Exploring Triadic Family Relationship Profiles and Their Implications for Adolescents' Early Substance Initiation

Mengya Xia[1,2] · Bridget B. Weymouth[3] · Bethany C. Bray[4,7] · Melissa A. Lippold[5] · Mark E. Feinberg[6] · Gregory M. Fosco[1,6]

Abstract

This study examined combinations of warmth and hostility in mother-father-adolescent triadic relationships when adolescents were in 6th grade and associations with adolescent middle school substance initiation. We conducted a latent profile analysis with a sample of 687 two-parent families (52.4% of adolescents were female, mean age = 11.27 at 6th grade). These analyses revealed five profiles of triadic relationships, labeled as: cohesive families (46%, high warmth and low hostility in all three dyads), compensatory families (24%, low interparental warmth but high parent-adolescent warmth), disengaged families (13%, average to low warmth and hostility in three dyads), distressed families (9%, high hostility and low warmth in all three dyads), and conflictual families (8%, high hostility and average warmth in all three dyads). There were significant differences across triadic relationship profiles in rate of alcohol initiation during middle school. Specifically, adolescents in distressed families and conflictual families initiated alcohol at higher rates than adolescents in other types of families. Cohesive families and compensatory families initiated alcohol at the lowest rates among all five types of families. Similar patterns appeared for drunkenness and cigarettes. Implications for family-based interventions to decrease adolescent substance use and future research directions are discussed.

Keywords Adolescence · Substance use initiation · Parent-child relationship · Marital relationship · Family conflict · Triadic family relationships · Latent profile analysis

Introduction

Adolescents' early substance initiation is a major public health concern. Considerable evidence implicates that early substance initiation is a long-term risk factor for substance use disorders, mental health problems, lower levels of educational attainment, and more criminal involvement by adulthood (Chassin et al. 2009; Gordon et al. 2004; King et al. 2006). Early substance use is also associated with a broad range of health risks, such as a higher probability of being in a motor

✉ Mengya Xia
  mxia3@ua.edu

1 Human Development and Family Studies, The Pennsylvania State University, State College, PA, USA

2 Department of Psychology, The University of Alabama, Tuscaloosa, AL, USA

3 Human Development and Family Studies, The University of Alabama, Tuscaloosa, AL, USA

4 The Methodology Center, The Pennsylvania State University, State College, PA, USA

5 School of Social Work, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

6 The Edna Bennett Pierce Prevention Research Center, The Pennsylvania State University, State College, PA, USA

7 Center for Dissemination and Implementation Science, The University of Illinois at Chicago, Chicago, IL, USA

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vehicle accident or engaging in health-risking sexual behavior (Hingson et al. 2009; Tapert et al. 2001). The multitude of negative consequences of early substance use calls for considerable effort to characterize family risk and protective factors that can be leveraged for the prevention of early substance initiation during adolescence (DuRant et al. 1999; Nguyen-Louie et al. 2017).

Warmth and hostility are two key affective qualities of family relationships that explain a substantial portion of adolescent risk for substance use (e.g., Kumpfer et al. 2003; Lippold et al. 2018; NIDA 2014). Warm and supportive family relationships help build strong family bonds, foster feelings of connectedness to parents, and help keep adolescents engaged with their family (thereby minimizing their exposure to and influence of problematic peer groups). Adolescents who form strong family bonds are more likely to adhere to family rules and regulations and thus avoid substance use behaviors (Foxcroft and Lowe 1991; Hawkins et al. 1992; Vakalahi 2001; Visser et al. 2012). This body of evidence underscores the protective role of parent-adolescent relationships that are characterized by trust, closeness, and affection in reducing rates of early substance initiation and the frequency of use (Ackard et al. 2006; Fosco et al. 2012; Horton and Gil 2008; Hung et al. 2009; Parker and Benson 2004; Resnick et al. 1997; Shelton and Van Den Bree 2010; Yap et al. 2017).

Family hostility, often characterized by coercive interactions that may include frequent anger, swearing, and contempt, is an important risk factor for early substance initiation and escalation across development. Adolescents in families with more hostility may develop more aggressive interpersonal behaviors (Fosco et al. 2014), an increased tendency for affiliations with antisocial peers (Dishion et al. 2015), and a greater likelihood of engaging in substance use (e.g., Dishion and Owen 2002; Van Ryzin and Dishion 2014). Accumulating evidence shows that family hostility is an important risk factor for early substance initiation and escalation in binge drinking, tobacco use, and long-term risk for substance use disorders (Hung et al. 2009; Ryan et al. 2010; Skeer et al. 2009).

