



Original article

Using Time-Varying Effect Modeling to Examine Age-Varying Gender Differences in Coping Throughout Adolescence and Emerging Adulthood

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 A B S T R A C T

Purpose: Little is known about how and when coping trajectories differ between males and females. The current study aimed to examine gender differences in the use of specific coping strategies across developmental ages using time-varying effect modeling (TVEM) in a large, diverse community sample.

Methods: A longitudinal study following adolescents across 4 years of high school and 5 years post graduation (N = 1,251) was combined with a nationally representative cross-sectional study of 18- to 22-year-olds (N = 595) to examine changes in gender differences in the use of coping strategies between ages 13 and 25. The same coping questionnaire was administered to both samples. TVEM was used to examine the age-varying prevalence rates of coping in males and females.

Results: Gender differences were greatest during middle-to-late adolescence (15–19 years) for active coping, social support seeking, planning, and venting emotions. Females reported greater use of these strategies than males, but males' use increased over time and became equivalent to females after the age of ~19–20. Gender differences in the use of humor did not emerge until the age of 22, at which point the use of humor increased continuously among males but remained stable among females. The use of denial was fairly stable across time, with no gender differences at any age.

Conclusions: Findings highlight the utility of TVEM for advancing our knowledge on gender and coping across developmental time, as males and females used coping strategies at differing rates throughout adolescence and emerging adulthood. Implications for tailoring gender- and age-specific intervention efforts to improve coping and related health behaviors are discussed.

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IMPLICATIONS AND CONTRIBUTION

This study used time-varying effect modeling to examine dynamic developmental shifts in the use of coping strategies across the ages of 13–25. Gender differences in coping strategies fluctuated throughout development, highlighting potential avenues for tailoring intervention efforts. Findings underscore the utility of time-varying effect modeling for enhancing knowledge on coping behaviors across developmental time.

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Contributions: K.F. and A.V. conceptualized the aims and hypotheses for the study and conducted analyses. K.F. took primary responsibility for drafting the manuscript text and figures. A.V. assisted with drafting the manuscript. C.O. designed the original studies as principal investigator, collected the data, and provided feedback on the conceptual direction and text of the manuscript. All authors approved the final article.

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Coping is defined as intentional, effortful strategies used to regulate stress [1]. In addition to helping to prevent the many negative physiological health risks associated with stress, the use of effective coping strategies has been shown to protect against the development of both psychological and physical health problems [1–3]. Despite the health benefits associated with effective coping, there has been little consensus regarding the most theoretically and empirically appropriate method to discriminate among coping strategies [4,5]. Common conceptualizations of coping have involved broad dimensions, including two-factor models (e.g., problem-focused vs. emotion-focused, approach vs. avoidance [6,7]) and three-factor structures (e.g., active, internal, and avoidant [8,9]). Broad coping dimensions serve as good organizational principles to characterize overarching stress responses, but fail to capture the complexity of the subtypes of coping strategies that may differ markedly in their intentions, actions, and effects. As such, some researchers have recommended examining individual coping strategies separately to allow for more nuanced distinctions and understanding of developmental processes [5].

The ability to cope with stressors is crucial to daily functioning, psychological adjustment, and physical health [1,10]. Learning to utilize effective coping strategies is a central task of adolescence and emerging adulthood [5]. Coping strategies are in constant flux throughout development as a result of changes in the nature of stressors and the extent of resources available (e.g., biological maturity, executive functioning, emotion regulation capabilities, and social context [4,11]). A small number of studies have found decreases in the use of avoidant and emotion-focused strategies, increases in active and problem-focused strategies, and stable use of social support seeking from adolescence to adulthood [11–14]. Some studies have examined age differences in more specific individual coping strategies, but have focused only on children and adolescents (e.g., see References 15 and 16) and have not evaluated developmental differences between adolescents and adults.

