DOI: 10.1111/cdev.13836

EMPIRICAL ARTICLE

CHILD DEVELOPMENT

In their own words: Finding meaning in girls' experiences of puberty

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Abstract

The present study pairs narrative meaning-making with topic modeling to richly capture how girls choose to describe their experiences of change during puberty and to establish how these narratives map onto depressive symptoms. Participants (N = 125 girls; M_{age} = 11.61 years; 90.40% White) wrote about changes during puberty and reported their level of pubertal development, relationships, and mood. The relationship between meaning-making and depressive symptoms was negatively moderated by early pubertal timing (d = .31) and positively moderated by more advanced pubertal status (d = .36). Exploratory analyses indicated that writing proportionally more about menstruation-related changes had a small effect on subsequent depressive symptoms (f^2 = .12). Results provide a conceptual and methodological update to decades-old, landmark qualitative findings on girls' perceptions and assessments of experiences at puberty.

INTRODUCTION

Substantial empirical evidence has characterized puberty as a critical time of change during which cognitive, social, and hallmark physical changes co-occur across early adolescence. In addition to these changes, puberty has been robustly linked to psychological distress, particularly for girls, in both the short and long term (e.g., Caspi & Moffitt, 1991; Mendle et al., 2018). Traditional research methodologies have typically emphasized survey approaches to understanding the psychology of puberty. However, we know considerably less about how girls describe their own experiences of puberty and how they attempt to make meaning from these experiences. This is notable because the ways in which girls perceive and react to the changes that accompany puberty may shape psychosocial consequences of the broader developmental transition (e.g., Moore et al., 2016). Indeed, findings from the narrative literature suggest that early adolescence represents a period during which youth experience a concert of cognitive and social changes that prompt more engagement in meaning-making (e.g., Habermas & de Silveira, 2008; McAdams, 2001), as well as a period during which more attempts at meaning-making may be linked to psychological distress (McLean & Breen, 2009).

Accordingly, prime questions in current developmental research on puberty and the life story are how do girls describe their experiences of puberty and what implications do these narratives have for their psychological well-being, specifically in terms of depressive symptoms? The present study addresses these questions with two complementary analytical approaches, meaning-making and topic modeling, to understand how the narratives of girls' experiences of puberty connect to depressive symptoms. While puberty holds challenges for all youth, the research literature consistently suggests it is disproportionately harder for girls, with striking gender disparities in the severity and prevalence of psychopathology and correlated mental health risks (Salk et al., 2017). We focus on depressive symptoms due to the especially pronounced spike in depression that begins in girls at puberty, with girls more than twice as likely as boys to receive a depression diagnosis by the age of 12 years (Salk et al., 2017).

Abbreviations: FIML, full information maximum likelihood estimation; IPR, Index of Peer Relation; LDA, latent Dirichlet allocation; MAR, missing at random; MLM, multilevel modeling; PCS, Parental Conflict Scale; PDS, Pubertal Development Scale.

Puberty and individual differences

Puberty is a universal developmental transition, yet girls' experiences of its physical changes are highly individual. Although myriad quantitative literature links the changes associated with puberty to changes in girls' psychological distress and perceived disruption to daily life, not all girls experience these negative outcomes (e.g., Alloy et al., 2016; Koch et al., 2020). Experiences of puberty may be affected by individual factors such as the extent to which girls are physically developed (i.e., pubertal status) and the timing of their physical changes in relation to peers (i.e., pubertal timing). Studying pubertal status allows us to investigate typical psychological experiences that occur as girls progress through physical maturation while studying pubertal timing allows us to investigate whether individual differences in the timing of that maturation produce different psychological experiences. Particularly relevant for the present study is research showing the importance of both pubertal status and timing for depressive symptoms. Girls who mature earlier than peers tend to experience greater levels of psychosocial distress, but depressive symptoms also tend to increase as girls grow more advanced in pubertal status (Alloy et al., 2016).

Whether puberty is accompanied by negative psychological effects like depression may depend on several additional factors. First, girls' ethnicity and social context matter. What girls perceive as comparison targets for their own physical changes may affect psychological outcomes either more positively or more negatively (e.g., Seaton & Carter, 2018). Relevant to the predominantly White sample in the present study, early research suggests that early maturation and more advanced pubertal status are linked with greater depressive symptoms and body image dissatisfaction in White girls, at least in part because of prominent sociocultural messaging of thin body ideals for White women (e.g., Stice, 2003). Furthermore, girls' peer experiences and contexts may amplify psychological distress at this time. Girls who report spending more time with mixed-sex friend groups, engaging in romantic relationships, and perceiving lower relationship quality with their peers also tend to report greater depressive symptoms and distress (reviewed in Rudolph, 2014). Finally, girls' reactions to change are important. Girls who perceive more disruption to their lives during this developmental period report greater depressive symptoms than their peers (Koch et al., 2020). Taken together, these findings suggest that how girls try to make sense of changes during puberty plays a significant role in shaping psychological distress beyond the actual changes themselves.

Findings from across the quantitative and qualitative literatures support that perceptions of physical change, social contexts of change, and perceptions of preparation may significantly contribute to mental health during puberty. Early qualitative work by Brown and Gilligan (1993), which documented the experiences of puberty and adolescence in a cohort of 100 girls over the course of 5 years, revealed that girls were acutely aware of how physical changes affected their interactions with their social worlds. Furthermore, some girls articulated feeling a sense of loss and trauma as they moved from childhood to adolescence. Although qualitative work within the past two decades has been limited (reviewed in Herbert et al., 2017), a recent qualitative study indicated that youth continue to have gaps in their understanding about puberty and reproductive changes (Hurwitz et al., 2017), and that these gaps in knowledge may affect attitudes and perceptions of physical changes that older studies have linked to psychological distress (e.g., Lee, 2008; Stubbs et al., 1989). This trend corresponds with quantitative findings that girls who self-reported maturing earlier than their peers were more anxious about menarche than peers (Natsuaki et al., 2011).

Narrative, meaning-making, and developmental age

We were interested in examining whether girls tried to make meaning out of changes during puberty, which we operationalized within the framework of narrative identity. Narrative identity is an act of personal storytelling that allows individuals to construct an integrative life story from their experiences, goals, and desires (McAdams & McLean, 2013). Within this framework, meaning-making is defined as the ability to explain how past events influenced other events or aspects of the self (Habermas & Bluck, 2000). Prior research indicates that not only is meaning-making a developmental concern during early adolescence, but that meaning-making is also significantly related to psychological distress.

The transition from early adolescence to mid-adolescence is a critical milestone in the development of narrative identity. During the broader period of adolescence, identity formation is a central developmental task and the capabilities to construct a coherent life story begin to emerge (Erikson, 1968; Habermas & Bluck, 2000). Youth demonstrate more causal coherence (i.e., accounting for how earlier events cause later events) and thematic coherence (i.e., deriving an organized set of meanings around life events) in their narratives as they move from late childhood through adolescence (Habermas & de Silveira, 2008). Furthermore, youth provide increasingly more interpretive information in their narratives and build more long-term conceptions of the self in their narratives across adolescence (Pasupathi & Wainryb, 2010). There are age-related increases across adolescence in meaning-making ability, with older adolescents capable of more complex meaning-making in personal narratives (McLean, 2005; McLean & Breen, 2009; McLean et al., 2010).

