

A Study on Intergenerational Transmission of Dark Triad and Emotion Reactivity

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Introduction: Moderate emotion reactivity in the face of daily stress is of positive significance regarding individuals' psychological well-being and environmental adaptation. The study on intergenerational transmission of Dark Triad and emotion reactivity has confirmed the existence of higher levels of Dark Triad and emotion reactivity in college students in the Chinese sample, which may provide a reference for future related studies.

Purpose: The study examined the intergenerational transmission effects of Dark Triad and Emotion Reactivity in families. And based on this, it further analyzed the mediating role of parental emotion reactivity and children's Dark Triad in the influence of parental Dark Triad on children's emotion reactivity.

Methods: The questionnaire was administered to 486 families inclusive of fathers, mothers, and children utilizing the Emotion Reactivity Scale (ERS) and the Dirty Dozen (DD).

Results: 1) The intergenerational transmission was presented in the three Dark Triad traits and emotion reactivity. 2) The level of Dark Triad and emotion reactivity of children was remarkably higher than that of their parents. 3) The Dark Triad scores of males were considerably higher than those of females, while there were no significant differences in the scores of emotion reactivity between them. 4) The actor and partner effects of Dark Triad and emotion reactivity between father and mother were established. 5) Parental emotion reactivity and children's Dark Triad exerted mediating effects on the impact of parental Dark Triad on children's emotion reactivity.

Conclusion: The effect of parental three Dark Triad on their children's emotion reactivity as well as its mediation mechanism were examined respectively by the present study in the light of APIM and intergenerational transmission analysis. It was concluded that the findings carried both theoretical and reference value for developing moderate emotion reactive ability toward college students.

Keywords: Dark Triad, emotion reactivity, intergenerational transmission, APIM, mediating effect

Introduction

An irreplaceable role can be attached to moderate emotion reactivity for individuals' environmental adaptation and health maintenance. College students in early adulthood are characterized by the intensity and instability of their emotional experiences.¹ Simultaneously, it is a pivotal period of time for cultivating their favorable emotion reactivity.² Emotion reactivity (ER) refers to the stable characteristics of individuals in terms of the arousal level, duration, and intensity of their emotions in response to the stimulus of both internal and external environments.³ Explicit individual differences exist in the emotion reactivity: It is not exactly the same across individuals, even when faced with the same stimulus.⁴ For instance, it is not identical for each individual to perceive how much sadness and how long it takes them to get over it upon watching the same sorrowful movie.

A complicated conception, emotion reactivity is composed of multi-dimensions, which could be roughly divided into three aspects: emotional sensitivity, emotional persistence, and emotional intensity.⁵ Emotional sensitivity is mainly reflected in the threshold of emotional reaction. Individuals with high sensitivity have a relatively low threshold and may induce mood fluctuations even with mild stimulus. Emotional persistence refers to the length of time it takes for an

individual's emotions to return to their initial state. Individuals with high persistence take longer to get rid of their emotions. Emotional intensity refers to the intensity of an individual's emotional experience. Individuals with high intensity may show a stronger emotional reaction when faced with the same stimulus. Good emotion reactivity is not only a core indicator of an individual's level of adaptation to the external environment,⁶ but also an essential factor in mental health.⁷ Numerous studies have shown that emotion reactivity is markedly positively associated with anxiety, depression,⁸ suicidal ideation⁹ and suicide attempts.¹⁰ Additionally, emotion reactivity is negatively correlated with emotional coping skills, implying that individuals with high emotion reactivity typically possess weaker problem-solving skills.¹¹

There is a synergistic combination of biological,¹² growth experiences,¹³ environmental,¹⁴ and individual¹⁵ factors that influence one's emotion reactivity. Among them, personality trait, as a crucial component of individual factors, is a powerful predictor of emotion reactivity.¹⁶ It is suggested in the Emotional Motivation-Differentiation Theory that the emotional system—in which the activation and regulation of the emotion could be shaped by personality factors—is the core motive of the personality system.¹⁷ Whether subjective emotional reactivity, or physiological emotional reactivity (eg, facial electromyography, heart rate, skin conductance level), both are driven by personality traits.¹⁸ Though the relationship between personality and emotion reactivity has been extensively substantiated,¹⁹ it is rarely addressed by studies concerning the relationship between Dark Triad (DT), a negative personality trait group, and emotion reactivity.

