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# Dynamics of Sibling Relationships Over Time: a Latent Transition Analysis

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## Abstract

Sibling relationships are key to social and emotional development, yet their longitudinal dynamics remain underexplored. This study examined stability and change in sibling relationship profiles among 498 children aged 8–14 from the German Family Panel (pairfam). Four dimensions (affection, hostility, conflict resolution, rivalry) were assessed at two time points two years apart. Latent profile analyses identified five profiles: harmonious, affect-intense, uninvolved, hostile, and rival, with measurement invariance across time. Latent transition analysis showed high stability for harmonious relationships, while other profiles were more fluid. Logistic regression indicated that a harmonious profile predicted stability, whereas demographic factors were not significant. Findings highlight both the persistence of positive sibling bonds and the developmental plasticity of less adaptive relationships.


## Introduction

Sibling relationships are among the most enduring and influential social bonds in human life. They encompass a wide spectrum of experiences - from affection and support to conflict and rivalry - making them powerful contexts for social and emotional development. Understanding the complexity of sibling relationships is essential for comprehending how they shape well-being across the lifespan. Yet, despite their ubiquity, little is known about how distinct constellations of affection, conflict resolution, hostility, and rivalry remain stable or change across time.

Research has demonstrated that positive sibling relationships, characterized by warmth, support, and cooperation, have been linked to numerous benefits for individuals' well-being and development. These relationships serve as important sources of emotional support, companionship, and social learning. Children who experience positive sibling interactions tend to develop stronger social skills, empathy, and emotional regulation abilities (Brody, 2004). Moreover, supportive sibling relationships can buffer the effects of stress and adversity, promoting resilience and psychological adjustment in both childhood and adulthood (Buist & Vermande, 2014; McHale et al., 2012). Conversely, negative sibling relationships, marked by conflict, rivalry, and hostility, can have detrimental effects on individuals' well-being and development. Persistent sibling conflict has been associated with increased levels of psychological distress, aggression, and behavioral problems (Buist & Vermande, 2014; Natsuaki et al., 2009).

Still, the dichotomous view of sibling relationships as either positive or negative fails to capture the complexity and variability within these relationships. Recent research emphasizes the importance of examining the diverse patterns of sibling relationships, considering factors such as affection, conflict, and emotional closeness (Killoren et al., 2017; McGuire et al., 1996; McHale et al., 2007).

Importantly, the present study builds on prior work demonstrating that sibling relationship processes cannot be reduced to the mere frequency of conflict but must also consider how conflicts are managed. Research distinguishes between constructive and destructive conflict resolution strategies, which show differential associations with relational quality and developmental outcomes (Ferrar et al., 2022; Ross et al., 2006; Szymańska, 2020). Furthermore, constructs such as rivalry capture competitive and comparison-based dynamics that are conceptually distinct from hostility or conflict behavior (e.g., resource competition and jealousy; McHale et al., 2012, Tucker et al., 2013). In line with broader efforts to move beyond global warmth-conflict frameworks toward more differentiated conceptualizations of sibling relationship quality (Bascoe et al., 2012; Holmes et al., 2024), we therefore treat rivalry and conflict resolution as distinct dimensions.

Building on these multidimensional conceptualizations, prior research has identified relationship patterns such as *harmonious* (high affection, low hostility), *uninvolved* (low affection, low hostility), *hostile* (high hostility, low affection), and *affect-intense* (high affection, high conflict) (e.g., McGuire et al., 1996; Sherman et al., 2006). Each pattern carries distinct developmental implications. Harmonious relationships tend to foster the most positive outcomes, while affect-intense relationships may face challenges despite the presence of warmth (Buist & Vermande, 2014; Sherman et al., 2006).

Theoretical frameworks provide critical insight into sibling relationships. From a developmental-contextual perspective (Bronfenbrenner, 1981; Lerner, 2018), they are dynamic subsystems within the family that both shape and are shaped by individual development and broader contextual influences. Family systems theory further suggests that relational patterns tend to stabilize through reciprocal reinforcement but can reorganize in response to changing circumstances (Cox & Paley, 1997). These frameworks emphasize that sibling relationships are not fixed, highlighting the need for longitudinal approaches to capture change over time.

To date, much of the existing research has relied on cross-sectional and/or variable-centered approaches, often focusing on isolated aspects of sibling relationships rather than examining how these relationships evolve over time. While person-centered approaches have been applied in this domain, longitudinal person-centered work - and in particular latent transition analyses that track profile membership across time - remains rare, leaving critical questions about how sibling relationship profiles emerge, persist, and shift largely unanswered (Noller, 2005).

The present study addresses these gaps by applying latent profile analysis (LPA) and latent transition analysis (LTA) to identify distinct sibling relationship profiles and track their trajectories over time. Specifically, we examine the questions: How stable are sibling relationship profiles over a 2-year-period? And what factors predict stability or transitions between profiles? This approach allows us to move beyond static descriptions by uncovering which relationship profiles persist, which change, and which individual factors help explain those movements. Through this framework, the study aims to provide a clearer picture of sibling dynamics across childhood and early adolescence and the forces that shape their development.

**Profiles of Sibling Relationships**

McGuire and colleagues (1996) highlighted that merely characterizing sibling relationships along individual dimensions fails to capture their intricate complexity. Consequently, several studies describe the multidimensional dynamics of these relationships using cluster or profile analyses (e.g., Buist & Vermande, 2014; Derkman, 2011; Killoren et al., 2016; Noller, 2005; Sherman et al., 2006). One common finding is that sibling relationships can be characterized by varying degrees of affection, conflict, rivalry and distance (McHale et al., 2012), which combine to distinct patterns of relationship quality.

Studies often identifiy four profiles of sibling relationships: *harmonious*, with high levels in affection and low levels in hostility; *hostile*, with high levels of hostility and low levels of affection; *affect-intense*, with high levels in hostility and affection; and *uninvolved*, with low levels in hostility and affection (e.g., McGuire et al., 1996). The number of profiles depends on factors such as age group, cultural context and the specific measures and methods used.

A substantial body of evidence demonstrates that these profiles predict various social-emotional outcomes. For instance, the harmonious profile is associated with higher levels of social competence, self-esteem, and fewer internalized and externalized problems (Buist & Vermande, 2014; Derkman, 2011; Sherman et al., 2006), whereas the hostile profile is associated with lower social competence, reduced self-esteem, and increased social isolation

(Sherman et al., 2006). The affect-intense profile exhibits mixed outcomes. While it is linked to greater social competence (Buist & Vermande, 2014), it is also associated with lower self-esteem and increased feelings of loneliness (Buist & Vermande, 2014; Sherman et al., 2006).

Interestingly, the uninvolved profile, despite the absence of conflict, does not necessarily yield positive outcomes. In fact, individuals with an uninvolved sibling relationship exhibit similar or even higher levels of depression, loneliness, and self-esteem compared to those in hostile sibling relationships (Derkman, 2011). However, they do not significantly differ in self-worth and loneliness from their counterparts in harmonious or affect-intense sibling relationships (Sherman et al., 2006).

These findings underscore the importance of examining not just individual dimensions, such as conflict or affection, but the dynamic interplay among these dimensions. Understanding how affection, conflict, rivalry, and conflict resolution combine to form complex sibling relationships is essential for capturing the full nuance of these bonds and their effect on well-being. Although prior research has identified distinct profiles of sibling relationships using person-centered approaches such as LPA, little is known about the longitudinal stability of these profiles. However, capturing relationship patterns at a single time point provides only a partial picture; to fully understand sibling relationships, it is critical to consider how they develop and change across time (Holmes et al., 2024; Persram et al., 2025).

**Development of Sibling Relationships**

Theoretically grounded in the developmental-contextual perspective (Bronfenbrenner, 1981; Lerner, 2018), sibling relationships are embedded within a dynamic system of reciprocal influences. This system evolves as individuals mature and as the broader family and social environment change. The Family Systems Theory (Cox & Paley, 1997) complements this view by emphasizing that relationships within the family are interdependent subsystems characterized by both stability and adaptability. These frameworks suggest that sibling bonds develop through ongoing feedback processes - for example, where affection and conflict continually interact. Consequently, transitions in these relational patterns reflect the developmental processes of differentiation and re-equilibration throughout childhood and adolescence.

Sibling relationships are thus both dynamic and, at times, stable. During childhood and adolescence, siblings transition from primarily cohabiting family members to individuals who increasingly engage in complex social interactions and emotional exchanges (Jensen et al., 2022; McHale et al., 2012). This period is characterized by increased independence, identity formation, and the exploration of social connections outside the immediate family. While this can lead to notable shifts in the sibling relationship, some relationships do remain stable (Jensen et al., 2022).