In concert with cognitive and neurological changes, this developmental trend may also be explained by

sociocultural factors. Specifically, individuals may first need to learn how to share stories from their culture and social groups (i.e., families, peers, media etc.) before a narrative identity can be developed (McLean et al., 2007). A range of studies examining parent–child dyads support this sociocultural explanation of developmental change in narrative identity. In particular, parent–child conversations serve as scaffolding to help youth learn how to construct a narrative and make meaning from personal events. Youth tend to engage in more meaning-making in mother–child conversations about personally salient memories and experience greater well-being when there is maternal expression and explanation of emotion within family narratives (Bohanek et al., 2008; McLean & Jennings, 2012).

Prior literature has established that adults who narrate their lives in richer detail and with greater coherency and emotional expression also report fewer symptoms of depression and anxiety, and lower levels of stress (reviewed in Adler et al., 2015). However, this pattern of results does not directly correspond to findings with adolescents. Rather, more attempts at meaning-making in early adolescence seem to be linked to greater psychological distress. For example, youth between the ages 8 and 12 years who engaged in more attempts of explanation and resolution when narrating difficult personal experiences report increased levels of anxiety (Fivush et al., 2007). Likewise, younger adolescents (i.e., younger than 16 years) who engage in more narrative meaning-making tend to show lower levels of well-being, including more depressive symptoms; in contrast, older adolescents (i.e., older than 16 years) who engage in more narrative meaning-making tend to show greater levels of well-being, including fewer depressive symptoms (McLean & Breen, 2009; McLean et al., 2010). As previously noted, youth depend on adults to help construct meaningful narratives while they develop their own capacities for narrative construction (e.g., Bohanek et al., 2009). Accordingly, it may be that without an adult present to help scaffold the narrative, younger adolescents may not have the emotional regulation skills necessary to use narrative meaning-making to successfully manage and resolve their experiences in a way that is conducive to growth (Fivush, 2019). It may also be that narrative meaning-making is more salient for individuals whose time horizon on events is longer. In this case, the act of drawing meaning from distressing events may be less intuitive in childhood and, in turn, linked to unsuccessful efforts and lower well-being (Wainryb et al., 2018).

Despite the salience of studying narrative identity construction and psychological distress during adolescence, and particularly early adolescence, puberty has received little empirical attention within the narrative identity literature. This is striking given that critical cognitive milestones in the development of autobiographical memory and narrative identity are reached during this time (Habermas & Bluck, 2000), and that the myriad changes of puberty present girls with rich and often bewildering life experiences. Furthermore, narrative identity literature indicates that the events least likely to be discussed with others are those associated with self-conscious emotions (Pasupathi et al., 2009). Because self-conscious emotions may be heightened at puberty and during early adolescence, girls may not seek or receive parental scaffolding to effectively make sense of some or all of the physical changes associated with puberty (Simmons et al., 1973). Research on mother–daughter communication surrounding puberty suggests that it is common for daughters to both discuss and not discuss physical changes with their mothers and that individual differences in emotional connection with mothers can reduce self-consciousness associated with discussing menstruation (Costos et al., 2002; Lee, 2008). It is also possible that parents discuss some changes openly with girls but not others given that cultural messaging around girls' physical changes is often prescribed differently depending on the change (e.g., menstruation with shame, breast development with sexualization; Johnston-Robledo & Chrisler, 2013). Accordingly, girls may attempt to make meaning of different changes at different rates depending not only on prior conversations with parents, but also on their own level of pubertal status. Girls who have experienced more physical changes may have had more opportunities to attempt meaning-making and, in turn, this may moderate the relationship between meaning-making and depressive symptoms.

Pubertal timing may have a different relationship with meaning-making than either age or pubertal status. A common predicament for early maturing youth is that they often experience a developmental mismatch wherein physical maturation occurs prior to cognitive development (e.g., Ge & Natsuaki, 2009). This could leave them without the skills to adaptively navigate meaning-making during this developmental shift. Thus, while early maturing girls may experience more strains and challenges during their development, it may benefit them to attempt meaning-making *less* given the negative relationship between attempted meaning-making and depressive symptoms during early adolescence.

Topic modeling

In addition to understanding how girls make meaning of their experiences during puberty, the present study is also concerned with what girls say about puberty. Both the content and representations of puberty within girls' narratives may map onto mood and relationships. In order to address this objective, the present study paired meaning-making analysis with an analytic approach known as topic modeling. We employed topic model analysis for three key reasons: (1) Unlike close-ended text analysis approaches that use a priori assumptions about word categories, such as Linguistic

Inquiry and Word Count, topic models derive categories from the words generated by participants. This provided us with an exploratory, data-driven method for analyzing the text that girls wrote without imposing assumptions about the words girls would use. (2) Topic models provide an estimate of how much participants proportionally write about each topic. These proportions can be used to explore relationships between topics and variables of interest (e.g., Resnik et al., 2013), which allowed us to examine how the topics that girls wrote about corresponded with depressive symptoms. (3) Previous research has established that topic model results correspond well with human-coded grounded theory approaches to the same data (Baumer et al., 2017). Taken together, our use of topic model analysis supports our research questions of understanding what girls write about when asked about change during puberty and also how the topics that girls write about may map onto depressive symptoms. Due to the exploratory nature of topic models, we could not predict what specific topics would emerge, but we did intend to select a model that characterized topics about peers and friends, parents, and physical changes. In addition, we were interested in exploring whether any topics were especially characteristic of early-maturing girls given that maturing earlier than peers has been linked with psychological distress and interpersonal challenges (e.g., Rudolph, 2014).

The present study

The central aims of the present study were to understand how girls described and made meaning of their experiences of puberty and to investigate the links between their narratives and depressive symptoms using both meaning-making and topic modeling analyses. We addressed four main research questions:

(R1) *Does pubertal development moderate the relationship between meaning-making and depressive symptoms?* We expected that girls who have more advanced pubertal status or earlier pubertal timing may attempt more meaning-making than peers to make sense of the many life changes they experience, but—in line with prior research—we hypothesized that these meaning-making attempts would be positively related to depressive symptoms.

(R2) *Does meaning-making vary across different aspects of change during this developmental period?* The physical changes in puberty are accompanied by powerful changes in social roles and relationships. We investigated if girls included more meaning-making in narratives specifically about physical changes versus narratives that focused on general changes or changes in interpersonal relationships.

(R3) *What topics do girls choose to include in their narratives of puberty?* Given the exploratory nature of topic models, we did not have a priori assumptions about what topics would emerge. However, given our broader study goals, we did intend to specify a topic model that yielded distinct topics about different changes associated with puberty as opposed to collapsing changes into one topic.

(R4) *How do emergent topics relate to depressive symptoms, relationship conflict, and pubertal development?* Since previous research emphasizes the unique mood and interpersonal challenges faced by early maturing girls, it was of particular interest to explore whether pubertal timing was associated with writing about any specific topics.

