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Development and Lability in the Parent-Child Relationship During Adolescence: Associations With Pubertal Timing and Tempo

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Abstract

Adolescents' and parents' reactions to pubertal development are hypothesized to contribute to changes in family dynamics. Using 7-year longitudinal data from the NICHD-SECCYD (488 boys, 475 girls) we examined relations between pubertal development (timing, tempo) and trajectories (developmental change and year-to-year lability) of parent-child conflict and closeness from age 8.5 to 15.5 years. Changes were mostly characterized by year-to-year fluctuations – *lability*. Parent-child conflict increased and closeness decreased some with age. Pubertal timing and tempo were more consistently associated with lability in parent-child relationships than with long-term trends, although faster tempo was associated with steeper decreases in parent-child closeness. Findings provide a platform for examining how puberty contributes to both long-term and transient changes in adolescents' relationships and adjustment.

Keywords

Puberty; Longitudinal; Mother-child; Father-child; Lability

Puberty is a developmental transition set in motion by a cascade of hormonal changes and accompanied by a variety of physiological, psychological, and social changes, including changes in the parent-child relationship (e.g. Dorn & Biro, 2011; Hollenstein & Lougheed, 2013; Steinberg & Silk, 2002). Between-child differences in how the neuroendocrine changes proceed contribute to heterogeneity in the timing and tempo of pubertal development and differences in the rate and stability of adjustment in multiple domains. Adolescents' and parents' reactions to pubertal changes likely contribute to changes in family dynamics and relationship quality (Paikoff & Brooks-Gunn, 1991). Using 7-year longitudinal data from the National Institute of Child Health and Human Development (NICHD) Study of Early Child Care and Youth Development (SECCYD) (NICHD Early Child Care Research Network, 2001) study we examine how timing and tempo of puberty is related to changes in parent-child closeness and conflict across ages 8.5 to 15.5 years.

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Changes in Parent-Child Relationships during Adolescence

The parent-child relationship changes dramatically across the lifespan. Dependency on parents early in life eventually transforms into a mature (hopefully) relationship between adults later in life (Aquilino, 1997). Adolescence is a developmental transition that effects significant change in the parent-child relationship (Steinberg & Morris, 2001; Steinberg et al., 2004). Studies investigating developmental change in parent-child relationships generally show that conflict increases and warmth or closeness decreases from middle childhood to early adolescence (e.g. 7-14 years; Fleming et al., 2010; McGue, Elkins, Walden, & Iacono, 2005; Shanahan et al., 2007a; 2007b). In later adolescence the parent-child relationship is thought to move out of a state of disequilibrium, and into a state characterized by more cohesion, autonomy, and less conflict (Steinberg & Morris, 2001). However, these general developmental trajectories of change are not always found, and may not adequately characterize all of the change occurring in parent-child relationships during adolescence. Other studies have shown that across adolescence (e.g. 10-16) parent-child conflict decreases slightly (e.g., Shanahan et al., 2007a, see Laursen et al., 1998).

One explanation of the inconsistent findings is that changes in parent-child relationships are not characterized by sustained long-term growth or loss of conflict (or closeness) over time, but rather manifest as transient, short-term bursts of conflict. That is, year-to-year changes in relationship quality during adolescence may be better characterized by ups *and* downs, rather than the smooth increases *or* decreases previously described. For example, Granic and colleagues (2003) found that age 13-14 was a period of increased lability in hostile, negative, neutral, and positive affect during parent-son interactions. Short term changes in conflict and emotion suggest that the typically described developmental trajectories of change in the parent-child relationship across adolescence may not provide a full description of how relationships actually change during adolescence. Rather, year-to-year changes during this developmental period may be better described in terms of fluctuations or lability (variability) in relationship quality.

Pubertal Development and Change in Parent-Child Relationships

Substantial work has examined disruptions in the parent-child relationship early in childhood, which are speculated to contribute to the timing and course of pubertal maturation (e.g., Belsky, Steinberg, & Draper, 1991; Belsky, Steinberg, Houts, & Halpern-Felsher, 2010; Ellis, Shirtcliff, Boyce, Deardorff, & Essex, 2011). In complement, pubertal development has also been hypothesized to affect family relationships through several mechanisms (e.g., Anderson, Heatherington, & Clingempeel, 1989). Focusing on concurrent associations between puberty and parent- adolescence relationships, we highlight two hypothesized mechanisms by which puberty may impact relationship quality. The *developmental readiness hypothesis* posits that when puberty begins early, adolescents may not be cognitively or emotionally prepared to adjust to the changes (Ge, Brody, Conger, Simons, & McBride-Murray, 2002; Ge & Natsuaki, 2009). That is, puberty may not progress in parallel to cognitive and emotional development and this asynchrony may lead to emotional and behavioral problems in the adolescent. There is evidence that early timing of puberty is associated with heightened risk for behavior problems and psychopathology (e.g.,

Negriff & Susman, 2011; Graber, 2013). The developmental readiness hypothesis can also explain associations between puberty and changes in family relationships via similar mechanisms. For example, puberty-related behavioral changes in the parent or adolescent may spill over into the parent-child relationship. There is evidence that early timing of puberty is associated with greater conflict and less closeness in parent-child relationships, though results differ somewhat for mother-son, mother-daughter, father-son, and father-daughter dyads (e.g., Collins & Laursen, 2004).

Similarly, the *maturational compression hypothesis* (e.g., Mendle, Harden, Brooks-Gunn, & Graber, 2010) posits that when adolescents develop quickly, both parents and adolescents may not have adequate time to adjust to pubertal changes (physical, cognitive, emotional, etc.). That is, the effects of early timing hypothesized by the developmental readiness hypothesis may be paralleled or exaggerated by a rapid progression of development, with disruptions in parent-child relationships for two reasons. Compressed changes may not provide enough time for adolescents (and parents) to acclimate to the changes the adolescent experiences. Second, faster tempo could compound the effects of early timing, as progression through the stages of puberty would occur at increasingly earlier ages relative to peers. Emerging evidence suggests that faster tempo of puberty is associated with psychological, behavioral, and peer relationship problems later in development (e.g., Marceau et al., 2011; Mendle et al., 2010), and there is some evidence that parental expectations are challenged most drastically during times of sudden or rapid changes in the child (Aquilino, 1997). However, no studies have examined the associations between pubertal tempo and changes in the parent-child relationship.

Although the theories highlighted above explain how different aspects of pubertal development are related to adolescent behavior and relationships, the mechanisms linking both timing and tempo of pubertal development to changes in parent-child relationships may hinge on a mismatch between parental expectations and adolescent competencies. That is, both theories suggest that parents assign physically mature adolescents responsibilities for which they are not prepared to assume. Multiple components of puberty likely all contribute to parents' and adolescents' expectations of their relationship and the adolescents' role. For example, the role of pubertal development in the mismatch between parental expectations and adolescent competencies could be driven by hormonally influenced brain changes and ultimately changes in the adolescent's behaviors and emotions, parents' reactions to changes in the adolescent's secondary sex characteristics with related expectations about how the adolescent will behave, and or emerging needs for autonomy (e.g., Paikoff & Brooks-Gunn, 1991; Susman et al. 1987). The resulting discrepancy between parents' expectations for mature decision making and behavior and adolescents' ability to consistently deliver those decisions and behaviors would then lead to increases in family conflict and decreases in closeness, and or increased lability of parent-child relationship quality. Shifts in expectations during adolescence may be normative, but when exaggerated by earlier and or faster pubertal development, the deterioration of the parent-child relationship may itself become more severe.

