

The Relationship between Temperament Types and Social Adaptation in Children Aged 1-3 Years

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Abstract: In July 2010, the Ministry of Education of the People's Republic of China, in the "National Medium- and Long-Term Educational Reform and Development Plan (2010–2020)," clearly affirmed the significant importance of preschool education for the physical and mental health development of young children, the formation of life habits and learning qualities, as well as cognitive and intellectual development. The "Guidelines for Kindergarten Education" also stated that "kindergartens should not only pay attention to children's physical health but also pay special attention to their mental health." This shows the increasing attention of the state and society to the mental health education of preschool children. Nowadays, preschool education often emphasizes physical health over mental health; however, true health requires both physical and mental well-being. This study focuses on the relationship between temperament types and social adaptability in children aged 1-3 years, particularly examining the mediating role of negative emotions in this relationship. Temperament, as an early manifestation of individual behavior and emotional responses, has a profound impact on children's social adaptation. Current machine learning technologies can provide more precise and efficient solutions, with deep learning techniques such as convolutional neural networks capable of extracting features from image data to improve prediction accuracy. Machine learning is playing an increasingly important role in the field of mental health, offering an efficient research method for studying temperament and social adaptation. This study uses machine learning to analyze children's facial emotions and further applies psychological measurements to analyze temperament and predict children's social adaptation.

Keywords: Temperament; Social Adaptation; Negative Emotions; Machine Learning.

1. Introduction

Early childhood is a critical stage of individual development that has a profound impact on future social adaptation and mental health. Temperament types are closely related to children's social adaptability, especially during the critical developmental period of 1-3 years. Children aged 1-3 are in the early stages of individual development, and the temperament types during this period are crucial to their subsequent development. At this age, children are undergoing rapid cognitive, emotional, and social development, and the formation and stabilization of temperament significantly affect their social adaptability. The temperament types of children aged 1-3 may differ from those of older children. Additionally, the relationship between temperament and social adaptation in children aged 1-3 may be influenced by specific developmental tasks and environmental factors.

Temperament is generally defined as an innate behavioral style or fixed emotional tendency that remains relatively stable over time and manifests in different environments (Calkins et al., 2004; Sanson et al., 2004). Temperament is an important factor influencing children's social behavior and adaptability. For preschool children, the transition from home to kindergarten is a critical period for the development of social adaptability (Johnson, Ironsmith, Snow, & Michael Poteat, 2000). During this period, cultivating positive social behaviors and communication skills is essential for adapting to kindergarten life as well as for future academic and social adaptation. Studies have indicated that difficulties in social adaptation during early childhood may predict future developmental problems such as learning difficulties, unemployment, self-harm behaviors, and crime (Brook & Newcomb, 1995; Darke et al., 2003). Therefore, it is crucial to explore the factors that influence young children's social

adaptation and their mechanisms of action.

The indirect effect model of temperament on children's social adaptation suggests that children's temperament influences their environment, which in turn affects their social adaptation (Sanson et al., 2004). Children with different temperaments show significant differences in emotional responses, behavioral performance, and social interactions, which lead to varied adaptability in social environments. Early childhood is considered a critical stage of individual development (Buss and Plomin, 2008) and an important feature influencing the development of children's early personality, psychological adaptation, emotions, and social behavior (Rothbart et al., 2000; Terry W. Sterry et al., 2010).

Negative emotions in children may lead to problem behaviors through the mediating role of harsh parenting by caregivers. A cross-sectional study found that negative emotions in 3-year-old children significantly influenced problem behaviors through mothers' authoritative parenting style (Paulussen-Hoogeboom et al., 2008). Another study followed 35 children and showed that maternal rejection and denial played a mediating role between mothers' reports of preschool children's negative emotions and anxiety/depression. Therefore, when caregivers adopt a positive and accepting attitude in dealing with young children's negative emotions, it has a significant positive impact on their social adaptation.

Effectively regulating both positive and negative emotions plays a crucial role in the emotional and cognitive development of young children and in their later academic achievements. Research by Djambazova-Popordanoska (2016) indicates that good emotional regulation abilities not only positively affect children's emotional health but are also closely related to their academic achievements.