More recently, other work indicates that interparental conflict may also be a risk factor for adolescent substance use. Conflict and tension in interparental relationships may spill over into parent-adolescent relationships. Specifically, parents who are hostile to each other are less warm to adolescents and more likely to use harsh discipline, which, in turn, increases adolescents' risk of engaging in problematic behaviors (Benson et al. 2008; Krishnakumar and Buehler 2000). High levels of interparental conflict also increase adolescents' feeling of threat, self-blame, and sense of helplessness, which are direct predictors for adolescent substance use (Fosco and Feinberg 2018; Kaplan 1975; Shagle and Barber 1993). However, little is known about how interparental positivity influence adolescent substance use behaviors.

With warmth and hostility in different family relationships now independently established as key predictors of substance use risk, it is important to integrate these processes into a more holistic conceptualization of family functioning. From a family systems viewpoint, families are comprised of multiple, interacting subsystems (Cox and Paley 1997; Minuchin 1985), but the effect of various family constellations of warmth and hostility on adolescent substance use is not well-known. Capturing the interplay of warmth and hostility in multiple family relationships enables us to explore how protective and risk factors of adolescent substance use work in the context of each other and how families function as integrative systems to influence early adolescent substance use initiation. Such information could guide tailoring of interventions to maximize fit for families exhibiting different constellations of risk or protective factors for adolescent substance use.

Prior work focusing on family relationship processes offers guidance about the potential configurations of warmth and hostility that might occur in family systems (e.g., Kerig 1995; Minuchin 1974). *Cohesive families* tend to exhibit warmth and closeness among family members and low levels of hostility in family relationships (Davies et al. 2004; Sturge-Apple et al. 2010). Conversely, *distressed families* tend to exhibit less warmth and affection in family relationships while simultaneously engaging in hostile and unsupportive behaviors toward each other (Gilbert et al. 1984). *Conflictual families* also exhibit high levels of hostility, but family members still display moderate levels of warmth and connection toward each other. This may reflect a general hostile interactive pattern in the family, or it might be due to family-level conflict or conflict in one dyad that spills over into other dyadic relationships (Fosco et al. 2014; Gerard et al. 2006). In contrast, *disengaged families* tend not to interact with each other—either affectionately or in conflict. Family members act as unrelated individuals who make independent decisions for themselves, and children's needs of belonging and connectedness are typically not satisfied in these families (Kerig 1995; Olson 2000). In summary, we expect to see four constellations of warmth and hostility in mother-father, mother-adolescent, and father-adolescent dyads: (1) cohesive families, where families have high levels of warmth and low levels of hostility in all three dyads, (2) distressed families, where families have low levels of warmth and high levels of hostility in all three dyads, (3) conflictual families, where families have high levels of hostility in all three dyads and moderate levels of warmth, and (4) disengaged families, where family members display low levels of warmth and hostility in all three dyads.

These family constellations may have different implications for adolescent substance use. Adolescents from cohesive families have a strong sense of belonging and feel most secure and connected in the family, contributing to better peer

relationships and greater adherence to family rules. Thus, adolescents in cohesive families are at the lowest risk of initiating substance use early (Hawkins et al. 1992; Vakalahi 2001). Conversely, adolescents from distressed and conflictual families may frequently perceive threat and feel insecure and helpless, which would increase the likelihood of their using substances as a maladaptive means of coping with stressful family experiences (Fosco and Feinberg 2018; Kaplan 1975; Skeer et al. 2009). Thus, they are thought to be at the highest risk of initiating substance use early. Finally, adolescents from disengaged families receive less nurturing and supervision and feel less connected to their family. Thus, they are also at high risk of affiliating with antisocial peers and engaging in problem behaviors, including early substance use initiation (e.g., Fosco and LoBraico In press; Friedman et al. 1987; Van Ryzin et al. 2012).

Person-centered, pattern-based approaches are recommended to capture multiple configurations of warmth and hostility in family systems (e.g., Maughan and Cicchetti 2002; Sturge-Apple et al. 2010; Sturge-Apple et al. 2014). Traditional variable-centered approaches can model the cumulative effects of multiple predictors and the relative contribution of warmth and hostility in each dyadic relationship in predicting substance use. In comparison, pattern-based analyses can model the heterogeneity among family constellations of warmth and hostility across multiple family subsystems and their association with early substance initiation. By examining the interplay between family subsystems, pattern-based analyses provide the opportunity to obtain a holistic view of family system functioning (Davies et al. 2004; Lippold et al. 2014; Sturge-Apple et al. 2010; Sturge-Apple et al. 2014). As a result, the identified mother-father-adolescent triadic relationship patterns reflect family system functioning and relationship processes between these subsystems, which may offer new insights into family systems' influence on adolescent early substance initiation and implications for family-based intervention design and implementation.

