The Relationship Between Parent-Adolescent Communication and Confidence and Academic Performance

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Abstract

This study examines the relationship between parenting styles, parent-adolescent communication, and key developmental outcomes such as self-esteem, self-regulation, and academic performance. Drawing from existing models of parenting, the research aims to identify how varying levels of autonomy support and control influence adolescent development, with a particular focus on self-esteem and academic motivation. Using a questionnaire-based design, the study incorporates established scales such as the Rosenberg Self-Esteem Scale, the Perceptions of Parents Scale, and the Academic Self-Regulation Questionnaire to assess self-esteem, perceived parenting styles, and academic motivation. The findings suggest that parenting styles characterized by high autonomy support and low control are positively correlated with higher self-esteem, intrinsic motivation, and better academic performance. In contrast, high control coupled with low autonomy support is linked to lower self-esteem and a tendency toward external regulation or amotivation. The study emphasizes the complexity and variability of these relationships, indicating that parental influence on adolescent development is moderated by individual and contextual factors such as temperament and socio-economic status. While the study identifies key trends, it also highlights the need for further research to explore causal pathways and the role of diverse cultural and socio-economic contexts. Future research should employ longitudinal designs and advanced statistical methods to refine understanding of how parenting styles shape adolescent development over time. The results contribute to a broader understanding of how parenting practices can foster positive academic and psychological outcomes, with implications for interventions aimed at supporting healthy adolescent development.

Introduction

Parenting styles encompass the constellation of values, behaviors, and strategies that parents employ to nurture and discipline their children. These styles have been extensively studied for their significant influence on the development of a child's personality traits, confidence, and academic abilities (Darling and Steinberg, 1993). Diana Baumrind, a pioneer in the field of parenting research, proposed that parental behavior can be categorized along two key dimensions: demandingness (the extent to which parents set and enforce rules and expectations) and responsiveness (the degree to which parents are attuned to their children's emotional needs and communicate openly).

This study uses the Perceptions of Parents Scale to operationalize parenting styles, categorizing them into four distinct types based on levels of control and autonomy support:

1. High control and high autonomy support
2. High control and low autonomy support
3. Low control and high autonomy support
4. Low control and low autonomy support

Each parenting style has unique implications for child development. High control and high autonomy support parenting styles, characterized by both demandingness and responsiveness, are considered authoritative (Baumrind, 1991). Parents in this category set clear, consistent boundaries and maintain open communication, striving to meet their children's emotional needs. Discipline in this style is less punitive and more instructional, focusing on teaching and guiding the child. These parents aim to foster independence and cooperation, ultimately contributing to greater confidence and academic performance in children.

On the other hand, high control and low autonomy support parenting styles, often referred to as authoritarian, are demanding but not responsive(Baumrind,1991). These parents adopt a rigid, controlling approach and emphasize obedience without encouraging feedback or negotiation. Communication is typically one-directional, and discipline is punitive. This style can hinder the development of a child's self-confidence and create additional stress.

In contrast, low control and high autonomy support parenting styles are indulgent or permissive. These parents are responsive to their child's emotional needs but set few demands or behavioral expectations(Baumrind, 1991).They often avoid confrontation, assuming a friend-like role rather than an authoritative one. While this style may promote emotional closeness, it can leave children without the structure necessary to develop self-discipline and academic success.

Finally, low control and low autonomy support parenting styles, often categorized as neglectful or uninvolved, are neither demanding nor responsive. These parents provide minimal guidance, nurturing, or attention to their children's needs and are often disengaged from their lives. This lack of involvement can have severe negative effects on a child's self-esteem and academic performance, as well as their overall well-being.

Recent studies emphasize the growing prevalence of stress among American college students, with 45% reporting "more than average stress," 33% experiencing "average stress," and 12.7% reporting minimal stress(ACHA, 2023). This trend poses a serious threat to mental health, increasing the risk of chronic conditions such as anxiety and depression(Liu et. al, 2019)Research suggests that maintaining high levels of student confidence can act as a protective factor against academic stress, while strong academic performance itself serves as a mitigating factor(Pekrun, 2002).Therefore, understanding how parenting styles influence adolescent confidence and academic success is critical in addressing this growing concern.

Extensive research has explored how parenting styles influence children's self-esteem and academic performance, with various studies highlighting the nuanced relationships between these variables.

Parenting Styles and Self-Esteem
Parenting styles, first categorized by Baumrind(Baumrind,1971), have been widely studied in relation to their effects on self-esteem:

1. **Authoritative Parenting** (high warmth, high control):
    - Consistently linked to higher self-esteem in children(Steinberg et. al, 1992)
    - Provides an optimal balance of autonomy support and structure, fostering confidence and independence (Deci and Ryan, 2000)

2. **Authoritarian Parenting** (low warmth, high control):
    - Often associated with lower self-esteem due to perceived harshness and lack of emotional support
    - Children may internalize failure and develop a fear of rejection, reducing self-confidence (Lamborn et. al, 1991)
3. **Permissive Parenting** (high warmth, low control):
    - Results are mixed: while warmth can foster self-esteem, a lack of structure may hinder the development of resilience and problem-solving skills.
4. **Neglectful Parenting** (low warmth, low control):
    - Strongly linked to the lowest levels of self-esteem and psychological well-being(Amato and Fowler, 2002).

Parenting Styles and Academic Outcomes

Parenting styles also predict various aspects of academic performance:

1. **Authoritative Parenting**:
    - Positively associated with intrinsic motivation, academic self-efficacy, and overall performance(Dornbusch et. al 1987)
    - Provides clear expectations and autonomy support, enabling students to internalize academic goals.
2. **Authoritarian Parenting**:
    - Linked to extrinsic motivation and compliance-driven behaviors, which can reduce academic engagement and creativity(Aunola et. al, 2000).
3. **Permissive Parenting**:
    - Associated with lower academic achievement due to a lack of emphasis on discipline and structured study habits(Glasgow et. al, 1997)
4. **Neglectful Parenting**:
    - Correlated with academic disengagement, low self-regulation, and poorer grades(Eisenberg et. al, 2005)

How the current study adds to the literature :

While existing studies have provided robust evidence on the effects of parenting styles, the current study fills critical gaps by integrating parent-adolescent communication as a moderating variable and using established scales to operationalize constructs such as self-esteem (RSES) and motivation (ASRQ). The key contributions are stated here:

Focus on Parent-Adolescent Communication:

- Previous research has emphasized parenting styles but often overlooked the role of communication in shaping self-esteem and academic outcomes(Yamamoto and Holloway, 2010).
- This study examines how communication mediates the effects of parenting styles, providing actionable insights for enhancing parent-child relationships.

Operationalization of Self-Esteem and Motivation:

- By using validated tools like the RSES and ASRQ, this study ensures a more standardized and reliable assessment of psychological constructs.

Hypothesis-Driven Approach:

- The hypothesis that autonomy-supportive parenting predicts intrinsic motivation and high self-esteem is informed by Self-Determination Theory (SDT)(Deci and Ryan, 1985).

Incorporation of Academic Stress:

- Academic stress, a critical factor influencing students' well-being, has not been extensively explored in relation to parenting styles and self-esteem. This study addresses that gap by examining how parenting impacts stress through its effects on self-esteem and academic motivation.

Population Diversity:

- Unlike many earlier studies conducted in Western cultural contexts, this research aims to explore the generalizability of findings across diverse populations, enhancing its cross-cultural applicability(Chao, 2001).

Other Scales and Methodologies used in recent research

In addition to the RSES, POPS, and ASRQ, modern research incorporates updated tools to measure parenting, self-esteem, and academic motivation:

Parenting:

  - **Parenting Practices Questionnaire (PPQ)**: Provides a more nuanced look at parental strategies.
  - **Parental Bonding Instrument (PBI)**: Adds dimensions such as care and overprotection(Parker et. al, 1979).

Self-Esteem:

- **State Self-Esteem Scale (SSES)**: Examines fluctuations in self-esteem under situational stress(Heatherton and Polivy,1991).

Academic Motivation:

  - **Academic Motivation Scale (AMS)**: Measures intrinsic and extrinsic motivation using the SDT framework(Vallerand et. al, 1992).

This study examines the relationship between parent-adolescent communication, adolescent confidence, and academic performance. Specifically, it explores how different parenting styles mediate academic stress through their influence on confidence and academic achievement. By identifying the optimal parenting style for fostering high confidence and strong

academic performance, this research aims to inform strategies for mitigating academic stress in adolescents.

Parenting styles are hypothesized to influence the development of intrinsic motivation, self-regulation, and self-esteem, all of which play critical roles in academic success and stress management (Deci and Ryan, 1985).This study employs validated psychological measures to quantify these constructs, operationalizing self-esteem through the Rosenberg Self-Esteem Scale (RSES) and academic self-regulation through the academic self-regulation questionnaire (ASRQ).

Measurement Tools

1. **Rosenberg Self-Esteem Scale (RSES):** This widely used scale measures self-esteem on a continuous scale. Scores will categorize participants into low self-esteem (RSES < 15), moderate self-esteem (RSES 16-25), and high self-esteem (RSES > 25) (Rosenberg, 1965).Self-esteem levels will be analyzed as a mediator between parenting style and academic stress.
2. **Academic Self-Regulation Questionnaire (ASRQ):** The ASRQ assesses academic motivation across four dimensions: a) Intrinsic motivation (self-driven learning for personal satisfaction), b) Identified regulation (motivation driven by personal goals) c) Introjected motivation (motivation influenced by guilt or obligation) and d) External regulation (behavior driven by external rewards or punishments).

A weighted score approach is usually employed to calculate indices for each dimension, allowing for comparative analysis(Ryan and Connell, 1989).

Hypotheses

The study posits the following hypotheses based on Deci and Ryan's Self Determination Theory (SDT) and Baumrind's parenting style model:

1. **High Autonomy Support + Low Control:**
   Expected Outcomes: Intrinsic Motivation and identified regulation will dominate leading to high self-esteem. Mathematically this can be represented as
   $$M_{intrinsic} = \alpha A_{support} - \beta C_{control} + \varepsilon$$
   The M represents intrinsic motivation, A is my support, C is parental control, and the last term represents error. The implication here is that adolescents are likely to experience minimal academic stress and optimal academic performance.
2. **High Autonomy Support + High Control:**
   The expected outcomes are a mix of intrinsic motivation, external regulation, and motivation will result in moderate to high self-esteem. The implication is that while communication is open, overregulation may dampen intrinsic motivation, leading to moderate levels of academic stress.
3. **High Control + Low Autonomy Support:**
   Expected outcomes include introjected motivation and external regulation, resulting in low self-esteem.
   The equation representing this is:
   $$S_{esteem} = \gamma - \delta C_{control} + \phi$$

Here S is the self-esteem, and on the right-hand side we have a baseline constant, with the coefficient of C being the negative influence of control, and finally, the rightmost term represents the individual variability.