2. Research Methods

2.1. Research Participants

In this study, 92 toddlers were randomly selected from an international daycare center in Shenzhen. A total of 92 teacher questionnaires were distributed, and 89 were returned. After excluding 3 invalid questionnaires, 89 valid questionnaires remained, including 42 boys and 47 girls, achieving an effective response rate of 97%.

2.2. Research Instruments

2.2.1. Toddler Temperament

The study used the "Chinese Toddler Temperament Scale" (CTTS), developed by Professor Yao Kainan and his team based on Carey's Temperament Scale from the United States, to measure the temperament types of toddlers aged 1-3 years. The scale consists of 97 items, scored on a 6-point scale ranging from "almost never" to "almost always," with scores from 1 to 6, respectively. The scale comprises nine dimensions of temperament, each containing a different number of items. The test-retest reliability of the scale ranges from 0.84 to 0.94, split-half reliability from 0.31 to 0.73, and construct validity from 0.60 to 0.79, demonstrating good homogeneity reliability and internal consistency, as well as high acceptability.

2.2.2. Toddler Social Adaptation

To assess the social adaptability of toddlers in this study, two subscales from the teacher version of the "Strengths and Difficulties Questionnaire" (SDQ) developed by Goodman were used: the Peer Problems Subscale and the Conduct Problems Subscale. These subscales measure difficulties in peer relationships and behavioral adaptation among toddlers. Each subscale consists of 5 items, scored on a 3-point scale ranging from "not true" to "certainly true," corresponding to scores from 1 to 3. Higher scores indicate poorer social adaptability. In this study, the Cronbach's α coefficients for the two subscales were 0.80 and 0.72, respectively.

2.2.3. Negative Emotions

The study utilized the YOLOv8s detection network for facial recognition and multi-class emotion detection of the children under observation (emotions such as Anger, Contempt, Disgust, Fear, Happy, Neutral, Sad, Surprise) using campus monitoring. The YOLOv8-cls classification network was employed for face matching of the children under observation.

Specifically, the YOLOv8 object detection and image classification networks were applied for facial recognition, face matching, and emotion detection of children on campus. By analyzing the video streams from campus surveillance, it accurately and quickly obtained daily emotion detection results for the observed children aged 1-3 years. These results provide reliable input for subsequent analysis of children's temperament types and other factors.

3. Results and Analysis

3.1. Correlation Analysis between Temperament and Social Adaptation

A bivariate correlation analysis was conducted on the dimensions of children's temperament, the dimensions of social adaptation, and their total scores. The specific results are presented below.

Table 1. Summary of Correlation Analysis between Temperament and Social Adaptation

	Peer Interaction Issues	Conduct Issues
Activity Level	-0.024	-0.116
Rhythmicity	-0.730**	-0.755**
Approach/Withdrawal	-0.359**	-0.255*
Adaptability	-0.725**	-0.724**
Intensity of Reaction	-0.154	-0.139
Quality of Mood	-0.717**	-0.686**
Persistence	-0.351**	-0.259*
Distractibility	-0.347**	-0.265*
Threshold of Response	-0.618**	-0.619**

Note: * indicates $p < 0.05$, ** indicates $p < 0.01$.

Based on the table above, there is no correlation between peer interaction issues and activity level. However, peer interaction issues are significantly negatively correlated with rhythmicity, approach/withdrawal, adaptability, quality of mood, persistence, distractibility, and threshold of response. There is no significant correlation between peer interaction issues and intensity of reaction. Similarly, there is no correlation between conduct issues and activity level. Conduct issues are significantly negatively correlated with rhythmicity, approach/withdrawal, adaptability, quality of mood, persistence, distractibility, and threshold of response. There is no significant correlation between conduct issues and intensity of reaction.