The Current Study

The current study has two primary goals. Our first goal was to identify distinct patterns of warmth and hostility in mother-father-adolescent triadic relationships. Second, we evaluated whether there were unique implications of family relationship patterns for adolescent initiation of alcohol, drunkenness, cigarettes, marijuana, inhalants, and hard drugs during middle school.

Guided by family systems theory and work delineating spillover and compensatory family processes (Minuchin 1974; Erel and Burman 1995), we expected analyses to yield four profiles of triadic relationship patterns: (1) cohesive families, characterized by high levels of warmth in all three dyads; (2) distressed families, characterized by low levels of warmth

and high levels of hostility in all three dyads; (3) conflictual families, characterized by high levels of hostility and moderate levels of warmth in all three dyads; and (4) disengaged families, characterized by low levels of warmth and low levels of hostility in all three dyads.

Regarding the associations between family constellations and early adolescent substance initiation, we expected that (1) adolescents from cohesive family constellations will exhibit the lowest rates of early substance initiation, (2) adolescents from distressed and conflictual family constellations will exhibit the highest rates of early substance initiation, and (3) adolescents from disengaged family constellations will exhibit high rates of early substance initiation.

Methods

Participants and Procedures

Data were from the Promoting School-Community-University Partnerships to Enhance Resilience (PROSPER) project (Spoth et al. 2004): a partnership-based delivery system for evidence-based preventive interventions. The project recruited 28 school districts from Iowa and Pennsylvania and involved two cohorts of 6th grade students and their families (designated Cohort 1 during 2002 fall and Cohort 2 during 2003 fall). Eligible communities had (a) school district enrollment from 1300 to 5200 and (b) at least 15% of the student population eligible for free or reduced-cost lunches. Data were collected during fall and spring of 6th grade, followed by yearly assessments every spring until 12th grade. A total of 10,849 youth and families completed baseline assessments (approximately 90% of those eligible). On average, 88% of all eligible students completed follow-up surveys across the spring of 6th to 12th grades, with slightly higher rates of participation at earlier data collection points.

Communities were blocked on school district size (enrollment) and geographic location, and then they were randomly assigned to intervention and control conditions. In the control condition, students received "normal programing" at school and were not involved in either school-based or family-focused intervention. In the intervention condition, both a school-based intervention and a family-focused intervention were assigned. The school-based intervention was implemented in 7th grade; four communities selected Life Skills Training, four selected Project Alert, and six selected the All Stars curriculum. For the family-focused intervention, all communities selected the Strengthening Families Program: For Parents and Youth 10–14 (SFP 10–14), which occurred in 6th grade after baseline assessment. Families in the intervention condition self-selected to receive family-focused intervention or not (for more detail, see Spoth et al. 2004).

A random sample of 2267 families from Cohort 2 were invited to participate in in-home family assessments. In-home assessments were completed by 980 (43%) of families, which included a family interview and written questionnaires completed independently by the adolescent, mother, and, if present, father. A subsample of two-parent families ($n = 687$) from the in-home assessment sample was used in this study. Adolescents in this subsample were 11.27 years old on average ($SD = 0.49$) during 6th grade. Females comprised 52.4% ($n = 360$) of the sample. Adolescents identified their race as White (88.9%), Latino or Hispanic (6.3%), African American (1.2%), Asian or Pacific Islander (0.6%), or Other (1.9%; 1.2% were missing data on race). Annual family income ranged from $9 to $362,661 (*Median* = $55,000 in 2003); parent education level ranged from "completed 2nd grade" to "Master's plus" with 68% having completed a high school education. The intervention group comprised 59.8% ($n = 411$) of the sample. Adolescents' substance use initiation data were gathered from the 8th grade assessment (average age = 13.87), with good sample retention (81.8% remained, $n = 562$). Little's test (Little 1988) indicated that data were missing completely at random ($\chi^2[364] = 373.218$, $p = .358$).