In terms of lability, developmental transitions are often accompanied by variability in behavior across domains (e.g. adolescent mood: Larson, Csikszentmihalyi, & Graef, 1980;

motor development: Vereijken & Adolph, 1999; cognitive development: Seigler, 1994; see also Ram & Gerstorf, 2009). For example, the transition from elementary to middle school is accompanied by increased variability in self-esteem (Molloy et al, 2011; Morin Maïano, Marsh, Nagengast, & Janosz 2013;). Middle-childhood and adolescence are also associated with changes in social relationships, including with parents and peers (Brown, 2004; Eccles, Wigfield, Midgley, Reuman, MacIver, & Feldlaufer, 1993; Steinberg & Morris, 2001). These changes in social environments are also linked with the timing of puberty. For example, earlier timing of puberty is related to earlier onset of romantic relationships (e.g., Ellis, 2004). Further, there is volatility in peer relationships during childhood and adolescence (e.g., Poulin & Chan, 2010). Therefore, because of increased variability associated with developmental transitions, experiencing the pubertal transition earlier and or in a more compressed timeframe may exacerbate lability in adolescents' behavior and parent-adolescent relationships.

Present Study

Applying methodological theoretical frameworks that distinguish intraindividual change from intraindividual variability (Nesselroade, 1991) we examined how timing and tempo of pubertal development are related to long-term changes (trends) and year-to-year lability (fluctuations) in parent-child conflict and closeness. The NICHD-SECCYD, was originally conceived to examine how early child care was related to children's development. As the study and its participants matured, the breadth of the study and the analyses it supports expanded. Longitudinal assessments across middle childhood and adolescence provide for examination of how timing and tempo of pubertal development may be associated with parent-child relationships. Using repeated measures of pubertal status and parent-child relationship quality, we (Aim 1) distinguished and quantified between-person differences in long-term change and lability of parent-child relationship quality from age 8.5 to to 15.5 years and (Aim 2) examined if and how between-child differences in the timing and tempo of pubertal development are related to these trajectories and fluctuations in relationship quality.

Following the literature on trajectories and lability in parent-child relationships, for the first aim we hypothesized that (1) parent-child conflict and closeness would be characterized by both trends (developmental change) and fluctuations (lability). For the second aim, in accordance with the developmental readiness hypothesis, we hypothesized (2) that earlier timing of pubertal development would be associated with steeper increases in conflict and decreases in closeness, and with generally greater levels of lability. In accordance with the maturational compression hypothesis, we hypothesized (3) that faster tempo of pubertal development would be associated with steeper increases in conflict and decreases in closeness, and with generally greater levels of lability. Finally, we hypothesized (4) that the interaction of timing and tempo would predict changes in parent-child relationships such that the combination of both earlier timing and faster tempo of pubertal development would be associated with steeper increases in conflict and decreases in closeness, and with generally greater lability.

Given differences in dyad types (e.g., mother-son, father-daughter; Collins & Laursen, 2004) and hormonal differences between boys' and girls' pubertal development (e.g., Susman et al., 1987), we examined each gender-pair separately. Further, although the theoretical predictions regarding associations among between-person differences in pubertal maturation and parent-child relationships are not considered to be ethnicity specific, there are known differences in the timing and tempo of puberty across different ethnicities (e.g., Styne, 2004; Susman et al., 2010) as well as ethnic/cultural differences in parenting practices (e.g., Julian, McKenry, & McKelvey, 1994). Thus, in post-hoc follow-up we also examined ethnic differences (White, Black, Hispanic) in measures of pubertal maturation, parent-child relationship quality, and their association.

Method

Participants

Data were drawn from the National Institute of Child Health and Human Development (NICHD) Study of Early Child Care and Youth Development (SECCYD), a longitudinal study following 1,364 children from age 0 to age 15.5 years (see NICHD Early Child Care Research Network, http://www.nichd.nih.gov/research/supported/seccyd/Pages/overview.aspx, for comprehensive information about the study). We used longitudinal data provided by the subsample of children (65%) who participated in the pubertal staging module (488 boys and 475 girls), which included assessments of pubertal status at age 9.5 (n = 871, 97.9%), age 10.5, (n = 796, 89.5%), age 11.5 (n = 752, 84.6%), age 12.5 (n = 748, 84.1%), age 13.5 (n = 728, 81.8%), age 14.5 (n = 688, 77.4%), and age 15.5 years (n = 672, 75.6%). Children were followed from 1991 to 2006 at 10 university-based recruitment sites across the United States. When children were 1 month of age, mothers, on average, had attained 14.3 years of schooling (SD = 2.4 years), and partners had attained 14.5 years of schooling (SD = 2.7). Children were primarily White (75% of boys, 78% of girls), with some identified as Black (13% of boys, 12% of girls), Hispanic (7% of boys, 5% of girls), and other ethnicities (5% of boys, 5% of girls). Total family income was assessed at the first wave of data collection used in this study (age 8.5 years), and subsequently converted to an income-to-needs ratio based on federal poverty guidelines where an income-to-needs ratio of less than 2 represents low income. The sample had an average income-to-needs ratio of 4.12 (SD = 3.36); approximately 25% of the sample were below the low income threshold. Retention was good; 72% of boys and 74% of girls provided data at five or more puberty assessments and only 10% of boys and 7% of girls provided data at only one assessment. Number of missed assessments was not significantly related to known demographics (income, ethnicity, mothers' education, χ^2s < 3.49, ps > .05).

Measures

Parent-Child Relationship—Parent-child *conflict* and *closeness* were measured via separate mother and father self-reports on the Child-Parent Relationship Scale (adapted for SECCYD from the Student-Teacher Relationship Scale, Pianta, 1994) when children were 8.5, 9.5, 10.5, 11.5 and 15.5 years old. Each parent rated the extent to which 15 statements applied to their relationship with the target child on a 1 (definitely does not apply) to 5 (definitely applies) scale. Sets of items were summed to obtain measures of parent-child

conflict (7 items; e.g., My child and I are always struggling with each other; My child is sneaky or manipulative with me) and parent-child closeness (8 items; e.g., I share an affectionate or warm relationship with the child; If upset, my child seeks comfort from me). Reliability of the scales was good (αs > .73 across subscales, raters, and assessments) and long-term stability (correlation between age 8.5 and 15.5 assessments) was moderate, *r*s = .28 to .56, *p*s < .05. A selection of observed trajectories are shown in Figure 1, Panel A (father-daughter conflict) and Panel B (mother-son closeness).