Although gender differences in the use of coping strategies have been observed during adolescence and emerging adulthood (e.g., see References 15, 17, and 18), because of the many different conceptualizations and assessments of coping, the literature on gender differences in adolescents' and emerging adults' dispositional use of coping strategies is difficult to interpret. For instance, some studies found that males reported greater use of problem-focused strategies and active coping than females, whereas females tended to report using more emotion-focused strategies and demonstrated greater reliance on social support [15,19,20]. However, others have found no gender differences or even the opposite, with females using multiple strategies at greater rates than males, including active coping [2,17,21,22]. Gelhaar et al. [15] posited that gender differences may be more apparent when considering specific individual coping strategies than when considering broader coping dimensions, prompting the need for additional work.

It is possible that gender differences in specific coping strategies may emerge more consistently when developmental factors are considered. The literature has been neither consistent nor integrated enough across ages to present a truly developmental perspective on coping [5]. It remains unclear as to *when* gender differences in coping emerge and *how* these differences change across developmental ages. Preliminary evidence has suggested that the presence of gender differences in active coping, in avoidant coping, and in support seeking may differ as a function of age, although the nature of these differences was difficult

to discern because of mixed findings [11,15,23]. Methodological differences in how age groups have been defined across studies may account for the lack of consistency. For example, Gelhaar et al. [15] operationalized early (11–13 years), middle (14–16 years), and late adolescent (17–21 years) age groups, whereas Amirkhan and Auyeung [11] created age groups defined as preteen (9–12 years), early teen (13–15 years), late teen (16–19 years), and young adult (20–29 years). Not only do these studies assess different age ranges in their groups, but also these studies impose artificial constraints on the continuous construct of age in the creation of such groups. Furthermore, the use of imposed age groups may mask the emergence and the disappearance of gender differences that occur within or across these broadly defined developmental periods.

Given the limitations associated with defining broadly pre-conceived age groups to distinguish developmental age, the use of time-varying effect modeling (TVEM [24]) may be especially appropriate for understanding how and when gender disparities in the use of coping strategies differ across adolescence and early adulthood. TVEM is a novel, innovative statistical approach used to model a large number of cross-sectional intercept coefficients as a continuous function of age [24]. Unlike traditional parametric analytic strategies that are subject to strong assumptions about how change is modeled, TVEM is incredibly flexible and allows researchers to examine the unique, nonparametric coefficient functions over time [25]. TVEM is especially important when examining coping, as previous research suggests that coping strategies develop in a nonlinear manner [11]. TVEM has been used to examine age-varying gender differences in depressive symptoms, exposure to violence, the number of sexual partners, and substance use [24,26,27], but has yet to be applied in coping.

Given the health benefits associated with effective coping, understanding when in development the use of coping strategies differs for males and females is necessary to advance theory on the nature and changes of responses to stress and to inform intervention efforts for males and females to match their developmental age. Therefore, the objective of the current study was to utilize TVEM to examine the relative frequency with which males and females utilized specific coping strategies dynamically across early adolescence into emerging adulthood in a large, diverse community sample.

Methods

Participants

The majority of the participants were drawn from a longitudinal study¹ (N = 1,251) of high school students from the Mid-Atlantic region of the U.S. At baseline, the participants' mean age was 15.05 (standard deviation = 0.78 years). Overall, 65% of the participants self-identified as non-Hispanic white, 19% as African-American, 10% as Hispanic, 2% as Asian American, and 4% as other.

A nationally representative cross-sectional sample of emerging adults (N = 595; ages 18–22; M = 20.00, standard deviation = 1.42 years) was also included in the present study. The race/ethnicity composition of the sample closely mirrors the U.S. population [28]. Of the total sample, 63% self-identified as

¹ For additional information about other measures included in this larger study, see the website <https://adolescentadjustmentproject.org/>.

Caucasian, 14% self-identified as African-American, 12% self-identified as Hispanic, 8% self-identified as Asian, and 3% self-identified as other.

The overall sample consisted of individuals who provided data about their gender and coping strategies in at least one wave of data collection ($N = 1,846$). All available data across waves were analyzed simultaneously, resulting in 3,365 measurement occasions. By combining all waves of data and considering age in terms of the nearest month [24], sufficient information was available for every possible month across the ages of 13.5–25.8 years to provide a near continuous measure of time.