Measures

Parent-Adolescent and Interparental Warmth (6th Grade)

We assessed warmth in mother-adolescent, father-adolescent, and mother-father dyads. Both individuals in a given dyad reported on their warmth toward the other and the warmth they received from the other using three items (six items in total for each individual) of positive affective quality from the Affective Quality of the Relationship Scale (AQRS; Spoth et al. 1998). These items included the following: during the past month, how often did you (your child/partner) (1) "let this child/partner know you really care about him/her (let you know he/she really cares about you)", (2) "let this child/partner know that you appreciate him/her, his/her ideas, or the things he/she does (let you know that he/she appreciates you, your ideas, or the things you do)", and (3) "act loving and affectionate toward him/her (act loving and affectionate toward you)". Items were rated on a 7-point Likert-type scale from *always* (1) to *never* (7). Responses from the same reporter were averaged across items, resulting in six scale scores for each dyad: mother reported mother-adolescent warmth; adolescent reported mother-adolescent warmth; father reported father-adolescent warmth; adolescent reported father-adolescent warmth; mother reported mother-father warmth; and father reported mother-father warmth. These six scores (αs = .79 to

.92) were reverse-coded so that higher values indicated more warmth in the dyad.

Parent-Adolescent and Interparental Hostility (6th Grade)

Similar to the assessment of warmth, hostility in three dyads were assessed by items of negative affective quality from the AQRS. Both individuals in each dyad reported on their hostility toward the other and the hostility they received from the other using three items (six items in total for each individual): During the past month, how often did you (your child/partner) (1) "get angry at him/her (get angry at you)", (2) "shout or yell at this child/partner because you were mad at him/her (shout or yell at you)", and (3) "yell, insult, or swear at him/her when you disagreed (insult or swear at you)". Items were rated on a 7-point Likert-type scale from *always* (1) to *never* (7). Using the same approach as for warmth, six reverse-coded scale scores of dyad hostility were created: mother reported mother-adolescent hostility; adolescent reported mother-adolescent hostility; father reported father-adolescent hostility; adolescent reported father-adolescent hostility; mother reported mother-father hostility; and father reported mother-father hostility. Higher values on these scores indicate more hostility in the dyad (αs = .55 to .86).

Substance Use Initiation (8th Grade) Six types of substance use initiation—alcohol, drunkenness, cigarettes, marijuana, inhalants, and hard drugs—were reported by adolescents when they were in 8th grade (Spoth et al. 2001). The questions used were as follows: (1) "Have you ever drunk more than just a few sips of alcohol?"; (2) "Have you ever been drunk from drinking alcohol?"; (3) "Have you ever smoked a cigarette?"; (4) "Have you ever smoked marijuana (grass, pot) or hashish (hash)?"; (5) "Have you ever sniffed glue, paint, gas or other things you inhale to get high?"; and (6) "Have you ever used hard drugs or medications that were prescribe by a doctor or someone else?". Each dichotomous item (0 = no; 1 = yes) was used individually in our analysis.

Analysis Plan

Data analysis proceeded in two steps. The first step used latent profile analysis (LPA) to identify and describe latent profiles of mother-father-adolescent triadic relationships using the indicators of warmth and hostility from each reporter in 6th grade. The second step determined whether profile membership was related to initiation of alcohol, drunkenness, cigarettes, marijuana, inhalants, or hard drugs between 6th grade and 8th grade (i.e., middle school). The first step used the full analytic sample ($n = 687$) to maximize power for identifying latent profiles. The second step was based on those who completed the

8th grade assessment ($n = 562$) and analyses for each substance included only those adolescents who had not yet initiated that substance at baseline (Ellickson et al. 2004; Spoth et al. 2002). Additional analyses indicated that family profile membership was not significantly different between families that were retained and families that were not retained at 8th grade.

LPA uses the configuration of continuous manifest indicators to categorize a population into a set of mutually exclusive and exhaustive subgroups (i.e., latent profiles; Gibson 1959; Lazarsfeld and Henry 1968). It is an ideal approach for identifying patterns of triadic relationships in this study because it can simultaneously consider three dyads within families (i.e., mother-adolescent, father-adolescent, and mother-father) and multiple dimensions of relationships (i.e., warmth and hostility) while also accounting for measurement error. LPAs are interpreted using two sets of parameters: latent profile membership probabilities and item-response means (and variances). Latent profile membership probabilities (i.e., profile prevalences) describe the distribution of the profiles in the population. Item-response means (and variances) describe the means (and variances) of the items within each profile and are used to name the profiles.