METHOD

Participants

The sample included 125 girls (M_{age} = 11.61 years, SD = 0.98, range = 10–14 years) recruited through a research partnership with New York State 4-H between 2014 and 2018. Girls were recruited through summer youth activity programs. Recruitment was facilitated through parents at activity drop-off. Girls were determined eligible if they were enrolled in programs for youth aged 10–13 years old at baseline. One girl was aged 14 years and enrolled in the 10–13 age group activities and was included in the present analyses. Girls self-identified as 90.40% European American; 1.60% American Indian or Native; 1.60% East Asian or Pacific Islander, 6.40% biracial or another racial or ethnical identity. Parental education was collected from consenting parents such that 28% reported having an associate degree or below, 28% reported having a master's degree, 24% reported having a bachelor's degree, and 20% reported having a doctoral or professional degree. Participants attended several schools across New York and represented a cross section of middle school grades. The study was approved by the Institutional Review Board at Cornell University (Protocol # 1207003173).

Procedure

Girls participated in two waves of data collection spaced approximately 4 months apart. Baseline measurement corresponded with the summer and follow-up measurement corresponded with the fall of the school year. Parents or legal guardians provided informed consent prior to study participation and all girls provided assent at both measurement occasions.

At baseline measurement, girls completed four consecutive days of journal-style expressive writing focused on their experiences of and feelings about puberty as part of a study to see if writing about changes during puberty was helpful to girls. The prompts cued participants for changes (i.e. social, family, and physical)

associated with the pubertal transition. There was no intent to prompt order aside from moving from general to specific. Each day focused on a different aspect of change. On the first day, girls were prompted to write about a specific experience they had surrounding puberty. On the second day, girls were prompted to write about recent changes they noticed in relationships with other kids their age. On the third day, girls were prompted to write about changes they noticed in their relationships with their parents or guardians. On the fourth day, girls were prompted to write about a recent physical change in their body or change in the way they felt about their body. Girls were asked to spend 20 uninterrupted minutes thinking and writing on each prompt.

Girls also completed pen-and-paper self-report questionnaires in a quiet space monitored by the researchers. The self-report questionnaires were administered on the first day of baseline measurement and took approximately 45–60 min to complete. The questionnaires assessed girls' reports of their pubertal development and depressive symptoms. At follow-up measurement, girls completed the same pen-and-paper self-report questionnaires at home after the questionnaires were distributed to participant addresses via mail. Participants were compensated with a gift card upon completion of the self-report questionnaires.

Measures

Pubertal development

The Pubertal Development Scale (PDS; Petersen et al., 1988) is a self-report scale that assesses changes in body hair, skin, height, and breast development to measure physical maturation. Items on the PDS are measured using a 4-point scale, where 1 = *no changes yet* and 4 = *seems completed*. Menarche is also assessed on the PDS and coded where 1 = *I have not yet begun to menstruate* and 4 = *I have begun to menstruate*. At baseline measurement, 32% of girls (n = 40) reported having begun menstruation and 68% of girls (n = 85) reported having not yet begun. For the present analyses, menarche was used as an independent indicator of pubertal development. The summed PDS score of changes in hair, skin, height, and breast size was used as an indicator of pubertal status, with higher scores indicating greater levels of pubertal development. Pubertal timing was operationalized as the deviation from a girl's actual PDS sum score from her predicted PDS sum score at her age of measurement (Dorn et al., 2006). Accordingly, greater residualized scores indicate greater pubertal development than the average development reported by girls of the same chronological age (i.e., earlier maturation than same-aged peers), and lower residualized scores indicate less pubertal development than the average development reported by girls of the same chronological age (i.e., later maturation than same-aged peers). Pubertal status scores at baseline measurement ranged from 3 to 15 (M = 9.34, SD = 2.61). Internal reliability was α = .80 at Time 1.

Peer conflict

The Index of Peer Relations was used to assess peer problems at Time 1 (IPR; Forte & Green, 1994; Hudson, 1982). The IPR is a 25-item measure designed to assess the severity of problems in peer relationships and frequency of peer conflict. Each item is scored on a 7-point scale where 1 = *none of the time* and 7 = *all of the time*. Items were modified to ask about "kids my age" rather than "my peers." For instance, the item "I get along very well with my peers" was modified to "I get along very well with kids my age." Total scores are calculated by taking the sum score of all items and subtracting from this value the number of total items answered. This value is then multiplied by 100 and divided by the product of total items answered multiplied by six. Total scores range from 0 to 100 where higher scores indicate greater problems with peers. Scores at baseline measurement ranged from 0 to 88 (M = 28.57, SD = 19.57). Internal consistency in this sample was α = .96 at Time 1.

Parent conflict

Conflict with parents was assessed using the Parental Conflict Scale (PCS; Lucas-Thompson, 2009), which was adapted from the Conflict subscale of the Braiker–Kelly Partnership Questionnaire (Braiker & Kelley, 1979). The PCS is a self-report scale that measures the frequency and intensity of conflict with parents. Conflict with mother and father was individually assessed with the same five items for a total of a 10-item scale. Items include "How often do you and your parent argue with one another?" and "When you and your parent argue, how serious are the problems or arguments?" Each item is scored on a 9-point scale where 1 = *not at all* and 9 = *very much* and sum scores for both conflict with mother and father were calculated from corresponding item responses. Summed scores ranged from 5 to 38 (M = 14.78, SD = 7.01) for the conflict with mother subscale and from 5 to 38 (M = 11.81, SD = 6.41) for the conflict with father subscale. Internal consistency in this sample was α = .82 for the conflict with mother subscale and α = .82 for the conflict with father subscale.

Depressive symptoms

The Center for Epidemiological Studies Depression Scale for Children (Weissman et al., 1980) is a 20-item self-report measure developed for studying depressive

symptomology in the general population. Items include "In the past week, I felt that everything I did was an effort" and "In the past week, I felt lonely." All items are scored on a 4-point scale where 0 = *rarely or none of the time* and 3 = *most or all of the time* and a sum score was calculated from item responses with higher sum scores indicating greater depressive symptoms. In this sample, baseline scores ranged from 0 to 56 (M = 14.01, SD = 11.65). Depressive symptom scores at four-month follow-up ranged from 1–51 (M = 15.30, SD = 12.21). Internal reliability was α = .92 at Time 1 and α = .94 at Time 2.

Meaning-making

Meaning-making is a function of narrative memory that youth may use to integrate experiences with causal coherence and explain how past events influenced other events or aspects of the self (Habermas & Bluck, 2000). Present analyses coded for *lesson learning* and *gaining insight*. Lessons tend to be considered less developmentally complex than insights (McLean, 2005). Given the developmental nature of the present study, analyzing narratives for complexity of meaning in addition to overall meaning-making was of interest. A response was coded as lesson learning if there was reference to having learned a specific lesson from the event that had implications for behavior in similar situations (e.g., "I learned that I could talk about my problems with my parents"). A response was coded for gaining insight if meaning was inferred that applied to broader life (e.g., "My experience through puberty will prepare me for helping others, like my future daughters."). Gaining insight was considered superordinate to lesson learning such that if a response contained both lesson learning and gaining insight, then the response was coded as gaining insight. Overall meaning-making was considered the sum of lessons and insights across all days. All responses were initially coded by the first author. An independent reliability coder blind to the hypotheses of the study also coded all narratives. Acceptable levels of reliability were achieved for *lesson learning* (κ = .76), *gaining insight* (κ = .79), and *overall meaning-making* (κ = .78).