Pubertal Status—Nurse practitioners or physicians assessed children's pubertal development annually using Tanner Stage criteria (1 = prepubertal to 5 = sexually mature; Marshall & Tanner, 1969, 1970) per the American Academy of Pediatrics Manual (Herman-Giddens & Bourdony, 1995). Adolescents judged as between stages were assigned the lower stage rating. See Susman et al (2010) for additional details.

Pubertal Development—Pubertal timing and tempo scores were obtained from the repeated measures of Tanner Stage using nonlinear growth curves (Grimm, Ram & Hamagami, 2011), specifically, a logistic function of the form,

$$TannerStage_{ti}=\beta_0+(\beta_1-\beta_0)\left[\frac{1}{1+\exp(-\alpha_i(Age_{ti}-\lambda_i))}\right]+r_{ti} \quad (1)$$

where $TannerStage_{ti}$, the observed level of development at assessment *t* for individual *i*, is a function of a lower asymptote β_0 = Tanner Stage 1, upper asymptote β_1 = Tanner Stage 5, growth rate α_i, = *tempo* of development, centering term λ_i = *timing* of development, and time-specific residual, r_{ti}. Timing and tempo coefficients (evaluated at the midpoint of development, Tanner Stage = 3) were in turn modeled as sample-level means and individual deviations from those means (see Marceau et al., 2011 for rationale and modeling details). The Bayes empirical estimates for individuals' timing (λ), and tempo (α) of puberty were extracted from models of boys' genital development (GD) and girls' breast development (BD). Incomplete data were treated using standard missing at random assumptions (Little & Rubin, 1987).

Boys, on average, were developing at a rate of 0.84 Tanner Stages per year (SD = .20) when reaching the mid-point of their GD (entry to Tanner Stage 3) at age 12.76 years (SD = .85). Girls, on average, were developing at a rate of 0.79 Tanner Stages per year (SD = .77) when reaching the mid-point of their BD at age 11.95 years (SD = 1.01). Later timing was associated with slower tempo among boys ($r_{\lambda\alpha}$ = -.44, p < .05), but not girls ($r_{\lambda\alpha}$ = -.01, p > .05). Significant ethnicity-related differences were apparent in timing (F > 10.14, p < .05), with Black boys and girls tending to mature earlier than White boys and girls (see also Susman et al., 2010), but not in tempo (F < 2.27, p > .05).

Analytic Strategy

To characterize year-to-year change in parent-child relationship quality (Aim 1), we derived a set of change measures from the longitudinal data using growth curves (Singer & Willett, 2003) and quantifications of intraindividual variability (Ram & Gerstorf, 2009). To examine

how between-family differences in long-term change and lability in parent-child relationships were related to between-child differences in pubertal timing and tempo (Aim 2), we examined associations among these derived measures using regression models. Incomplete data were treated according to standard missing at random assumptions in the growth curve models and missing completely at random in the calculation of lability scores and associations between changes in the parent-child relationship and pubertal maturation (Little & Rubin, 1987).

Aim 1: Changes in the Parent-Child Relationship

Long-term change (trends): To quantify long-term change in parent-child relationships, we used a standard linear growth curve model, extracting between-person differences in level of conflict (and closeness) at age 12.5 years (the assessment closest to the center of pubertal maturation) and long-term rates of change across the 8.5 to 15.5 year span. Specifically, we fit multilevel models of change (occasions nested within persons) separately to the repeated measures of parent-child conflict and closeness. The models were specified as

$$PCquality_{ti}=\beta_{0i}+\beta_{1i}(age_{ti})+e_{ti} \quad (2)$$

where $PCquality_{ti,}$ individual *i*'s parent-child conflict or closeness at time *t*, is modeled as a function of β_{0i} and β_{1i}, person-specific coefficients indicating the level of relationship quality at age 12.5 years and rate of linear age-related change across the study period, respectively, and e_{ti} a series of residuals. Person-specific coefficients were in turn modeled as

$$\beta_{0i}=\gamma_{00}+u_{0i} \quad (3)$$

$$\beta_{1i}=\gamma_{10}+u_{1i} \quad (4)$$

where γ_{00} and γ_{10} are sample means, and u_{0i} and u_{1i} are the person-specific deviations in intercept and slope, respectively, that are unrelated to the time-specific residuals. Following modeling procedures used elsewhere (e.g., Ram, Gerstorf, Lindenberger, & Smith, 2011), the empirical Bayes estimates of rates of change, u_{1i}, from these models were taken as quantifications of the between-person differences in systematic *trends* in how parent-child relationships developed across the study period.

Lability (fluctuations): Given that at least a portion of the remaining variance unaccounted for by growth curves might constitute meaningful *lability* in the parent-child relationship, the extent of dispersion (intraindividual standard deviation) of the residual scores obtained above (e_{ti}) was quantified for each dyad as

$$Lability_i=\sqrt{\sigma_i^2}=\sqrt{\frac{1}{T-1}\sum_{t=1}^{T}(e_{ti}-\bar{e}_i)^2} \quad (5)$$

(see e.g., Molloy, Ram & Gest, 2012; Ram et al., 2011 for empirical examples). Higher lability scores indicate greater fluctuation of conflict or closeness, separate from the long-term trends, whereas lower lability scores indicate more stable or systematically trending relationships.

Aim 2: Associations between Pubertal Development and Changes in the Parent-Child Relationship—To examine how between-family differences in long-term change and lability in parent-child relationships were related to between-child differences in pubertal timing and tempo, we examined associations among these derived measures using a series of linear regression models. In each model, the empirical Bayes estimates of timing and tempo extracted from the nonlinear growth models of pubertal maturation were entered as predictors (along with the timing × tempo interaction). The dependent variables were the empirical Bayes estimates of rates of change, u_{1i}, from the linear growth curve models of parent-child relationships and the quantification of between-person differences in lability (intraindividual standard deviations, square root transformed to alleviate skew) for mother-daughter, mother-son, father-daughter, and father-son closeness and conflict. Parameter estimates were obtained for the full sample, and then separately for each ethnicity.

Results

Aim 1: Changes in the Parent-Child Relationship

Long-term Change (Trends) in the Parent-Child Relationship—Results from fitting linear growth models for parent-child conflict are shown in Table 1. On average, mother-son, mother-daughter, father-son, and father-daughter conflict were characterized by significant long-term linear increases from age 8.5 to 15.5 years (e.g., father-daughter conflict increased $\gamma_{10} = .37$, $p < .05$ per year). For illustration, plots of the raw data for a subset of individuals and plots of the estimated prototypical and individual trajectories for father-daughter conflict (Panel A: raw, Panel C: estimated) and mother-son closeness (Panel B: raw, Panel D: estimated) are shown in Figure 1. Complementary long-term linear increases in conflict and decreases in closeness were found for each dyad type (e.g., mother-son closeness $\gamma_{10} = -.56$, $p < .05$). Tests for ethnic differences in the rates of long-term change suggested that there were no significant differences in average rate of change in conflict for any dyad type ($F < 1.05$, $p > .05$). As well, there were no significant differences in the decreases in closeness for mother-daughter, father-daughter, or mother-son dyads ($F < 1.58$, $p > .05$), but there was some indication that mother-son closeness decreased less rapidly in Black families than in White or Hispanic families ($F = 4.27$, $p < .05$).