Procedure

For the longitudinal study, data were collected in schools each spring across waves 1 (2006, $n = 340$), 2 (2007, $n = 965$), 3 (2008, $n = 823$), and 4 (2009, $n = 523$). Trained research staff administered self-report surveys during class to assenting adolescents with parental consent. Informed consent for participants was obtained after the age of 18. The survey took ~40 minutes to complete, with the coping questionnaire placed toward the end. The participants were given a movie pass upon turning in their survey. All procedures were approved by the University of Delaware Institutional Review Board.

The participants were contacted again 5 years later (wave 5, 2014; $n = 234$). Consenting participants completed an online Qualtrics survey and were mailed a \$15 gift card upon submitting their survey.

The same online survey was distributed within the same time frame to participants in the nationally representative cross-sectional sample. The national participants were recruited through Lightspeed GMI, a web-based recruiting company that specializes in global market research. GMI invited registered panelists who met the criteria of residing in the U.S. and being 18–22 years old to participate. Validity checks were included to ensure survey engagement and to avoid multiple responses from the same participant. Participants who provided informed consent and completed the survey received 100 MarketPoints (\$5 value). Seventy-nine percent of the participants who provided informed consent completed the survey. These procedures were approved by the Connecticut Children's Medical Center Institutional Review Board.

Measures

Demographic information. A demographic questionnaire assessed the participants' gender and month and year of birth. Age (in months) was calculated for participants at each wave by subtracting the participants' date of birth from the date they completed the survey.

Coping strategies. The 60-item COPE Inventory [29] assessed seven empirically derived coping strategies: problem solving (including active coping and planning), denial, social support seeking (including instrumental and emotional), humor, and focusing on and venting emotions. Adolescents reported on what they usually did and how they usually felt in response to stressful situations, with responses ranging from 1 ("I usually don't do this at all") to 4 ("I usually do this a lot"). Responses were summed to create subscales, with higher scores indicating greater frequency of use. The COPE has demonstrated good psychometric properties in adolescents and in adults [29]. Cronbach alphas in the current sample ranged from .75 to .96.

Statistical Analyses

Intercept-only time-varying effect models were used to examine changes in the use of coping strategies by gender from early adolescence to emerging adulthood. TVEM is a novel statistical technique that utilizes nonparametric spline regression to estimate intercept values of coping strategies as a continuous function of age [25]. Consistent with prior studies [24,27], the p-spline estimation method was used because it automatically selects the optimal regression coefficient functions and accounts for repeated measures data by modeling within-subject effects [30]. As the coping subscales were continuous and normally distributed, TVEMs estimated a normal linear regression function for each of the seven coping scales. Following procedures by Evans-Polce et al. [24], separate models were estimated for males and females to examine full moderation of the intercept function. Age, calculated to the nearest month, was used to represent time, with nearly all possible time points represented in the sample across the age range of 13–25 years.

Models were fit using the SAS TVEM macro, which is available for download at <http://methodology.psu.edu> [30], in SAS 9.3 (SAS Institute Inc.; Cary, NC). Because of the large number of regression coefficients estimated, results were presented as figures. Dotted lines in the figures represent the 95% confidence intervals around the estimates, with a lack of overlap indicating significant differences between males and females [24,26,31].

Results

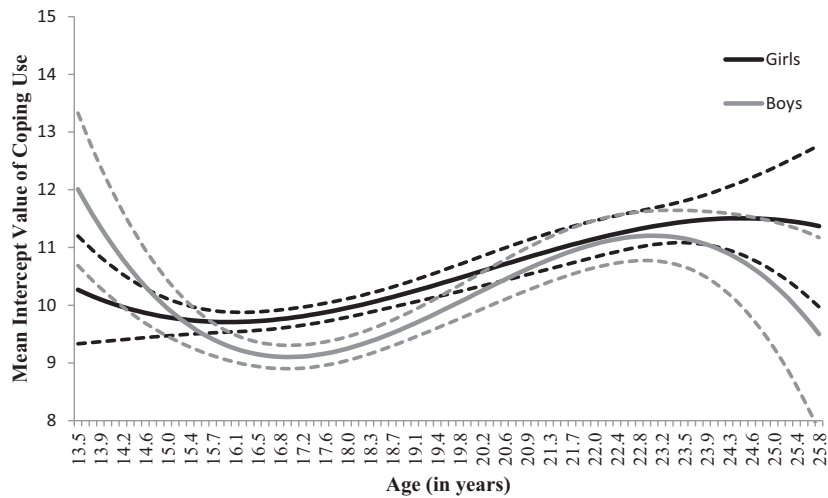
As depicted in the figures, which present the reported use of coping strategies for males and females between 13 and 25 years, nonlinear developmental trajectories were observed for each coping strategy.