Model selection was based on the consideration of three aspects: (1) model identification/stability, (2) statistical fit criteria, and (3) theoretical interpretability. Statistical fit criteria include the Akaike information criterion (AIC; Akaike 1974), Bayesian information criterion (BIC; Schwarz 1978), sample-size adjusted BIC (a-BIC; Sclove 1987), entropy (Celeux and Soromenho 1996), and a bootstrapped likelihood ratio test (BLRT; McLachlan 1987; McLachlan and Peel 2000). More optimal model fit is indicated by lower AIC, BIC, and a-BIC. High classification utility is indicated by higher entropy. A significant BLRT indicates that the model fits significantly better than a model with one fewer profiles. The selected optimal model should be well-identified, and each

identified profile should be theoretically distinct and meaningful. All models were estimated using Mplus version 7.3 (Muthén and Muthén 1998-2015). Model identification was checked with 500 initial and 100 final stage starts.

After identification of the triadic relationship profiles, profile membership was used to predict substance use initiation using the "BCH approach" (Bakk and Vermunt 2016; Vermunt 2010), which is currently viewed as the optimal approach to predicting distal outcomes in LPA (Asparouhov and Muthén 2015; Bakk and Vermunt 2016; Dziak et al. 2016). An overall test, similar to an overall test in an analysis of variance, indicated whether there were significant differences among all latent profiles; pairwise difference tests indicated whether probabilities of substance use initiation were significantly different between any two profiles.

Results

Triadic Relationship Profiles: Identification and Description

Model fit information and model selection criteria are shown in Table 1. Models with 1 to 7 profiles were compared; models with more than 7 profiles were not considered due to poor model identification. The AIC, BIC, and a-BIC were not minimized, but their relative reductions decreased around the 5- or 6-profile model. Entropy ranged from .85 (5-profile model) to .91 (4-profile model), and the BLRTs showed significant p-values for all models, indicating that all models fit significantly better than the model with one fewer profiles. Given the limited information provided by the fit information and selection criteria, we considered models with 4, 5, and 6 profiles, and the optimal model was selected among them based on profile distinctiveness, theoretical interpretability, and profile sizes.

Table 1 Model fit information and selection criteria for latent profile models

No. of profiles	Log-likelihood	No. of parameters estimated	AIC	BIC	a-BIC	Entropy	BLRT
1	−12,370.31	24	24,788.62	24,897.39	24,821.19	−	−
2	−10,214.12	37	20,502.23	20,669.93	20,552.45	0.88	< .001
3	−9983.33	50	20,066.65	20,293.27	20,134.51	0.91	< .001
4	−9814.16	63	19,754.32	20,039.86	19,839.82	0.91	< .001
5	**−9683.91**	**76**	**19,519.82**	**19,864.28**	**19,622.97**	**0.85**	**< .001**
6	−9574.78	89	19,327.55	19,730.93	19,448.34	0.86	< .001
7	−9481.73	102	19,167.47	19,629.76	19,305.90	0.88	< .001

AIC Akaike information criterion, *BIC* Bayesian information criterion, *a-BIC* sample size adjusted BIC, *BLRT* bootstrapped likelihood ratio test. Dashes indicate criterion was not applicable; bold line indicates selected model

All profiles from the 4-profile model appeared in the 5- and 6-profile models. Each of the profiles in 5-profile model was adequately sized for identifying family constellations and associations with substance initiation outcomes (smallest profile contained 56 families). The additional profile that emerged in the 5-profile model (compared to the 4-profile model) was qualitatively unique, theoretically interpretable, and large enough to warrant generalization (24%, $n = 168$). In contrast, the additional profile that emerged in the 6-profile model (compared to the 5-profile model) was conceptually indistinguishable from an existing profile in the 5-profile model and had a small prevalence (4%, $n = 28$), which suggested the identification of this additional profile was redundant and unnecessary. Therefore, the 5-profile model was selected as an optimal balance of theoretical interpretability and statistical fit for further analysis.

Overall item means and parameter estimates for the 5-profile model are shown in Table 2. Standardized mean differences are reported for each indicator within each profile, indicating the effect size of the difference between an item response mean and the overall sample mean. The four hypothesized profiles emerged—cohesive, distressed, conflictual, and disengaged—along with a fifth profile we termed compensatory families. The first profile (46% of the sample) was characterized by high warmth and low hostility (compared with their respective sample means) in all three dyads, which

is consistent with *cohesive families*. The second profile (9%) was characterized by low warmth and high hostility in all dyads and was thus labeled *distressed families*. The third profile (8%) was characterized by high hostility and average to low warmth in all dyads, consistent with *conflictual families*. The fourth profile 2 (13%) was characterized by low warmth and low hostility in all dyads and fit with the label *disengaged families*. The fifth profile (24%) was characterized by low warmth in mother-father dyads and adolescent-perceived high warmth from both parents, which was labeled *compensatory families*.

