseline A-A ($F(2, 28) = 1.61, p < .25$, see Table 4).

In order to test our fourth hypothesis (salivary A-A increases in response to mother–daughter conflict discussions) we conducted two repeated measure ANOVAs, one for daughters' and one for mothers' levels of salivary A-A. This hypothesis was confirmed for the daughters only. Their A-A levels ($F(1, 31) = 2.79, p < .10$) increased

Table 2 Topics of conflict discussions: frequencies and percentages by pubertal timing groups

Topic	Early maturing, <i>N</i> (%)	On-time maturing, <i>N</i> (%)	Late maturing, <i>N</i> (%)	All, <i>N</i> (%)
Household	1 (20.0)	5 (22.7)	3 (60.0)	9 (28.1)
Interpers. relations	0 (.0)	4 (18.2)	0 (.0)	4 (12.5)
Finances	1 (20.0)	4 (18.2)	0 (.0)	5 (15.6)
Education	1 (20.0)	2 (9.1)	0 (.0)	3 (9.4)
Personality	0 (.0)	2 (9.1)	0 (.0)	2 (6.3)
Health	1 (20.0)	1 (4.5)	0 (.0)	2 (6.3)
Planning activities	0 (.0)	3 (13.6)	1 (20.0)	4 (12.5)
Other	1 (20.0)	1 (4.5)	1 (20.0)	3 (9.4)
All	5 (100.0)	22 (100.0)	5 (100.0)	32 (100.0)

Table 3 Behavioral categories: means and standard deviations for daughters and mothers by pubertal timing and significant effects of pubertal timing on daughters’ and mothers’ behaviors (controlled by age)

	Early maturing		On-time maturing		Late maturing		All		Sig. of <i>F</i>	
	Daughter, <i>M</i> (<i>SD</i>)	Mother, <i>M</i> (<i>SD</i>)	Daughter, <i>M</i> (<i>SD</i>)	Mother, <i>M</i> (<i>SD</i>)	Daughter, <i>M</i> (<i>SD</i>)	Mother, <i>M</i> (<i>SD</i>)	Daughter, <i>M</i> (<i>SD</i>)	Mother, <i>M</i> (<i>SD</i>)	Daughter	Mother
<i>Separation</i>										
Confidence	4.75 (.50)	3.75 (1.26)	4.04 (.91)	4.37 (.71)	3.60 (1.14)	4.00 (.71)	4.06 (.93)	4.24 (.79)		
Rejection	3.50 (1.29)	2.75 (.96)	2.38 (1.17)	2.79 (1.22)	2.00 (.71)	2.80 (.84)	2.45 (1.18)	2.79 (1.11)	*	
Power	2.50 (.58)	2.00 (.00)	2.13 (.90)	2.63 (.92)	2.20 (1.30)	2.60 (.89)	2.18 (.92)	2.55 (.87)		
<i>Control/initiative</i>										
Suggesting input	4.50 (1.00)	3.75 (.96)	2.75 (1.15)	3.75 (.79)	2.60 (.89)	3.40 (1.52)	2.94 (1.22)	3.70 (.92)	*	
Attempt. resolut.	2.25 (1.26)	3.50 (1.29)	2.42 (1.06)	3.17 (1.09)	2.40 (.89)	3.40 (.55)	2.39 (1.03)	3.24 (1.03)		
<i>Connectedness</i>										
Warmth	3.25 (1.50)	3.75 (.50)	3.63 (.88)	3.58 (1.10)	3.40 (.89)	3.60 (1.14)	3.55 (.94)	3.61 (1.03)		
Receptiveness	3.00 (.82)	3.75 (.96)	3.96 (1.00)	3.92 (1.06)	3.60 (.89)	4.00 (1.00)	3.79 (.99)	3.91 (1.01)		

* *p* < .05

Table 4 Salivary alpha-amylase: means and standard deviations for daughters and mothers by pubertal timing

