A Comparative Analysis and Pilot Study of Parental Autonomy Support as a Predictor of Adolescent Self-Esteem in Twin and Non-Twin Populations

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Abstract: Adolescent self-esteem develops through the interaction of genetic and environmental factors, yet existing research fails to examine how these processes operate within twin families - where identity formation is uniquely shaped by comparison and expectations of similarity. This study investigates whether parental autonomy support predicts adolescent self-esteem differently for twins and non-twins. A quantitative cross-sectional design was used to assess self-esteem (Rosenberg Self-Esteem Scale), perceived parental autonomy support (Perceived Parental Autonomy Support Scale), and parent–child relational climate (Parent–Child Relationship subscale of the Parental Environment Questionnaire). Participants included monozygotic twins, dizygotic twins, non-twin adolescents, and their parents. Descriptive statistics, scatterplot trendline analyses, and Pearson correlation coefficients were used to evaluate associations among the three constructs across sibling groups. Results showed a positive correlation between autonomy support and self-esteem for both twins and non-twins, with preliminary evidence suggesting that autonomy-supportive parenting may play a particularly important role in supporting identity differentiation among twins. Parent–child relational climate also demonstrated meaningful associations with self-esteem across all groups. These findings contribute to developmental psychology by integrating autonomy theory with twin research and highlight the potential value of individualized parenting strategies in promoting healthy identity development in twin populations.

Keywords: Adolescent self-esteem, Parental autonomy support, Twin development, Non-shared environment, Identity formation, Parent–child relationship

1. Introduction

While monozygotic twins share identical genetic blueprints, biological factors account for less than 50% of the variance in their individual identities (Marshall, 2023). These differences frequently trace back to how parents encourage their children to develop a unique sense of self until adolescence. Despite the abundance of literature on adolescent self-esteem, contemporary studies often neglect the unique developmental trajectory of twins. Typically, research on twins centers on the “nature versus nurture” debate. In fact, nature relating to genetics has been proven, by studies, to have a substantial impact on overall twin identity. Specifically, the role of parental behavior, a critical non-shared environmental factor, remains an

understudied determinant of self-conceptualization in twin households. Other studies on parenting strategies highlight the importance of supporting adolescents' individuality and its connection to self-esteem. There is no current research or correlation tying these effects to twins. A study from Cambridge reported that twins often exhibit higher levels of self-differentiation, the ability to maintain an autonomous sense of self, than non-twins. However, the analysis did not account for parental influence when comparing self-esteem outcomes between twins and non-twins (Marshall, 2023). Since non-twins do not face the same "paired identity" dynamic, the influence of parent-led individualism strategies may differ. Without understanding this, it is difficult to support parents of twins in ways to promote healthy self-esteem, separate from twin relationships. Consequently, current frameworks regarding twin development remain incomplete, as they fail to account for the moderating influence of parental individualization strategies. Studying how parental autonomy support relates to adolescent self-esteem is especially salient because this developmental period is marked by rapid identity change, making self-concept particularly sensitive to parental influence. Twins have a unique circumstance at this time, as they are facing constant pressure that leads to either competition or dependency. If parental strategies that emphasize individuality are shown to strengthen self-esteem, they could lead to better counseling and parenting approaches. This research contributes to developmental psychology by identifying how parental behaviors shape self-perception and other emotional factors, specifically in twins. The question of the extent to which parental effort to foster individualism in twins influences self-esteem development, compared to non-twins during adolescence, will be answered in this paper. The remainder of this paper reviews the relevant literature on parenting and twin development, outlines the methodological approach used in this study, presents the correlational findings, and concludes with a discussion of their implications, limitations, and directions for future research.

2. Literature Review

2.1 Parenting Behaviors as Predictors of Adolescent Self-Esteem

Across the literature, parenting behaviors emerged as consistently influential predictors of adolescent self-esteem. Developmental research showed that adolescence was a period in which parental warmth, structure, and autonomy support carried heightened developmental importance, shaping how adolescents evaluated their own competence. This foundational understanding was expanded by Peng et al. (2021), who identified self-esteem as a mediating mechanism linking parenting style to adolescent mental-health outcomes. Their findings strengthen the existing body of knowledge by clarifying that self-esteem operates as the mediating process linking parenting style to psychological outcomes. However, they also share a defining limitation: these two studies evaluate adolescents as a generalized population. No current literature examines how these parenting behaviors manifest in twin households, where comparison is more frequent and shared identity is more entrenched. This gap becomes more salient when considering the distinct developmental context of twins.

2.2 Genetic and Environmental Contributions to Individual Differences

Understanding self-esteem development in twins also requires examining how genetic and environmental factors interact to shape identity. Plomin and Daniels (2011), whose work represents the foundational modern articulation of the non-shared environment, argue that environmental experiences, rather than genetics, largely explain why siblings raised in the same household differ from one another. Their updated analysis emphasizes adolescence as a developmental stage in which environmental divergence intensifies, making individual experiences especially consequential for identity formation. This perspective is critical for twin research, as it suggests that parental behaviors may serve as powerful differentiating forces even among genetically identical siblings. Unlike behavioral genetics studies that focus solely on trait heritability, Plomin and Daniels (2011) provide a theoretical justification for examining how parents may shape individuality in twins through differential treatment, autonomy support, or individualized expectations. However, their work remains conceptual: they do not identify which parental behaviors function as non-shared environmental contributors, nor do they test whether such influences affect self-esteem in twins differently than in non-twins. As a result, while genetics-environment research clarifies why environmental variation matters, it leaves the nature of parental influence empirically underexplored in twin populations.