In middle childhood (approximately ages 6 to 12), siblings typically spend more time together and engage in various activities, fostering the development of social skills, conflict resolution strategies, and emotional regulation (Brody, 1998). Cognitive advances enable children to better understand others´ perspectives and become better equipped to navigate conflicts. Research indicates that sibling relationships during this period often exhibit a mixture of warmth, cooperation, and occasional conflict (Brody et al., 1994; Buhrmester & Furman, 1990; Kim et al., 2006). Siblings may form strong emotional bonds and provide each other with emotional support and companionship. However, rivalry and competition for parental attention may also emerge as prominent features of sibling interactions (Tucker et al., 2013). Just as the parent-child relationship becomes more conflictual with the onset of puberty, this can also apply to the sibling relationship (Brody et al., 1994).

During adolescence (approximately ages 12 to 18), sibling relationships continue to evolve as individuals assert their independence and develop their identities (Whiteman et al., 2015). Siblings may experience increased conflict as they navigate issues related to autonomy, peer relationships, and academic pressure (Conger & Little, 2010). However, some studies find that conflict between siblings tends to decrease during adolescence (Buist et al., 2002; Kim et al., 2006). This may be because an expanded social network provides more opportunities to escape conflictual sibling relationships, potentially contributing to the observed decrease in sibling conflict during this period (Cole & Kerns, 2001; Scharf et al., 2005). Despite the potential for conflict, research suggests that sibling relationships remain an important source of social support and companionship during adolescence (Buist et al., 2013; Kim et al., 2006; Updegraff et al., 2002). Adolescents often turn to their siblings for advice, empathy, and validation, particularly in times of stress or emotional upheaval (Updegraff et al., 2002).

While individual dimensions such as conflict or affection may fluctuate over time, these fluctuations do not necessarily imply fundamental changes in the overall relationship pattern. So far, most studies have focused on cross-sectional patterns of sibling relationships or on mean-level changes in single dimensions (e.g., conflict decreases over time). To our knowledge, only Persram et al. (2025) investigated longitudinal stability of relationship profiles using LTA. While this study is an important step toward understanding developmental dynamics, it focused on adolescence and a relatively short time frame of six months, leaving open questions as to whether these dynamics can be generalized over a longer period of time, nor does it fully explore the mechanisms that might drive profile stability or change.

**Correlates of the Development of Sibling Relationships**

The development of sibling relationships in childhood and adolescence is a complex process influenced by various factors such as gender, age gap, and birth order (Kim et al., 2006). These relationships are dynamic, evolving over time as siblings grow and as family contexts change. Although research on the development of sibling relationships is sparse, existing studies have identified several correlates of relationship quality. Understanding these correlates may provide cues about driving factors of transitions in the relationship quality over time.

The gender composition of sibling pairs is important for the quality of their relationship. Research consistently shows that same-gender sibling pairs, especially sisters, tend to exhibit higher levels of intimacy and emotional closeness compared to mixed-gender pairs (Cole & Kerns, 2001; Derkman, 2011; Whiteman & Loken, 2006). This closeness is often attributed to shared gender-specific experiences and socialization processes. Brothers, while also close, typically engage in more shared activities rather than emotional exchanges, influencing the type and quality of their interactions (McHale et al., 2012). In contrast, mixed-gender pairs may experience more frequent conflicts, as siblings navigate different gender-specific socialization and experiences. Still, these interactions can also foster cross-gender understanding and empathy, contributing to social development (Kim et al., 2006; Stocker et al., 1997). Mixed-gender siblings may serve as safe practice grounds for learning to interact with the opposite sex, which might become invaluable as they mature into broader social and romantic worlds (McHale et al., 2001).

The age gap between siblings is another critical determinant of relationship quality. A smaller age difference often leads to more shared experiences, which can enhance the bond between siblings, particularly in early childhood (Dunn, 1983). On the other hand, larger age gaps may reduce competition and conflict, but they can also limit opportunities for shared activities and emotional closeness, potentially leading to more distant relationships over time (Volling, 2003). As siblings grow older, the developmental differences associated even with small age gaps can lead to increased competition and conflict, potentially destabilizing the relationship.

Birth order has long been recognized as an influential factor in sibling relationship quality. First-born children often assume a caretaker or leadership role, which can significantly shape their interactions with younger siblings. This dynamic can foster a nurturing relationship but may also result in rivalry, particularly if the first-born perceives the younger sibling as a threat to their status within the family (Whiteman et al., 2015).

**Purpose of the Present Study**

Despite the theoretical expectation that sibling relationships reflect both continuity and change, longitudinal research investigating these dual processes remains scarce. Prior studies have primarily focused on mean-level changes in specific dimensions (e.g., conflict, warmth), cross-sectional designs or examined stability over a short period of time, offering limited insight into whether children transition between qualitatively distinct profiles of relationship over time. By adopting a person-centered approach using LPA and LTA, the present study seeks to capture the heterogeneity and fluidity of sibling relationship patterns over time. Specifically, this study aims to address the questions: How stable are sibling relationship profiles across a two-year period? What demographic and relational factors predict transitions between profiles?

This longitudinal study is based on a German sample of children and adolescents of different age groups. At two measurement occasions spaced two years apart, latent profiles of sibling relationship quality are determined using the indicators affection, conflict resolution, hostility, and rivalry. Notably, this study conceptualizes positive and negative relationship features in a differentiated manner by separating rivalry from other hostility and by treating conflict resolution as a distinct facet of sibling interaction. A latent transition analysis provides insight into the stability of the relationship quality by estimating transitions between the different profiles from the first (t1) to the second (t2) measurement occasion. In addition, the stability of the relationship quality is regressed on the demographic variables gender composition, age difference, age, and birth order as well as the relationship quality at t1.

Drawing on prior analyses using data from an overlapping measurement wave but a distinct cross-sectional sample (Author, 2026), we anticipate the emergence of comparable latent profiles of sibling relationship quality. Specifically, we expect to identify five distinct profiles - rival, hostile, harmonious, affect-intense, and uninvolved. Replicating these profiles across time would provide evidence for the temporal stability of these relational structures and strengthen the theoretical validity of the proposed typology.

As previous research suggests that, on average, siblings maintain similar levels of warmth or conflict over time (Kim et al., 2007; Updegraff et al., 2005), we expect that latent transition analysis will reveal a general stability of sibling relationship profiles across childhood and adolescence. However, stability is unlikely to be uniform across all profiles. We anticipate higher stability for relationship profiles characterized mainly by positive emotions, because reinforcing patterns within the family system may promote continuity in supportive interactions. In contrast, relationship profiles characterized mainly by high conflict or rivalry are expected to show greater variability, as increasing maturity and contextual change provide opportunities for relational reorganization (Campione-Barr & Killoren, 2019; Noller, 2005). Changes in family dynamics as well as the renegotiation of roles and boundaries may further facilitate transitions toward more adaptive profiles for some sibling pairs (Campione-Barr & Killoren, 2019). Overall, the LTA results are anticipated to reveal distinct longitudinal patterns of relationship quality, with harmonious relationships demonstrating greater continuity and conflictual relationships showing more variability over time.

Furthermore, we anticipate that factors such as age, age gap, gender composition and birth order predict the stability of sibling relationship quality. Previous research has consistently shown that these factors play a significant role in shaping sibling dynamics (e.g., Cole & Kerns, 2001, Kim et al., 2006). Wider age gaps, cross-sex dyads, increasing age, and being later-born may be associated with less stability of perceived relationship quality, as these attributes can present unique challenges for siblings to navigate during childhood and adolescence. For example, siblings with small age differences may experience heightened competition for parental attention, whereas larger age gaps can create differences in interests and life stages that complicate interactions, leading to a lack of shared ecological contexts and interactional density (McHale et al., 2012). Cross-sex siblings may face divergent communication styles and social expectations, affecting the frequency and type of emotional exchange. Divergent gender socialization and peer-group orientations in adolescence often trigger a sharp, non-linear decline in intimacy that may only stabilize later. As siblings grow older, emerging independence, identity formation, and social networks outside the family can lead to fluctuations in relationship quality. Additionally, differences in birth order often entail distinct roles and responsibilities, which can create tensions or require renegotiation as siblings mature. Firstborns often report better sibling relationships than later-borns (Pollet & Nettle, 2009). They often maintain a stable “mentor” role, whereas later-borns’ perceptions of the relationship fluctuate more significantly as they strive for autonomy and "niche picking" during adolescence (Whiteman et al., 2011).

Birth order also moderates when instability occurs. For instance, sibling conflict typically peaks in early adolescence; however, research shows this peak occurs earlier for firstborns than for second-born siblings (McHale et al., 2024). Therefore, we examined the interaction between age and birth order to explore whether the influence of birth order on relationship stability is moderated by chronological age. This approach allowed us to test whether the roles associated with birth order - such as the caretaking or leadership functions often attributed to firstborns - exert a consistent effect on relationship stability across the study span, or whether these effects diminish or intensify as siblings grow older.

By investigating the longitudinal trajectories of sibling relationships and their influencing factors, this study aims to contribute to a more comprehensive understanding of the developmental patterns and interpersonal dynamics within the sibling subsystem.