Moderation analysis

To answer R1, we tested the moderating effect of pubertal status, pubertal timing, and age on the relationship between meaning-making and Time 2 depressive symptoms in three separate moderation analyses (see Figure 1). Due to the developmental significance of pubertal status, pubertal timing, and age, we wanted to examine if these constructs had distinct moderating effects from each other. We probed simple slopes for significant interactions (Aiken & West, 1991). Time 1 depressive symptoms were entered as a covariate in all models. Age was entered as a covariate in the pubertal status model but not the pubertal timing model given that age is already accounted for in the construction of pubertal timing.

Intraindividual variation

To answer R2, we examined intraindividual variation in meaning-making across prompt theme. Since girls provided responses for each of the four prompts, we employed multilevel modeling (MLM) to address the nested response data using proc MIXED in SAS. All pairwise comparisons were corrected with Tukey's adjustment. Prompt theme (dummy coded with the prompt about physical changes as the reference category), age, and pubertal status were included in the model as fixed effects. To meet the assumptions of a categorical X continuous interaction, age was categorized into four age groups according to year of chronological age: 10, 11,

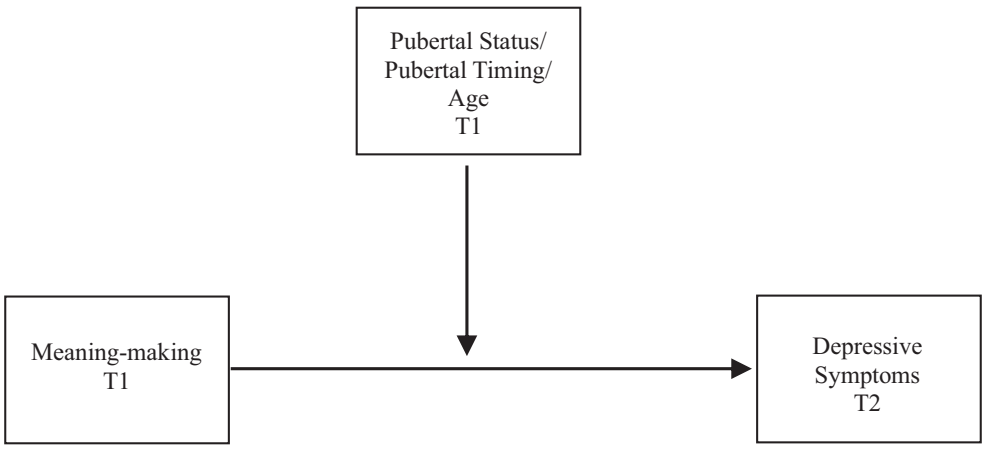

FIGURE 1 General moderation model for the interaction between meaning-making and pubertal status, pubertal timing, and age on the prediction of Time 2 depressive symptoms.

12, and 13 years (reference) to examine interactions of age with prompt theme on meaning-making. Note that there was one 14-year-old in the sample. We allocated her to the 13-year-old age group rather than remove her or increase pairwise testing. Models were specified using full-information maximum likelihood. We present results from main effect and interaction models, as well as excerpts from girls' responses to illustrate variation in meaning making for each prompt.

Topic modeling

Word count and word frequency of the responses were examined to provide a preliminary description of the responses. To answer R3 and R4, we fit the topic model using latent Dirichlet allocation (LDA; Blei et al., 2003). LDA processes a collection of text into a smaller number of topics to provide an interpretable summary of the data. We transformed our corpus of narratives into a document-term-matrix in which each row represented one response and each column represented the text of that response. The text was pre-processed before fitting the model in order to facilitate interpretability of the model. Pre-processing steps included removing punctuation, transforming all words to lower case, and removing a set of common English stop words. We used an adaptive density-based method for LDA, which facilitates finding a topic solution for which topics are least likely to overlap with each other, and researcher assessment of topic coherence to estimate how many topics to retain in the model (Cao et al., 2009).

The topic model was fit with Gibbs sampling in R using the topicmodels package (Grün & Hornik, 2011). Reliability was assessed by running the model run 10 times with independent random initializations to test whether the same topics reliably repeated with small variations in each iteration (Baumer et al., 2017). Topics were interpreted by their top-10 terms, which were ranked based on the marginal probability of that term appearing in that topic (Blei et al., 2003). Resulting topics from the selected model were labeled based on informed interpretation of relevant words in each topic and quotes from responses that highly corresponded with the topic.

We used the posterior topic distribution, which reports which responses exhibit which topics and to what proportion, to explore relationships between study variables and topic proportions. Previous topic model research has leveraged the posterior topic distribution to predict depression from essays by a sample of college students (Resnik et al., 2013). Consistent with this prior research, our exploratory analyses were geared toward describing potential relationships between writing topics and depressive symptoms using correlation and path analysis. We selected path analysis because this method allowed us to explore both direct and indirect effects. We note that the path analyses are exploratory in nature because we could not predict which topics would be derived a priori given the bottom-up approach of topic modeling.

Path models were fit in M*Plus* 7.4 using full information maximum likelihood estimation (FIML) with robust standard errors to account for missing data (Muthén & Muthén, 1998–2017). There were no significant differences in pubertal development or depressive symptoms at baseline across participants with complete data at all time points versus those missing depressive symptoms at follow-up. This suggests that the data satisfy the conditions of missing at random (MAR), which assumes that the probability of missingness on outcome variables is uncorrelated with the values of the outcome variables themselves. FIML is preferred to listwise deletion under conditions of MAR (Enders, 2010).

RESULTS

Descriptive summary of responses

The mean overall word count across all prompts was 578 words (SD = 288.28, range 58–1291). Mean overall word count was correlated with age (r = .21, p < .05) and more advanced pubertal status (r = .22, p < .05), but not early pubertal timing. The five most frequent words in the corpus were: "like" (712 instances), "friends" (557 instances), "really" (400 instances), "mom" (348 instances), "puberty" (338 instances), "get" (334 instances). The high frequency of "friends" indicates not only that girls focused on their relationships with peers, but also that they were more likely to talk about groups of peers rather than a singular friend. Given the high frequency of "mom," we also note that "dad" was used at a lower frequency of 124 instances.