2.3 Identity Formation in Twin Relationships

Research focused specifically on twins provides insight into the identity pressures that distinguish twin development from the experiences of non-twin adolescents. Akerman and Suurvee (2003) offer one of the most comprehensive longitudinal examinations of twin identity formation, following 32 twin pairs from infancy to age 16. Their findings show that cognitive differences between co-twins diminish over time. Yet identity differences become more pronounced during adolescence, particularly for monozygotic twins, a twin derived from a single ovum, who displayed more negative identity indicators on standardized assessments. This suggests that genetic similarity intensifies the difficulty of establishing a distinct sense of self. Additional research from Cambridge supports this conclusion, reporting elevated self-differentiation among twins as they deliberately work to separate themselves from the “twin identity” imposed by external labeling (Marshall, 2023). These studies collectively reveal that twins face developmental pressures unrelated to those experienced by non-twins, including heightened comparison, expectations of uniformity, and challenges in asserting individuality. However, neither study examines parental behavior. Identity outcomes are reported as inherent features of twin dynamics rather than as processes shaped by parenting. This omission restricts the field’s understanding of potential parental strategies that may alleviate or exacerbate identity challenges in twin households.

2.4 Psychological Scales to Measure Self-Esteem and Parental Autonomy

This study employs three validated psychological instruments - the Rosenberg Self-Esteem Scale (RSE), the Perceived Parental Autonomy Support Scale (P-PASS), and the

Parent-Child Conflict subscale of the Parental Environment Questionnaire (PEQ) - to quantify the constructs central to understanding how parental behaviors relate to adolescent self-esteem. The P-PASS measures adolescents' perceptions of autonomy-supportive versus controlling parenting using a 7-point agreement scale (Mageau, 2015). Autonomy support is consistently linked to healthier identity development and stronger self-esteem, offering a behavioral lens on parental influence that extends beyond genetic explanations of adolescent differences. This aligns with Plomin and Daniels' (2011) argument that non-shared environmental experiences, such as differential parental treatment, shape individual outcomes even among genetically similar siblings. However, neither study examines whether these dynamics operate differently in twin households, leaving a gap that this research addresses. Self-esteem was assessed using the Rosenberg Self-Esteem Scale (RSE), a 10-item Guttman-style measure with strong psychometric properties, including a reproducibility coefficient R 2 of .92 and test-retest correlations between .85 and .88 (Rosenberg, 1979). The RSE provides a stable, widely used metric for comparing self-esteem across sibling groups, allowing this study to evaluate whether autonomy support predicts self-esteem similarly for twins and non-twins. To capture the broader relational climate, the study incorporates the Parent-Child Conflict scale of the Parental Environment Questionnaire (PEQ). The PEQ consists of 12 items rated on a 4-point scale, with higher scores indicating lower conflict. Recent research demonstrates exceptionally high internal reliability for this scale (Cronbach's $\alpha = .982$), confirming its suitability for assessing parent-child relational dynamics (Wong et al., 2023). While the PEQ has been used to examine conflict and psychological distress in parents, it has not been applied to compare relational environments across twin and non-twin families. These three validated scales contribute to the body of knowledge by describing three commonly used psychological measures and how scores are interpreted, providing an understanding of how self-esteem and parental autonomy are measured. More importantly, they allow this study to address a clear gap in the literature: although prior research has examined parenting style, autonomy support, and twin identity separately, no existing work integrates these constructs to test whether parental behaviors relate to self-esteem differently for twins than for non-twins.

2.5 Initial Assumptions + Understanding the Gaps in Research

Across all four thematic areas, existing research supports several consistent conclusions regarding adolescent development. First, studies examining parenting style demonstrate that parental warmth, autonomy support, and emotional responsiveness contribute to stronger levels of adolescent self-esteem (Peng et al., 2021). Second, developmental psychology research on environmental influences establishes that even genetically identical individuals diverge in identity formation due to non-shared environmental experiences, including parental behavior (Plomin & Daniels, 2011). Third, research focused specifically on twins shows that twin adolescents encounter unique identity pressures, such as increased comparison, external labeling, and expectations of similarity, that distinguish their developmental context from that of

non-twins (Akerman & Suurvee, 2003). Finally, studies on autonomy development highlight that autonomy-restrictive parenting impedes identity formation and prolongs dependency (Shah et al., 2022), suggesting that parental individualization strategies play a role in strengthening adolescents' sense of self. Together, these findings lead to several initial assumptions. The first assumption is that parental behavior influences self-esteem across adolescent populations, regardless of genetic similarity. The second assumption is that twins, due to their unique social and familial positioning, may experience self-esteem differently than non-twin adolescents, even if raised by the same parents. The third assumption is that parents may unintentionally contribute to identity challenges in twins if individuality is not actively promoted. These assumptions are logically derived from existing research but remain untested in a combined framework.

Despite the coherence across these themes, a clear gap in the body of knowledge persists. Studies on parenting style do not examine twin-specific self-esteem outcomes. Studies on twin identity focus on developmental trajectories but omit the role of parental behavior. Studies on autonomy development do not include twin comparisons. As a result, the given body of knowledge fails to investigate how parental individualization strategies function within twin households, nor whether these strategies influence self-esteem differently for twins than for non-twins. The study conducted in this research paper will address this gap by examining how parental efforts to promote individuality relate to adolescent self-esteem in twin and non-twin populations. This integrated approach amplifies prior work by applying parenting and autonomy-development factorizations to a population that has been largely excluded from empirical analysis. Ultimately, creating the tentative hypothesis that there will be a correlation between self-esteem and parental influence in both twins and non-twins, to a significant degree.