3.2. Correlation Analysis between Temperament and Negative Emotions

A correlation analysis was conducted on the dimensions of children's temperament and negative emotions. The results are as follows:

Table 2. Correlation between Negative Emotions and Dimensions of Toddler Temperament

Negative Emotions	
Activity Level	-0.118
Rhythmicity	-0.474**
Approach/Withdrawal	-0.135
Adaptability	-0.415**
Intensity of Reaction	-0.127
Quality of Mood	-0.426**
Persistence	-0.123
Distractibility	-0.122
Threshold of Response	-0.394**

Based on the data in the table above, we analyzed the correlation between negative emotions and the nine dimensions of activity level, rhythmicity, approach/withdrawal, adaptability, intensity of reaction, quality of mood, persistence, distractibility, and threshold of response using Pearson correlation coefficients to measure the strength of these correlations.

Specific analysis shows that there is no correlation between negative emotions and activity level. Negative emotions are

significantly negatively correlated with rhythmicity, adaptability, quality of mood, and threshold of response. However, there is no significant correlation with approach/withdrawal, intensity of reaction, persistence, or distractibility.

3.3. Correlation Analysis between Negative Emotions and Social Adaptation

Table 3. Correlation Between Negative Emotions and Social Adaptation in Toddlers

Negative Emotions	
Conduct Issues	0.440**
Peer Interaction Issues	0.425**

According to Table 5, negative emotions show varying

Table 4. Linear Regression Analysis of Toddler Temperament Types on Negative Emotions

		R	R ²	ΔR ²	F	B	Beta(β)
Temperament Types	Intercept					0.829	
	Negative Emotions	0.47	0.218	0.209	24.299	0.324	0.467

The table above shows that when temperament types are used as independent variables and negative emotions as dependent variables in a linear regression analysis, the model formula is $Y = 0.829 + 0.324X$. The R² value of the model is 0.218, which means that the temperament type can explain 21.8% of the variance in negative emotions. The F-test for the model shows that the model passes the F-test ($F = 24.299$, $p < 0.05$), indicating that temperament type values significantly

degrees of correlation with children's social adaptation.

From the table above, the frequency of negative emotions is significantly positively correlated with conduct issues. Similarly, negative emotions are significantly positively correlated with peer interaction issues.

3.4. Linear Regression Analysis of Temperament Types on Negative Emotions

To further explore the causal relationship between temperament and social adaptation, a regression analysis was conducted. In this analysis, three types of temperament were used as independent variables, while the total scores of the two dimensions of social adaptation were used as dependent variables. The results of the analysis are as follows:

influence negative emotions. Further analysis reveals that the regression coefficient of temperament type is 0.324 ($t = 4.929$, $p < 0.05$), indicating that temperament type has a significant positive influence on negative emotions.

3.5. Regression Analysis of Negative Emotions on Social Adaptation

Table 5. Regression Analysis of Negative Emotions on Social Adaptation in Toddlers

		R	R ²	ΔR ²	F	B	Beta(β)
Negative Emotions	Intercept					-1.021	
	Social Adaptation	0.47	0.213	0.204	23.577	4.945	0.462

Based on the data in the table above, a linear regression analysis was conducted with negative emotions as the independent variable and the total scores of the two dimensions of social adaptation as the dependent variables. The model formula is $Y = -1.021 + 4.945X$. The R² value of the model is 0.213, indicating that negative emotions can explain 21.3% of the variance in the total scores of social adaptation. The F-test shows that the model passes the F-test ($F = 23.577$, $p < 0.01$), indicating that negative emotions significantly affect the total scores of the two dimensions of

social adaptation. The regression coefficient of negative emotions is 4.945 ($t = 4.856$, $p < 0.01$), suggesting that negative emotions have a significant positive influence on the total scores of social adaptation, indicating a significant negative impact of negative emotions on the degree of social adaptation.