Links Between Profile Membership and Substance Use Initiation

The links between profile membership in fall of 6th grade and six types of substance use initiation between fall of 6th grade and spring of 8th grade are presented in Table 3. Table entries show the proportions of initiation within each profile, as well as the overall proportions in the analytic samples for comparison. For example, in the first row, we report the percent of adolescents—28% in the overall analytic sample ($n = 538$), 22% in cohesive families, 54% in distressed families, 50% in conflictual families, 33% in disengaged families, and 22% in compensatory families—who reported alcohol use initiation. An overall likelihood ratio test indicated that family

Table 2 Parameter estimates for the five-profile model

Latent Profile Membership Probabilities		1 Cohesive $n = 317(.46)$	2 Distressed $n = 60(.09)$	3 Conflictual $n = 56(.08)$	4 Disengaged $n = 86(.13)$	5 Compensatory $n = 168(.24)$
	Overall item means (SDs)	Item-response means [Standardized mean differences]				
Mother-adolescent interactions						
M-A Warmth (M)	5.79(0.91)	6.11[a][0.35]	5.34[b][− 0.49]	5.60 [− 0.21]	5.13[b][− 0.73]	5.77 [0.02]
M-A Warmth (A)	6.03(1.05)	6.50[a][0.48]	5.33[b][− 0.67]	5.83 [− 0.19]	4.25[b][− 1.70]	6.37[a][0.32]
M-A Hostility (M)	2.11(0.75)	1.77[b][− 0.45]	2.90[a][1.05]	2.89[a][1.04]	2.18 [0.09]	2.17 [0.08]
M-A Hostility (A)	1.97(0.84)	1.60[b][− 0.44]	2.32[a][0.42]	3.49[a][1.81]	2.18[a][0.25]	1.95 [− 0.02]
Father-adolescent interactions						
F-A Warmth (F)	5.14(1.12)	5.65[a][0.46]	4.53[b][− 0.54]	4.43[b][− 0.63]	4.40[b][− 0.66]	5.00 [− 0.13]
F-A Warmth (A)	5.84(1.35)	6.49[a][0.48]	4.70[b][− 0.84]	5.08[b][− 0.56]	3.91[b][− 1.43]	6.26[a][0.31]
F-A Hostility (F)	2.06(0.71)	1.73[b][− 0.46]	2.67[a][0.85]	3.01[a][1.34]	1.98 [− 0.11]	2.20 [0.20]
F-A Hostility (A)	1.77(0.82)	1.38[b][− 0.48]	2.22[a][0.55]	3.69[a][2.34]	1.86 [0.11]	1.64 [− 0.16]
Mother-father interactions						
M-F Warmth (F)	5.27(1.15)	5.93[a][0.57]	4.01[b][−1.10]	5.28 [0.01]	5.01 [−0.23]	4.60[b][−0.58]
M-F Warmth (M)	5.41(1.19)	6.01[a][0.50]	3.90[b][−2.70]	5.45 [0.03]	5.23 [−0.15]	4.95[b][−0.39]
M-F Hostility (F)	2.15(0.87)	1.68[b][−0.54]	3.58[a][1.64]	2.54[a][0.45]	1.85[b][−0.34]	2.54[a][0.45]
M-F Hostility (M)	2.10(0.96)	1.62[b][−0.50]	4.11[a][2.09]	2.43[a][0.34]	1.82[b][−0.29]	2.30 [0.21]

M-A adolescent-mother dyad, *F-A* adolescent-father dyad, *M-F* mother-father dyad, *(M/F/A)* mother/father/adolescent report

[a] Value is statistically significantly higher than the overall item mean at $p < .05$

[b] Value is statistically significantly lower than the overall item mean at $p < .05$

Table 3 Proportions of profile members with substance use initiation between 6th and 8th grades

	Overall %(n) reporting use	1 Cohesive	2 Distressed	3 Conflictual	4 Disengaged	5 Compensatory	Overall test χ^2(p value)	Pairwise comparisons
Alcohol	.28(148)	.22[d]	.54[a]	.50[b]	.33[c]	.22[d]	24.28($p<.001$)	1, 5 < 2, 3; 4 < 2
Drunkenness[†]	.11(60)	.08[d]	.31[a]	.28[b]	.09[c]	.06[e]	–	–
Cigarettes[†]	.14(75)	.10[d]	.33[b]	.39[a]	.13[c]	.09[e]	–	–
Marijuana[†]	.05(30)	.06	.00	.20	.08	.01	–	–
Inhalants[†]	.05(26)	.05	.05	.14	.03	.03	–	——
Hard Drugs[†]	.09(49)	.07	.09	.24	.10	.10	–	–