3. Methods

3.1 Statement of Ethics:

Prior to the start of the study, IRB approval was obtained, and consent forms for participants under 18 were signed by a parent or guardian. All identifying data were kept anonymous and were removed to protect participant privacy. Survey responses were collected through Google Forms, which remained password-protected and accessible only to the researcher. No names, emails, or contact information were stored alongside survey responses. All identifying data were retained only for the duration of the research process and were permanently deleted upon completion of the paper to ensure participant confidentiality and compliance with ethical research standards.

A quantitative cross-correlational methodology was utilized to test the relationship between adolescent self-esteem, perceived parental autonomy levels (P-PASS), and the parent-child relational environment (PEQ), identifying whether these variables functioned differently for twins compared to non-twins. This method aligned with the purpose of the study, which was to determine whether parental individualization strategies influenced self-esteem

differently across sibling types. Because the study focused on identifying statistical relationships rather than establishing causation, correlational methods were deemed appropriate and feasible.

To gather the necessary data, three validated psychological instruments were administered. First, adolescent self-esteem was measured using the Rosenberg Self-Esteem Scale (RSE), a ten-item Likert-style instrument widely used in adolescent psychology research for its reliability and strong construct validity. Parental individualization and autonomy support were measured using the Perceived Parental Autonomy Support Scale (P-PASS), which assessed the degree to which adolescents perceive their parents as autonomy-supportive or autonomy-controlling. Lastly, the Parental Environment Questionnaire (PEQ) captured the parents' perspective on the relational climate, specifically levels of parent-child conflict. These instruments directly measured the constructs central to my research and allowed for the calculation of correlations between parental behaviors-perceived by both the child and parent-and self-esteem outcomes

3.2 Research Procedure and Statistical Framework

Twin participants were recruited through social media, twin organizations, and local outreach. Once twin participants were acquired, they were asked to complete surveys along with the families of non-twins: parents, siblings, and adolescents. After all data were collected, the correlational analysis was conducted in the following order.

First, descriptive statistics were used to summarize self-esteem levels, autonomy support scores, and parental environment questionnaire scores. These statistics were sorted by families of identical twins, fraternal twins, and non-twins to provide an initial overview of group differences.

Second, scatterplots were created to visualize the relationships between self-esteem (RSE) and both parental autonomy support (P-PASS) and parental environment (PEQ). Google Sheets automatically generated R^2 values for each scatterplot, which indicate the proportion of variance in self-esteem explained by each parental factor. These R^2 values were used solely for visualization and to illustrate the linear fit of each relationship for twins and non-twins.

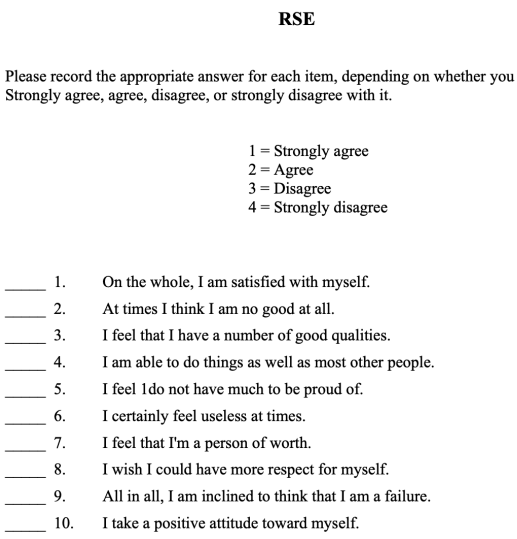
Third, Pearson correlation coefficients were calculated using the CORREL function to examine the strength and direction of the relationships between parental autonomy support, parental environment, and self-esteem within each group. These r-values were displayed in a heat map to allow for direct comparison of correlational patterns across twin and non-twin populations.

In summary, the three statistical tools used in this study were conducted to gain a full scope of how parental factors related to adolescent self-esteem across sibling groups. Descriptive statistics established the overall distribution of self-esteem, autonomy support, and parent-child environment scores (supported by organized group summaries). R^2 values from scatterplots then offered an initial visual indication of how strongly parental autonomy support and parental environment predicted self-esteem (supported by Google Sheets trendline outputs). Pearson correlation coefficients provided the final quantitative measure of the strength and direction of

these relationships within each group (supported by CORREL-generated values displayed in the heat map). Together, these tools created a cohesive analytical framework for evaluating whether parental behaviors related to self-esteem differently for twins and non-twins.

An alternative method initially considered was a longitudinal case study similar to Akerman and Suurvee's (2003) multi-year tracking of twins. While this approach offered rich developmental insight, it was limited in generalizability and was not feasible within the time and resource constraints of a high school project. A second alternative involved conducting a thematic analysis of free-response questions from twins and non-twins. Although these items were included in the survey, many responses were incomplete or too brief to categorize reliably, preventing a systematic qualitative analysis.

For these reasons, the correlational design was deemed more appropriate for the goals of the study. By combining validated psychological scales with structured group comparisons, this methodology directly addressed the gap identified in the literature review: there was no existing research examining how parental individualization strategies related to self-esteem differently for twins and non-twins. This design enabled reliable measurement of core psychological variables and produced evidence that contributed to existing theories of parenting and autonomy while addressing the applied question of whether twinship moderated the relationship between parental behavior and adolescent self-esteem.