## Method

# Sample and Study Design

The study uses data from the German Family Panel (pairfam), release 13.0 (Brüderl et al., 2022). Pairfam is a representative longitudinal survey in Germany based on a life course approach with a focus on partnership and family dynamics. The survey has a cohort-sequence and a multi-actor design, i.e., in addition to the main respondent in a household, their partner, parents, and children are also included in the survey. A detailed description of the study can be found in Huinink et al. (2011).

The sibling relationship quality was assessed in waves 8 (2015/2016), 10 (2017/2018) and 12 (2019/2020). In total, 721 children provided responses to at least one of the indicator scales in wave 8, 657 children in wave 10, and 565 children in wave 12. However, only 509 children provided responses to the indicators in at least two consecutive assessments (i.e., 330 in waves 8 and 10; 286 in waves 10 and 12). Because latent profile analysis requires large sample sizes (samples well into the hundreds are recommended, e.g. Spurk et al., 2020; Weller et al., 2020), the data from all three waves were included in the sample. That is, all children who participated in waves 8

and 10 (n = 330), and all children who did not participate in wave 8, but in waves 10 and 12 (n = 179), were included. Therefore, the combined sample comprises data from 509 children who provided information on their sibling relationship quality at two measurement occasions that were spaced two years apart. The first measurement occasion comprises data from waves 8 and 10, and the second measurement occasion comprises data from waves 10 and 12. According to the pairfam study protocol, sibling relationship data are collected only for the two youngest participating children within a household.

As some responses were identified as multivariate outliers, eleven children were excluded from the sample. Therefore, the final sample consisted of 498 children (49.6% girls), of whom 322 (64.7%) participated in waves 8 and 10, and 176 (35.3%) participated in waves 10 and 12. The data included 211 sibling pairs and 76 children whose siblings did not participate in the same waves, resulting in 287 household ids. The children were aged between 94 and 168 months at t1 (*M* = 125.83, *SD* = 19.90). In total, 162 of the participants (32.5%) were the first child of their family, while 336 participants (67.5%) were born second or later. The age difference between the sibling pairs ranged between 0 and 71 months (*M* = 30.33, *SD* = 14.88). Moreover, 267 of the children (53.6%) were part of a mixed sibling pair, while 111 (22.3%) belonged to a girls pair, and 120 (24.1%) to a boys pair.

# Instrument

To assess the sibling relationship quality, we used children's self-reports of their perceived relationship quality. Affection, hostility, and rivalry were measured using an adapted version of the Sibling Relationship Inventory (SRI; Boer et al., 1997; Stocker & McHale, 1992), with four items for each dimension. Children were asked to indicate the frequency of certain relational behaviors on a five-point Likert scale (e.g., “How often do you feel mad or angry at [name sibling]?”). Additionally, a three-item measure of conflict resolution, derived from the Sibling Qualities Scales (SQS; Cole & Kerns, 2001), asked children to rate their agreement on a five-point Likert scale ranging from "not at all correct" to "completely correct" (e.g., "If one of us does something that bothers the other, we can make up easily."). The internal consistency of these measures was evaluated using standardized Cronbach’s alpha. At t1, the consistency was 0.72 for affection, 0.79 for hostility, 0.86 for rivalry, and 0.73 for conflict resolution. At t2, the alphas were 0.74 for affection, 0.77 for hostility, 0.86 for rivalry, and 0.72 for conflict resolution.

# Analysis

Data analysis was conducted using Mplus Version 8.10 (Muthén & Muthén, 2017) for latent profile and transition analyses and R Version 4.4.1 (R Core Team, 2024) for data preparation, data exploration, descriptive statistics, and additional statistical procedures. All scripts, outputs, and the supplemental material are stored in the OSF project https://osf.io/hqfw8/overview?view_only=000089567bb54eb08ed75ae159f1dcdf.

Because outliers can bias the results of multivariate analyses, the four indicators of relationship quality were checked for extreme multivariate outliers using Mahalanobis distance. All cases with a corresponding p-value of less than .001 were excluded from the analyses, resulting in the final sample of 498 children. The relationship quality variables were z-standardized to account for the difference in scales. All other continuous variables were centered to facilitate the interpretation of the results.

# Latent Profile and Transition Analysis

To determine the stability of sibling relationships, latent profile analyses (LPA) and a latent transition analysis (LTA) were conducted (see Hickendorff et al., 2018, for an overview of these methods). All LPAs and the LTA were conducted with 2000 random starts in the first stage, 200 starting values in the second stage and 500 iterations each. Because some of the indicator variables were not normally distributed, Maximum Likelihood with robust standard errors was chosen as estimator (Spurk et al., 2020). On both measurement occasions, up to 50 children did not respond to one or in rare cases two of the four relationship quality scales. This was mostly due to missing values on the rivalry scale (45 at t1, 49 at t2). Full maximum likelihood was used to deal with the missing data. Furthermore, to determine the impact of the hierarchical structure of the data (children nested in households), we computed the intraclass correlation coefficient (ICC) for all relationship quality indicators. The ICC specifies which part of the variance of the variables can be attributed to the higher level (here the household id). The ICCs ranged between 0.09 and 0.56 and can thus be considered as high (see Hedges & Hedberg, 2007, for a comparison of ICCs in educational contexts). Therefore, the latent profile and transition analysis were conducted as multilevel models with the household id as cluster variable.

The LPAs and LTA were conducted in three main steps. First, for each measurement occasion, the appropriate number of latent profiles was determined by estimating LPAs with one to six profiles with the four relationship quality variables as indicators. For each indicator, the variances were constrained to be equal across all profiles. When deciding on the optimal number of latent profiles, both theoretical and statistical aspects should be considered (Morin et al., 2016). For the statistical aspect, the Lo-Mendell-Rubin adjusted likelihood ratio test (LMR adj. LRT, Lo, 2001), the Akaike information criterion (AIC, Akaike, 1974), the Bayesian information criterion (BIC, Schwarz, 1978), and the sample size adjusted BIC (SABIC, Sclove, 1987), were used to decide on the correct number of profiles. Previous simulation studies have shown that the BIC and LMR adj. LRT perform best at determining the correct number of latent profiles, however, these criteria tend to invariably suggest adding more profiles (Nylund et al., 2007; Nylund-Gibson & Choi, 2018). Therefore, we also reviewed classification diagnostics (Masyn, 2013). Although diagnostic statistics are not used to select the final profile model, they are important to consider, especially since inconsistent results across fit indicators are common in LPA models (Nylund-Gibson & Choi, 2018). Entropy is an indicator for the precision of classification, with a value close to one implying higher classification precision.

Second, both latent profile models derived in the first step (i.e., from t1 and t2) were combined into a longitudinal LPA to assess the measurement invariance across time, following the procedure suggested by Morin and Litalien (2017). The authors distinguish between three different levels of measurement invariance between two latent profile models: (a) configural similarity is given when both models contain the same number of profiles and are based on the same indicators, (b) structural similarity indicates further that the indicator means of each profile are equal, and (c) dispersion similarity implies that the models must additionally have the same within-profile variances. For each level of measurement invariance, one model was estimated. The best model was chosen based on the information criteria AIC, BIC and SABIC.

Third, the LTA was computed based on the correct level of measurement invariance. The LTA calculates the indicator means, the most likely class membership, the latent class probabilities, and posterior classification probabilities for all profiles at both measurement occasions, as well as the probability of transition between each of the profile pairs (e.g., the transition from the harmonious profile at t1 to the rival profile at t2).

# Profile Stability and Predictors

To examine the stability of sibling relationship quality across measurement occasions, we assessed (i) profile-specific transitions and (ii) overall profile stability. This was done using goodness-of-fit χ^2-tests, comparing the numbers of participants who stayed in the same profile with those who transitioned to a different one. Effect sizes were calculated using Cohen's *w* (see Ben-Shachar et al., 2023, for an overview of different effect sizes for χ^2-tests)

In addition, we explored potential predictors of profile stability. For this purpose, a logistic regression was conducted with the profile stability as dependent variable, and the relationship quality at t1 as well as the demographic variables age, birth order, age gap and gender composition as independent variables. The relationship quality was operationalized by creating two dichotomous indicators (adversarial, harmonious) that summarize the presence of the most critical relationship states at t1. This procedure retains the typological complexity established by the LPA while achieving the statistical power and interpretive focus necessary for the logistic regression model. The adversarial state (coded 1) captures children belonging to either the rival or hostile profile at t1, reflecting a complex configuration where antagonistic interaction and low affection are dominant in concert. Conversely, the optimal state (coded 1) captures children belonging to the harmonious profile at t1. The gender composition of each sibling dyad was represented by two dichotomous indicators identifying whether the dyad consisted of two boys (1 = two boys, 0 = not two boys) or two girls (1 = two girls, 0 = not two girls), with mixed-gender dyads as reference class.