As mutually independent and overlapping personality traits, Machiavellianism, psychopathy, and narcissism are uniformly named “The Dark Triad of Personality”,²⁰ since all of them are characterized by the antisocial traits of emotion apathy, hypo-agreeableness, and interpersonal manipulation.²¹ It was indicated in previous research that emotion reactivity could be positively predicted by the Dark Triad.²² Characterized by low-level emotional arousal and unstable emotional states,²³ individuals with highly Dark Triad are more prone to experience intense negative emotions while coping with negative emotional events, from which it is difficult to shake off.²⁴ Additionally, it was evidenced in studies of people across age groups that Dark Triad was a key predictor of emotion reactivity.^{25,26} Notably, however, all three Dark Triad traits are not exactly identical as to their impact on emotion reactivity. Machiavellians with sensitive emotional reactions are therefore more emotional in their responses to stress.²² Psychopaths show the traits of being emotionally impulsive and lacking empathy.²⁷ Narcissists exhibit inferior regulation in emotional reactions, whose personality traits are strongly positively correlated with inhibition of emotional expression.²⁸ Therefore, it is evident that although there are differences in the extent to which the three Dark Triad traits affect emotion reactivity, they all exhibit a positive correlation with the level of individual emotion reactivity.

Intergenerational transmission runs prevalently in the development of individual psychology and behavior. According to Family System Theory (FST), it is the couple system that forms the basis of the parent-child system and the sibling system, and interactions exist among individuals within the same and different systems.²⁹ Parents play such an influential role in the formation and development of their children's personality traits. It was discovered in past studies that intergenerational transmission was principally realized through three approaches: heredity, observation and imitation and parenting styles.³⁰ By way of example, children could be influenced by parental personality traits through genetic heredity in studies of twins.³¹ In addition, observation and imitation will be exerted to parents' indifferent and manipulative behavior by their children while they growing up, thus allowing them to establish their own Dark Triad.³² Meanwhile, negative parenting styles tended to be adopted by parents with high Dark Triad to over-control and neglect their children's psychological needs, resulting in frequent parent-child conflicts and affecting their children's personality traits.³³

There may similarly be intergenerational transmission in emotion reactivity. Parental emotion reactivity is a better predictor of their children's.³⁴ Normally, the higher level of parental emotion reactivity, the higher level that of their children.³⁵ Consequently, if parents are overly sensitive to stressful events to the point of frequently expressing strong and persistent negative emotions, this will enhance their children's concerns and fears, leading to intense negative emotion reactivity.³⁶ Besides, undergoing long-term exposure to their parents' negative emotions and experiencing persistent high-intensity of that, children are vulnerable to various types of emotional problems.³⁷ Negative parenting styles are frequently practiced by parents with high emotion reactivity, which does not only diminish the quality of the

parent-child relationship, but also threatens the establishment of children's secure attachment with negative effects on their emotional development.³⁸

Undeniably, the parental generation plays an essential role in the development of personality traits and emotion reactivity in the offspring. However, driven by external environmental factors as well as individual factors, the offspring do not exhibit identical characteristics to those of the parental generation, with possible degrees of intergenerational differences.³⁹ One manifestation of intergenerational differences is age differences.⁴⁰ It is noted that older individuals are better to regulate their emotional reactions.⁴¹ And elder parents tend to be greater at suppressing emotional reactions than their younger children.⁴² Thus, college students in early adulthood may be more emotionally reactive than their middle-aged parents. In addition, the intergenerational differences in Dark Triad are likewise reflected in age differences. What was found in a study of age differences in the Dark Triad cross-section was a significant negative correlation between age and Dark Triad.⁴³ It means that the older the individual, the lower the level of Dark Triad.⁴⁴ That is, children may have higher levels of Dark Triad than their parents. Therefore, it is imperative to analyze the differences between parental and offspring generations upon the analysis of intergenerational transmission effects of parental Dark Triad and emotion reactivity.

Individuals of different genders may share difference in the level of Dark Triad and Emotion Reactivity, as influenced by individual social characteristics.⁴⁵ Studies on gender differences in emotion reactivity indicated that females experienced more problematic symptoms and more deficits in emotion reactivity in comparison to males.⁴⁶ It is harder to control and regulate their emotional reactions when faced with negative emotional experiences.⁴⁷ In other words, the level of females' emotion reactivity is likely to be substantially higher than that of males. Analysis of gender differences works equally well for Dark Triad, but the levels of Dark Triad in men and women are different from emotion reactivity. Machiavellianism, psychopathy, and narcissism have been found to demonstrate greater positive correlations with men.⁴⁸ Personality traits such as apathy and impulsivity are more pronounced in men than in women.⁴⁹ Consequently, a high level of Dark Triad may be more likely to be developed in men than in women.