RSE

Please record the appropriate answer for each item, depending on whether you Strongly agree, agree, disagree, or strongly disagree with it.

1 = Strongly agree
2 = Agree
3 = Disagree
4 = Strongly disagree

_____ 1. On the whole, I am satisfied with myself.
_____ 2. At times I think I am no good at all.
_____ 3. I feel that I have a number of good qualities.
_____ 4. I am able to do things as well as most other people.
_____ 5. I feel 1do not have much to be proud of.
_____ 6. I certainly feel useless at times.
_____ 7. I feel that I'm a person of worth.
_____ 8. I wish I could have more respect for myself.
_____ 9. All in all, I am inclined to think that I am a failure.
_____ 10. I take a positive attitude toward myself.

Figure 1. The Rosenberg Self-Esteem Scale (RSE), a 10-item instrument that was used to measure global self-worth. Items were rated on a 4-point Likert scale ranging from Strongly Agree to Strongly Disagree. Five items were positively worded and five were reverse-scored. After reverse-scoring the appropriate items, responses were summed to produce a total self-esteem score, with higher scores indicating higher self-esteem.

Do not agree at all 1	Hardly agree 2	Slightly agree 3	Somewhat agree 4	agree 5	Strongly agree 6	Very strongly agree 7

BE CAREFUL, the order of responses for your mother and father changes for each item.

WHEN I WAS GROWING UP …

1. My parents gave me many opportunities to make my own decisions about what I was doing.	**Mother** 1 2 3 4 5 6 7 *Father** 1 2 3 4 5 6 7
2. When my parents asked me to do something, they explained why they wanted me to do it.	*Father** 1 2 3 4 5 6 7 **Mother** 1 2 3 4 5 6 7
3. When I refused to do something, my parents threatened to take away certain privileges in order to make me do it.	**Mother** 1 2 3 4 5 6 7 *Father** 1 2 3 4 5 6 7
4. My point of view was very important to my parents when they made important decisions concerning me.	*Father** 1 2 3 4 5 6 7 **Mother** 1 2 3 4 5 6 7
5. My parents refused to accept that I could want simply to have fun without trying to be the best.	**Mother** 1 2 3 4 5 6 7 *Father** 1 2 3 4 5 6 7
6. When my parents wanted me to do something differently, they made me feel guilty.	*Father** 1 2 3 4 5 6 7 **Mother** 1 2 3 4 5 6 7
7. My parents encouraged me to be myself.	**Mother** 1 2 3 4 5 6 7 *Father** 1 2 3 4 5 6 7
8. Within certain limits, my parents allowed me the freedom to choose my own activities.	*Father** 1 2 3 4 5 6 7 **Mother** 1 2 3 4 5 6 7
9. When I was not allowed to do something, I usually knew why.	**Mother** 1 2 3 4 5 6 7 *Father** 1 2 3 4 5 6 7
10. I always had to do what my parents wanted me to do, if not, they would threaten to take away privileges.	*Father** 1 2 3 4 5 6 7 **Mother** 1 2 3 4 5 6 7
11. My parents believed that, in order to succeed, I always had to be the best at what I did.	**Mother** 1 2 3 4 5 6 7 *Father** 1 2 3 4 5 6 7
12. My parents made me feel guilty for anything and everything.	*Father** 1 2 3 4 5 6 7 **Mother** 1 2 3 4 5 6 7
13. My parents were able to put themselves in my shoes and understand my feelings.	**Mother** 1 2 3 4 5 6 7 *Father** 1 2 3 4 5 6 7
14. My parents hoped that I would make choices that corresponded to my interests and preferences regardless of what theirs were.	*Father** 1 2 3 4 5 6 7 **Mother** 1 2 3 4 5 6 7
15. When my parents wanted me to do something, I had to obey or else I was punished.	**Mother** 1 2 3 4 5 6 7 *Father** 1 2 3 4 5 6 7
16. My parents were open to my thoughts and feelings even when they were different from theirs.	*Father** 1 2 3 4 5 6 7 **Mother** 1 2 3 4 5 6 7
17. In order for my parents to be proud of me, I had to be the best.	**Mother** 1 2 3 4 5 6 7 *Father** 1 2 3 4 5 6 7
18. When my parents wanted me to act differently, they made me feel ashamed in order to make me change.	*Father** 1 2 3 4 5 6 7 **Mother** 1 2 3 4 5 6 7
19. My parents made sure that I understood why they forbid certain things.	**Mother** 1 2 3 4 5 6 7 *Father** 1 2 3 4 5 6 7
20. As soon as I didn't do exactly what my parents wanted, they threatened to punish me.	*Father** 1 2 3 4 5 6 7 **Mother** 1 2 3 4 5 6 7
21. My parents used guilt to control me.	**Mother** 1 2 3 4 5 6 7 *Father** 1 2 3 4 5 6 7
22. My parents insisted that I always be better than others.	*Father** 1 2 3 4 5 6 7 **Mother** 1 2 3 4 5 6 7
23. When I asked why I had to do, or not do, something, my parents gave me good reasons.	**Mother** 1 2 3 4 5 6 7 *Father** 1 2 3 4 5 6 7
24. My parents listened to my opinion and point of view when I disagreed with them.	*Father** 1 2 3 4 5 6 7 **Mother** 1 2 3 4 5 6 7