Alpha-amylase (U/ml)	Early maturing		On-time maturing		Late maturing		All	
	Daughter, <i>M</i> (<i>SD</i>)	Mother, <i>M</i> (<i>SD</i>)	Daughter, <i>M</i> (<i>SD</i>)	Mother, <i>M</i> (<i>SD</i>)	Daughter, <i>M</i> (<i>SD</i>)	Mother, <i>M</i> (<i>SD</i>)	Daughter, <i>M</i> (<i>SD</i>)	Mother, <i>M</i> (<i>SD</i>)
Pre discussion	26.89 (21.04)	67.27 (70.80)	51.87 (27.72)	74.03 (51.13)	46.85 (31.62)	56.40 (31.33)	47.18 (28.08)	70.22 (50.86)
Post discussion	57.50 (56.38)	59.81 (55.81)	52.54 (40.43)	73.97 (49.02)	68.06 (38.00)	93.54 (72.47)	55.74 (41.67)	74.81 (52.92)
Change (post–pre)	30.61 (36.35)	–7.46 (57.89)	.68 (25.35)	–.06 (27.30)	21.22 (26.14)	37.14 (47.87)	8.56 (29.02)	4.60 (37.98)

significantly during the conflict discussion, whereas those of the mothers ($F(1, 31) = .47, p < .50$) did not.¹

¹ Additional analyses revealed only weak and non-significant correlations between communication behaviors and change in A-A of the daughters during the conflict discussion with their mothers (i.e., Confidence in Stating Opinion $r = -.06$, Rejection $r = -.16$, Power $r = .21$, Suggesting Input $r = .25$, Attempting Resolutions $r = -.03$, Warmth $r = -.06$, and Receptiveness $r = .16$). This suggests that a rather general stress reaction induced by the conflict discussion with

Finally, to test our fifth hypothesis, we conducted univariate analysis to compare daughter’s stress reactivity between the different timing groups. We therefore computed change scores of A-A between the two measurement

Footnote 1 continued

the mother is captured by A-A. This stress may be caused by earlier experiences within the family system (e.g., high behavioral control of the parents) triggered within the communication situation.

points immediately before (pre) and after conflict discussion (post) as indicators for stress reactivity. Results for daughters' A-A change scores revealed significant differences between the pubertal timing groups ($F(2, 28) = 3.54, p < .05$). In line with hypothesis 5, early maturing daughters increased in A-A during conflict discussions to a higher extent compared to those with on-time maturation ($p < .05$), indicating higher stress levels.

Discussion

To our knowledge, this is the first longitudinal study to investigate the consequences of variation in pubertal timing focusing on successful individuation development within the family in late adolescence/young adulthood. Referring to hypotheses drawn from an individuation theory framework, conflict discussions between daughters and mothers were investigated concerning verbal and non-verbal communication behaviors and physiological stress reactivity. Individuation theory postulates that growing separation from parents during adolescence is accomplished whilst maintaining a close emotional relationship to them. Successful individuation is characterized by a healthy separated relationship between grown up offspring and their parents, where 'healthy' is exemplified by high emotional connectedness and balanced control and power within the dyad (Youniss and Smollar 1985). In the following, the findings of this study which suggest a less successful individuation process among the families of early maturing girls will be discussed in detail.

Early Pubertal Timing in Females and Family Relationship at the Threshold to Adult Life

Our results suggest that early maturing females in particular display less successful individuation from their mothers. This is reflected by (1) problematic communication behaviors towards their mothers (e.g., high striving for Separation and Control/Initiative) and (2) an increase in stress during conflict discussions with their mothers. Conversely, during puberty, dyads with daughters of on-time pubertal timing showed the least problematic communication behaviors and lowest stress reactivity during the conflict discussions with their mothers as compared to their age mates, thus indicating successful individuation within the family system (Weichold and Silbereisen 2000). As the current study showed, early maturation in puberty seems to have consequences for communication and stress within families in late adolescence/young adulthood. As expected, it is particularly young women with early pubertal timing who still strive for Separation and Control during conflict

discussions with their mothers at age 20, and who still find arguing with their mothers stressful. More specifically, early maturing young women revealed the highest level of Rejection reflected by disapproval and criticism towards their mothers. Furthermore, early maturing daughters requested more input from their mothers by asking questions compared to those with on-time and late pubertal timing. Finally, during the conflict discussion, early maturing girls showed the highest increase in A-A (physical stress reactivity).