4. **Low Autonomy Support + Low Control:**
   The expected outcomes are amotivation and introjected regulation will prevail, resulting in low self-esteem. The implication here is that this disengaged parenting style is likely to lead to poor parenting performance and high levels of academic stress.

Expected Contributions

The findings of this study will contribute to the growing body of literature on the interaction between parenting styles, adolescent psychological traits, and academic outcomes. Specifically, it will provide actionable insights into how parenting can promote resilience to academic stress by fostering self-esteem and intrinsic motivation. Educational practitioners and policymakers can leverage these insights to design family-based interventions aimed at supporting adolescents in academic environments.

Methods

Participants

Participants were recruited using self-selected and word-of-mouth methods through psychology online forums such as Reddit.com and psychologyforum.com. The aim was to recruit participants between the ages of 15~18 who were students residing in Vietnam. Participants were excluded if they either had a recent major life event, or psychological intervention or could not read and understand English. 50 participants will be included in the analyses. Participants were on average 16.7 years old (range: 14.0 years to 18 years). The final sample included 45 females and 29 males.

Procedure

The design of the research is going to be a questionnaire where the results are going to be statistically analyzed. An online survey using Google Forms was used and it took about 10 minutes to complete. The questionnaire survey was open for 5 days. It consisted of pre-existing multiple choice and Likert scale questionnaires including the Rosenberg self-esteem scale (Steinberg et. al 1992) perceptions of parents scale(Grolnick et. al, 1997) and academic self-regulation questionnaire(Ryan and Connell, 1989).

Overview of the methods:

The Rosenberg Self-Esteem Scale (RSES), developed by Morris Rosenberg in 1965, is one of the most widely used instruments for measuring global self-esteem. It consists of 10 statements rated on a 4-point Likert scale, which is known for its simplicity and ease of administration making it ideal for large-scale surveys and research and demonstrates high internal consistency (Cronbach's alpha > 0.8) and validity across diverse cultural and demographic groups (Blascovich and Tomaka, 1991). However, the global focus does not address domain-specific self-esteem and may also be susceptible to social desirability bias since self-reported measures are influenced by how participants want to be perceived. The Perceptions of Parents Scale (POPS) was developed by Grolnick, Deci, and Ryan (Grolnick, Deci and Ryan,1997), within the framework of Self Determination Theory (SDT). It assesses children's perceptions of parental

autonomy support, involvement, and control separately for maternal and parental figures. The scale uses a 7-point Likert scale. The main strength of this is the strong predictive validity for outcomes such as intrinsic motivation and psychological well-being(Deci and Ryan, 2000). Naturally, the results depend on the children's perceptions, and this may or may not align with the actual behavior of parents. Nor does the POPS account for the external factors, such as cultural or socio-economic influences that shape parental practices. The Academic Self-Regulation Questionnaire (ASRQ) designed by Ryan and Connell (Ryan and Connell, 1989) evaluates the type of motivation driving student academic behaviors. As Iyenger and Lepper(Iyenger and Lepper, 1999), have stated, cultural differences in how motivation is perceived and expressed may limit the generalizability of results.

Although all three tools, RSES, POPS, and ASRQ continue to be widely used in research, newer scales and frameworks have emerged that address the limitations of these instruments.

1. For Self-Esteem (RSES): State Self-Esteem Scale (SSES) which measures situational changes in self esteem rather than global traits(Heatherton and Polivy,1991). In addition, there is the Domain-Specific Self-Esteem Scales, which are tools like the Academic Self-Esteem Questionnaire (ASEQ), which focus on specific areas such as academic or social self-esteem(Marsh, 1990).
2. For Parental Perceptions (POPS): There is the Parental Bonding Instrument (PBI) which focuses on dimensions like care and overprotection, offering insights into parent-child relationships(Parker et. al, 1979). In addition, there is the Parenting Styles and Dimensions Questionnaire (PSDQ), which provides detailed measures of authoritative, authoritarian, and permissive parenting styles.
3. For Academic Motivation (ASRQ): First, there is the Motivated Strategies for Learning Questionnaire (MSLQ) which includes motivation alongside learning strategies and provides a comprehensive view of academic regulation(Pintrich, et. al , 1991). There is also the Academic Motivation Scale (AMS), which is an SDT-based tool that measures motivation across contexts(Vallerand et. al, 1992).

1. Rosenberg Self-Esteem Scale (RSES)

The **Rosenberg Self-Esteem Scale (RSES)** is one of the most widely used tools for assessing global self-esteem. Developed by Morris Rosenberg in 1965, it comprises ten items measured on a 4-point Likert scale, ranging from "Strongly Agree" to "Strongly Disagree." Five of the items are positively worded, while the other five are negatively worded, reducing response bias. Scores range from 0 to 30, with higher scores indicating greater self-esteem.

Strengths of the RSES:

- **Validity and Reliability:** Extensive research has shown that the RSES demonstrates high construct validity and test-retest reliability across diverse cultural and demographic populations(Gray et. al, 1997).
- **Simplicity and Speed:** Its brevity makes it an efficient tool for both researchers and respondents, taking only a few minutes to complete.
- **Broad Applicability:** It captures a general sense of self-worth, making it suitable for various studies examining confidence, well-being, and psychological health.

Weaknesses of the RSES:

- **Unidimensional Focus:** The scale measures only global self-esteem and does not account for domain-specific self-esteem, such as academic or social self-esteem[22].
- **Potential for Social Desirability Bias:** Respondents may overestimate their self-esteem due to the stigmatization of admitting low self-esteem.
- **Limited Diagnostic Utility:** While it is excellent for research, the RSES may not provide sufficient nuance for clinical diagnoses.

2. Perceptions of Parents Scale (POPS)

The **Perceptions of Parents Scale (POPS)**, developed by Grolnick, Deci, and Ryan(Grolnick et. al, 1997), assesses adolescents' perceptions of their parents' autonomy support, involvement, and control. It is rooted in **Self-Determination Theory (SDT)**, which posits that autonomy support fosters intrinsic motivation and well-being.

The POPS consists of separate subscales for maternal and paternal behaviors and measures three key dimensions:

1. **Autonomy Support:** Encouragement of independent decision-making and acknowledgment of the adolescent's feelings.
2. **Involvement:** The degree to which parents are actively engaged in their child's life.
3. **Control:** The extent to which parents use controlling, directive behaviors.

Strengths of the POPS:

- **Comprehensive:** It provides a nuanced understanding of parental influence by differentiating between autonomy support and control.
- **Cultural Sensitivity:** Its constructs can be adapted for different cultural contexts, where parental roles may vary(Chirkov and Ryan, 2001).
- **Predictive Power:** Studies have shown strong correlations between autonomy support and positive developmental outcomes such as academic motivation and psychological well-being(Steinberg et. al, 1992).

Weaknesses of the POPS:

- **Subjectivity:** Adolescents' perceptions of their parents may not accurately reflect parental behaviors, potentially skewing results.
- **Limited Contextualization:** The scale does not account for external factors, such as socioeconomic status, that might influence parenting styles.
- **Parental Overlap:** Some respondents may struggle to differentiate between maternal and paternal influences if both parents exhibit similar behaviors.

3. Academic Self-Regulation Questionnaire (ASRQ)

The **Academic Self-Regulation Questionnaire (ASRQ)**, developed by Ryan and Connell (Ryan and Connell, 1989), measures the different types of motivation behind students'

academic behaviors. It classifies motivation along a continuum from external regulation to intrinsic motivation, aligned with **Self-Determination Theory (SDT).**

The ASRQ includes items such as:

- "Why do I do my homework?"
- Responses correspond to one of four motivation types:
    1. **Intrinsic Motivation:** Doing activities for inherent satisfaction.
    2. **Identified Regulation:** Performing tasks to achieve personally valued goals.
    3. **Introjected Regulation:** Behaving to avoid guilt or gain approval.
    4. **External Regulation:** Acting to obtain rewards or avoid punishment.

Strengths of the ASRQ:

- **Granularity:** By capturing different types of motivation, the ASRQ provides a detailed picture of students' motivational dynamics.
- **Diagnostic Utility:** It helps identify maladaptive motivational patterns, such as reliance on external rewards.
- **Predictive Validity:** Intrinsic motivation scores have been linked to higher academic performance, engagement, and psychological well-being.

Weaknesses of the ASRQ:

- **Self-Reporting Bias:** As with many self-report instruments, participants may provide socially desirable answers.
- **Cross-Cultural Limitations:** The intrinsic-extrinsic dichotomy may not fully apply in collectivist cultures where external regulation is more normative(Iyengar and Leppar, 1999).
- **Limited Scope:** While it measures motivation, it does not directly assess other critical factors affecting academic performance, such as cognitive ability or study habits.

The combined use of the RSES, POPS, and ASRQ allows for a multidimensional examination of how parenting styles influence adolescent confidence and academic performance. While these instruments offer robust frameworks for measuring self-esteem, perceived parental behaviors, and academic motivation, their limitations must be acknowledged to ensure an accurate interpretation of findings. Future research might consider complementing these tools with qualitative methods or domain-specific measures to gain deeper insights.