Figure 2. The Perceived Parental Autonomy Support Scale (P-PASS), which was used to assess the extent to which adolescents perceived their parents as supporting their autonomy. The scale included items rated on a 7-point Likert scale from Strongly Disagree to Strongly Agree. Negatively phrased items were reversed-scored, and all responses were averaged to generate a continuous autonomy-support score, with higher values reflecting greater perceived parental autonomy support

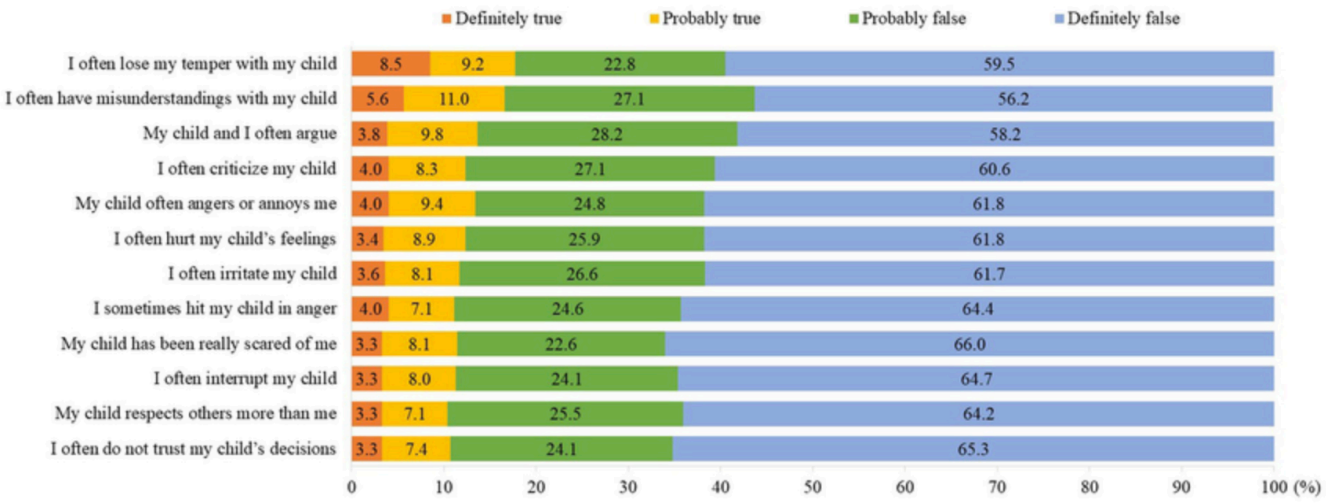


Figure 3. The Parent-Child Relationship subscale of the Parental Environment Questionnaire (PEQ), which was used to measure the emotional quality of the parent-adolescent relationship. Items were rated on a 4-point Likert scale ranging from Almost Never to Almost Always. Negatively worded items were reversed-scored, and all items were averaged to produce a composite score, with higher scores indicating a more positive parent-child relational environment.

Figures 1-3 portrayed the likert scales utilized on the participants. With Figure 1 (RSE) used on all participants; Figure 2 (P-PASS) used on twins, non-twins and siblings; Figure 3 (PEQ) completed by the parents of twins and non-twins. Based on the data, two master tables were created, as shown in Figure 4 (twins) and Figure 5 (non-twins), which converted participants' scores into numerical values. Figures 1–3, as well as the scoring procedures previously described in Section 2.4, outlined how the data were converted into numerical form, a step necessary to conduct the correlational analysis.

Participant ID	Group	Gender	RSE Score	P-PASS AVG Score	PEQ Score
1A	MZ	F	27	5.8	N/A
2A	MZ	F	25	5.2	N/A
3A	P-F	M	28	N/A	3.4
4A	P-M	F	27	N/A	3.3
5B	DZ	M	29	6.0	N/A
6B	DZ	F	26	5.5	N/A
7B	S-T	F	29	6.1	N/A
8B	P-F	M	27	N/A	3.6
9B	P-M	F	27	N/A	3.6
10C	MZ	M	26	5.7	N/A
11C	MZ	M	27	5.9	N/A
12C	S-T	F	29	6.2	N/A
13C	P-F	M	29	N/A	3.4
14C	P-M	F	25	N/A	3.2
15D	DZ	F	23	5.0	N/A
16D	DZ	M	27	5.9	N/A
17D	S-T	M	29	6.5	N/A
18D	P-F	M	27	N/A	3.5
19D	P-M	F	27	N/A	3.6

Figure 4. The master table contained all numerical data for twin participants and their family members. Each row represented a single participant, with group abbreviations indicating MZ (monozygotic twin), DZ (dizygotic twin), S-T (sibling of a twin), P-F (father), and P-M (mother). Each of the last three columns corresponded to one of the three psychological scales: Rosenberg Self-Esteem Scale (RSE), Perceived Parental Autonomy Support Scale (P-PASS), and the Parent-Child Relationship subscale of the Parental Environment Questionnaire (PEQ). All responses were converted into numerical values using the scoring procedures outlined in Figures 1–3, including reverse-scoring where required. The table consolidated these processed scores into a single dataset that was used for subsequent correlational analysis.

Participant ID	Group	Gender	RSE Score	P-PASS AVG Score	PEQ Score
20F	NT	M	29	6.7	N/A
21F	NT	M	27	6.3	N/A
22F	P-F	M	26	N/A	3.4
23F	P-M	F	27	N/A	3.6
24G	NT	F	27	6.6	N/A
25G	NT	M	28	6.6	N/A
26G	P-F	M	26	N/A	3.5
27G	P-M	F	27	N/A	3.4

Figure 5. Master table for non-twin participants. Similar to the twin dataset, each row corresponded to a non-twin adolescent or a family member. All items were converted into numerical values, ensuring consistency across sibling groups. This table served as the parallel dataset to Figure 4, used to conduct the correlational analysis between parental factors and self-esteem in non-twin families.