Figure 1 presents the intercept values of two coping strategies intended for problem solving. As seen in Figure 1A, both males and females demonstrated curvilinear development of active coping, but this pattern was more exaggerated for males. For females, active coping decreased from ages 13.5 to 15.7, at which point active coping reached its lowest frequency of use. From ages 15.7 to 24.4, females increased their use of active coping, reaching their peak at 24.4, after which their use leveled off. Males followed a similar pattern, with the use of active coping decreasing through age 17.0 (more steeply than it decreased for females) and then increasing through age 23.0, where males reached their peak in use. Following this peak, males' use of active coping again decreased through age 25.6. Significant gender differences were observed between the ages of 16.0 and 19.4, with females utilizing active coping with greater frequency than males.

The second problem solving strategy, planning, is presented in Figure 1B. Males' and females' use of planning followed a similar curvilinear trajectory as active coping, with males' and females' use of planning decreasing, reaching their lowest frequency of use at age 16.5 for males and at age 16.1 for females. Females' use of planning then increased continually through age 25.6, when their peak use was demonstrated, whereas males' use of planning increased until reaching its peak at age 23.9, and then started to decrease slightly. Males used significantly less planning than females between the ages of 16.3 and 19.3.

There was a relatively stable use of denial, with no significant gender differences (Figure 2). Both males and females relied on denial as a coping strategy most at age 13.5. The lowest

A. Active Coping



B. Planning

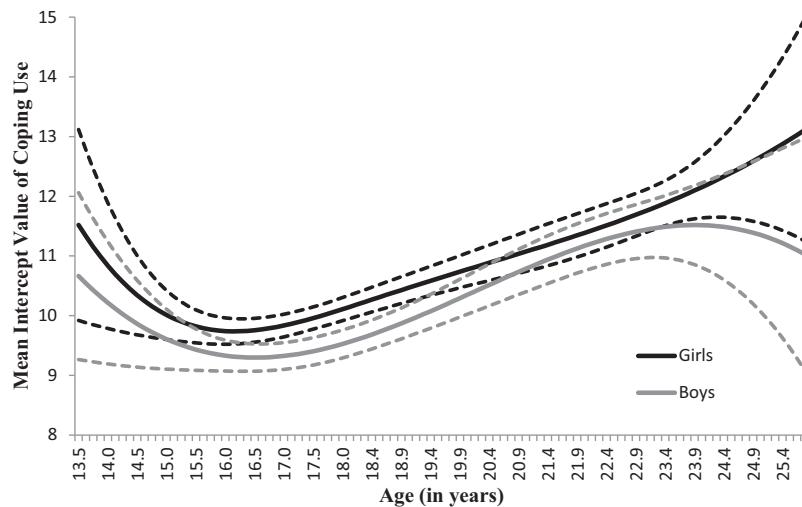


Figure 1. Regression coefficients of the intercept for the use of problem solving coping strategies (A,B) in males and females between 13 and 25 years. Note: The dotted lines represent the 95% confidence intervals around the coefficients. Significant gender differences are present when the confidence intervals do not overlap.

frequency of use of denial was observed at age 16.5 for males and at age 25.8 for females.