Lability (Fluctuations) in the Parent-Child Relationship—Systematic age-based trends did not account for all observed changes in parent-child conflict and closeness. As can be seen in Panels E and F of Figure 1, there was substantial change that was ‘left-over’. Quantifications of explained variance (proportional reduction in residual variance; Snijders & Bosker, 1999) confirmed that the long-term trends accounted for only a modest proportion (between 17 and 49%) of the year-to-year changes in parent-child relationships (bottom rows of Table 1; e.g., for father-daughter conflict, age trends only accounted for

28% of within-person variance), whereas lability accounted for between 51 and 83% of the year-to-year changes in relationship quality.

There was also evidence of substantial between-family differences in lability of parent-child relationship quality (Ms range between 1.46 and 2.67, SDs between .98 and 1.62); some families experienced more lability, whereas other families experienced less lability (i.e., more stable or systematically trending relationships). Thus, hypothesis (1), that parent-child conflict and closeness would be characterized by both trends (developmental change) and fluctuations (lability), was confirmed.

ANOVAs examining ethnicity-related differences revealed no significant differences between White, Black and Hispanic sub-groups in the lability of mother-daughter, mother-son, or father-son conflict ($F < 1.58$, $p > .05$). White families had significantly less lability of father-daughter conflict and mother-daughter closeness than Black or Hispanic families (Fs = 4.87 and 4.36, $p < .05$). No significant ethnicity-related differences were apparent in the lability of mother-son, father-son, or father-daughter closeness ($F < 2.08$, $p > .05$).

Aim 2: Associations between Puberty and Changes in the Parent-Child Relationship

Associations between timing and tempo of puberty and long-term change and lability of parent-child conflict and closeness are shown in Table 2. The hypothesis that earlier timing would be associated with steeper increases in conflict and decreases in closeness (2) was not supported. The hypothesis that faster tempo of pubertal development would be associated with steeper increases in conflict and steeper decreases in closeness (3) was partially supported: faster tempo of puberty was associated with greater developmental decreases in closeness for each dyad (βs = -.06 to -.42, ps < .05, Figure 2). Pubertal timing and its interaction with tempo were not systematically associated with rates of long-term change in conflict or closeness, contrary to hypothesis (4).

There were three systematic findings of note regarding the associations between pubertal development and lability of parent-child relationships (see Table 2). First, for girls, earlier timing was associated with greater lability of conflict and closeness with both mothers and fathers (βs = -.03 to -.04, ps < .05, Figure 3), partially supporting (i.e., for girls but not boys) hypothesis (2). Second, for girls, slower tempo was associated with greater lability of conflict and closeness with fathers (βs = -.15 and -.16, ps < .05, Figure 4A), but not mothers, contrary to hypothesis (3). Finally, for boys, faster tempo was associated with greater lability of conflict with fathers and closeness with mothers (βs = .16 and .28, ps < .05, Figure 4B), partially supporting hypothesis (3). There was no systematic evidence that either timing or tempo moderated the others' association with lability, therefore hypothesis (4) was not supported.

Breakdown by Ethnicity—Results for associations between developmental change in parent-child relationships and puberty are presented separately by ethnicity in Table 3. The finding that faster tempo of pubertal development was associated with greater developmental decreases in closeness for mother- and father-daughter closeness and mother-son closeness was significant specifically among White youth (βs = -.06 to -.42, ps < .05). Although not reaching standard levels of statistical significance, the same pattern of

associations was seen for father-son closeness among White boys and mother- and father-son closeness among Hispanic boys.

Findings for associations between lability of parent-child relationship quality and pubertal development are presented separately by ethnicity in Table 4. The finding that for girls, earlier timing was associated with greater lability was significant only for lability of conflict with mothers among White girls (β = -.05, p < .05). The same pattern (i.e., not statistically significant) was observed for lability of conflict with fathers and closeness with mothers and fathers for White girls, and lability of conflict and closeness with fathers for Hispanic girls. The finding that for girls, slower tempo was associated with greater lability of conflict with fathers was significant only among Hispanic girls (β = -.15, ps < .05). This pattern was present for White and Black girls, and was echoed for father-daughter closeness among White and Hispanic girls. Finally, the finding that faster tempo was associated with greater lability of father-son conflict and mother-son closeness was driven in part by the Black and in part by the White sub-samples. Faster tempo of boys' GD was associated with greater lability of conflict and closeness with fathers among Black boys (β > 4.18, p < .05). Faster tempo of GD was associated with greater lability of closeness with mothers among White boys (β = .92, p < .05), and this pattern was observed for Black and Hispanic boys.

Discussion

The present study is among the first to distinguish and examine both long-term changes (trends) and year-to-year lability (fluctuations) of parent-child relationships, and to assess if and how differences in both types of changes are associated with the timing and tempo of puberty. Although there were notable, but relatively small developmental increases in conflict and developmental decreases in closeness from middle-childhood through mid-adolescence, year-to-year changes in parent-child relationships were mostly characterized by fluctuations. While faster tempo of puberty was associated with greater developmental decreases in closeness for each dyad, generally pubertal development was more strongly associated with lability. Earlier timing of puberty was associated with greater lability across conflict and closeness in mother- and father-daughter relationships. Slower tempo was associated with greater lability of conflict and closeness in father-daughter relationships, whereas faster tempo was associated with greater lability of father-son conflict and mother-son closeness. Thus, our findings provide initial evidence that the timing and tempo of puberty is related to the severity of these fluctuations.

Changes in the Parent-Child Relationship

Consistent with much of the literature on parent-child relationship development (see Collins & Laursen, 2004), our sample exhibited slight developmental increases in parents' perceptions of conflict and decreases in parents' perceptions of closeness from middle childhood to mid-adolescence (age 8.5 to 15.5 years). However, these age-related developmental trends accounted for only between 17 to 49% of the year-to-year changes in relationship quality. Mostly, relationships were marked by ups *and* downs, lability, in conflict and closeness.

Some evidence suggests lability in relationships is normal, and that rigid relationships can be detrimental for adolescent adjustment (Granic et al., 2003). Given that developmental transitions are often accompanied by increases in within-person variability (e.g., Adolph, Robinson, Young, & Gill-Alvarez, 2008; Siegler, 1994), we cautiously interpret the substantial lability we observed in parent-child relationships as part of healthy maturation of interpersonal relationships. This interpretation is consistent with theories of change during the adolescent transition, and of reorganization of the parent-child relationship after adolescence (Steinberg & Morris, 2001; Steinberg & Silk, 2002).