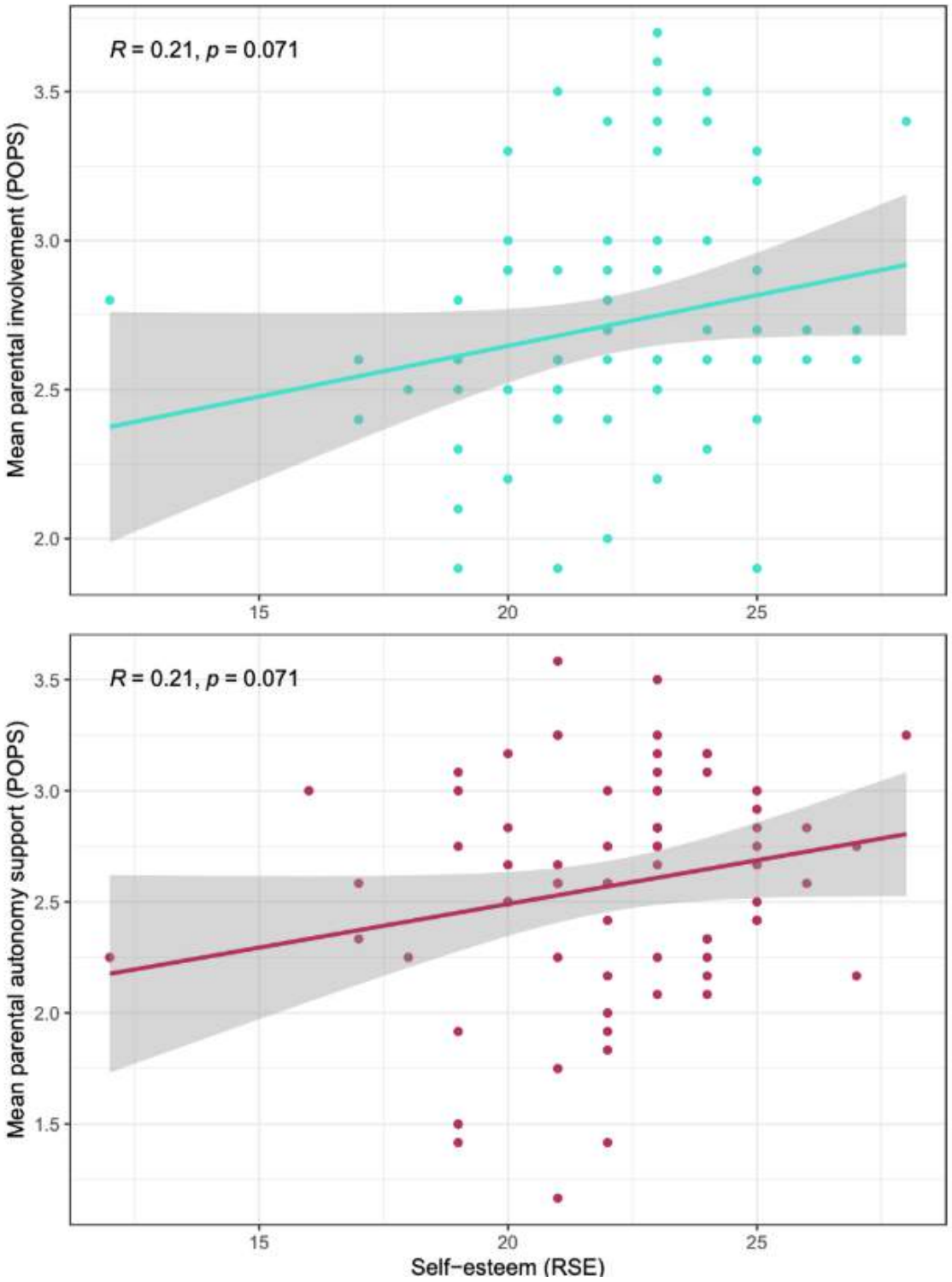
The following table summarizes the different methods used in this paper in a structured manner in order to highlight purposes, strengths, weaknesses, and specific applications.

Criterion	**Rosenberg Self-Esteem Scale (RSES)**	**Perceptions of Parents Scale (POPS)**	**Academic Self-Regulation Questionnaire (ASRQ)**

Purpose	Measures global self-esteem or overall self-worth.	Assesses adolescents' perceptions of parental autonomy support, involvement, and control.	Evaluates the types of motivation driving students' academic behaviors.
Origin	Developed by Morris Rosenberg in 1965.	Developed by Grolnick, Deci, and Ryan in 1997, based on Self-Determination Theory (SDT).	Developed by Ryan and Connell in 1989, aligned with SDT.
Key Constructs	Global self-esteem, measured on a 4-point Likert scale.	Autonomy support, involvement, and control from maternal and paternal perspectives.	Motivation types: intrinsic motivation, identified regulation, introjected regulation, and external regulation.
Format	10-item scale; responses range from "Strongly Agree" to "Strongly Disagree."	Subscales for maternal and paternal perceptions; include Likert-style questions.	Likert-style responses to questions about reasons for engaging in academic activities.
Strengths	- High validity and reliability.	- Differentiates between autonomy support and control.	- Captures nuanced motivational dynamics.
	- Simple, quick to administer.	- Predicts positive developmental outcomes like intrinsic motivation and well-being.	- Diagnoses maladaptive patterns like external regulation or motivation.
Weaknesses	- Focuses solely on global self-esteem, ignoring domain-specific aspects.	- May not reflect actual parental behavior, relying on adolescents' perceptions.	- Self-report bias and limited applicability in collectivist cultures.
	- Social desirability bias may influence responses.	- Limited attention to external factors like socioeconomic	- Does not address external factors influencing academic

		status.	outcomes.
When Effective	- Effective for broad surveys or research requiring a quick, reliable self-esteem measure.	- Effective in research examining parenting influences on autonomy, motivation, and development.	- Effective for analyzing motivation and its role in academic performance and engagement.
When Ineffective	- Limited use in studies needing detailed or domain-specific self-esteem measures.	- Less useful in assessing behaviors directly rather than perceptions.	- Limited applicability in studies requiring direct measurement of academic outcomes.
Applications	- Used in psychological studies on confidence, self-worth, and social behavior.	- Applied in studies of parenting styles, motivation, and child development.	- Commonly used in educational psychology to explore motivation and academic outcomes.

Plots and Spearman's correlations



Findings

Sample description Survey responses: N = 103 Final sample: N = 76 Gender: sex n Female 45 Male 29 Other 2 Age: ## Min. 1st Qu. Median Mean 3rd Qu. Max. ## 14.0 16.0 17.0 16.7 18.0 18.0 Mean: 16.7 years Standard deviation: 1.19 years

Linear regression analysis

```
##
## Call:
## lm(formula = RSE ~ POPS_mean_involvement * POPS_mean_autonomy,
##     data = data_final)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -9.9640 -1.4688 -0.0218  1.4722  5.3305
##
## Coefficients:
##                                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)                         13.2356    11.2582   1.176    0.244
## POPS_mean_involvement                2.3293     4.2870   0.543    0.589
## POPS_mean_autonomy                   2.6159     4.0725   0.642    0.523
## POPS_mean_involvement:POPS_mean_autonomy  -0.5841     1.5107  -0.387    0.700
##
## Residual standard error: 2.568 on 68 degrees of freedom
##   (4 observations deleted due to missingness)
## Multiple R-squared:  0.0795, Adjusted R-squared:  0.03889
## F-statistic: 1.958 on 3 and 68 DF,  p-value: 0.1286
```

Multiple R-squared (0.0795)
This indicates that only 7.95% of the variation in self-esteem is explained by the predictors of parental involvement, autonomy support, and interaction. This value is quite low, suggesting that the model has limited explanatory power for the dependent variable.

Adjusted R-Squared (0.03889)
The adjusted R-squared, which accounts for the number of predictors in the model, is even lower at 3.89%. This further confirms that the predictors do not substantially improve the model's ability to explain the variance in self-esteem.

F-Statistic (1.958, p = 0.1286)
The F-statistic tests the overall significance of the regression model.
A p-value of 0.1286 indicates that the model is NOT statistically significant at common significance levels like 0.05.

This implies that the predictors and their interaction do not significantly predict self-esteem.

Interpretation:
The low R-squared values and non-significant F-statistic suggest that the model DOES NOT PROVIDE a good fit to the data. This could imply that other factors, not included in the analysis, may better predict self-esteem. The other issue it highlights is that there are WEAK RELATIONSHIPS between the predictors and the outcome or insufficient sample variability.

It should be noted that the F-statistic is not always reliable in certain circumstances. This will happen under specific conditions, such as misspecification, multicollinearity, non-normality of residuals, or heteroscedasticity. Let's understand why this is true.

In a linear regression model, we have $y = X\beta + \varepsilon$ This equation has the dependent vector y which is an n by 1 vector of dependent variable observations, the X is the n by k matrix of independent variables including the intercept, the β is the k by 1 vector of coefficients and the additive term is the error (it is assumed that the error is additive).
The F statistic tests the null hypothesis:
$H_0 : \beta_0 = \beta_1 = \ldots = \beta_{k-1} = 0$ (no effect of predictors) against the alternative that at least one $\beta_i \neq 0$
The F-statistic is computed as:
$F = \frac{ExplainedVarianceperdegreeoffreedom}{UnexplainedVarianceperdegreeofFreedom}$

$= \frac{SSR/(k-1)}{SSE/(n-k)}$

Here the SSR is the sum of squares for the regression, and the SSE is the sum of squares for the error, n is the number of observations and k is the number of predictors (including the intercept).

Let's understand the cases where the F-Statistic is not reliable. First, there is the model misspecification. This means that there could be omitted variable bias or the wrong functional form. For instance, if an important variable is omitted, SSR will decrease, inflating the F-statistic, even though the model is inadequate. In addition, irrelevant variables can reduce SSR unnecessarily, underestimating the significance.

Next, there is the idea of multicollinearity. When independent variables are highly correlated, the individual contribution of predictors becomes unclear. This affects the computation of the β coefficients, leading to unreliable SSR, and therefore the F statistic becomes less meaningful. A measure of the multicollinearity is the Variance Inflation Factor (VIF) which is written as:
$VIF_j = \frac{1}{1-R_j^2}$

Here, R_j^2 is the coefficient of determination when X_j is regressed on other predictors. A high value implies multicollinearity and unreliable F-statistic.

We then need to check for the non-normality of residuals. The F-statistic assumes that the residuals ε follow a normal distribution. If residuals deviate significantly from normality, the distribution of the F-statistic under the null hypothesis is not valid. Non-normality affects hypothesis testing, as the critical F-values are based on a central F(k-1,n-k) distribution.

Finally, we have heteroscedasticity. This simply means non-constant variance of residuals. Essentially the assumption of homoscedasticity is violated. This will lead to a biased estimation of β, an incorrect computation of SSR and SSE, and invalid F-test results due to misestimated variances. One can usually detect heteroscedasticity using the Breusch-Pagan test or the White test. One can then use weighted least squares or robust standard errors.

Typically another issue can arise if one has a small sample size ($n < 30$), but this is not the case here. This means that the Central Limit Theorem can be used to ensure the normality of the estimators, and the degrees of freedom are sufficient to produce robust estimates of variance.

There are also issues that can come up in terms of the reliability of Multiple R-squared as well as adjusted R-squared values. For instance, in the case of multiple R-squared, issues that can come up are overfitting and outliers. Adding more independent variables to a model will always increase multiple R-squared, even if those variables are irrelevant. This can lead to overfitting, where the model fits the noise in the data rather than the underlying relationship. In the case of outliers, these can make the adjusted R-squared much higher than it should be.