Presented in Figure 3 are two social support coping strategies: seeking instrumental support and seeking emotional support. Both support-seeking strategies demonstrated similar trajectories for males and females. Females were relatively stable in their support seeking across adolescence through about age 21 (at age 21.0 and 20.8, females demonstrated their lowest frequency of using instrumental and emotional social support seeking, respectively), and then increased from there, with a steeper increase in instrumental support seeking (reaching peak use at age 25.8 for both). Males demonstrated somewhat different curvilinear trajectories in their reliance on social support seeking, with a decline in use between early and midadolescence (reaching a low at age 16.3 for instrumental support seeking and 16.6 for emotional support seeking, respectively). Males subsequently reported gradual increases in emotional social support seeking and relatively steeper increases in instrumental social support across

emerging adulthood, but they never reached the same level of use as was displayed at their peak at age 13.5. Males utilized both types of social support seeking less often than females across development, with significant differences emerging between the ages of 14.7 and 20.7 and between 22.9 and 24.3 for instrumental support seeking, and between 14.1 and 25.3 for emotional support seeking.

Figure 4 presents males' and females' use of humor to cope. The use of humor exhibited a relatively stable trajectory across adolescence for both males and females. During this time, males reported using humor significantly more than females between the ages of 16.1 and 18.1. Males and females diverged in their use of humor at age 21.9, at which time males reported using humor significantly more than females. In addition, males demonstrated an increase in their use of humor onward after 21.9, reaching peak use at age 25.8. In contrast, females' use of humor peaked at age 17.5 and decreased slightly from that point on, reaching the lowest point of use at age 25.8.

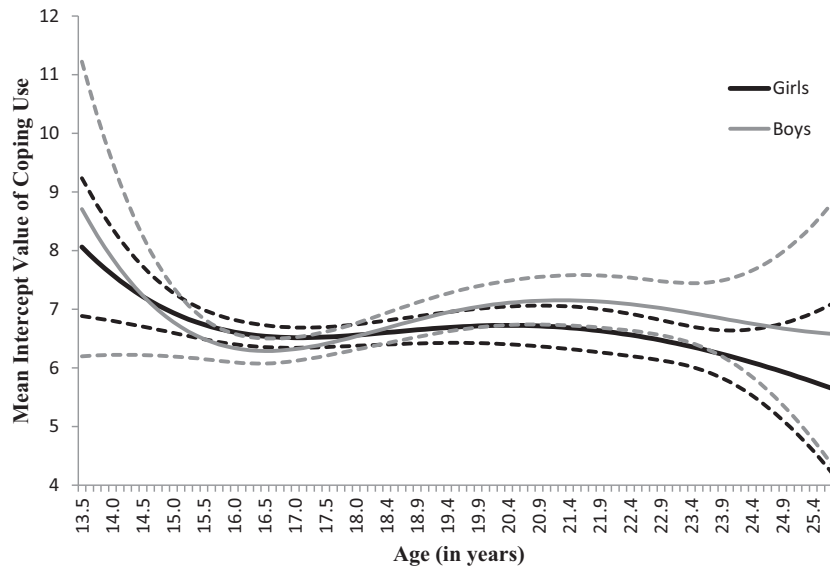


Figure 2. Regression coefficients of the intercept for the use of denial as a coping strategy in males and females between 13 and 25 years. Note: The dotted lines represent the 95% confidence intervals around the coefficients. Significant gender differences are present when the confidence intervals do not overlap.

Finally, as shown in [Figure 5](#), males reported focusing on and venting emotions as a coping strategy significantly less than females from ages 14.6 to 24.2. During this time, females exhibited a stable trajectory, reaching peak use at age 13.5 and demonstrating lowest use at age 25.8. In contrast, males followed a curvilinear trajectory. Specifically, males decreased in their use of focusing on and venting emotions between the ages of 13.5 and 16.7. Males subsequently reported increases in the use of this coping strategy through the age of 21.4, at which point they started decreasing their use of this coping strategy again through the age of 23.9. This decrease was followed by an increase again to peak use at age 25.8.

Discussion

Although many prior studies have examined gender differences in coping with mixed results [2,15,17,19,22], few have considered the role of developmental age in understanding commonalities and differences between males and females in their relative use of strategies to cope with stress. Understanding how the use of coping strategies changes in gender-specific ways across adolescence and emerging adulthood is needed to inform theory and practice, especially given that effective coping is crucial for promoting both mental and physical health in adolescence [3,5]. The current study is novel in its application of TVEM, a powerful method for examining developmental differences across time [25], to address this critical knowledge gap across multiple crucial developmental periods. Importantly, findings from the present study illuminated precisely *how* and *when* the use of distinct coping strategies differed by gender.