Associations between Puberty and Changes in the Parent-Child Relationship

Both methodologically and substantively, we see benefits for explicit consideration of the distinction between processes that contribute to long-term development and those that contribute to temporary ‘development’ (Nesselroade, 1991). Taking a step in this direction, we examined how timing and tempo of puberty were differentially related to between-family differences in long-term trends and in extent of year-to-year fluctuations in parent-child relationship quality. We found, across dyad types, that faster tempo of puberty was associated with steeper decreases in parents' perceptions of parent-child closeness. This pattern of results provides evidence for the maturational compression hypothesis, which suggests that rapid pubertal changes in appearance (i.e., height, weight, and secondary sex characteristics) may lead to parental or self-expectations for which the emerging adolescent is not cognitively or emotionally prepared. Based on evidence that a slightly decreasing trajectory of parent-adolescent is normative (as it has been observed in prior studies of normative samples, e.g., McGue et al., 2005), faster tempo may exacerbate the rate of decline of parent-adolescent closeness noted across adolescence generally.

Contrary to the developmental readiness hypothesis and some previous studies, we found no evidence that pubertal timing was associated with rate of long-term, developmental change in parent-child relationships. The lack of significant associations may reflect differences in measures; our model-based measure of timing assesses the timing of stage 3 within each individual, whereas other measures of timing assess comparisons of more and less mature youth within a sample (e.g., Steinberg, 1988). These different measurement strategies may tap different phenomena. Further, pubertal timing may be associated with youths' perceptions, but not parents' perceptions of the evolving parent-child relationship. Additionally, it could be that the implications of the developmental readiness and maturational compression hypotheses actually apply more to the lability in parent-child relationships than to the long-term trajectories. Neither theory suggests that the mismatch between parents' expectations and children's capacities will remain indefinitely. As puberty ends, the mismatch may be resolved and the relationship quality may recover. Thus, it may be that in families with adolescents who develop earlier and or faster the parent-child relationship is simply challenged and renegotiated more dramatically (greater lability), rather than sent on a continuous, never to be resolved decline.

Generally, pubertal timing and tempo were more consistently associated with the extent of lability in parent-child relationships than with the long-term trends in those relationships. In line with both the developmental readiness hypothesis and the maturational compression

hypothesis, we found that among boys, faster tempo, and that among girls, earlier timing of development were associated with greater lability in parent-child conflict and closeness, across ethnicities. This may indicate for boys, a cascade where faster than normal rise in testosterone (as would be the case in faster tempo) increases adolescents' tendency for confrontational and aggressive behavior and cause more drastic changes in conflict. For girls, results suggest that the associations of earlier timing and potentially increased emotional and behavioral difficulties extend to lability in parent-child relationships. The lability in parent-child relationship quality may be a downstream effect of changes in girls' fluctuating moods and behaviors, which may help to explain the relatively small effects.

Contrary to our hypotheses, we found that among girls, faster tempo was associated with lower lability in the father-daughter relationship. This may reflect underlying sex differences in the effects of primary hormones driving puberty. Or, parents may find different aspects of the pubertal transition more or less salient for boys and girls. It may be that for boys compressed transitions lead to greater lability because the salient factor for parents and sons is the sudden or unexpected nature of the transition, but for girls, elongated transitions lead to greater lability because parents and daughters undergo multiple renegotiations of the relationship for a longer period of time (i.e., a shortened transition). Parents and daughters moving both into and out of the renegotiation stage more quickly would manifest as year-to-year stability.

The mixed pattern of significant associations for pubertal tempo with lability in both directions suggests consideration of nonlinear relations and a set of hypotheses derived from a maturational deviance perspective, where any form of off-time pubertal development (early-late and or fast-slow) may lead to adjustment problems. This would be consistent with the notion that child and parent reactions to pubertal development may actually be renegotiated several times along the transition from childhood to adolescence. While it remains unclear whether the resulting lability of parent-child relationships is maladaptive, protective, or simply normative, our findings suggest further examination of the interplay between pubertal development and lability in parent-child relationships, and potentially later adjustment.

We have examined and attributed the changes in the parent-child relationship to changes in puberty. However, it is also possible that changes in context may also contribute to changes in parent-child relationship quality. It is important to note that puberty is not the only transition youth experience between (approximately) age 8 and 16 years. The pubertal transition co-occurs with the transition from elementary school through middle school and even into high school. These school transitions are associated with decreases (Eccles et al., 1993) and fluctuations (Morin et al., 2013) in self-concept, self-esteem and body image (Eccles et al., 1993), and peer relationships, including romantic relationships (Brown, 2004). These changes could be explained by a mismatch between the developmental needs of the adolescent and shifts in instructional practices (Molloy et al., 2011). Thus, it may be that changes and lability of parent-child relationship quality are also associated with school transitions, not only the transition of puberty, or the combination or interaction of multiple transitions happening in tandem.

Limitations and Future Directions

We made use of a select set of parent- and observer-reports obtained from a heterogeneous sample of youth as they transitioned through puberty. A limitation of the data is that information on the parent-child relationship was not available during mid- puberty, (i.e., age 12 through 14 year assessments). Based on previous studies, we would hypothesize even greater lability during this period (e.g., Granic et al., 2003). More intensive sampling during periods of rapid physical change will be important to include in future studies. Further, we relied on parent reports to track changes in the parent-child relationship, thus the available reports provide only one perspective. Future work should include child reports, and examine not only how each family member's perception of the relationships change, but also how the discrepancies between members of each dyad change. Comprehensive measurement of all family members will provide a rich array of data for examining both long-term and short-term changes in family functioning.

Pubertal stage, while rigorously measured with nurse reported Tanner stages, and breast palpation for girls, was assessed via observation at yearly intervals. Although the richness of the longitudinal data facilitated our analysis, more in-depth and intensive repeated measurement of other aspects of puberty (e.g., hormone changes, brain development) and family functioning (e.g., parenting practices or styles) would allow for more refined investigation of the nature and duration of developmentally induced tension and bonding between parents and children (Minuchin, 1985). In particular, precise tracking of change in lability likely requires multiple-time-scale study designs (Ram & Gerstorf, 2009) consisting of multiple bursts of intensive assessments at several points across development. Coupled with advances in technology and use of social media, such designs would facilitate tracking of real-time changes in parent-child relationship quality on a conversational level across many years.

We measured the timing and tempo of pubertal development using a logistic growth model, the mathematical form of which closely maps the theoretical shape of pubertal development (see Marshall and Tanner, 1969; 1970; see also original work of Greulich et al., 1942). Convergent and discriminant validity is emerging as the rates of change extracted from the model (and linear versions of it) are examined in relation to a variety of psychological and biological outcomes (Dorn & Biro, 2011; Biro et al., 2001; Graber, 2013; Llop-Vinolas et al., 2004; Marceau et al., 2011). From a statistical accuracy perspective, the availability of more frequent and precise measurements of Tanner stage would improve the reliability of the timing and tempo measures. For example, the study protocol of nurses rounding down to the lower stage when youth were between stages during assessment may have obfuscated the precision of the growth rate estimate (as opposed to allowing half-stages). Thus, the pattern of results regarding the association of pubertal timing and tempo should be interpreted with consideration that there is still some “noise” in the measures. In the future, studies (or measurement) of pubertal tempo may be improved by incorporating more continuous and precise measures of pubertal development.