Meaning-making

Across all prompts, 44% of the sample (n = 55 girls) included some kind of meaning and 56% included no meaning at all. More girls described lesson learning (39.20%, M = 0.57, SD = 0.83, range = 0–3) than gaining insight (11.20%, M = 0.14, SD = 0.41, range 0–2) in their responses (p < .001, d = .48). See Table 1 for full table summarizing relationships between study variables. Age was positively associated with overall meaning-making (r = .22, p < .05) and overall insight gaining (r = .23, p < .01), but not overall lesson-learning. Contrary to hypotheses, pubertal status and pubertal timing were not significantly correlated with meaning-making, lesson-learning, or insight-gaining. The remainder of analyses were conducted with the sum total of meaning-making rather than lessons and insights as separate components. Given that 78.57% of girls who included insight in their responses were 12 years of age or older, it was unclear if

TABLE 1 Correlation matrix of topics and study variables

	Pubertal status	Pubertal timing	Age	T1 depressive symptoms	T2 depressive symptoms	Mother conflict	Father conflict	Peer conflict	Parental education	Race	Meaning-making
Pubertal status	—										
Pubertal timing	.82***	—									
Age	.51***	.002	—								
T1 depressive symptoms	.12	.04	.14	—							
T2 depressive symptoms	.27*	.05	.43***	.69***	—						
Mother conflict	.33***	.26**	.10	.34***	.26*	—					
Father conflict	.14	.16	−.01	.25**	.20	.58***	—				
Peer conflict	.18*	.10	.15	.60***	.45***	.45***	.37***	—			
Parental education	.07	.02	.31	−.26	−.26	−.06	−.06	−.19	—		
Race	−.08	−.06	−.12	−.02	.08	.12	.03	−.15	.36	—	
Meaning-making	.05	−.07	.22*	.07	.01	−.07	−.03	.05	−.12	−.05	—
Topic 1	.06	−.02	.11	.18*	.30**	.03	−.03	.10	−.23	.04	.03
Topic 3	.06	.06	.08	−.06	.05	−.09	.001	−.12	.32	−.05	−.09
Topic 4	−.05	−.09	.06	−.003	−.07	.11	.05	−.09	.36	−.08	.04
Topic 5	.15	.27**	−.13	.06	−.02	−.04	.08	−.04	−.10	−.08	−.08
Topic 6	.27**	.16	.23**	.03	.28*	.07	−.04	.10	.17	−.07	.01
Topic 8	−.03	−.05	.05	−.03	−.09	−.09	.09	−.17	−.02	−.10	.02
Topic 9	.03	.07	−.04	.16	.17	.14	.26**	.12	−.06	.13	−.15
Topic 10	.04	−.02	.13	−.02	−.05	−.13	−.06	−.10	−.36	−.13	−.10
Topic 11	−.10	−.07	−.11	−.26**	−.21	−.07	.12	−.16	−.04	−.03	.02
Topic 12	.02	−.11	−.07	.005	−.03	.17	.09	.04	.15	.10	−.002
Topic 13	.03	−.02	.13	.07	.18	.13	.14	.25**	.16	−.07	−.03
Topic 14	−.03	.08	.12	.05	−.12	−.03	.06	.05	−.10	−.05	−.17
Topic 15	−.03	−.07	−.02	−.10	−.11	−.09	−.07	−.10	.03	.10	.18*
Topic 18	−.07	−.08	.01	.003	−.02	−.09	−.14	.17	.08	−.05	−.09
Topic 19	.10	.07	.05	−.03	−.12	−.09	−.17	−.18*	.20	.11	.07
Topic 21	−.03	−.05	−.02	−.15	−005	−.03	−.09	−.20*	.20	.35***	.12

Note: Only correlations between topics and study variables are presented.

*$p<.05$; **$p<.01$; ***$p<.001$.

doing two sets of analyses would contribute to the research questions beyond highlighting effects of age.

(R1) Does pubertal development moderate the relationship between meaning-making and depressive symptoms?

Moderation by pubertal status

There were main effects of meaning-making (b = 9.39, 95% CI [2.60, 16.19], $p<.01$, d = .32) and pubertal status (b = 1.28, 95% CI [0.23, 2.33], $p<.05$, d = .28) on Time 2 depressive symptoms. Counter to hypothesis, pubertal status moderated the relationship between meaning-making and depressive symptoms such that more meaning-making at greater levels of pubertal status was negatively related to depressive symptoms (b = −1.07, 95% CI [−1.75, −0.39], $p<.01$, d = .36). Simple slope analyses indicated that more meaning-making for girls with greater pubertal status (+1 *SD*; b = −3.35, $p<.01$, d = .32) resulted in decreases of Time 2 depressive symptoms (Figure 2).

Moderation by pubertal timing

There was a main effect of pubertal timing (b = 3.87, 95% CI [0.97, 6.77], $p<.05$, d = .31) on Time 2 depressive symptoms. In line with our hypothesis, pubertal timing moderated the relationship between meaning-making and depressive symptoms such that more meaning-making at earlier pubertal timing was positively related to depressive symptoms (b = −3.33, 95% CI [−5.79, −0.87], $p<.01$, d = .31). Simple slope analyses indicated that more meaning-making for earlier maturing girls (−1 *SD*; b = 3.60, $p<.05$, d = .26) resulted in increases of Time 2 depressive symptoms but decreases in depressive symptoms for later maturing girls (+1 *SD*; b = −3.06, $p<.05$, d = .23).

Moderation by age

There was a main effect of age (b = 4.47, 95% CI [1.89, 7.06], $p<.001$, d = .40) on Time 2 depressive symptoms. The interaction between age and meaning-making on Time 2 depressive symptoms was not significant. Rather, older age was predictive of Time 2 depressive symptoms regardless of meaning-making levels. This result does not replicate prior findings that age may moderate the relationship between meaning-making and depressive symptoms.

(R2) Does meaning-making vary across different aspects of change during this developmental period?

In the main effects model, Type 3 tests of fixed effects indicated that age group (F(3, 123) = 5.39, $p<.01$) and prompt theme (F(3, 369) = 5.98, $p<.001$) were associated with meaning-making but not pubertal status. Pairwise comparisons indicated that girls included more meaning in the physical change prompt than the general change prompt (d = .16, $p<.05$) and prompt about changes with parents (d = .20, $p<.01$). Girls also included more meaning in the changes with peers prompt than the changes with parents prompt (d = .14, $p<.05$).

In the interaction model, Type 3 tests of fixed effects indicated that age group (F(3, 123) = 5.39, $p<.01$), prompt theme (F(3, 369) = 6.00, $p<.001$), and their interaction (F(9, 369) = 1.96, $p<.05$) were associated with meaning-making. Neither pubertal status nor its interaction with prompt theme was significantly related to meaning-making. Pairwise comparisons indicated that 11-year-old girls included more meaning in the physical change prompt than they did in the general change prompt (d = .19, $p<.05$). Girls in the 13-year-old age group included more meaning in the changes with peers prompt than 10-year-old girls (d = .20, $p<.01$), 11-year-old girls (d = .22, $p<.01$), and 12-year-old girls (d = .19, $p<.01$). These results partially supported our hypothesis that girls would engage in more meaning-making about physical changes than other prompt, but the effect this was dependent on girls' age.

Meaning-making in responses to the prompt about changes with peers was positively correlated with depressive symptoms (r_{pb} = .21, $p<.05$) and peer conflict (r_{pb} = .21, $p<.05$). The following excerpt illustrates a lesson learned about dating male peers:

> I realized when you rush in a relationship it does not last long. So when you are dating never rush or say yes to a boy you do not like. What you need to do is say yes to who you want to date and not others you do not want to date. If you get in a relationship keep it slow and simple.

Meaning-making in responses to the prompt about changes with parents reported was negatively associated with depressive symptoms (r_{pb} = −.19, $p<.05$) and maternal conflict (r_{pb} = −.21, $p<.05$), but not paternal conflict. The following excerpt illustrates a lesson learned about interacting with parents:

> Now I know that I should respect my parents more often than I did. Now that I am older, can talk to my mom more about boys and puberty and stuff like that. I can really trust my mom more now than when I was younger. My mom has been giving me advice about my friends and how to deal with some of the situations the next time I have the same situation or have to deal with it the next day. My mom tells me that I am going to meet difficult people but that is part of life. And I am going to have to deal with it.