3.6. Linear Regression Analysis of Temperament Types on Social Adaptation

Table 6. Linear Regression Analysis of Toddler Temperament Types on Social Adaptation

		R	R ²	ΔR ²	F	B	Beta(β)
Temperament Types	Intercept					-3.082	
	Social Adaptation	0.84	0.71	0.71	212.46	6.248	0.842

According to the statistical results in the table above, a linear regression analysis was conducted with temperament types as the independent variables and the total scores of the two dimensions of social adaptation as the dependent variables. The model formula is $Y = -3.082 + 6.248X$. The R² value of the model is 0.71, indicating that the temperament type value can explain 70.9% of the variance in the total scores of social adaptation. The F-test shows that the model

passes the F-test ($F = 212.460$, $p < 0.05$), indicating that the temperament type value significantly affects the total scores of the two dimensions of social adaptation. The regression coefficient of temperament type is 6.248 ($t = 14.576$, $p < 0.01$), indicating that temperament type has a significant positive influence on the total scores of social adaptation.

3.7. Mediating Role of Negative Emotions between Toddler Temperament and Social Adaptation

In this part of the study, based on the previous tests, further exploration was conducted on the mediating effect of the

caregiver-child relationship between temperament and social adaptation. A model was constructed in the study, with the three categories of toddler temperament as independent variables, social adaptation level as the dependent variable, and emotion type as the mediating variable.

Table 7. Mediating Role of Negative Emotions Between Toddler Temperament and Social Adaptation

	Total Effect	a	b	Mediating Effect	Direct Effect	Conclusion
Temperament Type => Negative Emotions => Social Adaptation	0.217**	0.394**	0.157	0.062	0.155*	Partial mediation

From the table above, it can be seen that negative emotions have a partial mediating effect between temperament types and social adaptation.

Table 8. Proportion of Mediating Effect

	Conclusion	Total Effect	Mediating Effect	Direct Effect	Effect Proportion
Temperament Type => Negative Emotions => Social Adaptation	Partial Mediation	0.217	0.062	0.155	28.481%

As shown in the table above, negative emotions have a partial mediating effect between temperament types and social adaptation. According to the model presented in the table, the 95% confidence interval [0.053, 0.257] does not contain 0, indicating that the mediating effect is significant. Therefore, negative emotions play a partial mediating role between temperament types and social adaptation, accounting for 28.481% of the effect.

4. Discussion and Recommendations

4.1. The Relationship between Toddler Temperament, Negative Emotions, and Social Adaptation

The study shows a significant association between toddler temperament and social adaptation, particularly in the dimensions of emotional response, rhythmicity, approach/withdrawal, and adaptability. The correlation analysis indicates that, except for activity level, peer interaction issues are significantly negatively correlated with other dimensions of temperament, suggesting that the level of temperament in toddlers greatly influences their social adaptation. This is consistent with the findings of Prior et al. (2000), who discovered that certain dimensions of toddler temperament, such as emotional reactivity and adaptability, significantly predict the quality of social behavior and peer interactions.

Children with high emotional reactivity tend to exhibit intense emotional responses when facing conflicts, which may intimidate other children and lead to difficulties in playing with others. Similar results have been supported by research, such as that of Eisenberg et al. (2001), which found that toddlers with high emotional reactivity are more likely to display unstable emotions in social situations, affecting their interactions with peers. In contrast, children with low emotional reactivity are more likely to resolve problems peacefully, thus performing better in peer interactions.

Children with low rhythmicity may feel discomfort when faced with changes in daily activities, which can affect their emotions and behaviors, making them appear unsociable or uncooperative in peer interactions. In contrast, children with high rhythmicity have stronger adaptability and are more likely to integrate into group activities, thereby performing better in peer interactions. This finding aligns with the research of Rothbart and Bates (2006), who noted a significant association between rhythmicity in temperament and children's adaptability and behavioral adjustment. Moreover, children with high approach/withdrawal tendencies are often very cautious in new environments or when facing new peers and may choose to withdraw, missing opportunities to build connections with peers. This result echoes the findings of Kagan et al. (1998), who found that toddlers with strong approach/withdrawal tendencies are more likely to exhibit avoidance behaviors in unfamiliar environments, which in turn affects social adaptation. Conversely, children with low approach/withdrawal tendencies are more willing to engage with and explore new things, making it easier for them to form new friendships, thus performing better in peer interactions. Children with low adaptability need more time to adjust to changes, during which they may exhibit resistance and behaviors that impact peer interactions.