Finally, we were quite limited in deciphering the role of ethnicity in parent-adolescent relationships because the sample was overwhelming White, thus limiting the power to detect ethnic differences in the covariance patterns between pubertal maturation and changes in

parent-child relationship quality. We chose to examine White, Black, and Hispanic youth separately in order to gain insight into the pattern of findings in each ethnicity, though we lacked the power to detect significant interactions. Previous findings that Black boys and girls had earlier timing of puberty than White boys and girls (e.g., Susman et al., 2010) was replicated here, and no ethnic differences were found for the tempo of puberty. We found little evidence of ethnic differences in the developmental change and lability of parent-child closeness and conflict. We found little support for ethnic differences in associations: significant effects in the full sample were echoed in the same direction across ethnicities. This is largely consistent with the one previous study identified that examined differences between associations of pubertal maturation and parent-child relationships in Hispanic vs. Non-Hispanic White families (Molina & Chassin, 1996, except one ethnic difference found in that study which was not replicated here). In the future, ethnic differences in associations between puberty and parent-child relationships should be probed in more diverse samples with participants proportionally distributed across ethnic groups.

Conclusion

In summary, the present study suggests that lability in parent-child relationships is an important facet of change that is (by definition) distinct from the long-term development of those relationships. We made use of a relatively large sample (N = 963), the still current gold standard for assessment of puberty (Tanner stages), and novel analytic approaches to examine relations between the timing and tempo of pubertal development and changes in parent-child relationships. Tempo and, to some extent, timing of pubertal development explain some of the between-family differences in the lability of parent-child relationships during middle-childhood and adolescence. Overall, these findings provide a platform for examining mechanisms that contribute to both long-term and transient changes in parent-child relationships and the ramifications of those changes for adolescent adjustment.

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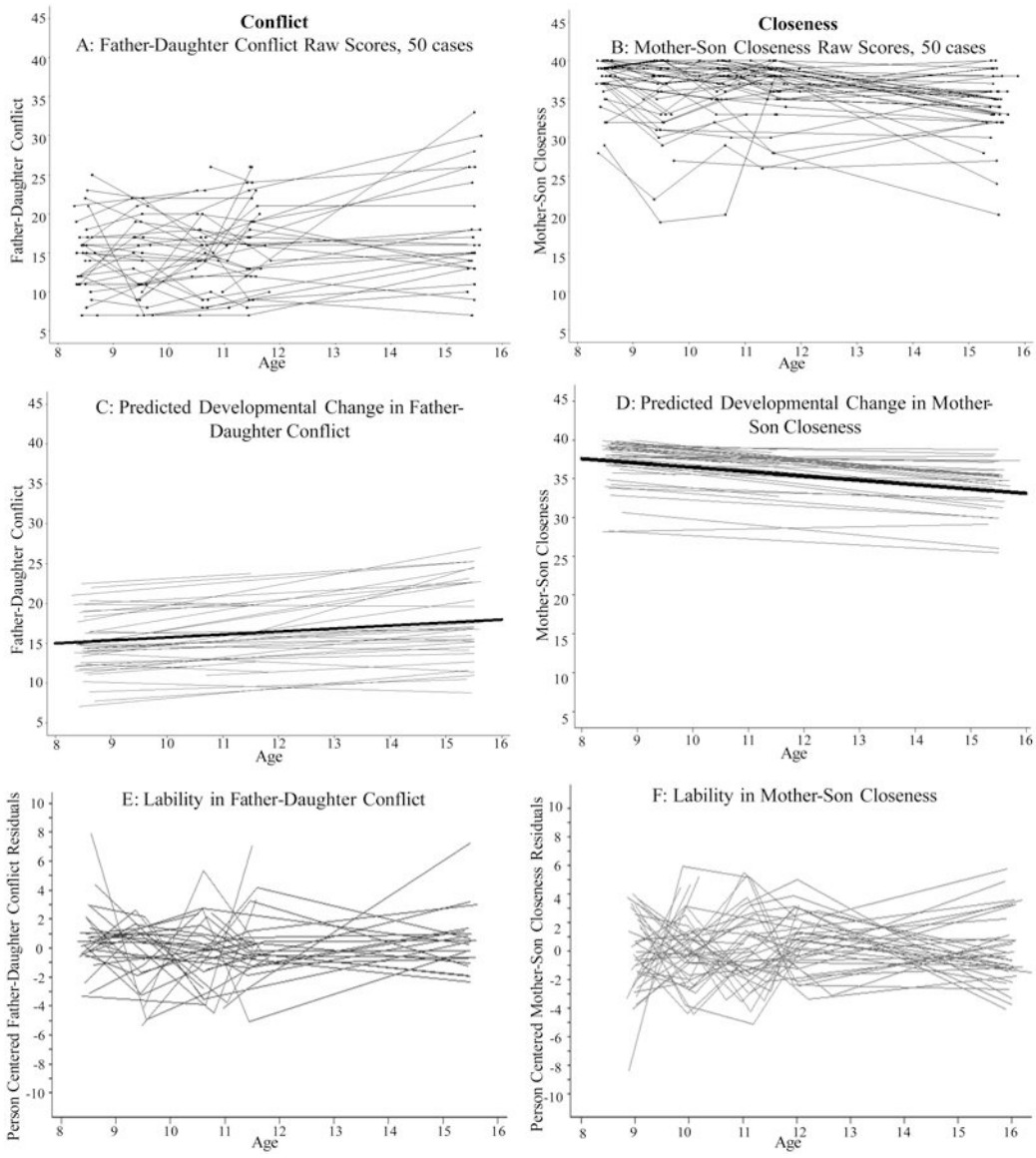

Figure 1.

Model-Fitting Results for Conflict and Closeness. Panels A and B depict raw data for a subset of the sample for father-daughter conflict (A) and mother-son closeness (B), exemplifying conflict and closeness across dyads. Panels C and D depict fitted curves for developmental change in conflict (C) and closeness (D) for the same subset. Solid gray lines depict the predicted curves for the subset of individuals, and bold curves show the small but significant sample average increase in conflict (C) and decrease in closeness (D). Panels E and F depict the lability (residual variance) in conflict (E) and closeness (F) for the same subset.