With the twin and non-twin datasets organized into their respective master tables, the next step involved visualizing the relationships among the variables. To accomplish this, scatterplots were generated for each group, allowing the linear association between parental autonomy support, parental environment, and self-esteem to be examined. Each scatterplot

included a trendline accompanied by an R^2 value, which provided an indication of how closely the data points aligned with the fitted line- that is, how much of the variation in self-esteem was accounted for by the parental factor being examined. These visualizations formed the basis for the comparative analysis and provided validation, presented in Figures 6-9.

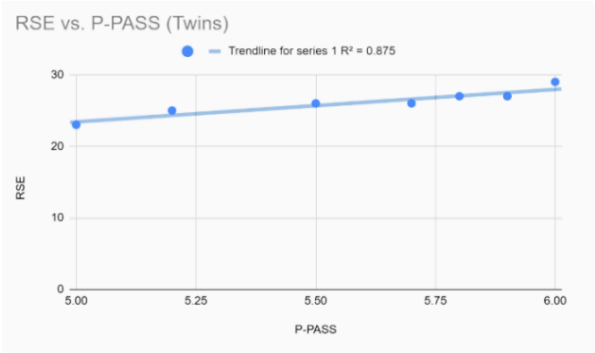


Figure 6. Scatterplot displayed the relationship between Rosenberg Self-Esteem (RSE) scores and P-PASS average scores for twin participants, including a linear trendline with an R 2 value of 0.875.

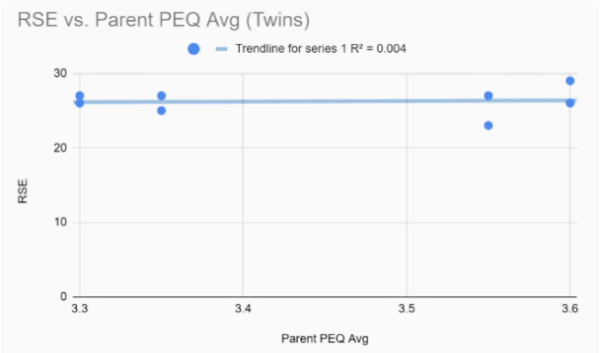


Figure 7. Scatterplot displayed the relationship between Rosenberg Self-Esteem (RSE) scores and Parent PEQ average scores, with an R^2 value of 0.004.

Figures 8-9 presented the same variable comparisons shown in Figures 6 and 7, but were applied to the non-twin sample to illustrate the corresponding relationships within that group.

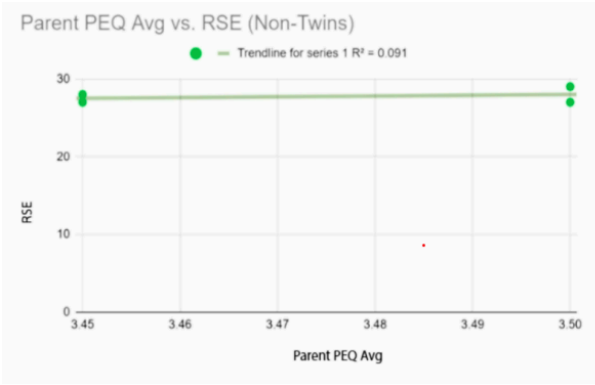


Figure 8. Scatterplot illustrated the association between Rosenberg Self-Esteem (RSE) scores and Parent PEQ averages for non-twin participants, shown with a R^2 value of 0.091.

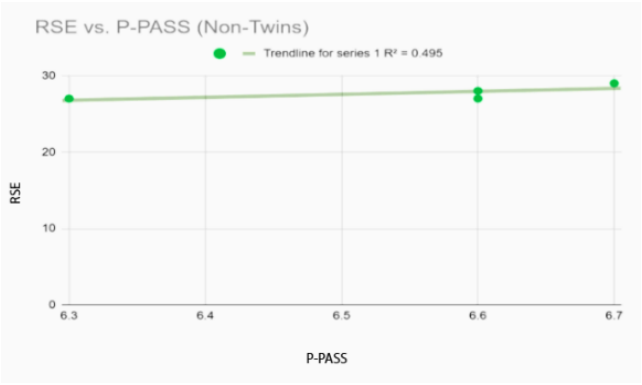


Figure 9. Scatterplot illustrated the relationship between Rosenberg Self-Esteem (RSE) scores and P-PASS average scores for non-twin participants, shown with a R 2 value of 0.495.

To prepare the dataset for correlational analysis, a matched comparison table was created to ensure equal numbers of twin and non-twin participants with complete data. Because Pearson correlation required paired lists of equal length, four twins and four non-twins with complete RSE, P-PASS, and PEQ scores were selected and were organized into a single table (Figure 10). All values were transferred using the master tables (Figures 4–5). PEQ scores were assigned based on each participant's corresponding parent report. This matched dataset served as the foundation for generating the correlation coefficients displayed in the heat map (Figure 11).