In terms of the adjusted R-Square, this metric penalizes the model when unnecessary variables have to be added, but it is still not perfect. Typically small sample sizes can be an issue since the adjusted R-square can become unstable. Typically high R-squared with low predictive power is a sign of an underlying problem. Then the model assumptions as well as the data quality come into the picture. In addition, an overreliance on R-squared can be an issue, since other factors like the significance of coefficients, model assumptions, and the practical relevance of the model also matter.

Although not considered in this report, there are specific tests one can run to check for issues.

Testing for Issues with the F-statistic

One can test for specific issues that might affect the F-statistic using various diagnostic tests. These are summarized as follows:

1. Misspecification:

- **Residual Plots:** Plotting the residuals against the fitted values. If the pattern is not random, it suggests misspecification.
- **Ramsey RESET Test:** This test checks for functional form misspecification. It adds powers of the fitted values to the model and tests their significance.

2. Multicollinearity:

- **Variance Inflation Factor (VIF):** One calculates the VIF for each independent variable. A high VIF (typically above 10) indicates multicollinearity.
- **Correlation Matrix:** Examine the correlation matrix between independent variables. High correlations suggest multicollinearity.

3. Non-normality of Residuals:

- **Q-Q Plot:** One could plot the quantiles of the residuals against the quantiles of a normal distribution. If the points deviate significantly from the line, it suggests non-normality.
- **Jarque-Bera Test:** This test formally tests the normality of residuals.

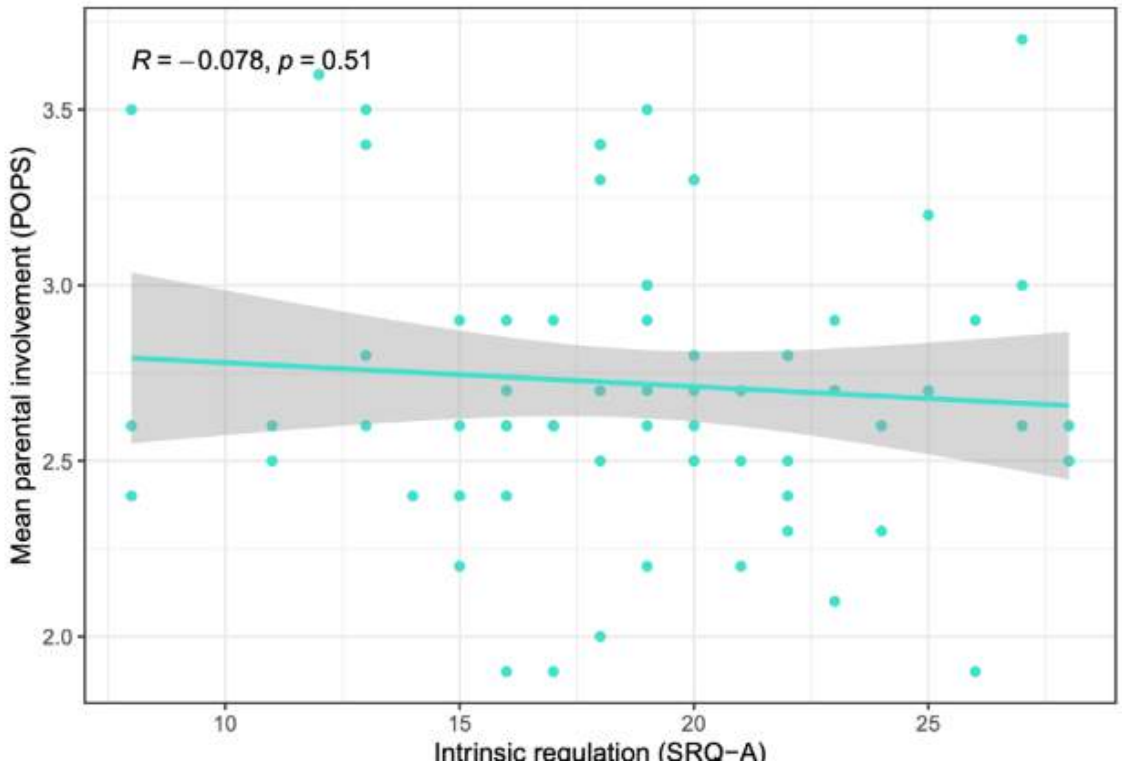
4. Heteroscedasticity:

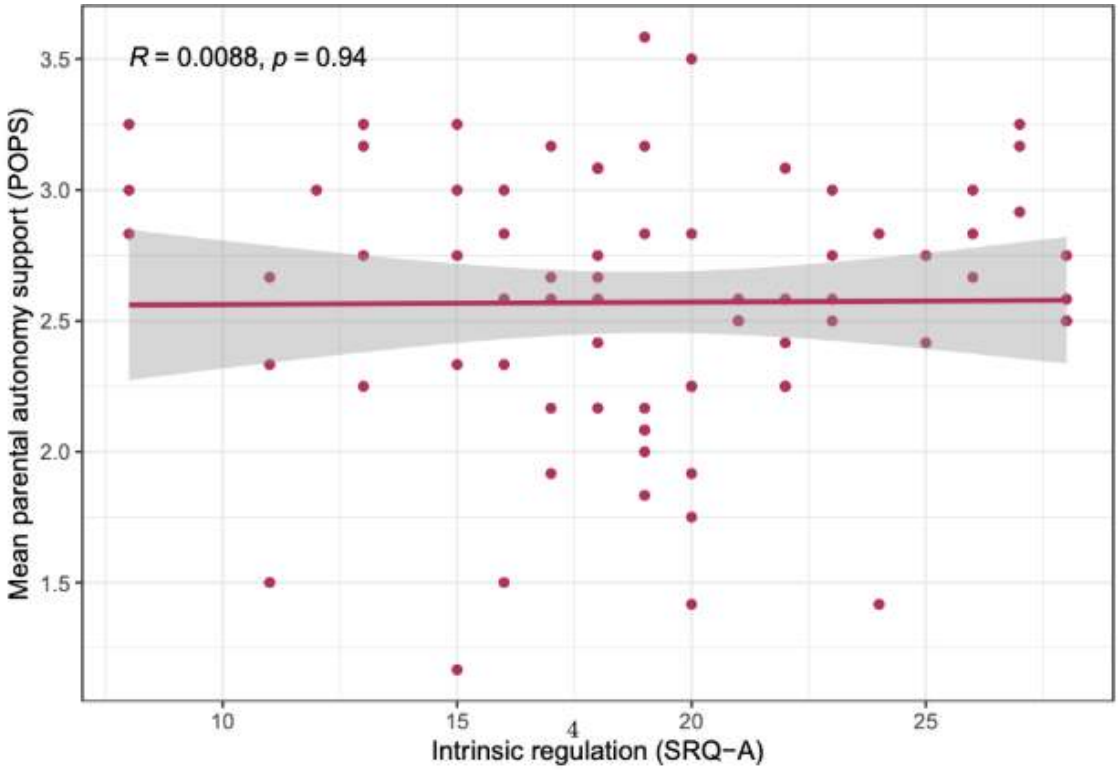
- **Breusch-Pagan Test:** This test checks for the constant variance of residuals. It regresses the squared residuals on the fitted values and tests the significance of the regression.
- **White Test:** This test is a more general test for heteroscedasticity. It regresses the squared residuals on the fitted values, the squared fitted values, and the cross-product of the fitted values.

Additional Considerations

- **Outliers:** One needs to test for outliers in the data, as they can significantly impact the F-statistic.
- **Sample Size:** We also need to ensure that we have a sufficient sample size to have reliable estimates and test statistics.
- **Data Quality:** Additionally we need to verify the quality of the data.

Plots and Spearman's correlations





Linear regression analysis

```
##
## Call:
## lm(formula = SRQA_intrinsic ~ POPS_mean_involvement * POPS_mean_autonomy,
##     data = data_final)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -11.6517  -3.1221   0.0081   2.8942   9.4878
##
## Coefficients:
##                                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)                            13.512     21.332   0.633    0.529
## POPS_mean_involvement                   1.944      8.123   0.239    0.812
## POPS_mean_autonomy                      3.105      7.717   0.402    0.689
## POPS_mean_involvement:POPS_mean_autonomy  -1.105      2.863  -0.386    0.701
##
## Residual standard error: 4.867 on 68 degrees of freedom
##   (4 observations deleted due to missingness)
## Multiple R-squared:  0.01056,    Adjusted R-squared:  -0.03309
## F-statistic: 0.242 on 3 and 68 DF,  p-value: 0.8668
```

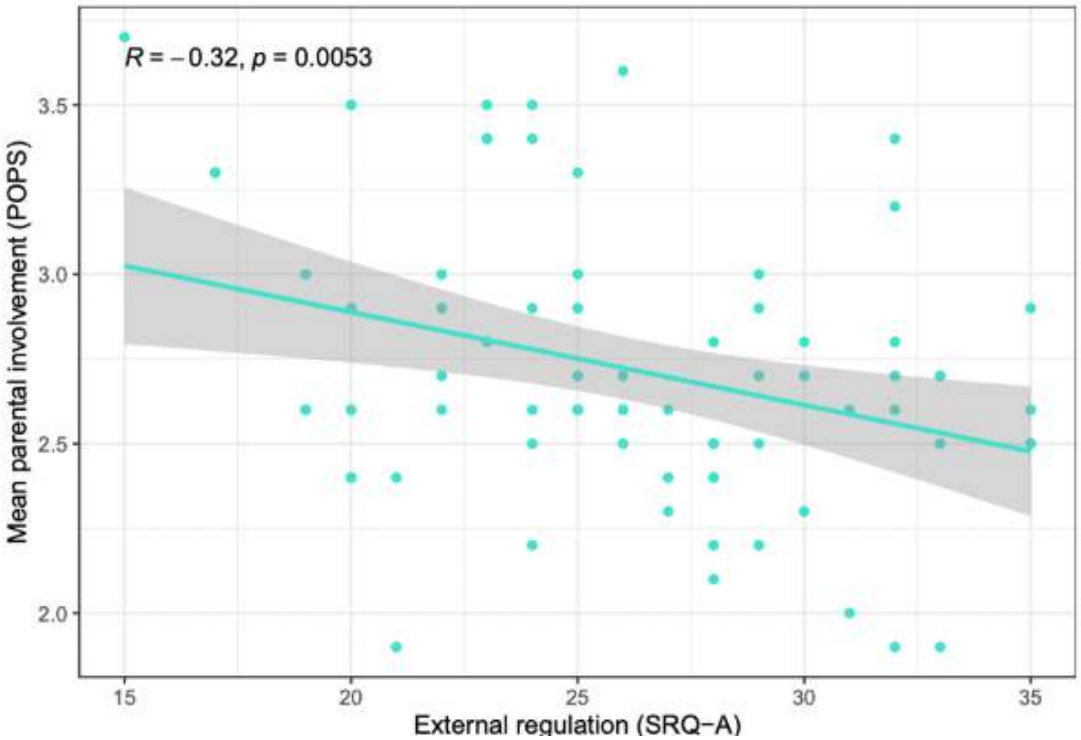
Multiple R-Squared:

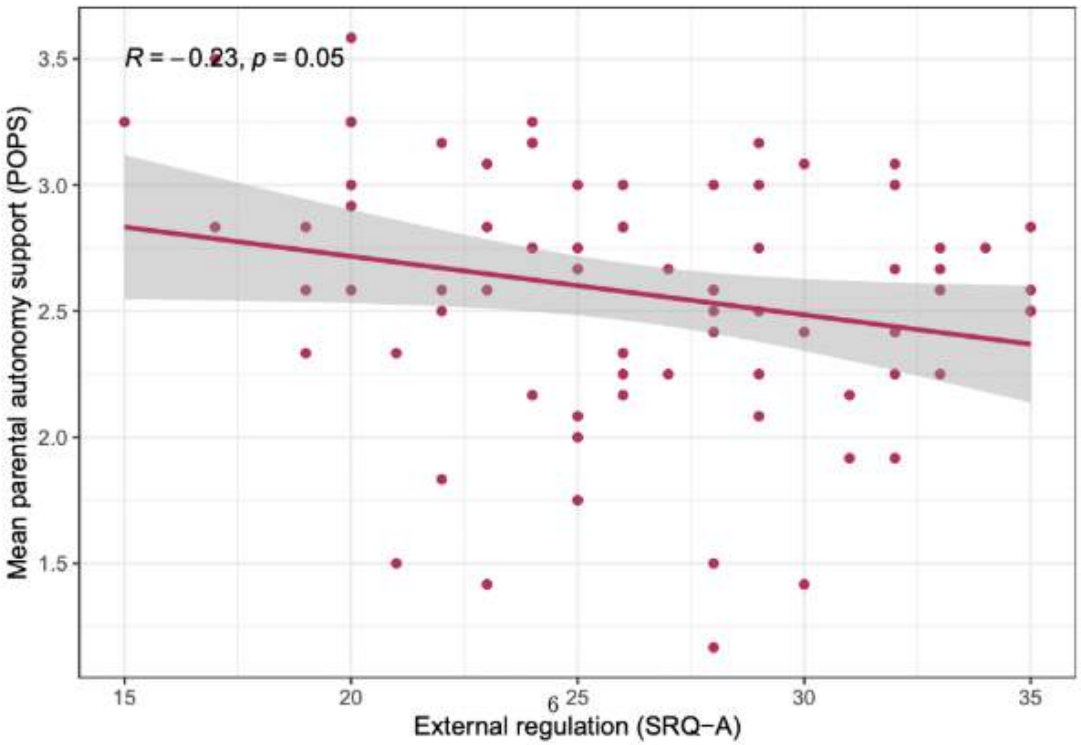
Adjusted R-Squared: -0.03309
This negative value means that the inclusion of predictors does not improve the model fit. In this case, it implies that the model performs worse than a model with no predictors. This means that there is a WEAK RELATIONSHIP between the predictors and intrinsic regulation.

F-Statistic: (0.242, p = 0.8668):
Small F value and high p-value mean that the MODEL IS NOT STATISTICALLY SIGNIFICANT. This means that a significant amount of variance is not explained.
If the p-value is above 0.05, it means that there is no meaningful relationship between the predictors and intrinsic regulation.

This means that there are factors outside the scope of the model that have not been considered.

Plots and Spearman's correlations





Linear regression analysis

```
##
## Call:
## lm(formula = SRQA_external ~ POPS_mean_involvement * POPS_mean_autonomy,
##     data = data_final)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -8.0467 -3.3667 -0.0286  3.3819  9.4333
##
## Coefficients:
##                                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)                             8.881     20.498   0.433    0.666
## POPS_mean_involvement                   7.851      7.805   1.006    0.318
## POPS_mean_autonomy                      9.296      7.415   1.254    0.214
## POPS_mean_involvement:POPS_mean_autonomy -3.946     2.751  -1.434    0.156
##
## Residual standard error: 4.676 on 68 degrees of freedom
##   (4 observations deleted due to missingness)
## Multiple R-squared:  0.1421, Adjusted R-squared:  0.1042
## F-statistic: 3.754 on 3 and 68 DF,  p-value: 0.01478
```

Multiple R-Squared 0.1421

This indicated that 14.21% of the variance in external regulation is explained by the predictors. This is a NOTABLE IMPROVEMENT from the previous models.

The adjusted R-squared is 0.1042, which is a small but meaningful proportion of variance in external regulation that is measured by this model. This is ALSO AN IMPROVEMENT.

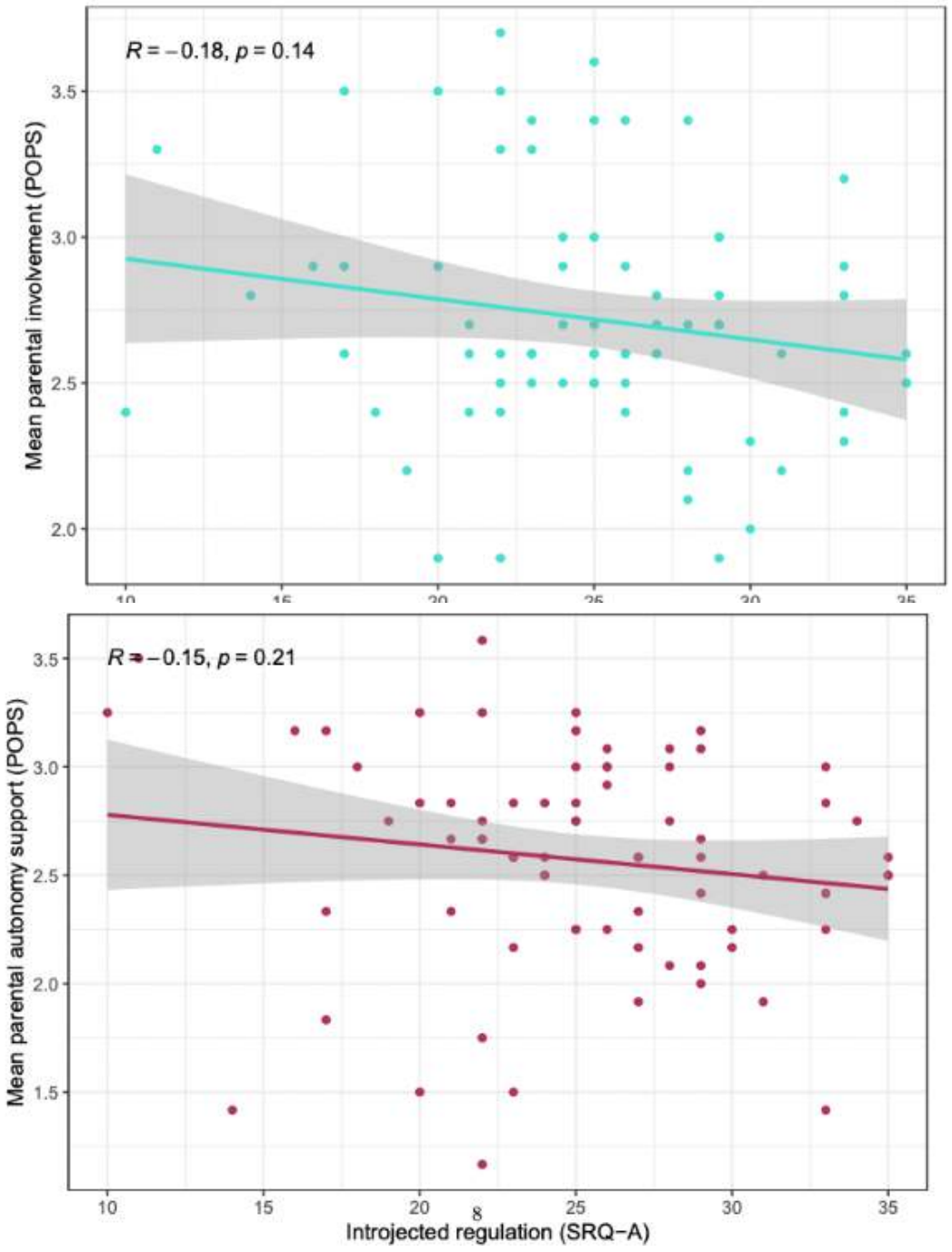
The F-Statistic of 3.754 and the p-value of 0.01478

The p-value is statistically significant at the 0.05 level. This indicates that the predictors, collectively contribute to explaining the variance in the external regulation. This is the FIRST MODEL in this analysis that achieves statistical significance.

HOWEVER, the individual predictors: parental involvement, autonomy support, and their interaction, are not statistically significant, based on their p-values.

This indicates multicollinearity, or a weak influence of each predictor alone, despite their combined effects being significant.

Plots and Spearman's correlations



Linear regression analysis

```
##
## Call:
## lm(formula = SRQA_introjected ~ POPS_mean_involvement * POPS_mean_autonomy,
##     data = data_final)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -14.9736  -3.4058   0.2805   3.1165   9.7563
##
## Coefficients:
##                                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)                              17.356     23.337   0.744    0.460
## POPS_mean_involvement                     4.170      8.886   0.469    0.640
## POPS_mean_autonomy                        4.163      8.442   0.493    0.624
## POPS_mean_involvement:POPS_mean_autonomy  -2.041      3.132  -0.652    0.517
##
## Residual standard error: 5.324 on 68 degrees of freedom
##   (4 observations deleted due to missingness)
## Multiple R-squared:  0.04801,    Adjusted R-squared:  0.006013
## F-statistic: 1.143 on 3 and 68 DF,  p-value: 0.338
```

This regression model attempts to explain the introjected regulation (SQRA) based on parental involvement, parental autonomy support, and their interaction term.
We look at each of the outputs in some detail. First, we have the Residual Standard Error.

$$RSE = \sqrt{\frac{\text{Residual Sum of Squares}}{n-k+1}}$$

Here, n=72 and k = 3. There are 76 data points minus 4 missing values, and k = 3 is the number of predictors (involvement, autonomy, interaction).
Next, note that the RSS is given by:

$$RSS = \sum_{i=1}^{n}(y_i - \hat{y}_i)^2$$

The value 5.324 indicates that, on average, the predicted values differ from the observed values by about 5.324 units. A high RSE relative to the range of the dependent variable (introjected regulation) suggests limited model precision.
Next, we consider the multiple R-squared value of 0.04801.
The R^2 value measures the proportion of variance in the dependent variable explained by the predictors:

$$R^2 = 1 - \frac{RSS}{TSS}$$

Here, $RSS = \sum(y_i - \hat{y}_i)^2$ and $TSS = \sum(y_i - \bar{y})^2$, the RSS being the residual sum of squares and the TSS being the total sum of squares which represents the variation of y around its mean.