The profile stability was operationalized by creating a dummy variable that indicates whether the participant stayed in the same profile (coded 1) or moved to another profile (coded 0). Note that this dummy variable is based on the most likely class membership of the latent transition analysis and is thus subject to classification errors. To account for the potential bias in the regression estimates, the posterior classification probabilities of the participants were used as regression weights, as suggested by Hickendorff et al. (2018). However, even with this method, the estimates can still exhibit a moderate downward bias and thus underestimate the true effects (see Bakk & Kuha, 2018, for a simulation study that compares the bias introduced by different methods). The variables barely contained any missing values, only the age difference between the siblings was missing for 17 participants (3.4%). These cases were listwise deleted in the logistic regression, as this approach renders mostly unbiased results for small amounts of missing data (Meeyai, 2016). Because the ICC was very small (<.01), the regression was conducted as a single-level model. No multicollinearity or outliers were detected in the predictors. Standardized odds ratios (OR; see Bland, 2000, for an introduction) are reported as effect sizes.

## Results

# Descriptive Results

Descriptive statistics and correlations among study variables are presented in Table 1 and provide initial insight into the associations among sibling relationship dimensions across the two timepoints. Children reported moderately high levels of affection and conflict resolution suggesting generally positive interactions. Hostility scores were, on average, lower, and rivalry was rated lowest among the dimensions. These patterns remained relatively stable across the two time points, with only minor fluctuations in mean values. Overall, the correlations show coherent associations among the constructs across both waves, and their magnitudes indicate related but clearly non-identical dimensions.

# Latent Profile Analysis

# Number of Latent Profiles

Supplementary Tables S1 and S2 present model fit indices for latent profile analyses (LPA) conducted at t1 and t2, respectively. Model selection in LPA typically relies on a combination of statistical criteria and theoretical interpretability (Masyn, 2013; Nylund et al., 2007). Lower values of AIC, BIC, and SABIC indicate better model fit, while significant LMR-LRT p-values suggest that a model with *k* profiles fits significantly better than a model with *k–1* profiles. Entropy values closer to 1 indicate clearer classification of individuals into profiles (Masyn, 2013).

Across both measurement occasions, AIC, BIC, and SABIC values decreased with increasing numbers of profiles, indicating gradual improvements in model fit. At t1, the Lo–Mendell–Rubin likelihood ratio test (LMR) was significant for the two-class solution and marginal for the three-class solution but nonsignificant thereafter, suggesting that the statistical benefit of adding further classes diminished beyond three profiles. For t2, the LMR test remained significant up to the five-class solution but not beyond, suggesting that model fit improved meaningfully up to five profiles. Entropy values ranged between .68 and .78, indicating acceptable to good classification accuracy across solutions.

Despite the small incremental statistical gains, we selected the five-class model for both time points based on theoretical interpretability and developmental meaningfulness. The three-class solution largely differentiated participants by overall relationship quality (high, moderate, low), offering limited insight into the heterogeneity of sibling interactions. In contrast, the five-class solution yielded conceptually distinct and theoretically grounded profiles - such as harmonious, affect-intense, uninvolved, rival, and hostile - that are consistent with prior research on sibling relationship typologies (e.g., Buhrmester & Furman, 1990; McHale et al., 2012). While the LMR test did not remain significant beyond five classes, the combination of lower information criteria, adequate entropy, and theoretical interpretability supported selection of the five-class model as the most balanced and conceptually informative representation of sibling relationship patterns over time. This approach aligns with best practices in LPA, which recommend considering multiple indices and evaluating both empirical fit statistics and the conceptual distinctiveness, theoretical plausibility, and practical utility of the resulting profiles (Nylund et al., 2007; Vermunt, 2010).

# Measurement Invariance Across Time

After deciding on the optimal number of latent profiles, measurement invariance across time was examined by conducting three longitudinal latent profile analyses with varying degrees of profile similarity as suggested by Morin and Litalien (2017). The model summaries are reported in Table S3 in the supplemental material. As expected, all three information criteria AIC, BIC, and SABIC favored the model with the highest measurement invariance (i.e., dispersion similarity), which assumes equal indicator means and variances across measurement occasions. Therefore, the dispersion similarity model was used as baseline model for subsequent analyses.

# Description of Longitudinal Latent Profiles

Table 2 presents the means and variances of the latent profile indicators, providing an overview of the central tendency and dispersion within each profile, whereas Fig. 1 offers a graphical depiction of the indicator means for the five different profiles. The first profile, which we call *harmonious*, included 23% of the participants at t1 (*n* = 115; t2: 24%, *n* = 120). It showed above-average levels in affection and conflict resolution, and the lowest scores in hostility and rivalry. The second profile, characterized by above-average levels in hostility and rivalry and below-average levels of affection and conflict resolution, contained about 10% of the sample at t1 (*n* = 50; t2: 10%, *n* = 50) and was labelled *hostile.* About 6% of the children belonged at t1 (*n* = 30; t2: 6%, *n* = 30) to the third profile, *rival*,

which has similarities to the second profile, but is characterized by especially high scores in rivalry and slightly higher scores in affection and conflict resolution compared to the hostile profile. The fourth profile, with above-average scores on almost all scales, is referred to as *affect-intense* and included about 29% of the children at t1 ($n$ = 144; t2: 30%, $n$ = 149). Finally, the fifth profile consisted of below average scores on all scales except hostility. Approximately 32% of the sample belonged at t1 ($n$ = 159; t2: 30%, $n$ = 149) to this profile, which is referred to as *uninvolved*.

# Latent Transition Analysis

Using the longitudinal baseline model determined in the previous section, the LTA was conducted as described in the methods section. The transition probabilities between different profiles in the latent transition analysis are summarized in Table 3 and illustrated in Fig. 2. The highest probability of remaining in the same profile was observed for the harmonious profile (0.86), followed by the affect-intense (0.61), the uninvolved (0.58), the hostile (0.53), and the rival (0.43) profiles. Transitions from the affect-intense profile to other profiles were relatively rare, with the highest transition probability being to the uninvolved profile (0.26). The harmonious profile showed minimal transitions to other profiles, with the highest being to the uninvolved profile (0.08). The uninvolved profile had a notable probability of transitioning to the affect-intense profile (0.29) and a moderate probability of transitioning to the hostile profile (0.10). The hostile profile showed a moderate probability of transitioning to the uninvolved profile (0.25) and a lower probability of transitioning to the rival profile (0.14). Finally, the rival profile had a moderate probability of transitioning to the hostile profile (0.23) and a lower probability of transitioning to the harmonious profile (0.13).

# Profile Stability

The analysis of profile stability was conducted using a chi-square test comparing stayers (participants who remained in the same profile from t1 to t2) and movers (participants who transitioned to a different profile) for each sibling relationship profile. Overall, participants demonstrated a significant tendency to remain in their original profile rather than to transition, $\chi2(1) = 52.70$, $p < .001$, with a moderate overall effect size ($W = 0.33$). However, this stability varied markedly across the profiles. The harmonious profile exhibited high stability, with a large majority of participants remaining in this profile ($N$ = 104 stayers vs. $N$ = 11 movers). This difference was significant, $\chi2(1) = 75.21$, $p < .001$, and was associated with a large effect size ($W = 0.81$), making it the most stable profile. The affect-intense profile was also significantly more stable than unstable, $\chi2(1) = 16.57$, $p < .001$, though the associated effect size was moderate ($W = 0.32$). In contrast, the uninvolved ($\chi2(1) = 1.64$, $p = .200$), hostile ($\chi2(1) = 0.20$, $p = .655$), and rival ($\chi2(1) = 0.04$, $p = .841$) profiles did not show a statistically significant difference between the number of stayers and movers. This lack of significance suggests that these three relationship profiles were roughly equally likely to persist as they were to transition to a different profile over the two-year period, indicating comparatively lower inherent stability.

# Prediction of Profile Stability

The stability of the relationship quality was regressed on the relationship quality at t1 and the demographic variables. The results of the logistic regression are displayed in Table 4. Standardized ORs and their 95% confidence intervals (CI) are reported; associations were considered statistically significant at $p < .05$, which corresponds to 1 not being included in the 95% CI of OR.

A harmonious relationship at t1 was significantly associated with higher stability, $OR = 2.73$ (95% CI: [1.93, 4.21]). This indicates that children with harmonious relationships at t1 were more than twice as likely to experience stable

relationship quality over time. Conversely, an adversarial relationship at t1 was not significantly associated with stability, as indicated by an odds ratio of 0.87 (95% CI: [0.71, 1.07]).

As shown in Table 4, structural characteristics - including age, age spacing, birth order, and gender composition - did not significantly predict the stability of sibling relationship quality. Specifically, neither age-related factors (e.g., age at t1, age gap) nor being a firstborn sibling significantly altered the likelihood of maintaining stable relationship dynamics over time. Furthermore, gender composition (i.e., brother, sister, or mixed-sex dyads) showed no significant association with stability. Finally, the interaction between age and birth order was non-significant, indicating that the influence of birth order on stability does not vary by the child's age. To summarize, while harmonious relationships were associated with a higher stability of relationship quality, none of the demographic variables or adversarial relationships significantly predicted profile stability.

## Discussion

The present study investigated the longitudinal dynamics of sibling relationship quality in middle childhood and adolescence using a person-centered approach (LPA/LTA). By identifying distinct profiles of sibling relationships and tracking transitions between them, this study illuminates how multi-dimensional constellations of affection, hostility, rivalry, and conflict resolution evolve within individuals over time. This person-centered lens goes beyond single-dimension analyses by capturing the combinations of relational features that children actually experience, thereby offering a more ecologically valid picture of sibling interactions.