Besides the behavioral differences in Separation and in Control/Initiative, the young women of different pubertal timing did not differ in Connectedness and emotional relatedness towards their mothers during conflict discussions. This indicates that, despite the sustained striving for separation and control during young adulthood observed in the early maturing young women, emotional attachment and connectedness to their mothers was still maintained.

Our results, which are based on observational and physiological data, suggest that early maturing young women in particular display less successful individuation development. These findings are in line with prior questionnaire data indicating a lowered quality of family relations (i.e., low trust in parents, low levels of social support) for early maturing females during young adulthood (Graber et al. 2004; Stattin and Magnusson 1990). One explanation may be that in families with early maturing girls, parents and adolescents differ in their expectations regarding developmental timetables in puberty than in other families (see Weichold et al. 2003 for review). This discrepancy might result in high levels of control and restrictions and more intensive periods of heightened conflict in families of early maturing girls during adolescence (Holmbeck and Hill 1991). These frequent conflicts may be linked with less successful individuation and general stressful social interactions within the families of early maturing females as they get older.

Furthermore, previous research has shown that early maturing females receive less support from family and social networks not only in adolescence (Graber et al. 1997) but also in early adulthood (Graber et al. 2004). They also are subject to higher levels of control and restriction (Holmbeck and Hill 1991). Given the fact that there is a positive association between high levels of social support and low levels of behavioral restrictions, on the one hand, and healthy individuation development on the other (Walper 1997), it might be that the less successful individuation of early maturing females at age 20 is a result of lacking support within the family context accompanied by intensive behavioral restrictions.

The findings regarding physiological stress reactions showed daughters' levels of salivary A-A to have increased significantly during the discussions with their mothers. This result suggests that A-A seems to be a promising SNS

biomarker for stress reactivity not only during standardized tests (e.g., TSST, see Susman 2007) but also during conflict discussions in a free format. In addition, A-A can be measured non-invasively and inexpensively in saliva. Compared to other diagnostic fluids (e.g., urine, blood) saliva sampling enables collection in everyday circumstances, and enables access to participants who otherwise would be unlikely to participate in studies requiring traditional physiological samplings (Granger et al. 2006).

The results of the current study are subject to some limitations. The small sample size and the selective recruitment strategy reduce the generalizability of results, and also implicates lowered test power. Finally, the large number of tests conducted may lead to an accumulation of Type I error (Bortz 2005).

We acknowledge these limitations, but nevertheless found them tolerable given the novelty of our biopsychosocial approach using a very time-consuming observation methodology in combination with questionnaire data and biological assessments. Further, one has to bear in mind the scarcity of research on the role of puberty on the development of positive behaviors (the vast majority is on various aspects of malfunctioning, Weichold et al. 2003). Additionally, we computed the effect sizes according to Cohen (1988) and found that all significant effects reported in this study were large and meaningful (i.e., Cohen's d ranges between .95 and 2.01). Nevertheless, larger samples are definitely required in future investigations. Furthermore, future research should try to clarify the source of the higher physiological stress reactivity among the early maturing girls when discussing a conflict topic. We speculated that prior experiences in the family (i.e., higher control and restrictions of the early maturing girls by their parents during early adolescence) may influence the extent to which interpersonal exchanges with their mothers are generally experienced as stressful.

To our knowledge, this is the first study focusing on the consequences of inter-individual differences in pubertal timing in females at the micro-level of family relations beyond puberty and adolescence. As the findings indicate, early physical maturation in girls does not only relate to more problematic family relationships during puberty but also seems to have consequences for communication and stress within families in late adolescence and young adulthood indicative of a less than optimal individuation development. This may add to the long-term manifestation of negative developmental pathways during adult life (e.g., characterized by interpersonal relationships with low bonding, support, and relationship quality). Against this backdrop, prevention measures could target the enhancement of positive family interactions and effective conflict solution strategies among early maturing girls and their parents. To sum up, this study is of relevance because it

adds to the understanding of the proximal risk mechanisms by which early pubertal maturation in females relates to later adaptation problems. Additionally, the findings of this study help building effective components of theory-based prevention programs to support positive development in early maturing girls.

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