A R^2 value of 0.04801 means that the model explains only 4.8% of the variance in the introjected regulation. This is very low suggesting that the predictors are extremely ineffective at explaining the outcome.
Then we have the adjusted R^2 value of 0.006013. This accounts for the number of predictors in the model, penalizing for adding variables that do not improve the model. This is calculated as:

$$R^2_{adjusted} = 1 - \frac{RSS/(n-k-1)}{TSS/(n-1)}$$

The value of 0.006013 suggests that, after adjusting for the number of predictors, the explained variance is almost negligible (close to 0). This confirms the weak explanatory power of the model.

Next, we look at the F statistic of 1.143 with a p-value of 0.338. The F-statistic tests whether the model as a whole provides a better fit than a model with no predictors. It is given by

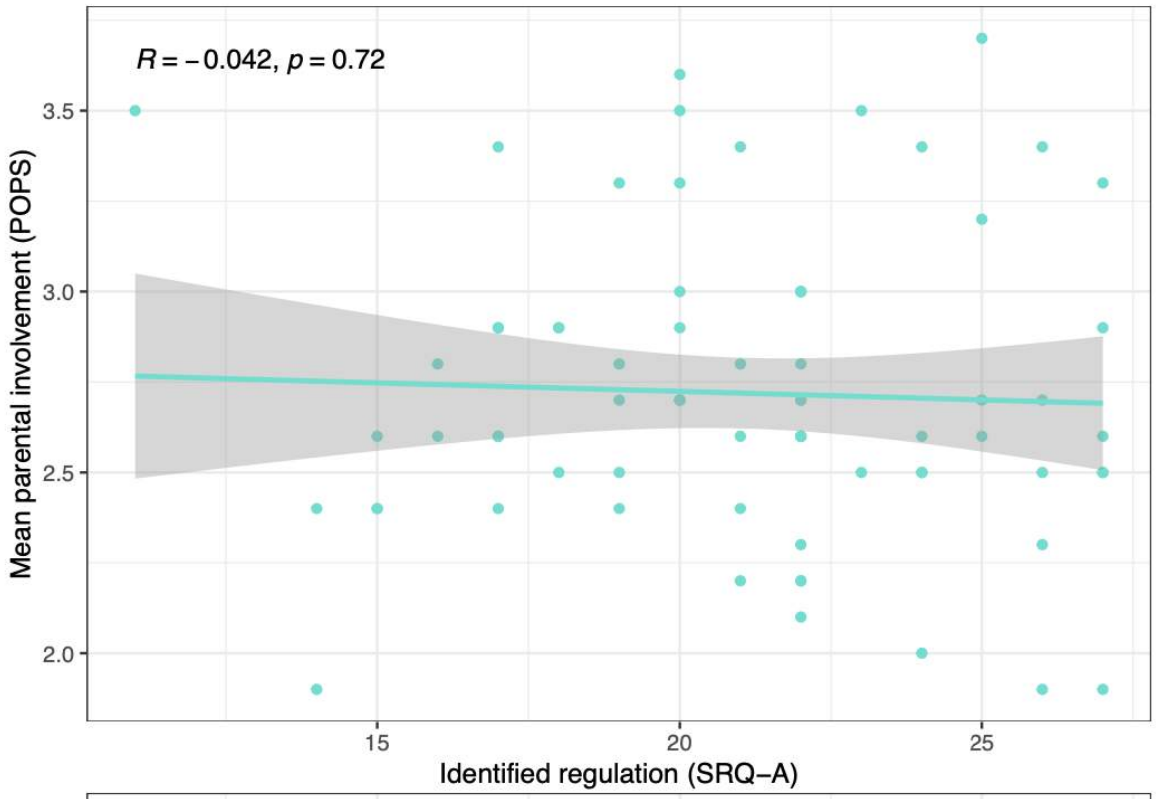
$$F = \frac{\frac{TSS-RSS}{k}}{\frac{RSS}{n-k-1}}$$

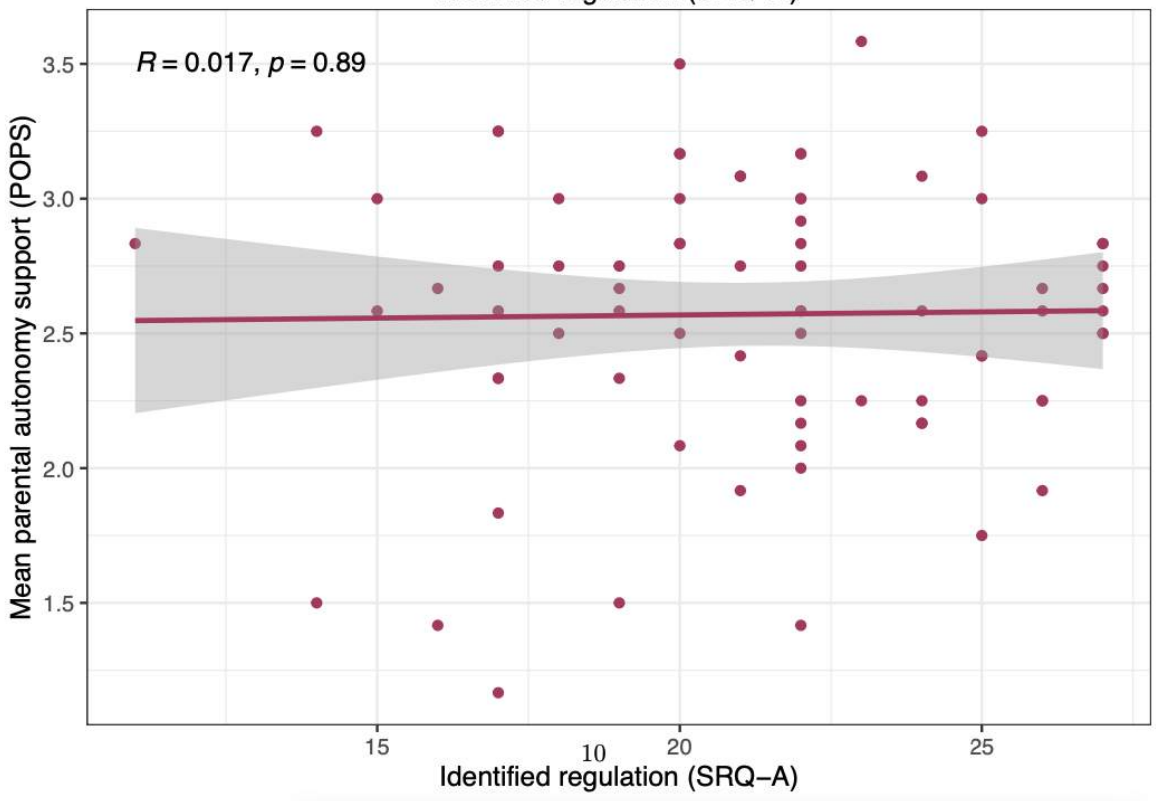
In the numerator,, we have the variance explained by the model TSS-RSS, and in the denominator, we have the model explained by RSS. Here the F-statistic is 1.143, with a p-value of 0.338, indicating that the model is not statistically significant at the common threshold such as α=0.05.

Overall this means that the predictors (involvement, autonomy support, and their interaction) explain 4.8% of the variance in the introjected regulation . After adjusting for the number of predictors, the explained variance drops to nearly 0%, highlighting that adding these variables does not significantly improve the model. The high RSE of 5.324 indicated a poor fit with substantial deviations between observed and predicted values. The non-significant F-Statistic and p-value of p=0.338 suggest that the model as a whole does not meaningfully explain the outcome. This regression model provides little evidence that parental involvement, autonomy support, and their interaction are significant predictors of introjected regulation.

Predicting identified regulation with autonomy support and involvement

Plots and Spearman's correlations





Linear regression analysis

```
##
## Call:
## lm(formula = SRQA_identified ~ POPS_mean_involvement * POPS_mean_autonomy,
##     data = data_final)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -9.722 -2.254  0.434  2.712  6.145
##
## Coefficients:
##                                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)                              17.4035    16.4118   1.060    0.293
## POPS_mean_involvement                     1.2776     6.2494   0.204    0.839
## POPS_mean_autonomy                        1.9961     5.9368   0.336    0.738
## POPS_mean_involvement:POPS_mean_autonomy -0.6866     2.2023  -0.312    0.756
##
## Residual standard error: 3.744 on 68 degrees of freedom
##   (4 observations deleted due to missingness)
## Multiple R-squared:  0.005577,   Adjusted R-squared:  -0.03829
## F-statistic: 0.1271 on 3 and 68 DF,  p-value: 0.9437
```

For your results section, you can say:

I also tested for an interaction between parental involvement and parental autonomy support on identified regulation using linear regression. The interaction was not statistically significant ($b = -0.69$, 95% CI $[-5.08, 3.71]$, $t(68) = -0.31$, $p = .756$).

Internal consistency of survey measures

Cronbach's alpha is a measure of reliability (internal consistency). Values over 0.9 are excellent; values over 0.7 are acceptable.

```
##
## Cronbach's alpha for the 'data_itemscores %>% dplyr::select(contains("POPS")) %>% drop_na()' data-se
##
## Items: 22
## Sample units: 74
## alpha: 0.75

##
## Cronbach's alpha for the 'data_itemscores %>% dplyr::select(contains("RSE")) %>% drop_na()' data-set
##
## Items: 10
## Sample units: 78
## alpha: 0.203

##
## Cronbach's alpha for the 'data_itemscores %>% dplyr::select(contains("SRQA")) %>% drop_na()' data-se
##
## Items: 32
## Sample units: 78
## alpha: 0.922
```

Cronbach's Alpha is a measure of the internal consistency or how closely related a set of items is, as a group. It is used to measure the reliability of a test. Let's understand this in some detail. Cronbach's alpha (α) is a measure of internal consistency, often used to evaluate how well a set of items such as survey questions measures a single unidimensional construct. It assesses the interrelatedness of items and provides a reliability coefficient.