Consistent with previous research, increases in the use of coping strategies oriented toward problem solving were observed in both males and females, including planning and active coping, throughout middle-to-late adolescence and emerging adulthood [5,11,14]. These increases may be precipitated by advances in executive functioning and metacognitive abilities that occur simultaneously during these developmental periods [32].

Indeed, the development of these cognitive abilities may enable a more organized, flexible, and targeted approach to coping with stress. Males reported using active coping *less* than females for a brief time during mid-to-late adolescence, which is consistent with prior work examining coping [15]. This finding also is consistent with research suggesting that boys may lag behind girls in some aspects of structural brain development, which may be implicated in their executive functioning [33].

Findings also were consistent with previous work demonstrating that males tend to utilize social support seeking and focusing on and venting emotions less than females to cope with stress [15,34]. However, TVEM analyses indicated that the magnitude of these gender differences changed across time, especially for social support seeking. During a few years in emerging adulthood, males and females did not demonstrate differences in their use of instrumental support seeking, perhaps because of the demands of this time period (for instance, both males and females may rely on more instrumental support when moving away from parents and establishing their own residences for the first time [35,36]). Examining the source of the support (e.g., parental vs. institutional support [15]) may also prove interesting when examining gender differences. Notably, both emotion-focused coping strategies (i.e., emotional support seeking, and focusing on and venting emotions) were utilized least by males during early-to-middle adolescence, a time when the pressures to adhere to the prescribed gender roles of not focusing on emotions are especially strong for males [37].

For the coping strategies discussed previously, males and females tended to diverge most in their use of these strategies in adolescence and then converge by adulthood. Haan [38] theorized that early gender differences in coping strategies would start to dissipate into adulthood as females begin to adopt more masculine characteristics, such as assertiveness and independence, whereas males tend to rethink their relationships and to adopt more empathic behaviors. It also is possible that as individuals develop and gain more experience in coping with stress, they adopt a wider variety of coping strategies and possess greater