Children with high adaptability adapt more quickly to changes and are more likely to integrate into group activities and new environments, thereby performing better in peer interactions. This conclusion is consistent with the research results of Zentner and Shiner (2012), who argued that adaptability in temperament is a key predictor of children's social behavior.

4.2. Correlation and Predictive Role of Negative Emotions and Temperament Types

The study found that negative emotions are significantly negatively correlated with the three dimensions of rhythmicity, adaptability, and quality of mood. Regression analysis revealed that temperament type has a significant positive impact on negative emotions.

The study found that children with high rhythmicity have regular routines in daily life, which makes their physiological and psychological states more stable. They are more likely to get sufficient sleep and nutrition, resulting in more stable emotions and a lower frequency of negative emotions. This conclusion aligns with the research results of Monk et al. (2003), who found a positive correlation between regular sleep and routines and lower negative emotions, especially in children and adolescents, where a regular daily life can

significantly reduce emotional fluctuations and anxiety.

4.3. Correlation and Predictive Role of Negative Emotions and Social Adaptation

The study found that the frequency of negative emotions is significantly positively correlated with the two dimensions of conduct issues and peer interaction issues. Regression analysis revealed that negative emotions have a significant negative impact on the degree of social adaptation in toddlers.

This may be because children with a high frequency of negative emotions score higher on behavioral problems, possibly due to strong emotional reactions when encountering setbacks, such as crying or anger. In some cases of emotional loss of control, these children are more likely to exhibit rule-breaking behaviors or refuse to participate in group activities. As one teacher at the daycare noted: "Some children, when playing with other kids during activity time, will show extreme disappointment and anger if their constructed blocks are accidentally knocked over by others. They may start crying or even push other kids."

4.4. Regression Analysis of Temperament Types and Social Adaptation

Based on the regression analysis study from the previous chapter, temperament types have a significant positive impact on the sum of the two dimensions of social adaptation. Toddlers with an "easy" temperament have the best social adaptation, while those with a "difficult" temperament have lower social adaptation.

"Easy" temperament toddlers are characterized by emotional stability, where their mood swings are typically small, allowing them to maintain a cheerful and positive emotional state. They are highly adaptable and have a strong ability to accept new environments and new things. With high rhythmicity, their physiological and behavioral patterns are more regular, enabling them to better integrate into the daily rhythm of life. "Easy" temperament toddlers are also more likely to interact with others and exhibit cooperative and sharing behaviors. These characteristics make "easy" temperament toddlers more likely to receive positive feedback in social situations, further enhancing their social adaptation abilities. According to Thomas and Chess's temperament theory, these children are more likely to form stable attachment relationships and demonstrate confidence and optimism in social interactions. In contrast, children with "difficult" temperaments usually have emotional problems and are prone to loss of control, have poor adaptability to new environments, low rhythmicity in daily life, and often display withdrawal or aggressive behaviors in peer interactions. These characteristics make "difficult" temperament toddlers more likely to encounter negative feedback in social situations, further reducing their social adaptation abilities.

4.5. Mediating Role of Negative Emotions

The study shows that the frequency of negative emotions in toddlers plays a partial mediating role in the relationship between temperament types and social adaptation, with an effect size of 28%. This means that temperament types influence children's negative emotional responses, and negative emotions, in turn, affect children's social adaptation abilities. Specifically, toddlers with different temperament types will exhibit negative emotions at different frequencies when faced with environmental and social challenges, which will further impact their social behaviors and adaptation

abilities. Doudou (a pseudonym), an "easy" temperament girl, shows high activity levels, strong emotional stability, and strong adaptability in her daily activities. When faced with strangers or separation from parents, due to her strong adaptability, she rarely exhibits negative emotions. The stable emotions further lead her to be well-liked by other children in the daycare, and Doudou is also willing to build positive interactions with them, performing well in group life and adapting well to life in the daycare.

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