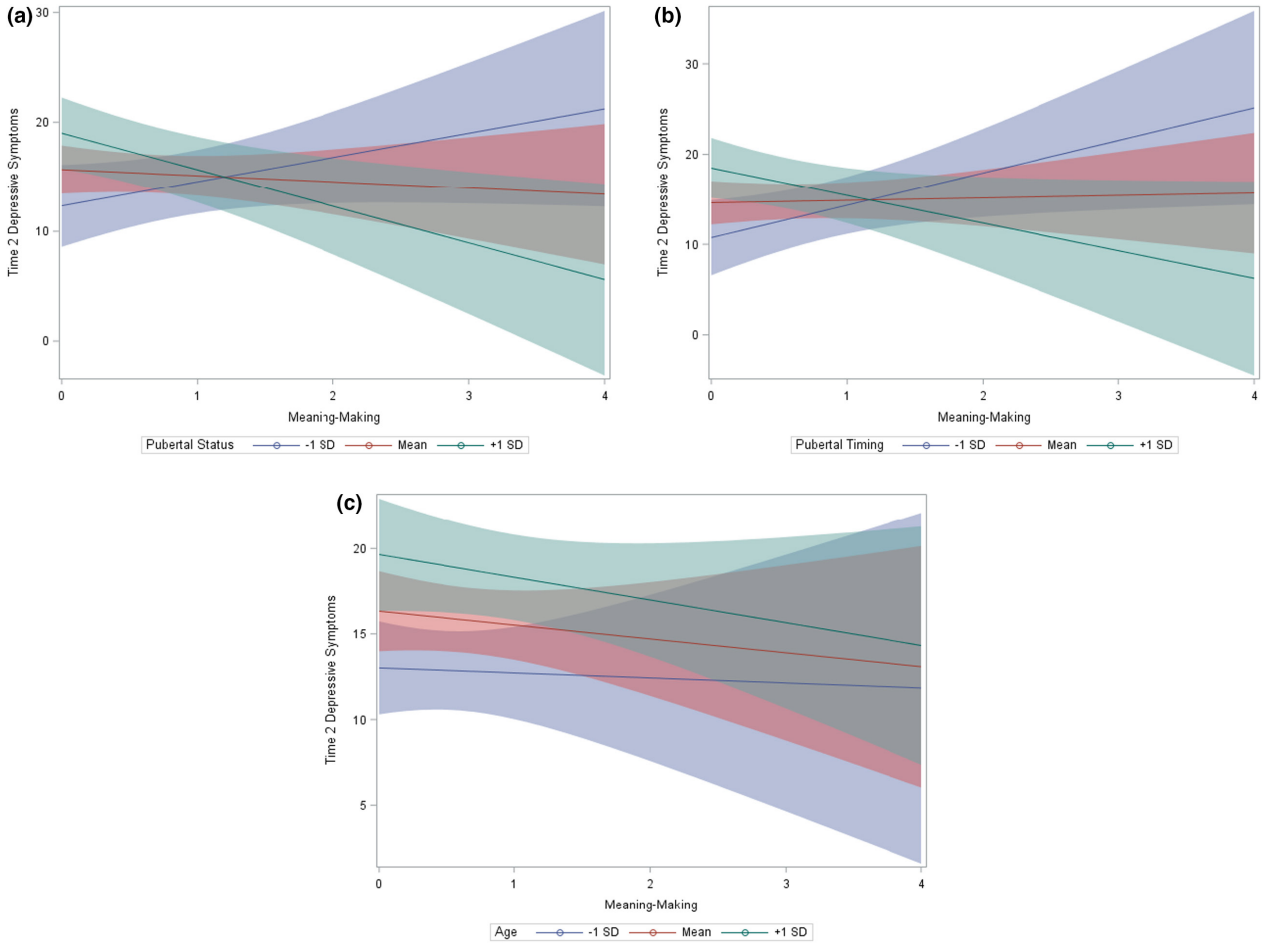

FIGURE 2 Fit plots with 95% confidence intervals and prediction limits of the interaction between meaning-making and (a) pubertal status, (b) pubertal timing, and (c) age predicting Time 2 depressive symptoms.

Topic modeling

(R3) What topics do girls choose to include in their narratives of puberty?

After evaluating selection statistics and topic coherence, the LDA model included 21 topics. The model was specified such that topics captured the different physical changes associated with puberty (i.e., menstruation, breast development, changes in height, skin changes) as individual topics rather than packaging them as a single topic about physical development. Of the 21 topics, five topics were not relevant to presented analyses (e.g., characterized conjunctive statements) and were not reported. The presented 16 topics include content such as changes related to boys and peer groups, changes related to breast development, changes related to menstruation, and the experience of noticing bodily changes (see Table 2 for keywords and topic labels; see supplemental material for exemplary excerpts from each topic).

(R4) How do emergent topics relate to depressive symptoms, relationship conflict, and pubertal development?

Correlation analyses were used to explore relationships between topic proportions and study variables (see Table 1) Time 2 depressive symptoms (r = .28, p < .05) and pubertal status (r = .27, p < .01) were both positively correlated with the topic about changes related to menstruation. Baseline depressive symptoms were negatively correlated with the topic about not having started puberty yet (r = −.26, p < .01). Peer conflict at baseline was positively correlated with both the topic about changes related to boys (r = .25, p < .01) and negatively correlated with the topic about breast development (r = −.20, p < .05).

Exploratory path analyses

Given that changes related to menstruation emerged as a topic associated with both pubertal development and depressive symptoms, path analysis was conducted to explore the prospective nature of these emergent

TABLE 2 Summary of topic words and descriptions of topic themes related to puberty in girls' narratives

Topic	Top-10 topic words	Description of topic themes
1	Like, mom, dad, lot, nice, mean, help, say, try, make	Reflection on relationship with parents
3	Really, relationship, changed, another, got, parents, annoying, talking, nothing, still	Changes related to relationships
4	Feel, sometimes, getting, kind, talk, now, happy, much, makes, weird	Feelings about changes
5	Started, now, hair, changing, growing, parents, got, well, one, said	Changes since pubertal onset
6	Period, first, even, though, around, class, care, pimples, thought, hope	Changes related to menstruation
8	Grade, best, people, kids, going, girls, school, parents, fifth, like	School-related
9	Mom, told, got, brother, went, wanted, day, happened, sister, play	Changes in the context of family dynamics
10	Friends, new, made, better, make, lot, when, used, taller, old	Change in reference to friends
11	Puberty, friends, yet, think, get, older, little, different, gotten, still	Puberty not yet started
12	Will, get, know, always, time, just, normal, sister, now, breasts	Learning about puberty
13	Boys, one, everyone, girls, never, started, boy, mad, went, think	Changes related to boys and peer groups
14	Friend, said, like, time, day, year, last, one, asked, next	Friendships
15	Changes, think, body, different, people, time, noticed, parents, felt, talk	Reflecting on change over time
18	People, know, just, four, two, dad, back, tall, feet, grow	Changes related to height
19	Noticed, change, school, family, age, awkward, growing, something, become, younger	Noticing changes
21	Bra, started, wear, little, wearing, also, start, much, bras, girls	Changes related to breast development