Cronbach's Alpha is given by:

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum_{i-1}^{k} \sigma_i^2}{\sigma_{total}^2}\right)$$

Here k is the number of items (questions) in the scale, σ_i^2 is the variance of the i-th item, and σ_{total}^2 represents the variance of the total score (sum of all items). Let's understand the components of the formula.T

The term $\frac{\sum \sigma_i^2}{\sigma_{total}^2}$ calculates the proportion of total variance that is due to the variance of the individual items. Subtracting 1 from this gives the proportion of total variance attributed to covariance (shared variance) among the items. Multiplying by $\frac{k}{k-1}$ adjusts for the number of items, ensuring that this parameter is not biased downward in scales with fewer items.

This means that the higher the value of Cronbach's Alpha, the better the internal consistency, meaning items are likely to measure the same construct. A lower value means that the items are poorly correlated or measure different constructs, requiring revision of the scale.

Analysis of the data:

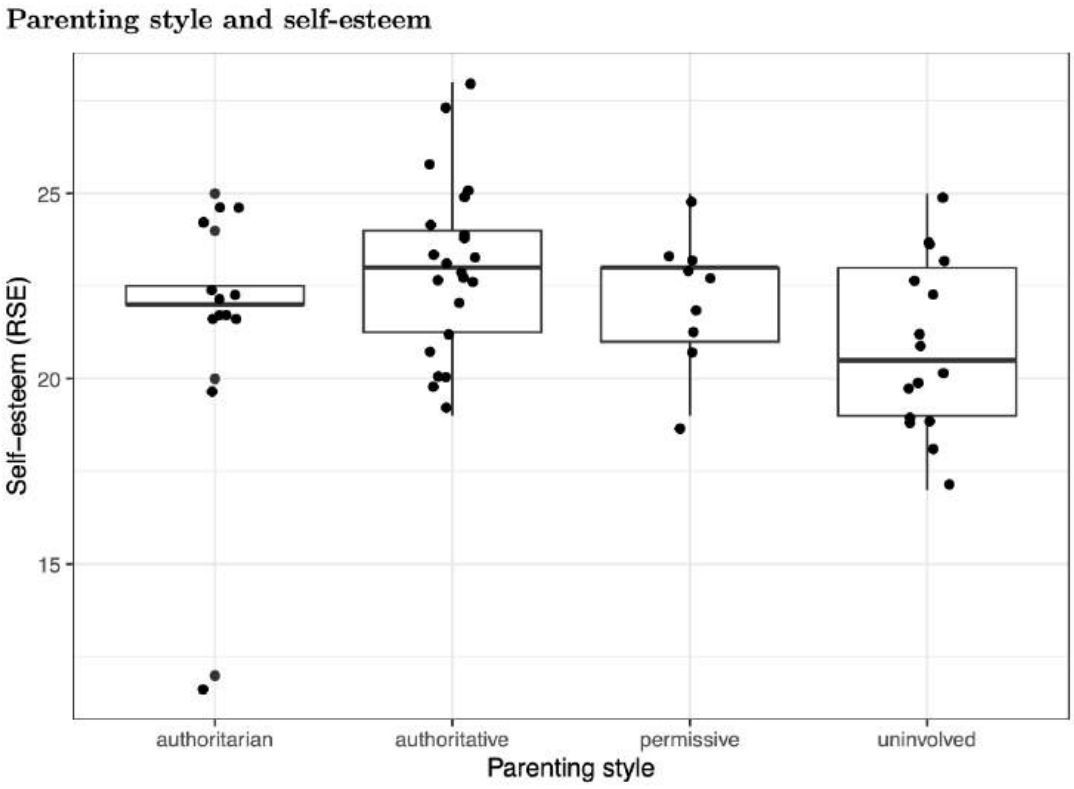
POPS (parental autonomy support and involvement)

Alpha = 0.75, This is acceptable internal consistency. The items measuring POPS are reasonably consistent. Most items contribute well to measuring the construct of parental involvement or autonomy support.

RSE Alpha = 0.203 Extremely low, which means questionable or poor internal consistency. This means that the items are not consistently measuring self-esteem. This could occur if the items have little shared variance or measure different constructs.

SRQA Alpha = 0.92 Extremely reliable measure in this sample. The items strongly correlate, reliably measuring self-regulation.

The ANOVA (Analysis of Variance) results test whether there are significant differences in self-esteem between groups characterized by parenting style (authoritarian, authoritative, permissive, uninvolved) based on the median splits of parental autonomy support and involvement.



ANOVA: $F(3, 55) = 2.32,\ MSE = 6.26,\ p = .085$

Key Metrics:

F Statistic (F(3,55) = 2.32)

The F statistic is the ratio of the variance explained by the group means to the variance within the groups.

In this case, the F value is 2.32 which suggests that there is some variation in self-esteem but this variation is not very strong.

The (3,55) represents the degrees of Freedom. The first value 3, is the degrees of freedom between groups and is equal to a number of groups - 1. Here there are 4 groups (authoritarian, authoritative, permissive, and uninvolved), so this number is 4- 1 = 3.

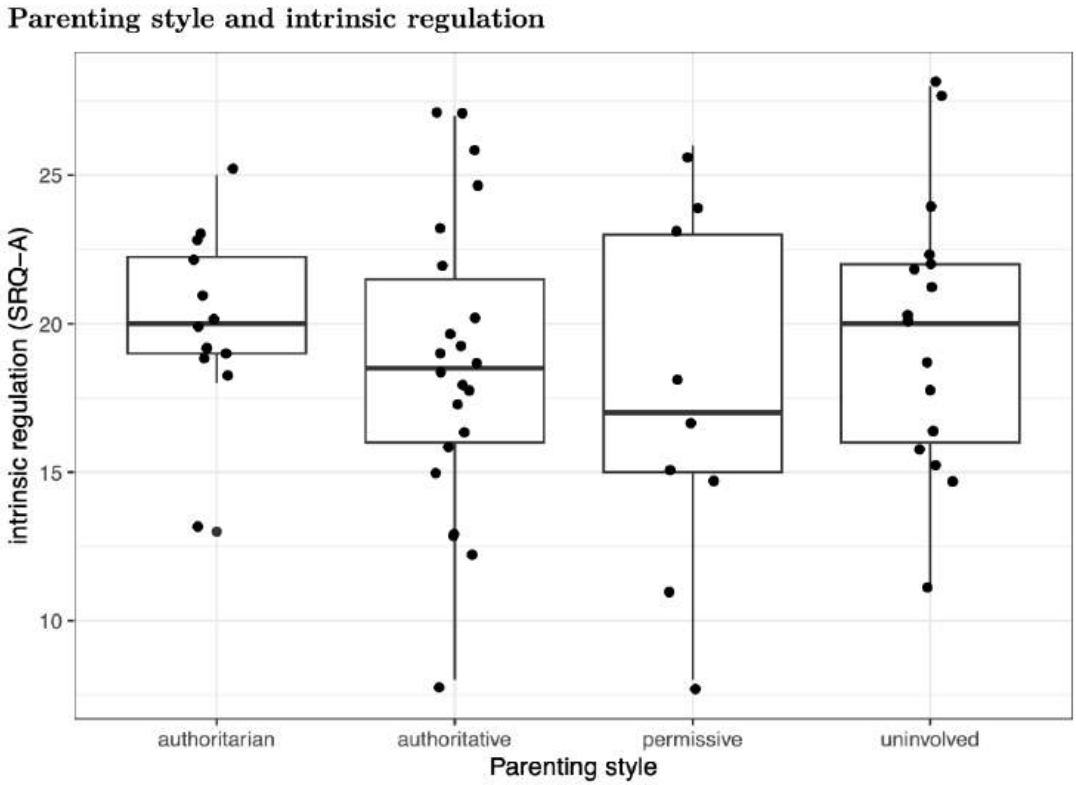
The second value, 55, is the degree of freedom within groups and is equal to the total sample size minus the number of groups.

The MSE (mean square error) = 6.26 measures the average variance within groups. A lower MSE indicates less variability, 6.26 is moderate, not too low, and not too high.

The p-value 0.085 is the probability of observing an F statistic or a more extreme value if there is no true difference between the groups.

0.085 is higher than the significance level of 0.05, which means the differences in self-esteem between different parenting styles are NOT STATISTICALLY SIGNIFICANT.

The ANOVA suggests that there is some variation in self-esteem across parenting styles but the differences are not statistically significant at the 0.05 level.



ANOVA: $F(3, 55) = 0.74,\ MSE = 22.53,\ p = .530$

The F-statistic tests whether there is significant variability in intrinsic regulation scores across the four parenting style groups (authoritarian, authoritative, permissive, uninvolved). The formula is:

$$F = \frac{\text{Mean Square Between Groups}}{\text{Mean Square Error}}$$

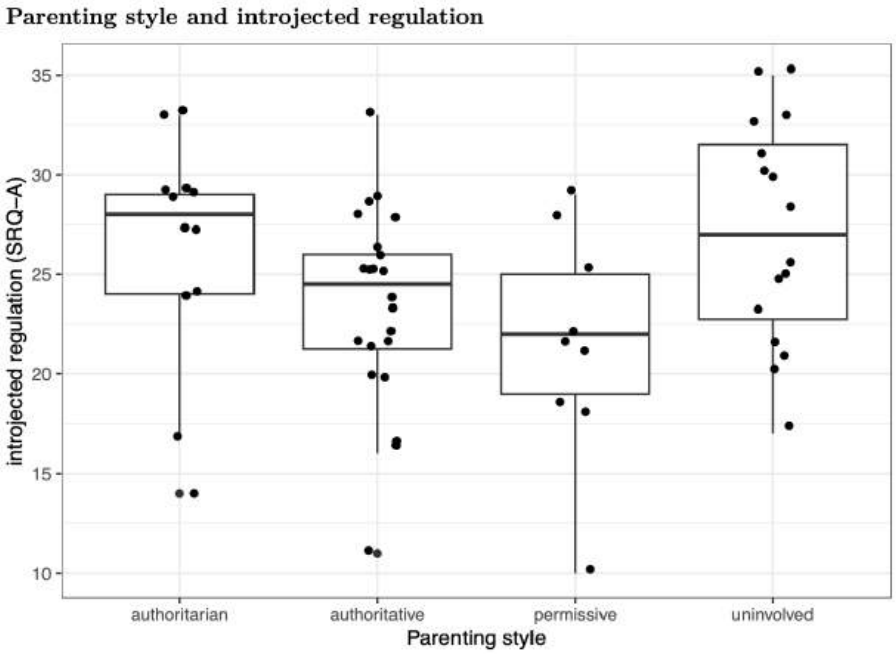
A low F-Statistic suggests that the variability between group means is small relative to the variability within groups. This means that the parenting style does not explain much of the variation in intrinsic regulation.
Next, consider the MSE. This is given by:

$$MSE = \frac{\text{Residual Sum of Squares (RSS)}}{\text{Degrees of Freedom Within Groups (df\_\{within\})}}$$

The value of 22.53 indicates the average deviation of the data points from their group means.