Family	ID	Zygosity	RSE	P-PASS AVG	Parent PEQ Avg
A	1A	MZ	27	5.8	3.35
A	2A	MZ	25	5.2	3.35
B	5B	DZ	29	6	3.6
B	6B	DZ	26	5.5	3.6
F	20F	NT	29	6.7	3.5
F	21F	NT	27	6.3	3.5
G	24G	NT	27	6.6	3.45
G	25G	NT	28	6.6	3.45

Figure 10. The resulting table served as the foundation for calculating the nine Pearson correlation coefficients used in the heat map (Figure 11), enabling a structured examination of how parental autonomy support and parental environment related to self-esteem across sibling types.

After the data were organized into parallel columns for RSE, P-PASS, and parent PEQ scores for both twins and non-twins, each pair of variables was compared using the CORREL() function. For example, the correlation between non-twin RSE and twin RSE was calculated using the formula =CORREL(D6:D9, D2:D5), where the first range represented the non-twin scores and the second range represented the matched twin scores. This procedure was repeated for all nine cross-group combinations, producing a complete 3×3 matrix of Pearson coefficients.

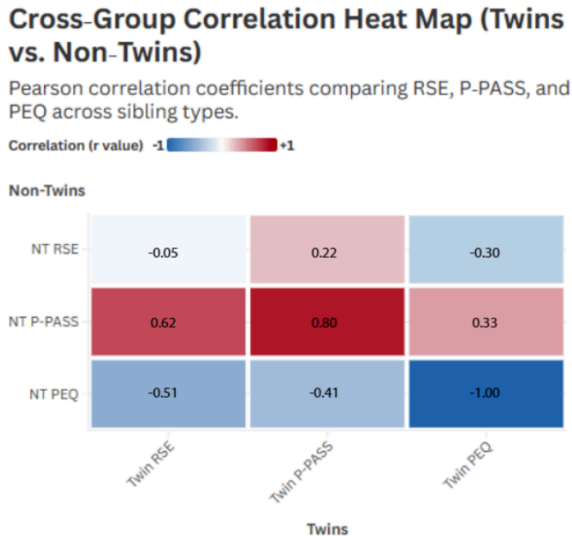


Figure 11. Summary graphic presented the study methodology organized by cross-group scale classification. Correlations between twins and non-twins were depicted by color, indicating the strength of relationships and highlighting the similarities and differences across constructs.

Taken together, this methodological design provided a clear and replicable framework for examining how parental individualization strategies related to adolescent self-esteem across sibling groups. By using only validated psychological scales and a matched-pair correlational structure, the study ensured consistent measurement and statistically balanced comparisons between twins and non-twins. Matching participants across groups strengthened internal validity by allowing Pearson correlations to be calculated from parallel datasets of equal length, meeting the statistical requirements for cross-group analysis.

This quantitative approach directly addressed the gap identified in the scholarly review: although prior studies had examined parenting style, autonomy support, and twin identity separately, none had tested how these constructs interacted within a unified statistical model or whether these relationships differed for twins compared to non-twins. By organizing the data into aligned variables and computing a full matrix of cross-group correlations, the methodology enabled a focused evaluation of whether twinship moderated the relationship between parental behavior and adolescent self-esteem. This positioned the study to generate preliminary but meaningful insights, setting the foundation for the correlational findings presented in the findings.

4. Findings and Data Analysis

This study examined the relationship between parental individualization strategies and adolescent self-esteem in twin and non-twin populations using three validated psychological instruments: the Rosenberg Self-Esteem Scale (RSE), the Perceived Parental Autonomy Support Scale (P-PASS), and the Parental Environment Questionnaire (PEQ). The final dataset included monozygotic and dizygotic twins as well as non-twins, each linked to at least one parent. Figures 4 and 5 summarize the core variables, showing that most adolescents scored in the high self-esteem range, with P-PASS scores clustering between 5.0 and 6.7 and PEQ scores around the mid-3 range. These descriptive statistics suggest generally positive self-esteem and moderately high perceived autonomy support across the sample.

The correlational analysis revealed distinct patterns between groups. Among twins, self-esteem and perceived parental autonomy support were strongly positively correlated. Figures 6-7 display a tight, upward-sloping relationship ($R2 = 0.875$), indicating low variance and a strong association between perceived autonomy support and higher self-esteem. In contrast, the relationship between RSE and PEQ in twins (Figure 8-9) were negligible ($R2 = 0.004$), suggesting that parent-reported environmental measures were not meaningfully associated with twin self-esteem.

For non-twins, the relationship between RSE and P-PASS was moderately positive (Figure 10; $R 2 = 0.495$), indicating a weaker and more variable association compared to twins. The relationship between PEQ and RSE in non-twins was small but present ($R2 = 0.091$), suggesting that the broader parental environment may play a slightly greater role for non-twins than for twins.

Figure 11 presents a heat map summarizing cross-group correlations among RSE, P-PASS, and PEQ. The strongest relationship is observed between twin and non-twin P-PASS scores, indicating substantial consistency in perceived autonomy support across groups. In contrast, correlations involving PEQ, particularly between twin and non-twin PEQ, are negative, suggesting divergence in how parents report the environment across sibling types. Relationships involving RSE are comparatively weak, with non-twin RSE showing minimal association with twin variables. Overall, these patterns indicate that autonomy support (P-PASS) is the most stable construct across sibling types, whereas parental environment (PEQ) shows greater divergence. Self-esteem (RSE) demonstrates limited cross-group correspondence, suggesting it is less uniformly shared across sibling contexts. In other words, this means that parental autonomy support plays a very prominent role in influencing self-esteem levels in twin adolescents, while not being a significant determinant in non-twin adolescents, partially aligning with the initial hypothesis.