Analytic sample sizes for the outcomes were n (ever use alcohol) = 538, n (ever drunkenness) = 557, n (ever use cigarettes) = 538, n (ever use marijuana) = 557, n (ever use inhalants) = 542, and n (ever use hard drugs) = 526. Rank order not reported when overall initiation was less than 10%

[†] Expected frequencies for some classes are too small for trustworthy significance testing of the contingency table. Overall and pairwise significance tests are not reported

[a] Value is rank order 1st (high to low) among the five profiles for initiation of that substance

[b] Value is rank order 2nd (high to low) among the five profiles for initiation of that substance

[c] Value is rank order 3rd (high to low) among the five profiles for initiation of that substance

[d] Value is rank order 4th (high to low) among the five profiles for initiation of that substance

[e] Value is rank order 5th (high to low) among the five profiles for initiation of that substance

profile membership was significantly related to initiation of alcohol ($\chi^2 = 24.28$, $p < .001$). Pairwise comparisons showed that alcohol initiation was lowest for adolescents in cohesive (22%) and compensatory (22%) and highest in distressed (54%) and conflictual (50%) family profiles. Although low expected frequencies of the outcomes for certain classes prevented formal significance testing for the other substances, similar patterns in the rank ordering of risk for initiation were exhibited for drunkenness and cigarettes. In addition, post-hoc analyses that included T1 substance initiators were compared with the presented analysis (i.e., T1 substance initiators coded as missing); nearly identical results were obtained.

Discussion

Although the associations between family relationship quality and adolescent substance use are well-established, prior work has typically focused on warmth or hostility in specific relationships (i.e., parent-adolescent, interparental), leaving less known about how the family as a whole—drawing on constellations of warmth and hostility among the three dyads—predicts adolescents' early substance use initiation. This study used person-centered, pattern-based analyses to examine the different constellations of warmth and hostility in mother-father-adolescent triadic relationships during early adolescence and further evaluated their associations with adolescents' substance use initiation during middle school.

Our findings revealed five family profiles, based on constellations of warmth and hostility across dyads in the mother-father-adolescent triad: cohesive, distressed, conflictual,

disengaged, and compensatory families. Consistent with our expectations, cohesive families had high levels of warmth and low levels of hostility in all three dyads and were the most prevalent (46%) family subgroup in the sample. As hypothesized, distressed families had low levels of warmth and high levels of hostility in all three dyads, which is slightly different from conflictual families—another profile that had high levels of hostility but moderate levels of warmth in all three dyads. Both profiles with high levels of hostility were least prevalent (9% and 8%, respectively). Moreover, disengaged families (13%) were characterized by low levels of warmth and hostility in all three dyads as expected. Finally, we found one additional profile—compensatory families—which was characterized by less warm interparental relationships, but adolescents perceived high levels of warmth from both parents. Consistent with prior work demonstrating the compensatory hypothesis, this pattern may reflect a dynamic in which parents seek fulfillment of warmth and love in parent-adolescent subsystems to compensate for deficiencies in interparental subsystems (Erel and Burman 1995; Sturge-Apple et al. 2014).

Our results demonstrated nuanced differences between these family profiles, enabled by including warmth and hostility in all three dyads from multiple family members' perspectives. By examining the co-occurrence of warmth and hostility, we were able to distinguish distressed families (with low levels of warmth) from conflictual families (with moderate levels of warmth). Moreover, simultaneously including multiple family relationships enabled the comparison of relative magnitudes of warmth and hostility in three dyads that may imply unique family processes in different family constellations. In conflictual families, the moderate warmth in

three dyads may indicate that these family systems still function adequately, but parents in these families tend to use hostile parenting behaviors frequently (indicated by the particularly high levels of parent-adolescent hostility). In distressed families, the combination of low warmth and high hostility in all three dyads depicted dysfunctional family systems, and the especially high levels of interparental hostility might reflect how distress in the interparental relationship spills over to the whole family. This finding might highlight the primacy of interparental relationship in family system functioning (Kerig 1995; Minuchin 1974). Additionally, by using multi-informant data, we are able to capture family members' unique perceptions of warmth and hostility. Consistent with prior work, our findings showed that in some families (i.e., compensatory families), adolescents and parents have different perceptions of their dyadic warmth (Lippold et al. 2014).