Across both measurement occasions, the latent profile analyses identified five conceptually distinct sibling relationship patterns - harmonious, affect-intense, uninvolved, hostile, and rival. Although the statistical support for the five-profile solution differed between time points, the recurrence of these patterns suggests that they represent meaningful and interpretable configurations of sibling relationships rather than ad hoc categories. While some prior work has reported four-profile solutions, the present five-profile structure adds conceptual precision. Distinguishing a rival from a hostile profile separates predominantly competitive dynamics (e.g., status negotiation and comparison) from overtly antagonistic conflict, whereas the affect-intense profile captures relationships that are high in both affection and hostility - consistent with ambivalent, highly engaged sibling ties. This additional granularity clarifies developmental pathways: a dyad may shift from hostility to rivalry (reducing antagonism while competition remains), or from uninvolved to affect-intense (increasing engagement alongside occasional conflict), pathways that are obscured when fewer profiles collapse these nuances.

The five-profile solution demonstrated measurement invariance across time, which means that the definitions of the profiles remained substantively the same at both measurement points. In other words, the associations between the indicators (e.g., affection, hostility) and the profiles (e.g., harmonious, affect-intense) were stable and replicable, strengthening the validity of the typology and ensuring that observed transitions reflect genuine developmental change rather than shifting measurement frames.

Overall, the findings suggest moderate to high stability in sibling relationship quality, with the harmonious profile showing the highest likelihood of persistence (~ 86%), suggesting that once affection and mutual support are established, these bonds tend to remain intact. This accords with prior work proposing that warmth and support in early sibling interactions set enduring relational patterns that scaffold later adjustment (Buist & Vermande, 2014; Kim et al., 2006; Persram et al., 2025). By contrast, conflictual or low-engagement profiles (e.g., hostile, rival, uninvolved) were comparatively more variable, indicating greater malleability and potential for improvement as

children age (Buist et al., 2002; Kim et al., 2006). This higher degree of malleability may be attributed to the lack of a "harmonious buffer"; without the stabilizing combination of high affection and effective conflict resolution, these relationships appear more susceptible to being reshaped by external transitions. Rather than abrupt change, most transitions occurred between adjacent profiles, defined by shared characteristics across the four indicators. For instance, a transition from hostile to uninvolved represents a de-escalation of overt hostility and rivalry while maintaining a baseline of low affection. Similarly, a move from uninvolved to affect-intense signifies an increase in relational salience, where a rise in affection is accompanied by a simultaneous increase in hostility and rivalry. These shifts reflect a gradual recalibration of engagement and conflict as children develop emotion regulation, perspective-taking, and autonomy with increasing age (McHale et al., 2012; Whiteman et al., 2015). Because of the heterogenous age of the sample, our interpretation emphasizes age-related development more generally: as children grow older, gains in self-regulation and social understanding may promote movement away from more negative or disengaged patterns toward more constructive engagement.

Among the examined demographic factors - age, age gap, gender composition, and birth order - neither significantly predicted general profile stability. This does not imply that these features are irrelevant to relationship quality; rather, it suggests they may be more informative for specific transitions (e.g., whether a relationship becomes or remains harmonious) than for stability in the aggregate. In other words, structural factors could help explain *which* or *where* dyads move (e.g., toward rivalry versus toward affect-intense) rather than *if* they generally move.

This study contributes methodologically by employing a longitudinal person-centered approach to capture both intraindividual change and interindividual differences in sibling relationship dynamics. Previous research has largely relied on variable-centered or cross-sectional approaches, limiting the ability to observe multi-dimensional relationship patterns across time. By establishing that profiles are replicable across measurement occasions and by estimating transition probabilities, this study advances understanding of how distinct constellations of affection, hostility, rivalry, and conflict resolution evolve within individuals over time. The results extend existing typological approaches to sibling research (e.g., Buist & Vermande, 2014; Sherman et al., 2006) by demonstrating that relationship profiles can remain meaningfully stable, yet developmentally flexible.

# Limitations and Future Directions

Despite its strengths, this study has several limitations. First, the one-cohort, two-wave design limits the ability to capture nonlinear or cyclical patterns of change and to disentangle age-related effects from cohort differences. Moreover, due to the heterogenous age of the children and adolescents in our sample, we cannot make definitive claims about the influence of specific developmental shifts on sibling relationships. Future research should employ multi-wave longitudinal designs with age-homogeneous cohorts to trace how sibling relationship profiles evolve across middle childhood, adolescence, and into adulthood. Such designs would allow researchers to examine whether and how relationship quality changes over time; for example, by determining whether the relationship profiles change structurally, rather than assuming stability in their composition.

Second, it remains unclear whether similar patterns would emerge in adult samples or in different cultural contexts. Investigating contextual moderators - such as family climate, parenting practices, or major life events (e.g., parental separation, COVID-19 pandemic) - could clarify why some sibling relationships improve while others remain conflictual. We did not include such moderators here because our primary aim was to establish the

longitudinal stability and transitions of profiles; however, future work should integrate these factors to explain variability in developmental trajectories.

Third, the reliance on self-reported measures may introduce perceptual bias; incorporating multi-informant data (e.g., parent or observational reports) would enhance validity and reduce shared-method variance. Cross-validating self-reports with external observations or informant ratings could help confirm the stability and generalizability of the findings.

Fourth, because the dependent variable in the logistic regression was based on the most likely class membership, regression estimates can be underestimated. Even though we accounted for this potential bias by using the posterior classification probabilities of the participants as regression weights (Hickendorff et al, 2018), the estimates can still exhibit a moderate downward bias and thus underestimate the true effects (Bakk & Kuha, 2018). Therefore, the effect of demographic variables on the stability of relationship quality may be stronger than we assume in the current study. Further, these factors might not predict overall stability but could shape specific transitions (e.g., whether a relationship becomes harmonious), an avenue for future research.

Finally, this study's strength lies in its person-centered, longitudinal approach, which enabled us to capture both intraindividual change and interindividual differences in multi-dimensional sibling relationship patterns. Future research should build on this by combining multi-wave designs, contextual moderators, and developmentally sensitive samples to deepen understanding of how sibling relationships adapt to changing family and social environments.

# Implications for Practice

The finding that harmonious relationships exhibit high persistence underscores the importance of fostering affection and mutual support early in childhood. Interventions aimed at promoting positive sibling engagement - such as cooperative activities, shared responsibilities, and emotion coaching - may help establish enduring relational patterns that buffer against later adjustment difficulties and may even have long-term benefits for emotional well-being and resilience.

Also, the relative malleability of negative or low-engagement profiles (hostile, rival, uninvolved) indicates that these patterns are not fixed and can improve over time. This suggests that targeted interventions during middle childhood, when emotion regulation and perspective-taking skills are developing, may be particularly effective. Strategies could include conflict-resolution training, perspective-taking exercises, and parental guidance to reduce antagonism and encourage constructive engagement.

Finally, the absence of strong effects of structural factors (age gap, gender composition, birth order) on overall stability implies that practitioners should prioritize relational processes over demographic characteristics when designing interventions. While structural features may influence specific transitions, they do not appear to constrain the potential for positive change. This reinforces the value of focusing on modifiable interactional patterns rather than immutable family structures.

## Conclusion

This study shows that sibling relationships in middle childhood and adolescence can be meaningfully described through five distinct profiles that remain structurally stable over time. While harmonious ties tend to persist, less

positive patterns are more variable, suggesting opportunities for change. These findings underscore the importance of early relational processes in setting trajectories for later sibling dynamics.

Importantly, the person-centered approach added unique value by revealing nuanced constellations of affection, hostility, rivalry, and conflict resolution that children actually experience. Tracking transitions between these profiles offers a more ecologically valid and practically relevant understanding of sibling dynamics. For example, observing shifts from hostile to rival or from uninvolved to affect-intense highlights gradual recalibration processes that single-variable models cannot detect. This granularity is particularly valuable for informing interventions, as it points to specific relational configurations that may require different strategies for support. Further, it highlights the need for continued longitudinal, person-centered research to elucidate the mechanisms underlying these developmental pathways.

# Declarations

### Data Availability Statement

This paper uses data from the German Family Panel pairfam, which is publicly available via https://www.pairfam.de/en/data/data-access/. Pairfam is funded as long-term project by the German Research Foundation (DFG; Project number: 165713635).


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### Analytic Code

Code is available at the following URL: https://osf.io/hqfw8/overview?view_only=000089567bb54eb08ed75ae159f1dcdf.

### Materials

Materials are available at the following URL: https://osf.io/hqfw8/overview?view_only=000089567bb54eb08ed75ae159f1dcdf.

### Preregistration

The analyses presented here were not preregistered.