A higher MSE relative to the scale of the dependent variable (intrinsic regulation) reduces the F-statistic and makes it harder to reject significant group differences.
The p-value of 0.530 shows that there is not much statistical significance as there is insufficient evidence to conclude that parenting style has any effect on intrinsic regulation.

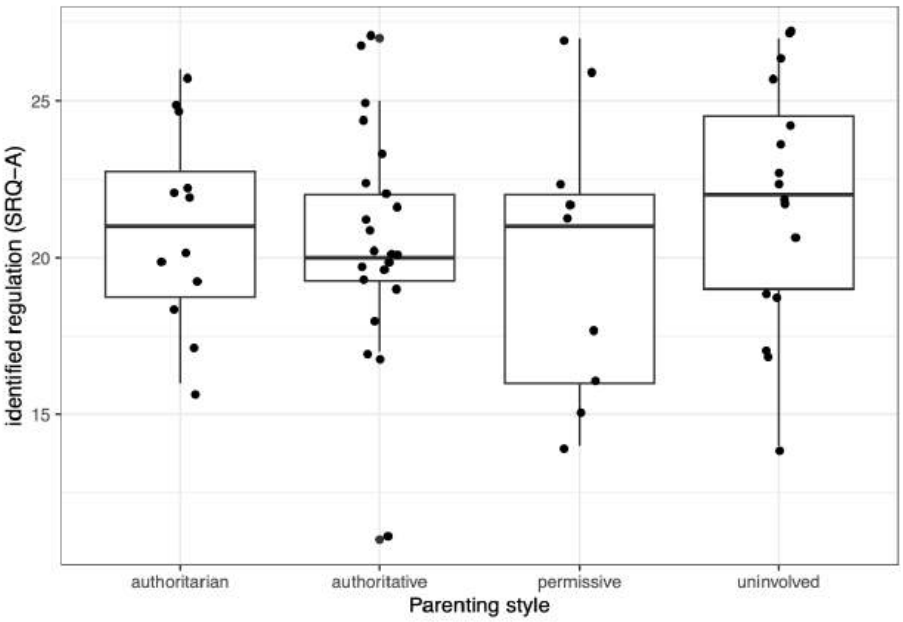
These are poor results, as the low F-statistic, high MSE, and non-significant p-value suggest that the parenting style groups do not meaningfully differ in their intrinsic regulation scores. Parenting style does not appear to explain variation in intrinsic regulation in this sample. Intrinsic regulation might be influenced by other factors not included in the analysis, or the measurement method might lack sensitivity to detect differences. No meaningful relationship between parenting style and intrinsic regulation can be inferred from this analysis. It is possible that the sample size or group variability is insufficient to detect significant effects. Further investigation with a larger or more diverse sample might yield different results.



ANOVA: $F(3, 55) = 2.78$, $MSE = 29.19$, $p = .050$

This represents a modest improvement. The F-statistic is now higher, which represents a stronger relationship. The MSE is now also higher which could be worse for the analysis but the effects of the higher F-statistic outweighs this increase in the MSE. The p-value here has dropped significantly, which is on the cusp of statistical significance. At the 0.05 level this is borderline significant but at 0.01 level this is not significant.

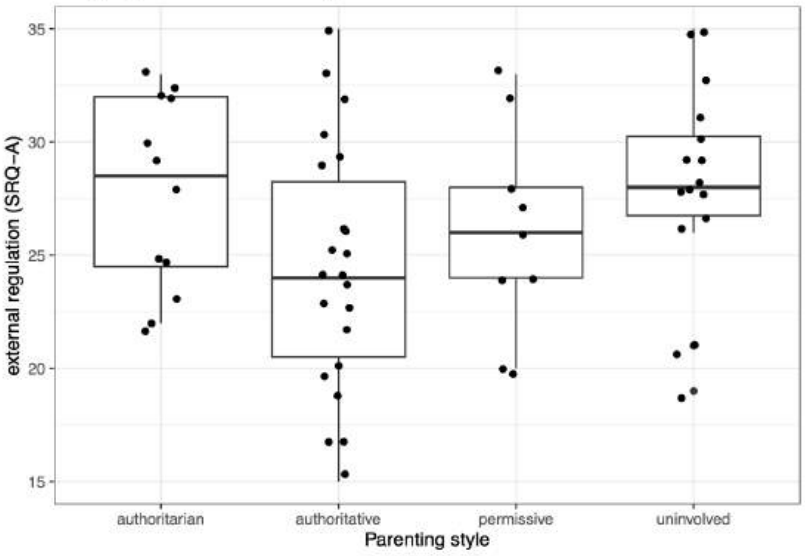
Parenting style and identified regulation



ANOVA: $F(3, 55) = 0.51$, $MSE = 14.03$, $p = .675$

This is a mixed result in the sense that the F-statistic has again dropped but so has the MSE value compared to the previous result. However, the dramatic increase in the p-value shows that this result is statistically insignificant.

Parenting style and external regulation



ANOVA: $F(3, 55) = 2.10$, $MSE = 23.34$, $p = .110$

Although here the F-statistic is higher, which is positive, and the MSE is still on the lower side, the statistically insignificant p-value shows that this model is statistically not significant.

Discussion

Limitations of the Study

This study has several limitations that affect the robustness and generalizability of its findings. First, the internal consistency of some measures, such as the Rosenberg Self-Esteem Scale (Cronbach's alpha = 0.203), was exceedingly low, indicating poor reliability. This undermines the validity of results related to self-esteem, as the scale may not have consistently captured the intended construct across participants. On the other hand, while the Self-Regulation Questionnaire for Adolescents (SRQA) demonstrated excellent internal consistency (Cronbach's alpha = 0.92), the variability in reliability across measures highlights the need for cautious interpretation of the findings. The inconsistency in scale reliability likely contributed to the limited explanatory power observed in the regression models, as evidenced by the low multiple R-squared values, such as 0.04801 for introjected regulation and 0.005577 for identified regulation.

Another limitation lies in the use of a median split to categorize parenting styles into authoritarian, authoritative, permissive, and uninvolved groups. While convenient, this approach reduces the richness of the data by forcing continuous measures into artificial categories, which can obscure meaningful differences. This limitation is reflected in the ANOVA results, where parenting style failed to explain significant variance in intrinsic regulation (F(3,55)=0.74, MSE=22.53,p=0.530, F(3, 55) = 0.74, MSE = 22.53, p = 0.530, F(3,55)=0.74, MSE=22.53,p=0.530) and was only marginally significant for introjected regulation (F(3,55)=2.78, MSE=29.19,p=0.050, F(3, 55) = 2.78, MSE = 29.19, p = 0.050, F(3,55)=2.78, MSE=29.19,p=0.050). The limited statistical power, compounded by a sample size of only 76 (with 4 observations deleted due to missingness), may have prevented the detection of subtle but potentially important effects.

Future Directions of Research

To address these limitations, future studies should prioritize improving the reliability of measures. For instance, the Rosenberg Self-Esteem Scale could be modified or replaced with a more reliable instrument that better aligns with the study population. Additionally, using advanced statistical techniques, such as confirmatory factor analysis, could help ensure the validity and reliability of the scales used. These improvements would enable a more robust exploration of the relationships between parenting styles, autonomy support, and self-regulation.

Moreover, future research should move beyond median splits by employing methods like latent profile analysis or cluster analysis to classify parenting styles. These approaches allow for a more nuanced understanding of parenting dimensions and their interplay. Increasing the sample size and ensuring diversity in terms of demographics, such as socioeconomic status and cultural background, would also enhance the generalizability of findings. Longitudinal designs are particularly needed to establish causation and track how parenting styles and autonomy support

influence self-regulation and self-esteem over time. Expanding the scope of analysis to include contextual factors, such as peer relationships and school environments, would further enrich the understanding of these developmental processes.

By addressing these limitations and expanding the scope of inquiry, future research can build a more comprehensive understanding of how parenting influences adolescent development. This would not only refine theoretical models but also provide a stronger evidence base for interventions and policies aimed at fostering healthy child development.

Strengths

Despite its limitations, this study contributes valuable insights into the relationships between parenting styles, autonomy support, and various aspects of self-regulation and self-esteem. By examining specific dimensions of parenting, the study provides a more nuanced understanding of how these factors may differentially affect developmental outcomes. This focus helps to bridge the gap between broad theoretical frameworks and specific actionable findings.

Another strength lies in the use of reliable measures for certain constructs, such as the

Self Regulation Questionnaire for Adolescents (SRQA), which demonstrates excellent internal consistency (Alpha = 0.92). The inclusion of interaction terms in the regression models also reflects an effort to investigate more complex relationships, paving the way for future research to build on these findings. This exploratory approach highlights potential areas of influence that could inform both theory and practice.

Practice and Policy Implications

For practitioners, the findings suggest the importance of fostering both parental involvement and autonomy support to promote positive self-regulation and self-esteem outcomes. Educational programs targeting parents could emphasize strategies for balancing support with opportunities for children to develop independence. Tailored interventions, particularly for families experiencing high stress or limited resources, could be especially impactful in fostering optimal parenting practices.

At the policy level, these findings underline the need for systemic support for families, such as accessible parenting workshops and community programs that reinforce positive parenting behaviors. Policymakers could invest in resources that help parents navigate the challenges of fostering autonomy while maintaining strong involvement in their children's lives. These initiatives could be integrated into school systems, where they would have the potential to reach a broad audience and benefit child development outcomes at scale.

Conclusion

This study makes a significant contribution to the growing body of literature on the relationships between **parenting styles**, **autonomy support**, and child developmental outcomes such as **self-regulation** and **self-esteem**. It provides valuable insights into how different parenting styles can influence a child's emotional and academic growth. The findings demonstrate that parenting behaviors, such as levels of warmth, control, and autonomy support, are integral to the development of a child's self-esteem and academic motivation. These results align with and extend previous research that has found a strong link between authoritative parenting and positive developmental outcomes

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