5. Conclusion

5.1 New Understandings + Evaluation of Initial Assumptions

This study was guided by three primary assumptions: that parental behavior broadly influences adolescent self-esteem, that twins may experience self-esteem differently due to identity-related pressures, and that parental individualization strategies may be particularly important in twin households. Together, these assumptions shaped the central research question: to what extent does parental autonomy support adolescent self-esteem in twins compared to non-twins? The findings partially support and refine this question. Parental autonomy support showed a strong positive relationship with self-esteem in twins, while the relationship was more moderate among non-twins, suggesting that autonomy-supportive parenting may play a comparatively larger role in shaping self-esteem for adolescents navigating the paired-identity dynamics of twinship.

The strong positive association between P-PASS and RSE in twins supports the hypothesis that parental autonomy support is a key correlate of self-esteem in adolescence. This finding aligns with prior research showing that autonomy-supportive parenting promotes healthier identity development and stronger self-esteem (Peng et al., 2021). It also complements twin-identity research indicating that twins face heightened comparison and identity-related pressures (Akerman & Suurvee, 2003), suggesting that autonomy-supportive parenting may be especially impactful for adolescents working to differentiate themselves within a twin dyad. When twins perceive their parents as encouraging individuality and independent decision-making, their self-esteem appears particularly robust.

For non-twins, the weaker but still positive relationship between P-PASS and RSE suggests that autonomy support is important across sibling types, but not equally so. In this population, self-esteem seems less tightly bound to autonomy support and somewhat more diffusely related to the broader parental environment (PEQ). This detail refines the initial assumption that parental behavior influences self-esteem regardless of genetic similarity by indicating that which parental behaviors matter most may differ by sibling context. The near-zero relationship between PEQ and RSE in twins challenges any simplistic assumption that a generally positive or negative parental environment, as reported by parents, directly shapes twin self-esteem. Rather, the data suggest that twins' self-esteem is more sensitive to the degree of autonomy they personally perceive than to how parents globally characterize the home environment. This pattern aligns with non-shared environment theory (Plomin & Daniels, 2011), which emphasizes that subjective experiences, rather than objective parental reports, explain why siblings raised in the same household diverge in psychological outcomes. For twins, this divergence appears to center specifically on perceived autonomy support.

5.2 Implications

Following the conclusions drawn from the data, both theoretical and practical implications can be made. Theoretically, they suggest that twinship may moderate the relationship between parenting and self-esteem by altering which parental behaviors are most influential. This is consistent with the Plomin and Daniels' (2011) argument that subjective experiences, rather than shared household conditions, drive sibling differences. Because twins often face heightened comparison and identity pressure (Akerman & Suurvee, 2003), practices such as explaining reasons for rules, encouraging independent choices, and acknowledging each twin's perspective may help them build a more differentiated and confident sense of self.

Practically, parents of twins may benefit from intentionally emphasizing individualization, by allowing each twin to pursue distinct interests, avoiding performance-based comparisons, and recognizing their unique strengths. These strategies align with the broader literature, showing that autonomy-supportive parenting promotes healthier identity development and stronger self-esteem (Peng et al., 2021). For non-twins, the more moderate correlations suggest that both autonomy support and the general parent-child environment contribute to self-esteem, indicating that a wider range of parenting behaviors may be relevant.

Lastly, for school counselors, pediatricians, and family therapists, these results highlight the importance of asking adolescents, not just parents, how much autonomy they feel they have at home. This is especially important for twins, whose self-esteem may depend less on the overall family climate and more on whether they feel individually recognized within it.

5.3 Limitations

Several limitations affect the interpretation of this study. The sample size was relatively small, particularly when subdivided into twin subgroups, limiting statistical power and the stability of correlation estimates. The strong association observed in twins may be influenced by restricted variability and sample size.

Additionally, the cross-sectional design prevents causal inference. While autonomy support is associated with higher self-esteem, it is also possible that adolescents with higher self-esteem perceive their parents more positively. Furthermore, self-report bias may have led participants to provide responses that did not accurately reflect their typical attitudes or behaviors. Longitudinal research is needed to clarify directionality.

The PEQ data were incomplete and unevenly distributed, which may have contributed to weak associations. Furthermore, PEQ reflects parent self-report rather than adolescent perception, potentially reducing its relevance to adolescent self-esteem. Cultural, socioeconomic, and family-structure diversity were not systematically controlled, limiting external validity. The sample was recruited through social media and twin organizations, which may introduce selection bias and limit generalizability. Finally, the study did not differentiate between monozygotic and dizygotic twins or account for gender composition, despite evidence that these factors may influence identity development.

5.4 Future Directions

Future research can build on this pilot in several key ways. Including more diverse samples, such as a larger number of twin and non-twin families, with intentional stratification by zygosity, gender composition, and socioeconomic background, would allow for more precise estimates and subgroup comparisons.

Additionally, longitudinal designs would clarify whether autonomy-supportive parenting predicts changes in self-esteem, and whether this trajectory differs by sibling type. Adding scales or interview items that directly assess parental individualization strategies, such as separate activities, differentiated expectations, and avoidance of comparison, would more directly test the hypothesis that such strategies buffer identity pressures in twins. Combining adolescent reports, parent reports, and possibly observational coding of parent-child interactions would reduce shared-method bias and better capture the non-shared environment processes theorized in the literature. Overall, this pilot study provides preliminary evidence that perceived parental autonomy support is a particularly strong correlate of self-esteem in twins, while non-twins exhibit a more distributed pattern of influences. These findings highlight parental individualization as a promising area for future research on adolescent self-esteem.

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