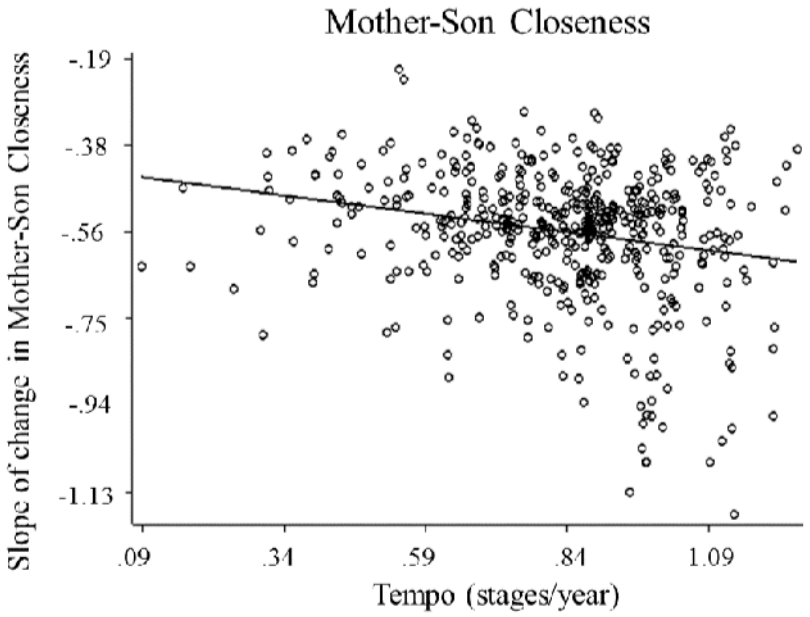

Figure 2.

Association Between Tempo and Developmental Change in Mother-Son Closeness. Faster tempo is associated with steeper decreases in closeness across adolescence (β = -.56).

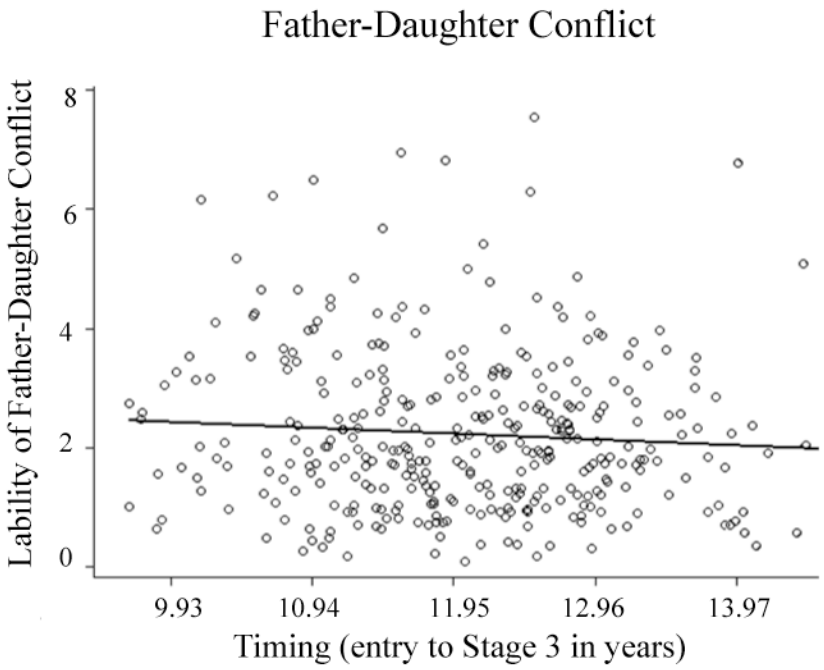

Figure 3.

Associations Between Timing and Lability in Father-Daughter Conflict. Earlier timing was associated with greater lability of conflict with mothers among White girls (β = -.05).

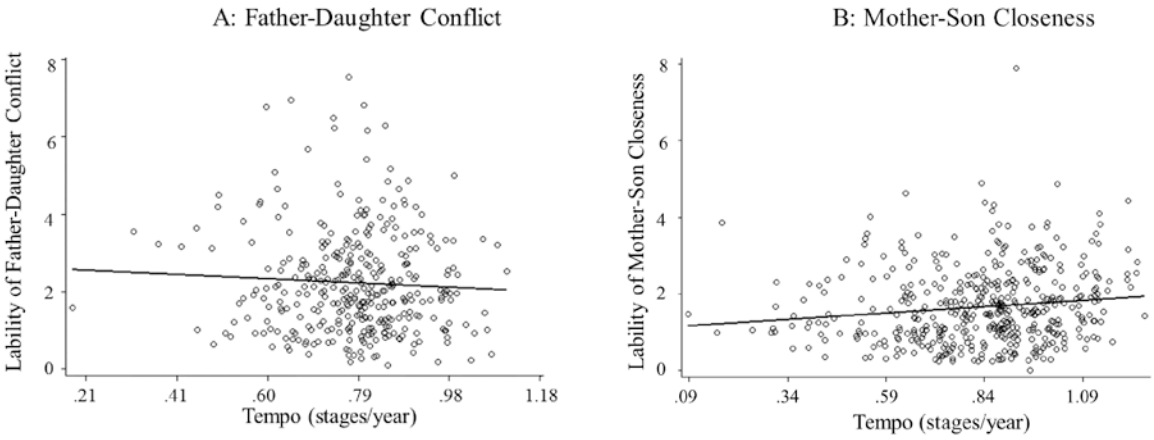

Figure 4.

Associations Between Tempo and Lability. Lability is the standard deviation of the residuals from the growth curve models. Panel A: Slower tempo is associated with more lability in father-daughter relationships (father-daughter conflict shown, β = -.15). Panel B: Faster tempo is associated with greater lability of father-son conflict and mother-son closeness (mother-son conflict shown, β = .28).

Table 1

Growth Models for Parent-Child Conflict and Closeness

	Mother-reported Conflict				Father-reported Conflict				Mother-reported Closeness				Father-reported Closeness			
	Sons		Daughters		Sons		Daughters		Sons		Daughters		Sons		Daughters	
Parameter	**Est.**	**SE**	**Est.**	**SE**	**Est.**	**SE**	**Est.**	**SE**	**Est.**	**SE**	**Est.**	**SE**	**Est.**	**SE**	**Est.**	**SE**
Fixed effects																
Intercept, γ_{00}	16.63*	(.25)	17.60*	(.26)	16.43*	(.25)	16.67*	(.27)	35.06*	(.16)	35.87*	(.14)	32.99*	(.21)	33.27*	(.21)
Age, γ_{10}	.19*	(.04)	.33*	(.05)	.22*	(.05)	.37*	(.05)	-.56*	(.03)	-.44*	(.03)	-.47*	(.04)	-.52*	(.05)
Random effects																
Intercept, σ^2_{u0}	25.02*	(1.91)	27.52*	(2.10)	20.34*	(1.82)	23.94*	(2.09)	9.74*	(.78)	6.93*	(.58)	14.41*	(1.31)	12.91*	(1.22)
Age, σ^2_{u1}	.33*	(.06)	.35*	(.06)	.25*	(.06)	.79*	(.30)	.28*	(.03)	.25*	(.03)	.16*	(.04)	.32*	(.06)
Residual, σ^2_e	9.95*	(.42)	10.89*	(.46)	10.25*	(.53)	8.62*	(.05)	4.51*	(.19)	4.27*	(.18)	7.32*	(.37)	6.12*	(.32)
Fit statistics																
-2LL	11579		11695		8423		8243		9982		9704		7912		7660	
AIC	11587		11703		8431		8251		9990		9712		7920		7668	
Variance Decomposition																
Baseline Residual, $\sigma^2_{e(base)}$	12.80		14.28		12.43		11.96		8.76		7.57		10.38		9.75	
% Long-term Change	22%		24%		17%		28%		49%		43%		29%		37%	
% Lability	78%		76%		83%		72%		51%		57%		71%		63%	