### Ethical Approval

The ethics committee of the Faculty of Management, Economics, and Social Sciences of the University of Cologne approved the study (see, https://www.pairfam.de/en/study/ethic-approval/). All procedures performed were in accordance with the ethical standards of German social research and data protection laws and with the 1964 Helsinki declaration and its later amendments.

### Informed Consent

Informed consent was obtained from all participants involved.

**Declaration of Conflicting Interests**

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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**Authors' Contributions (CRediT Taxonomy)**

| | EW | JW |
|---|---|---|
| **Conceptualization** | X | X |
| **Data curation** | X | X |
| **Formal analysis** | | X |
| **Funding acquisition** | Not applicable | |
| **Investigation** | X | X |
| **Methodology** | | X |
| **Project administration** | X | X |
| **Resources** | Not applicable | |
| **Software** | X | X |
| **Supervision** | X | |
| **Validation** | X | X |
| **Visualization** | X | |
| **Writing – original draft** | X | X |
| **Writing – review & editing** | X | X |

# References

1. Author (2026) Manuscript submitted for publication
2. Akaike H (1974) A new look at the statistical model identification. IEEE Trans Autom Control 19(6):716–723. https://doi.org/10.1109/TAC.1974.1100705
3. Bakk Z, Kuha J (2018) Two-Step Estimation of Models Between Latent Classes and External Variables. Psychometrika 83(4):871–892. https://doi.org/10.1007/s11336-017-9592-7
4. Bascoe SM, Davies PT, Cummings EM (2012) Beyond Warmth and Conflict: The Developmental Utility of a Boundary Conceptualization of Sibling Relationship Processes. Child Dev 83(6):2121–2138. https://doi.org/10.1111/j.1467-8624.2012.01817.x

5. Ben-Shachar MS, Patil I, Thériault R, Wiernik BM, Lüdecke D (2023) Phi, Fei, Fo, Fum: Effect Sizes for Categorical Data That Use the Chi-Squared Statistic. *Mathematics*, *11*(9), 1982. https://doi.org/10.3390/math11091982
6. Bland JM (2000) Statistics Notes: The odds ratio. BMJ 320(7247):1468–1468. https://doi.org/10.1136/bmj.320.7247.1468
7. Boer F, Westenberg PM, McHale SM, Updegraff KA, Stocker CM (1997) The Factorial Structure of the Sibling Relationship Inventory (SRI) in American and Dutch Samples. J Social Personal Relationships 14(6) Article 6. https://doi.org/10.1177/0265407597146009
8. Brody GH (1998) Sibling Relationship Quality: Its Causes and Consequences. Ann Rev Psychol 49(1). Article 1. https://doi.org/10.1146/annurev.psych.49.1.1
9. Brody GH (2004) Siblings' Direct and Indirect Contributions to Child Development. Curr Dir Psychol Sci 13(3). Article 3. https://doi.org/10.1111/j.0963-7214.2004.00289.x
10. Brody GH, Stoneman Z, McCoy JK (1994) Forecasting Sibling Relationships in Early Adolescence from Child Temperaments and Family Processes in Middle Childhood. Child Dev 65(3):771. https://doi.org/10.2307/1131417
11. Bronfenbrenner U (1981) The Ecology of Human Development: Experiments by Nature and Design. Harvard University Press. https://doi.org/10.2307/j.ctv26071r6
12. Brüderl J, Drobnič S, Hank K, Neyer FJ, Walper S, Alt P, Borschel E, Bozoyan C, Garrett M, Geissler S, Gonzalez Avilés T, Gröpler N, Hajek K, Herzig M, Lenke R, Lorenz R, Lutz K, Peter T, Preetz R, Wetzel M (2022) *The German Family Panel (pairfam)Beziehungs- und Familienpanel (pairfam)* (Version 13.0.0) [Data set]. GESIS. https://doi.org/10.4232/PAIRFAM.5678.13.0.0
13. Buhrmester D, Furman W (1990) Perceptions of Sibling Relationships during Middle Childhood and Adolescence. Child Dev 61(5). Article 5. https://doi.org/10.2307/1130750
14. Buist KL, Deković M, Meeus W, Van Aken MAG (2002) Developmental Patterns in Adolescent Attachment to Mother, Father and Sibling. J Youth Adolesc 31(3):167–176. https://doi.org/10.1023/A:1015074701280
15. Buist KL, Deković M, Prinzie P (2013) Sibling relationship quality and psychopathology of children and adolescents: A meta-analysis. Clin Psychol Rev 33(1). Article 1. https://doi.org/10.1016/j.cpr.2012.10.007
16. Buist KL, Vermande M (2014) Sibling relationship patterns and their associations with child competence and problem behavior. J Fam Psychol 28(4). Article 4. https://doi.org/10.1037/a0036990
17. Campione-Barr N, Killoren SE (2019) Love Them and Hate Them: The Developmental Appropriateness of Ambivalence in the Adolescent Sibling Relationship. Child Dev Perspect 13(4):221–226. https://doi.org/10.1111/cdep.12345
18. Cole A, Kerns KA (2001) Perceptions of Sibling Qualities and Activities of Early Adolescents. J Early Adolescence 21(2). Article 2. https://doi.org/10.1177/0272431601021002004
19. Conger KJ, Little WM (2010) Sibling Relationships During the Transition to Adulthood. Child Dev Perspect 4(2):87–94. https://doi.org/10.1111/j.1750-8606.2010.00123.x
20. Cox MJ, Paley B (1997) FAMILIES AS SYSTEMS. Ann Rev Psychol 48(1):243–267. https://doi.org/10.1146/annurev.psych.48.1.243
21. Derkman MMS (2011) *Siblinks: The implications of siblings for adolescents' adjustment and parent-child relationships*. http://hdl.handle.net/2066/91240
22. Dunn J (1983) Sibling Relationships in Early Childhood. Child Dev, *54*(4), Article 4.

23. Ferrar SJ, Stack DM, Baldassarre KS, Orsini A, Serbin LA (2022) Conflict Resolution and Emotional Expression in Sibling and Mother-Adolescent Dyads: Within-Family and Across-Context Similarities. J Early Adolescence 42(2):227–261. https://doi.org/10.1177/02724316211020360
24. Hedges LV, Hedberg EC (2007) Intraclass Correlation Values for Planning Group-Randomized Trials in Education. Educational Evaluation Policy Anal 29(1):60–87. https://doi.org/10.3102/0162373707299706
25. Hickendorff M, Edelsbrunner PA, McMullen J, Schneider M, Trezise K (2018) Informative tools for characterizing individual differences in learning: Latent class, latent profile, and latent transition analysis. Learn Individual Differences 66:4–15. https://doi.org/10.1016/j.lindif.2017.11.001
26. Holmes MR, Bender AE, O'Donnell KA, Miller EK, Conard IT (2024) Illuminating the landscape of sibling relationship quality: An evidence and gap map. Child Dev 95(4):1425–1440. https://doi.org/10.1111/cdev.14065
27. Huinink J, Brüderl J, Nauck B, Walper S, Castiglioni L, Feldhaus M (2011) Panel Analysis of Intimate Relationships and Family Dynamics (pairfam): Conceptual framework and design. J Family Res 23(1):77–101. https://doi.org/10.20377/jfr-235
28. Jensen AC, Alexander C, Jensen, Killoren SE, Sarah E, Killoren, Campione-Barr N, Campione-Barr N, Padilla J, Padilla J, Chen B-B, Binbin Chen (2022) Sibling Relationships in Adolescence and Young Adulthood in Multiple Contexts: A Critical Review. J Social Personal Relationships 026540752211041–026540752211041. https://doi.org/10.1177/02654075221104188
29. Killoren SE, Alfaro EC, Kline G (2016) Mexican American emerging adults' relationships with siblings and dimensions of familism values. Personal Relationships 23(2):234–248. https://doi.org/10.1111/pere.12125
30. Killoren SE, De Jesús SAR, Updegraff KA, Wheeler LA (2017) Sibling relationship quality and Mexican-origin adolescents' and young adults' familism values and adjustment. Int J Behav Dev 41(2):155–164. https://doi.org/10.1177/0165025415607084
31. Kim J, McHale SM, Osgood W, D., Crouter AC (2006) Longitudinal Course and Family Correlates of Sibling Relationships From Childhood Through Adolescence. Child Dev 77(6):1746–1761. https://doi.org/10.1111/j.1467-8624.2006.00971.x
32. Lerner RM (2018) Concepts and Theories of Human Development, 4th edn. Routledge. https://doi.org/10.4324/9780203581629
33. Lo Y (2001) Testing the number of components in a normal mixture. Biometrika 88(3):767–778. https://doi.org/10.1093/biomet/88.3.767
34. Masyn KE (2013) Latent class analysis and finite mixture modeling. The Oxford handbook of quantitative methods: Statistical analysis, Vol. 2. Oxford University Press, pp 551–611
35. McGuire S, McHale SM, Updegraff K (1996) Children's perceptions of the sibling relationship in middle childhood: Connections within and between family relationships. Personal Relationships 3(3). Article 3. https://doi.org/10.1111/j.1475-6811.1996.tb00114.x
36. McHale SM, Sun X, Updegraff KA, Whiteman SD (2024) Patterns and correlates of changes in sibling intimacy and conflict from middle childhood through young adulthood. Dev Psychol. https://doi.org/10.1037/dev0001750
37. McHale SM, Updegraff KA, Helms-Erikson H, Crouter AC (2001) Sibling influences on gender development in middle childhood and early adolescence: A longitudinal study. Dev Psychol 37(1):115–125. https://doi.org/10.1037/0012-1649.37.1.115