Note: Illustrative quotes for each topic available in Table S1.

relationships. Specifically, we explored whether the changes related to menstruation topic predicted subsequent depressive symptoms when controlling for pubertal development and baseline depressive symptoms. In addition, we examined the indirect effect of pubertal development on subsequent depressive symptoms in order to determine whether any effect of the changes related to menstruation topic on depressive symptoms could be driven by the greater physical development of the girls writing about that topic. Both pubertal timing and pubertal status were assessed as independent models given that early pubertal timing and more advanced pubertal status have both been associated with greater risk for depressive symptoms in prior research (see Figure 3). Both models were saturated (χ^2 = .00, comparative fit index = 1.00, root mean square error of approximation = .00, standardized root mean square residual = .00) and fully identified with perfect fit. Parental education, race, age, and menarche were covaried in the models. Results for the pubertal timing path model indicated that writing about menstruation-focused physical changes positively predicted depressive symptoms at follow-up (B = .23, SE = .11, 95% CI [0.01, 0.46], p < .05). Cohen's f^2 test indicated a small effect size (f^2 = .12). This effect was not explained by indirect effects of pubertal timing or menarche on subsequent depressive symptoms; that is, the association of writing about menstruation and depression was not explained by a greater tendency of early maturing girls to write on this topic. Results from the pubertal status model did not indicate that the menstruation-focused physical changes topic significantly predicted subsequent depressive symptoms.

DISCUSSION

It has been several decades since early qualitative work on girls' experiences of adolescence highlighted the psychological salience of puberty (e.g., Brown & Gilligan, 1993; Ruble & Brooks-Gunn, 1982). The field's emphasis on having girls describe their maturational experiences has dwindled as survey methods have become more complex and copious. The present study blends this early prioritizing of girls' voices and individual stories with newly developed methods for the computational text analysis of narratives in order to understand how girls described and made meaning from their experiences of puberty, and how to situate well-being in the context of these experiences.

Meaning-making and puberty

Puberty is a sweeping period of change that signals the start of adolescence and, with it, the mounting importance of identity and developing capacity for meaning-making. Given the narrative identity literature indicates that age tends to moderate the relationship between meaning-making and depressive symptoms in adolescence (McLean & Breen, 2009), we anticipated that pubertal development might also moderate the relationship

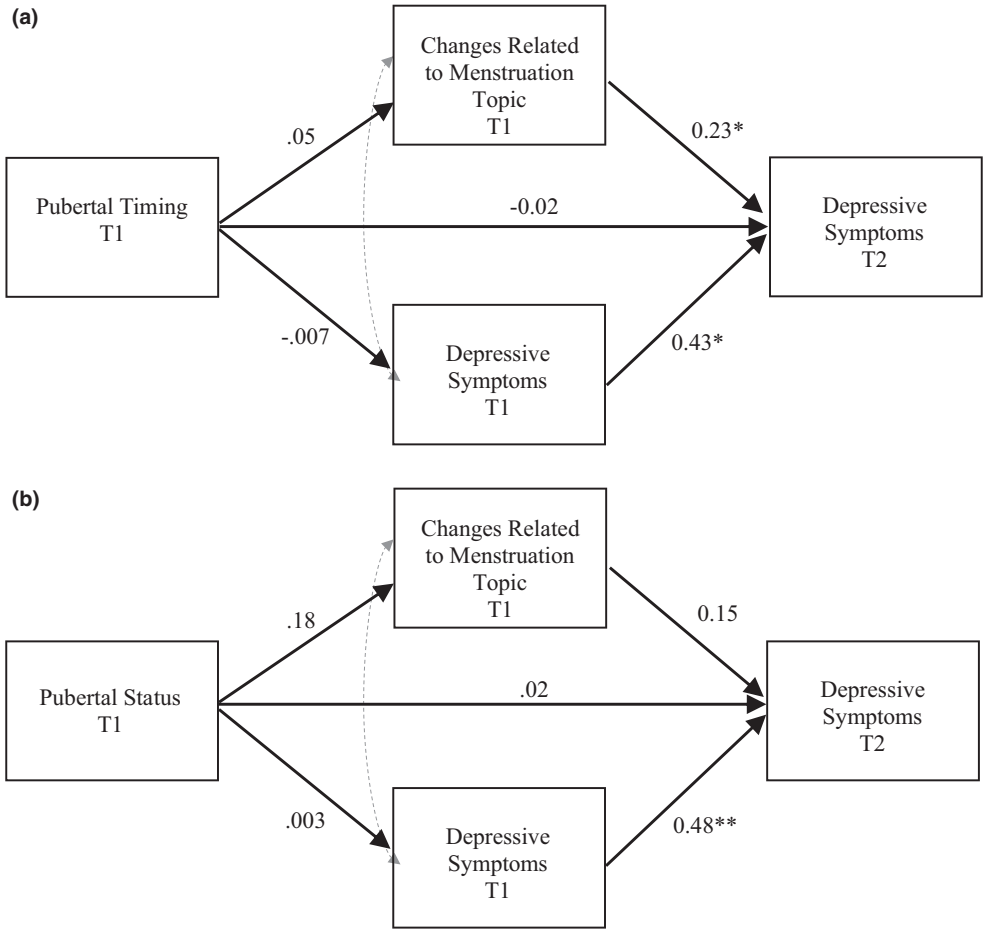

FIGURE 3 Pubertal timing (a) and pubertal status (b) predicting depressive symptoms and predicted proportion of writing about the changes related to menstruation topic. Solid lines represent primary paths of the model and dotted lines represent nonprimary paths. Parental education, race, age, and menarche were also covaried but were not included in the figure for ease of interpretation. Coefficients are standardized. *$p < .05$, **$p < .01$.

between meaning making and depressive symptoms. We found that the relationship between meaning-making and depressive symptoms during adolescence is not purely a matter of getting older. Rather, experiencing the many physical and social changes associated with puberty offered opportunities for girls to make meaning. We found that more meaning-making by girls with early pubertal timing was associated with increased depressive symptoms 4 months later. However, in girls with later pubertal timing or more advanced pubertal status, more meaning-making was associated with decreased depressive symptoms. It is possible that girls with early pubertal timing were experiencing more concurrent physical changes than their age-graded peers at the time of the study. Being in the midst of change may motivate early-maturing girls to search for meaning but not necessarily in ways that are adaptive. In contrast, girls with more advanced pubertal status may not be going through as much concurrent physical change and, accordingly, may have a longer time horizon from the onset of physical changes that allows them more space from initial negative emotions about changes and a broader perspective on the changes.