Note. N = 488 boys, N = 475 girls. Percentages in variance decomposition represent percent of the total variance. Baseline residual, $\sigma^2_{e(base)}$ is the residual from an unconditional means model.

$$\%\text{Long-term Change} = \frac{\left(\sigma^2_{e(base)} - \sigma^2_e\right)}{\sigma^2_{e(base)}}$$

, the proportional reduction of residual variance when age is included as a predictor (see Snijders & Bosker, 1999). % Lability is the proportion of residual variance *not* accounted for by long-term age-related trends. Est. = Estimate, SE = Standard Error,

*$p < .05$.

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Table 2

Relation of Timing and Tempo to Developmental Change and Lability of Parent-Child Conflict and Closeness

		Developmental Change						Lability					
		Boys' GD			Girls' BD			Boys' GD			Girls' BD		
		B	F	R^2	B	F	R^2	B	F	R^2	B	F	R^2
Mother-reported Conflict			1.13	.001		9.37*	.01		.26	.00		3.05*	.004
	Timing	.01			.000			-.01			**-.03***		
	Tempo	.02			.16*			-.03			.07		
	Tempo × Timing	-.02			-.17*			.01			-.07		
Father-reported Conflict			1.79	.002		3.21*	.004		3.63*	.01		4.84*	.01
	Timing	.01			-.001			-.02			**-.03***		
	Tempo	-.005			.05			**.16***			**-.15***		
	Tempo × Timing	-.01			.12*			-.13*			-.006		
Mother-reported Closeness			43.27*	.05		5.67*	.01		20.77*	.03		4.52*	.01
	Timing	.02			-.01			-.02*			**-.03***		
	Tempo	**-.42***			**-.16***			**.28***			.10†		
	Tempo × Timing	.10*			-.02			-.17*			-.04		
Father-reported Closeness			3.62*	.004		13.48*	.02		5.23*	.01		15.09*	.03
	Timing	-.01*			.03*			-.04*			**-.04***		
	Tempo	**-.06***			**-.19***			**.10†**			**-.16***		
	Tempo × Timing	-.03			-.02			-.03			-.40*		

Note. N = 488 boys; 475 girls

* $p < .05$,

† $p < .10$.

Systematic findings noted in text are boldface.

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Table 3

Ethnicity Specific Relations of Timing and Tempo to Developmental Change of Parent-Child Conflict and Closeness

Developmental Change																		
		Boys									**Girls**							
		White			**Black**			**Hispanic**			**White**			**Black**			**Hispanic**		
		β	**F**	**R^2**	**β**	**F**	**R^2**	**β**	**F**	**R^2**	**β**	**F**	**R^2**	**β**	**F**	**R^2**	**β**	**F**	**R^2**
		0.25	.00		0.32	.02		0.44	.04		1.72	.01		0.53	.03		0.11	.01	
	Timing	.004			-.04			-.06			.01			.02			-.02		
	Tempo	.08			-.05			.21			.19†			-.21			.19		
Mother-child Conflict	T×T	.07			-.12			.19			-.14			-.32			-.20		
			0.61	.01		1.65	.08		3.17*	.23		0.40	.00		0.36	.02		1.57	.18
	Timing	-.02			.00			-.01			.00			.03			.01		
	Tempo	.09			-.16			-.06			.00			.15			1.11†		
Father-child Conflict	T×T	.02			-.09			.38*			.10			.28			-.05		
			8.89*	.07		0.36	.02		1.70	.14		1.38	.01		0.31	.02		0.26	.04
	Timing	-.05			.03			-.03			-.01			.05			-.06		
	Tempo	**-.46***			.12			**-.59**			**-.20***			**.09**			.08		
Mother-child Closeness	T×T	-.20			.09			-.19			-.05			.27			.29		
			0.66	.01		3.19*	.14		0.30	.03		3.36*	.03		0.34	.02		1.86	.21
	Timing	.01			-.03†			.03			.04*			.03			-.07		
	Tempo	**-.10**			.10			**-.10**			**-.24***			**-.14**			.28		
Father-child Closeness	T×T	-.02			.12*			.06			.04			-.10			-1.02*		
		N = 359			N = 63			N = 35			N = 367			N = 58			N = 25		

Note.

* $p < .05$,

† $p < .10$.

Systematic findings noted in text are boldface.

Table 4

Ethnicity-Specific Relations of Timing and Tempo to Lability of Parent-Child Conflict and Closeness

		Lability																
		Boys									Girls							
		White			Black			Hispanic			White			Black			Hispanic		
		β	F	R^2	β	F	R^2	β	F	R^2	β	F	R^2	β	F	R^2	β	F	R^2
			0.07	.00		0.51	.03		1.12	.10		1.35	.01		1.46	.08		1.89	.21
	Timing	-.04			.28			.53			**-.05***			.08			.06		
	Tempo	.01			-.41			-2.22			.05			.60			-1.04*		
Mother-child Conflict	T×T	-.16			.66			-1.31			-.16			.80†			.21		
			0.18	.00		2.70†	.26		0.75	.09		0.24	.00		1.16	.13		3.31*	.38
	Timing	.01			-.58			-.12			**-.02**			**-.16**†		**-.02**			
	Tempo	**.26**			**5.22***			-.97			**-.08**			**-.48**			**-1.86***		
Father-child Conflict	T×T	.35			-1.66			.01			-.02			-.57			1.29		
			4.25*	.04		0.43	.02		0.86	.08		0.94	.01		2.00	.10		0.40	.05
	Timing	.02			-.25			.08			**-.02**			**-.003**		.04			
	Tempo	**.92***			**.55**			**.93**			.13			.31			-.34		
Mother-child Closeness	T×T	.58*			-.25			.20			-.18			1.01*			.61†		
			0.85	.01		1.55	.17		1.59	.18		2.92*	.03		0.22	.03		0.80	.12
	Timing	.22			-.48			.52			**-.05**†			.07			**-.20**		
	Tempo	-.12			**4.18***			**1.48**			**-.18**			.10			**-.28**		
Father-child Closeness	T×T	.24			-2.03			1.08			-.39*			-.02			-1.10		
		N=344 moms; 284 dads			N=57 moms; 27dads			N=34 moms; 26 dads			N=350 moms; 287 dads			N= 57 moms; 27 dad			N=25 moms; 20 dads		

Note.

* $p < .05$,

†$p < .10$.

Systematic findings noted in text are boldface.