38. McHale SM, Updegraff KA, Whiteman SD (2012) Sibling Relationships and Influences in Childhood and Adolescence. J Marriage Family 74(5):913–930. https://doi.org/10.1111/j.1741-3737.2012.01011.x
39. McHale SM, Whiteman SD, Kim J-Y, Crouter AC (2007) Characteristics and correlates of sibling relationships in two-parent African American families. J Fam Psychol 21(2):227–235. https://doi.org/10.1037/0893-3200.21.2.227
40. Meeyai S (2016) Logistic Regression with Missing Data: A Comparison of Handling Methods, and Effects of Percent Missing Values. J Traffic Logistics Eng. https://doi.org/10.18178/jtle.4.2.128-134
41. Morin AJS, Meyer JP, Creusier J, Biétry F (2016) Multiple-Group Analysis of Similarity in Latent Profile Solutions. Organizational Res Methods 19(2):231–254. https://doi.org/10.1177/1094428115621148
42. Natsuaki MN, Ge X, Reiss D, Neiderhiser JM (2009) Aggressive behavior between siblings and the development of externalizing problems: Evidence from a genetically sensitive study. Dev Psychol 45(4):1009–1018. https://doi.org/10.1037/a0015698
43. Noller P (2005) Sibling relationships in adolescence: Learning and growing together. Personal Relationships 12(1). https://doi.org/10.1111/j.1350-4126.2005.00099.x. Article 1
44. Nylund KL, Asparouhov T, Muthén BO (2007) Deciding on the Number of Classes in Latent Class Analysis and Growth Mixture Modeling: A Monte Carl. Struct Equation Modeling: Multidisciplinary J 14(4):535–569. https://doi.org/10.1080/10705510701575396
45. Nylund-Gibson K, Choi AY (2018) Ten Frequently Asked Questions about Latent Class Analysis. Translational Issues Psychol Sci 4(4) Article 4. https://doi.org/10.1037/tps0000176
46. Persram RJ, Dirks MA, Craig WM, Recchia HE (2025) Stability of distinct relational profiles of adolescent sibling relationships and friendships: A latent transition analysis. J Social Personal Relationships 02654075251345283. https://doi.org/10.1177/02654075251345283
47. Pollet TV, Nettle D (2009) Birth order and adult family relationships: Firstborns have better sibling relationships than laterborns. J Social Personal Relationships 26(8):1029–1046. https://doi.org/10.1177/0265407509347940
48. Ross H, Ross M, Stein N, Trabasso T (2006) How Siblings Resolve Their Conflicts: The Importance of First Offers, Planning, and Limited Opposition. Child Dev 77(6):1730–1745. https://doi.org/10.1111/j.1467-8624.2006.00970.x
49. Scharf M, Shulman S, Avigad-Spitz L (2005) Sibling Relationships in Emerging Adulthood and in Adolescence. J Adolesc Res 20(1):64–90. https://doi.org/10.1177/0743558404271133
50. Schwarz G (1978) Estimating the Dimension of a Model. Annals Stat 6(2). https://doi.org/10.1214/aos/1176344136
51. Sclove SL (1987) Application of Model-Selection Criteria to Some Problems in Multivariate Analysis. Psychometrika 52(3):333–343. https://doi.org/10.1007/BF02294360
52. Sherman AM, Lansford JE, Volling BL (2006) Sibling relationships and best friendships in young adulthood: Warmth, conflict, and well-being. Personal Relationships 13(2). Article 2. https://doi.org/10.1111/j.1475-6811.2006.00110.x
53. Spurk D, Hirschi A, Wang M, Valero D, Kauffeld S (2020) Latent profile analysis: A review and how to guide of its application within vocational behavior research. J Vocat Behav 120:103445. https://doi.org/10.1016/j.jvb.2020.103445

54. Stocker CM, Lanthier RP, Furman W (1997) Sibling Relationships in Early Adulthood. J Fam Psychol, *11*(2), Article 2.
55. Stocker CM, McHale SM (1992) The Nature and Family Correlates of Preadolescents' Perceptions of their Sibling Relationships. J Social Personal Relationships 9(2):179–195. https://doi.org/10.1177/0265407592092002
56. Szymańska P (2020) A systemic approach to sibling functioning in childhood – a research review. Educational Psychol 59(17):111–128. https://doi.org/10.5604/01.3001.0014.2653
57. Tucker CJ, Finkelhor D, Shattuck AM, Turner H (2013) Prevalence and correlates of sibling victimization types. Child Abuse Negl 37(4):213–223. https://doi.org/10.1016/j.chiabu.2013.01.006
58. Updegraff KA, McHale SM, Crouter AC (2002) Adolescents' Sibling Relationship and Friendship Experiences: Developmental Patterns and Relationship Linkages. Soc Dev 11(2):182–204. https://doi.org/10.1111/1467-9507.00194
59. Vermunt JK (2010) Latent Class Modeling with Covariates: Two Improved Three-Step Approaches. Political Anal 18:450–469. https://doi.org/doi:10.1093/pan/mpq025
60. Volling BL (2003) Sibling Relationships. In: Bornstein MH, Davidson L, Keyes CLM, Moore KA (eds) Well-being: Positive development across the life course. Lawrence Erlbaum Associates, pp 205–220
61. Weller BE, Bowen NK, Faubert SJ (2020) Latent Class Analysis: A Guide to Best Practice. J Black Psychol 46(4):287–311. https://doi.org/10.1177/0095798420930932
62. Whiteman SD, Loken E (2006) Comparing Analytic Techniques to Classify Dyadic Relationships: An Example Using Siblings. J Marriage Family 68(5). Article 5. https://doi.org/10.1111/j.1741-3737.2006.00333.x
63. Whiteman SD, Solmeyer AR, McHale SM (2015) Sibling Relationships and Adolescent Adjustment: Longitudinal Associations in Two-Parent African American Families. J Youth Adolesc 44(11):2042–2053. https://doi.org/10.1007/s10964-015-0286-0

# Tables

**Table 1** *Means, Standard Deviations, and Correlations with Confidence Intervals*

| Variable | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|
| 1. affection t1 | 3.05 | 0.74 | | | | | | | |
| | | | | | | | | | |
| 2. hostility t1 | 2.70 | 0.69 | -.42** | | | | | | |
| | | | [-.49, -.34] | | | | | | |
| 3. rivalry t1 | 1.82 | 0.78 | -.22** | .41** | | | | | |
| | | | [-.30, -.13] | [.33, .48] | | | | | |
| 4. conflict | 3.31 | 0.88 | .52** | -.49** | -.38** | | | | |
| resolution t1 | | | [.45, .58] | [-.55, -.42] | [-.45, -.30] | | | | |
| 5. affection t2 | 3.07 | 0.72 | .61** | -.22** | -.21** | .34** | | | |
| | | | [.55, .66] | [-.30, -.13] | [-.30, -.12] | [.26, .42] | | | |
| 6. hostility t2 | 2.66 | 0.66 | -.19** | .48** | .22** | -.33** | -.19** | | |
| | | | [-.27, -.10] | [.41, .54] | [.13, .31] | [-.40, -.25] | [-.27, -.10] | | |
| 7. rivalry t2 | 1.78 | 0.72 | -.21** | .25** | .43** | -.31** | -.18** | .34** | |
| | | | [-.29, -.12] | [.16, .33] | [.36, .51] | [-.39, -.22] | [-.27, -.09] | [.26, .42] | |
| 8. conflict | 3.40 | 0.81 | .34** | -.29** | -.23** | .43** | .46** | -.42** | -.34** |
| resolution t2 | | | [.26, .41] | [-.37, -.21] | [-.31, -.14] | [.36, .50] | [.39, .53] | [-.49, -.34] | [-.42, -.26] |

*Note.* *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). * indicates $p < .05$. ** indicates $p < .01$.