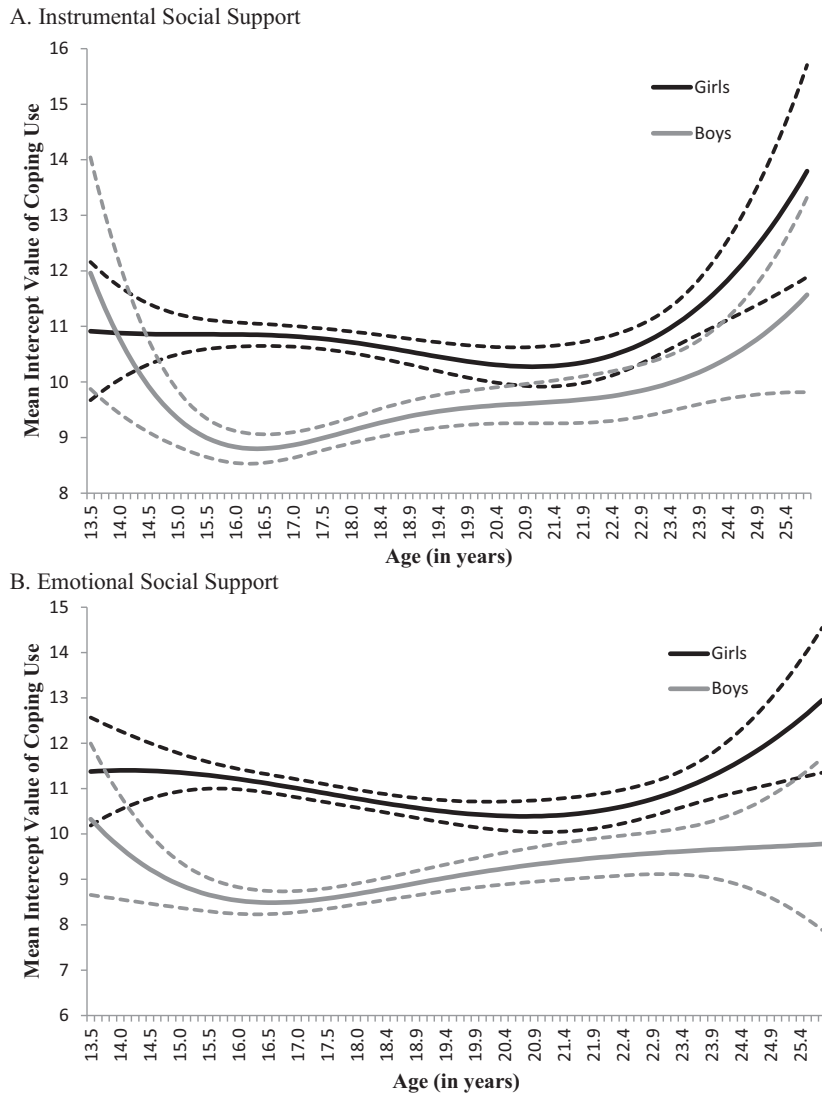


Figure 3. Regression coefficients of the intercept for the use of social support as a coping strategy (A,B) in males and females between 13 and 25 years. Note: The dotted lines represent the 95% confidence intervals around the coefficients. Significant gender differences are present when the confidence intervals do not overlap.

flexibility in their application across a range of problems [5,16,39]. Gender differences still may exist in how males and females apply coping strategies to various problems, as well as in how effective they are, even though they may retain a similar overall repertoire. Additional work is needed to evaluate these hypotheses.

Of note, the use of humor did not follow the pattern described earlier. Although males and females reported similar frequencies of using humor to cope throughout adolescence (with a brief period of males utilizing humor significantly more than females), the greatest divergence occurred in emerging adulthood. This pattern is consistent with research on communication patterns in friendships, in which males increased their use of humor across adolescence and found humor comforting when discussing problems, whereas females did not [40].

The use of denial as a coping strategy was relatively stable throughout adolescence and emerging adulthood. The peak frequency of using denial occurred at age 13.5 for males and females, with a slight decline subsequently observed. This pattern is con-

sistent with studies in which less mature participants were more likely to utilize avoidance strategies to deal with stress [13]. Indeed, denial represents a simplistic, yet maladaptive cognitive avoidance strategy that requires few cognitive abilities and emerges in childhood [5]. It is possible that individuals' continued use of denial stems from its relative ease of implementation, and its slight decline potentially may reflect the increase in more advanced or adaptive coping strategies that individuals learn to rely on more frequently. Of note, there were no gender differences observed at any point throughout adolescence or emerging adulthood in the use of denial.

In sum, the application of TVEM to examine dynamic changes in gender differences in specific coping strategies provided novel developmental information regarding *how* and *when* males and females exhibit commonalities and differences in their responses to stress. The benefits of using TVEM involve the ability to examine change as a continuous function of age, to merge multiple samples, to use cross-sectional and longitudinal data in analyses, and to examine nonparametric functions. However, TVEM