By identifying constellations of risk and protective processes in families, it was possible to identify adolescents at risk for substance initiation during middle school (e.g., alcohol). As hypothesized, adolescents from distressed and conflictual families were at the highest risk for early substance use initiation, which is consistent with prior work showing that overall hostile family climate is associated with increases in adolescents' substance use behaviors (Hung et al. 2009; Skeer et al. 2009). More specifically, family hostility, either derived from hostile parenting behaviors (in conflictual families) or as a result of family system dysfunction (in distressed families), is a risk factor for adolescents disengaging from family and developing problematic behaviors, such as engaging in substance use. These findings suggest that interventions for reducing early substance use initiation need to address family issues in promoting effective parenting strategies as well as strengthening family system functioning. It is worth noting that different levels of warmth in conflictual families (moderate) and distressed families (low) were not associated with a significant difference in adolescent early substance initiation. It may support the "swamping" effect that the protective effect of warmth is diminished when hostility is extremely high (Solmeyer and Feinberg 2011), or it may suggest that a conflictual family relationship pattern regardless of warmth levels is a significant risk factor for adolescent early substance initiation. Future research is needed to clarify the possible processes.

On the other hand, adolescents who experienced high levels of warmth in their families, specifically cohesive and compensatory families, were at lower risk of alcohol initiation during middle school. Compared with compensatory families, cohesive families exhibited significantly higher levels of warmth in interparental relationships and parents' perceptions of parent-adolescent relationships; however, adolescents in cohesive families were not significantly different from adolescents in compensatory families in terms of their early substance initiation. This finding suggests that, in the context of

average to low levels of hostile family climate, adolescents' perception of being treated warmly by their parents is a key protective factor for early substance initiation, which supports a risk-focused model in which adolescents' sense of belonging and connection serves as a strong protective factor for preventing adolescent substance use (Hawkins et al. 1992). Based on this finding, we stress the value of considering adolescents' subjective sense of connection and closeness to parents and facilitating parents' affection, warmth, and support to their adolescent child in family-based substance use intervention designs.

Considering the negative life course implications of early adolescent substance initiation, it is valuable to identify developmental precursors in the family context for its prevention (Odgers et al. 2008). Our results have shown that there are differences across the identified family profiles in 6th grade in rates of early substance use initiation during middle school. Thus, this study supports the idea that family interventions aiming to change integrative family relationship dynamics as early as grade 6 have potential to make later impacts on substance use (Fosco and Feinberg 2018; Van Ryzin et al. 2012). Given the low initiation rates of drunkenness, cigarettes, marijuana, inhalants, and hard drugs between 6th grade and 8th grade in our sample, limited conclusions can be drawn about the associations between family constellations and early substance use initiation; further investigation in future work is needed.

There are several limitations to this study. First, generalizability of findings is limited by the sample of primarily rural and semirural, White families. It is important to replicate the study in more diverse samples to determine how findings can be generalized to other cultural and ethnical populations. Moreover, this study focused on mother-father-adolescent triadic relationships to get a holistic conceptualization of family functioning, which limited our sample to traditional two-parent families. Future research should account for the influence of different family types to get a nuanced understanding on how relevant factors (e.g., split-household families, families with extended-family caregivers, single-parent families) would potentially differ the association between constellations of warmth and hostility in family and adolescent substance use. Additionally, the influences of other important relationships, such as sibling relationships and peer relationships, will be important to consider and will provide a more complete picture of how warmth and hostility in multiple interpersonal relationships simultaneously influence adolescent substance use.

Beyond evaluating the implications of family system functioning for adolescent substance use, our findings also suggest important implications for family-based preventive intervention design, high-risk population identification, and the implementation timing of early substance initiation interventions. First, family-based interventions may be more effective if it

targets the change in the relationship pattern at the family level instead of focusing on one of the dyadic subsystem at a time. Second, identifying high-risk family constellations of early substance initiation and maximizing the fit between families and interventions may promote the effectiveness of family-based substance use intervention. Finally, family-based interventions aiming to change integrative family relationship dynamics as early as 6th grade have potential to make later impacts on adolescent early substance initiation.

Compliance with Ethical Standards

Conflict of Interest   The authors declare that they have no conflicts of interest.

Research Involving Human Participants   All procedures performed in the study involving human participants were approved by PSU Institutional Review Board # PRAMS00038100 and were in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent   All youths and families were informed about and consented to participate in this project.

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