**Table 2** *Means and Variances of the Latent Profile Indicators*

| Indicator | Profile | | | | | All profiles |
|---|---|---|---|---|---|---|
| | Affect-intense | Harmonious | Uninvolved | Hostile | Rival | |
| | *M* (*SE*) | *M* (*SE*) | *M* (*SE*) | *M* (*SE*) | *M* (*SE*) | $\sigma^2$ (*SE*) |
| Affection | 0.08 (0.12) | 0.89 (0.15) | -0.28 (0.17) | -1.13 (0.26) | -0.53 (0.17) | 0.64 (0.04) |
| Conflict Resolution | -0.05 (0.13) | 1.03 (0.14) | -0.17 (0.16) | -1.23 (0.21) | -0.89 (0.18) | 0.55 (0.04) |
| Hostility | 0.24 (0.11) | -0.90 (0.15) | 0.03 (0.13) | 0.85 (0.21) | 0.76 (0.15) | 0.68 (0.05) |
| Rivalry | 0.79 (0.05) | -0.84 (0.05) | -0.67 (0.05) | 0.45 (0.26) | 2.14 (0.19) | 0.21 (0.05) |

**Table 3** *Latent Transition Probabilities Based on the Estimated Model*

| Profile at t1 | Profile at t2 | | | | |
|---|---|---|---|---|---|
| | Affect-intense | Harmonious | Uninvolved | Hostile | Rival |
| Affect-intense | 61.0% | 6.1% | 26.0% | 0.0% | 6.9% |
| Harmonious | 6.1% | 85.7% | 8.2% | 0.0% | 0.0% |
| Uninvolved | 28.9% | 3.4% | 57.5% | 10.1% | 0.0% |
| Hostile | 6.4% | 1.9% | 25.4% | 52.5% | 13.8% |
| Rival | 13.7% | 13.4% | 6.6% | 23.0% | 43.3% |

*Note.* t1 = first measurement occasion; t2 = second measurement occasion. Displayed is the probability for each transition based on the estimated model. The transitions into the same profile (stayers) are displayed on the diagonal.

**Table 4** *Parameter Estimates from Logistic Regression on Stability in Latent Profile Membership Across Two Measurement Occasions*

| Variable | Estimate | SE | z value | Pr(> \|z\|) | Std. Odds Ratio | 95% CI |
|---|---|---|---|---|---|---|
| Intercept | 0.45 | 0.20 | 2.22 | .026 | 2.67 | [1.95; 3.76] |
| Optimal State | 2.33 | 0.45 | 5.14 | <.001 | 2.73 | [1.93; 4.21] |
| Adversarial State | -0.39 | 0.30 | -1.32 | .187 | 0.87 | [0.71; 1.07] |
| Age | 0.01 | 0.01 | 0.81 | 0.42 | 1.11 | [0.84; 1.47] |
| Age Gap | -0.01 | 0.01 | -0.87 | .382 | 0.90 | [0.72; 1.14] |
| Firstborn[1] | 0.10 | 0.34 | 0.30 | .766 | 1.05 | [0.77; 1.44] |
| Two Brothers[2] | -0.24 | 0.28 | -0.88 | 0.38 | 0.90 | [0.72; 1.14] |
| Two Sisters[2] | 0.17 | 0.30 | 0.57 | .567 | 1.08 | [0.84; 1.38] |
| Age*Firstborn[1] | -0.01 | 0.02 | -0.28 | .782 | 0.96 | [0.71; 1.29] |

*Note.* CI = Confidence Interval; SE = Standard Error. Stability indicates remaining in the same latent profile across two measurement occasions (coded 1 = stable, 0 = transition to a different profile). Age and Age Gap are reported in months. All covariates were assessed at the first measurement occasion (t1). Odds ratios are standardized. Optimal State and Adversarial State are dummy variables indicating the child's relationship profile at t1 (see text for profile classification criteria).

[1] Firstborn is coded with laterborn children as te reference category.

[2] Two Brothers and Two Sisters are coded with mixed-sex sibling pairs as the reference category.

## Figures

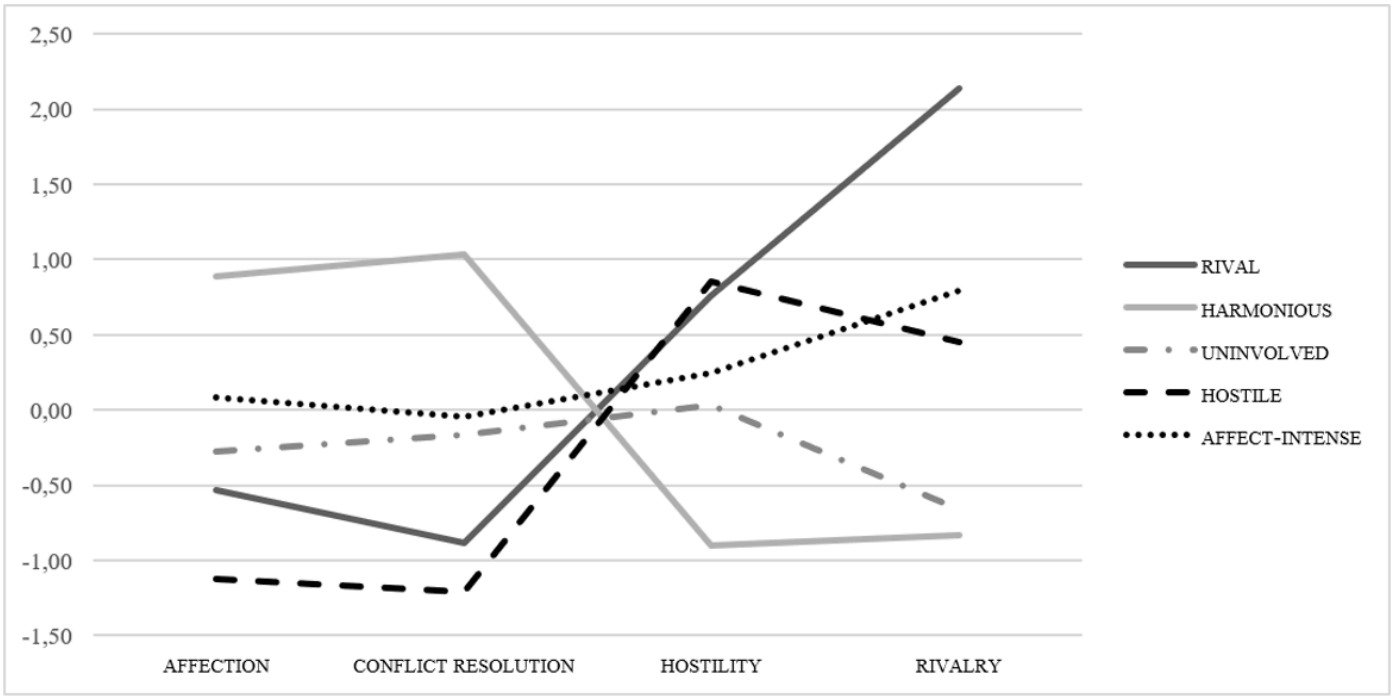



**Figure 1**

*Mean Values across the Sibling Relationship Scales for Five Profiles*

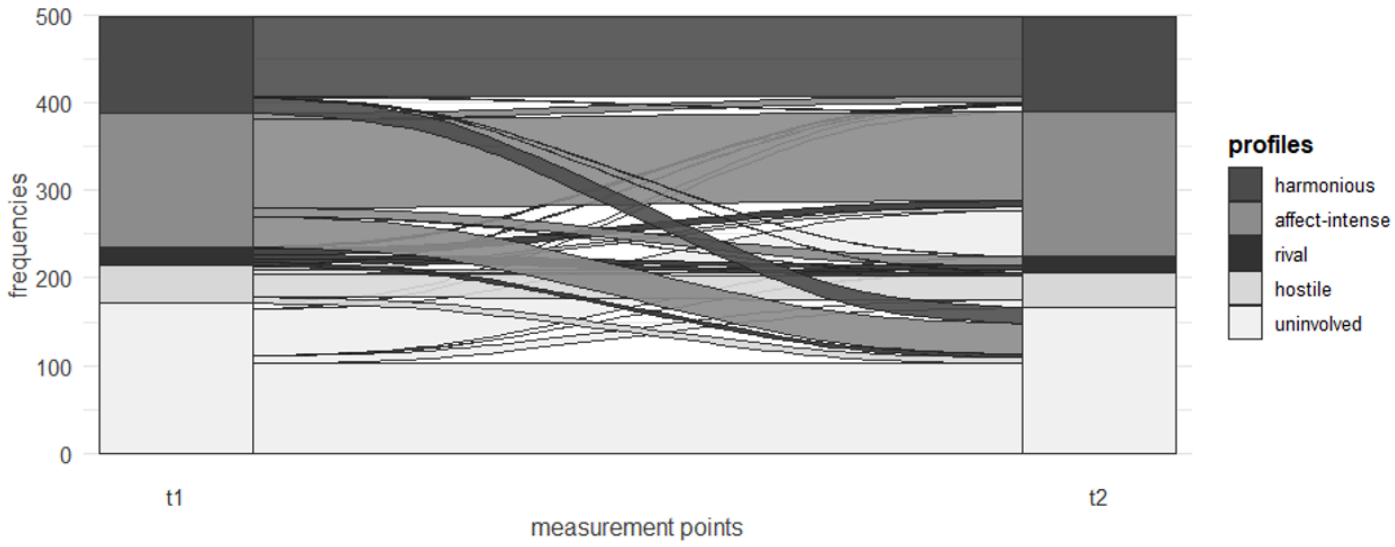



**Figure 2**

*Latent Transitions between Sibling Relationship Profiles across two Measurement Occasions*

# Supplementary Files

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