Girls tended to include more meaning-making when writing about changes with peers and physical changes than they did when writing about changes with parents or general change. Furthermore, while older girls (13 years and older) tended to include more meaning overall, they specifically included more meaning when writing about changes with peers compared to younger girls. In contrast, younger girls (11 years old) tended to concentrate meaning-making when writing about physical changes. These variations were not moderated or explained by pubertal development, so it is not the case that the younger girls engaging in meaning-making about physical change were experiencing more concurrent physical change. Rather, it seems to be the case that physical changes are the wrinkle that needs to be smoothed in girls' stories at age 11; by age 13, girls turn their attention to the growing wrinkle of navigating peers and friends. Another possibility is that girls may receive social scaffolding for making meaning out of physical change starting around age 11. Upon examining narrative content for the physical change prompt, many girls described events in school focused

on puberty education or conversations they had with mothers or peers. These results suggest that scaffolding about physical changes may be related to a variety of social factors, such as school policies on puberty education, as opposed to being in reaction to girls' level of physical development or chronological age. Although there are did not appear to be immediate benefits to mitigating psychological distress when engaging in meaning-making about physical changes, future work should examine potential longitudinal benefits. Prior narrative research has found that adolescents who engage in more narrative meaning-making may experience more positive benefits to well-being later on than peers who do not attempt meaning-making, but that it may take practice before these benefits pay out (Borelli et al., 2019; Tavernier & Willoughby, 2012).

Key topics for girls during puberty

Findings from the topic model characterized girls' descriptions of specific topics and changes associated with puberty. In particular, menstruation was characterized as confusing, uncomfortable, and distressing relative to how girls qualitatively described other physical changes. Exploratory analyses indicated that writing about changes related to menstruation was related to greater pubertal development and subsequent depressive symptoms. Furthermore, path analyses showed that writing about changes related to menstruation was predictive of depressive symptoms at follow-up measurement, even when controlling for pubertal timing and baseline depressive symptoms and taking into account potential indirect effects of pubertal timing. This is notable not only because early pubertal timing is robustly associated with risk for depressive symptoms, but also because the effect of writing proportionally more about changes related to menstruation was not just driven by girls' physical development or personal experiences with menstruation. It was not the case that girls who were more developed or who had reached menarche wrote more about this topic and, in turn, created an artificial relationship with depressive symptoms. Rather, some girls were more prone to writing about changes related to menstruation regardless of physical development, and these girls were also more prone to depressive symptoms. However, we do note that the effect size of this finding was small. Accordingly, while it may add to the developmental mechanisms explaining depressive symptoms at puberty, other risk factors may play more powerful roles.

Exploratory findings on writing about menarche also support the idea that the psychological experience of menarche may be different than other physical changes associated with puberty. As noted by Brooks-Gunn and Ruble (1983), menarche is unique from other changes in that it is a discrete event embedded in a broader, more gradual process of puberty. Accordingly, menarche may be especially salient to girls as an indicator of development and womanhood. In addition, menarche is a relatively private change. While physical changes in height or breast development are typically visible, menarcheal status is not usually readily visible. On one hand, this may be a relief to girls, who often experience unwanted commentary on changes in their breasts and body shape. On the other hand, the more covert nature of menarche may contribute to girls feeling less prepared for menarche or more isolated by its experience. Finally, menstruation may be a source of social stigma and shame for girls, as it is often depicted as a "taboo" topic in American sociocultural messaging in a way that other physical changes for girls are not (Johnston-Robledo & Chrisler, 2013). Therefore, spending more time thinking about menstruation changes may result in greater exposure to stigma and shame that elevates psychological distress.

Limitations and future directions

The paired approaches of narrative meaning-making and topic modeling are a strength of the present study as these findings build from each other. While computational text analysis is a relatively novel methodology for developmentalists, it is important to note that results are driven by the given corpus. There are two important points to note about the corpus in this study. First, it was generated by a sample of predominantly White girls. While consistent with the geographic region in which the data were collected, the psychological effects associated with puberty may vary by race and social context. For example, the finding that early pubertal timing is linked with increased depression risk does not reliably replicate in samples with Black girls, which may be due in part to differing body ideals (Carter et al., 2011). Accordingly, girls with different racial and ethnic backgrounds than the present sample may characterize their experiences of puberty differently, focus on different changes, and different patterns of well-being may emerge.

In addition, the present study included only girls in its analyses. As noted, girls are at increased risk for negative outcomes associated with the challenges of puberty (e.g., Rood et al., 2009), and present analyses prioritized understanding how girls' narratives of puberty experiences may contribute to this elevated psychological risk. With that said, gender differences are likely to emerge in future work with boys given that boys experience different physical changes and different levels of psychological risk associated with pubertal changes, and boys tend to engage in less elaboration, emotional expression, and self-reflection in their narratives than girls during adolescence (Grysman & Hudson, 2013; Rood et al., 2009). Likewise, youth who are not gender conforming represent a growing population and we expect that the way they characterize their experiences

of puberty and attempt to make meaning from these changes will be different from gender conforming youth. The fact that there are so many questions about other samples underscores the importance of collecting data like this. While the present study cannot contribute to representing experiences of puberty from historically understudied groups, we hope it provides a foundation for utilizing tools like topic models as tractable approaches to characterizing a broader array of narratives.

The second important fact about the corpus in this study is that our research protocol asked girls to write about pubertal changes that are well-documented in the research literature. Responses were open-ended, and girls were free to respond that they had not yet experienced any changes for any given prompt. (Indeed, topic model results yielded a topic specific to physical changes having not yet started.) However, cuing girls to think and write about change, as opposed to stability, likely shaped their narratives. It may be beneficial to know whether girls who spontaneously discuss change versus girls who do not are more at-risk for depressive symptoms. Likewise, it would be interesting to know how youth reflect on stability during a time of sweeping developmental change that includes increasing salience of gender role identity, sexual identity, and identity exploration (e.g., Natsuaki et al., 2015). How do youth make sense of stability in personal identity during a time of significant physical change? Does perceiving stability provide psychological benefits? These are important questions for future studies.

Finally, how girls reflect on and make meaning from puberty and its associated changes may be related to cognitive development, verbal intelligence, and previous experience with reflective writing via journaling or on social storytelling platforms. While we cannot control for these factors in the present study, we do note that girls' self-reported grade achievement was not related to overall word count or meaning-making, nor did including grade achievement in our models yield significant changes in results. Of course, academic achievement and verbal intelligence are related but not synonymous (e.g., Ekinci, 2014), and future research may want to consider verbal abilities and writing history as moderators of effects. However, in the present study, it seemed to be the case that when the topic was personally relevant, girls wrote more.

CONCLUSION

The act of writing is an act of thinking, self-expression, and voice. When people are asked to write, what comes out is a reflection of who they are and what is on their minds. In the present study, we found that girls were concerned with a broad range of topics and changes during puberty. They may struggle to make meaning of their experiences and to develop insights into their changing peer and parent relationships. As the first empirical investigation examining the pattern between narrative meaning-making and puberty in early adolescence, we propose that pubertal development may be an important consideration when evaluating developmental trends of meaning-making and psychological well-being.

In addition, although researchers tend to operationalize puberty as a single process, girls unsurprisingly think about and respond to the diverse changes of puberty in different ways. Those girls who chose to describe changes related to menstruation were more psychologically vulnerable than those who considered other physical changes, and these results highlight the importance of thinking about adolescent menstruation. Accordingly, the ways in which girls describe and come to terms with their experiences during puberty holds significant relevance for understanding their psychological well-being. Collectively, these findings underscore the value of girls' individual stories to guide empirical work, and the enduring challenge of how best to capture and represent girls' voices across diverse methodological approaches.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Koch, M. K., & Mendle, J. (2022). In their own words: Finding meaning in girls' experiences of puberty. *Child Development*, *00*, 1–16. https://doi.org/10.1111/cdev.13836