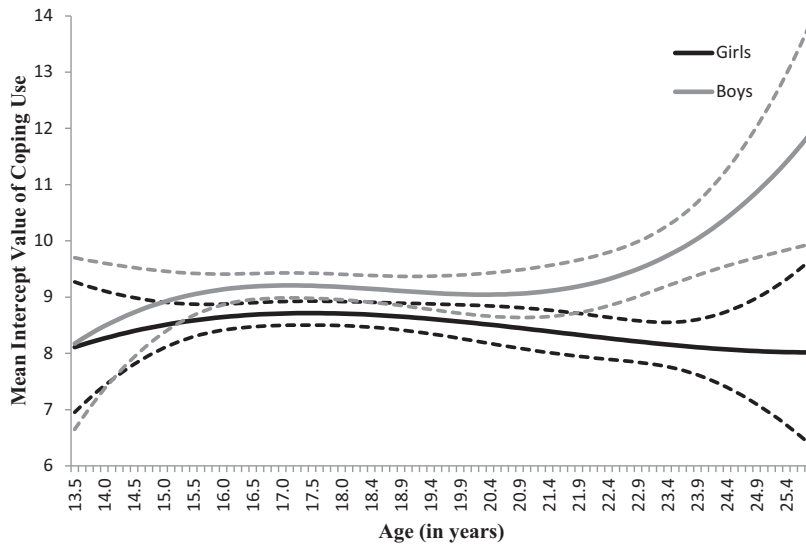


Figure 4. Regression coefficients of the intercept for the use of humor as a coping strategy in males and females between 13 and 25 years. Note: The dotted lines represent the 95% confidence intervals around the coefficients. Significant gender differences are present when the confidence intervals do not overlap.

does limit the assertions we can make regarding causality and developmental change as the estimates provided are derived from cross-sectional intercept values. Additional study strengths include the large sample size, the diverse community sample, the broad age range, and the assessment of numerous individual coping strategies. However, many coping strategies crucial to psychological adjustment were not assessed (e.g., behavioral avoidance, cognitive restructuring, additional forms of social support coping) and should be investigated in additional similar studies using TVEM. Future studies also should aim to assess how coping varies as a function of race/ethnicity, something the current study could not address because of the small subgroups.

Overall, findings from the current study underscore the importance of taking into account developmental age when considering gender differences in coping strategies. The extant literature is mixed in regard to gender differences in coping strategies [5]. The current study demonstrates that this is likely due to the developmental shifts in both the existence and the magnitude of gender differences across this time, making it difficult for cross-sectional studies to consistently identify gender differences. By understanding how the use of dispositional coping strategies develop for males and females across adolescence and emerging adulthood, more targeted gender- and age-sensitive intervention strategies can be recommended. For instance, given

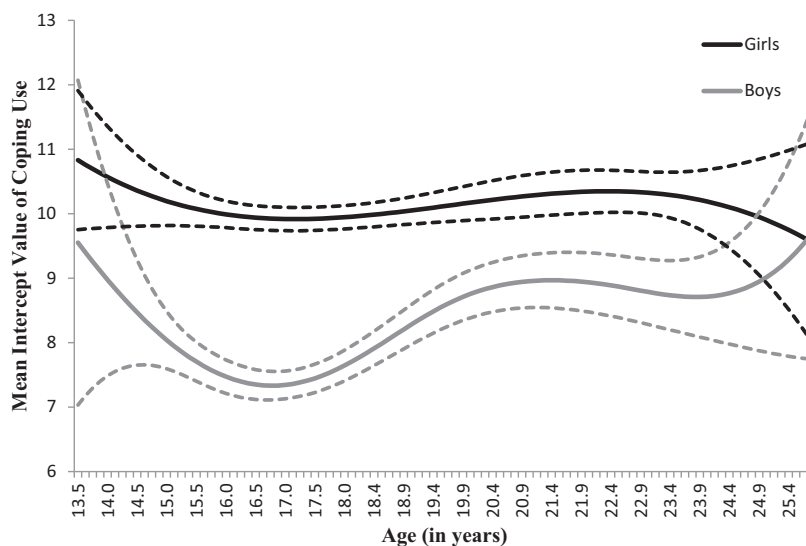


Figure 5. Regression coefficients of the intercept for the use of focusing on and venting emotions as a coping strategy in males and females between 13 and 25 years. Note: The dotted lines represent the 95% confidence intervals around the coefficients. Significant gender differences are present when the confidence intervals do not overlap.

the developmental capabilities of early adolescents, it may be advisable for providers to encourage the adaptive use of social support seeking and humor and to discourage the use of denial, as opposed to encouraging the use of planning or active coping, which may be out of reach based on adolescents' cognitive abilities. Specific intervention efforts may focus on social support seeking during adolescence as an especially important area to bolster for males as they tend to utilize this strategy least during the early adolescent years, especially between ages 15 and 17, despite it being an effective way to cope with problems at this age [2]. Future studies should use TVEM to examine how age-varying associations between coping strategies and psychological adjustment outcomes differ between males and females to facilitate more developmentally tailored interventions with the potential to maximize the public health benefits of mental health treatments with a focus on coping strategies.

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