The most fundamental unit of interpersonal relationship is the dyadic relationship, of which the couple relationship is a typical dyadic relationship formed as a result of marriage. Paired data surveyed on couples are non-independent in nature with interactions of both, and commonly analyzed using the Actor-Partner Interdependence Model (APIM). Within this model, the actor effect refers to the influence of an individual's predictor variable on self own outcome variable. While the partner effect refers to individual's outcome variable being influenced by the predictor variable of the other party in the relationship.⁵⁰ Therefore, in the current study, the effect of one party's Dark Triad on self emotionally reactivity is termed the actor effect; While one party's emotion reactivity influenced by the Dark Triad of the other party in the relationship is referred to as the partner effect. Not only one's own emotion reactivity, but also that of the spouse may be affected by the individual's personality.⁵¹ Individuals with high Dark Triad are frequently oblivious to the emotional feelings and psychological needs of their spouse, which probably results in the enhancement of the emotion reactivity of the spouse.^{52,53} APIM was mostly conducted in previous studies to examine the effects of Dark Triad of couples on marital quality⁵⁴ and marital satisfaction.⁵⁵ However, as evident from the analysis of the available literature, no studies have so far explored the interactions between couples' Dark Triad and emotion reactivity.

According to related studies, parents with higher levels of Dark Triad are susceptible to negative emotions generating persistent and intense emotional reactions.⁵⁶ Such states are transmitted to their children, thereby shaping their children's levels of emotion reactivity.⁵⁷ Moreover, such parents tend to treat their children with manipulative or avoidant emotional response strategies, which easily ignore their children's emotional reaction states, thus triggering problems with their children's emotional reactions.⁵⁸ Overall, parents' Dark Triad levels positively predicted their own emotion reactivity levels; and under the influence of intergenerational transmission effects, parents' emotion reactivity levels in turn positively predicted those of their children. In view of this, an inference can be made that parental emotion reactivity may play a mediating role between parental Dark Triad and children's emotion reactivity.

The personality traits of children are influenced by those of their parents according to intergenerational transmission of the personality.⁵⁹ Numerous studies have concluded that the emergence of Dark Triad in children is associated with dark personality traits such as parental indifference and control during childhood, with such influences persisting.⁶⁰ That is, the higher the level of parental Dark Triad, the more likely that their children will develop Dark Triad.⁶¹

Whereas the level of individual Dark Triad is positively correlated with the level of emotion reactivity.⁶² Therefore the children with Dark Triad are more likely to have high levels of emotion reactivity. Hence, the present study hypothesizes that children's Dark Triad may be a mediator variable between parental Dark Triad and children's emotion reactivity.

In summary, a mediation model was constructed in this study based on the analysis of intergenerational transmission effects and APIM for clarifying the relationship among parental Dark Triad, parental emotion reactivity, children's Dark Triad, and children's emotion reactivity together with their mechanism of action. The following hypotheses were proposed: 1) scores of parental Dark Triad and emotion reactivity can strongly and positively predict those of the children; 2) scores of children's Dark Triad and emotion reactivity are greatly higher than those of the parents; 3) scores of men's Dark Triad are significantly higher than those of women, whereas scores of women emotion reactivity are strongly higher than those of men; 4) fathers' and mothers' Dark Triad can positively predict their own emotion reactivity (actor effect); 5) fathers' and mothers' Dark Triad can positively predict spouses' emotion reactivity (the partner effect); 6) parental emotion reactivity and children's Dark Triad play a mediating role in the effect of parental Dark Triad on children's emotion reactivity. The research hypothesis model is shown in Figure 1.

Method

Participants

College students were recruited to participate in this survey through an online platform. Inclusion criteria were (1) age \geq 16 years, (2) voluntary participation in the study, (3) parental marital status of being married, and (4) parental consent for participation of this survey. A minimum sample size was calculated before the start of the study. The formula was calculated as, sample size = Max (number of dimensions) \times (15 ~ 20) \times [1 + (15% ~ 20%)].⁶³ This study took 20 times the number of dimensions, while accounting for the possible invalid questionnaires and the inability to match the data, an additional 20% of invalid data was required. The maximum number of dimensions included in the research tools of the ERS and the DD used in this study was 3, and the sample size was calculated as $3 \times 20 \times 1.2 = 72$. Therefore, the minimum number of families to be recruited for the study was 72.

The investigator posted the recruitment advertisement to the class WeChat group after obtaining the approval of the counselor. Students who agreed to participate in this survey came to the laboratory at the appointed time and were briefed

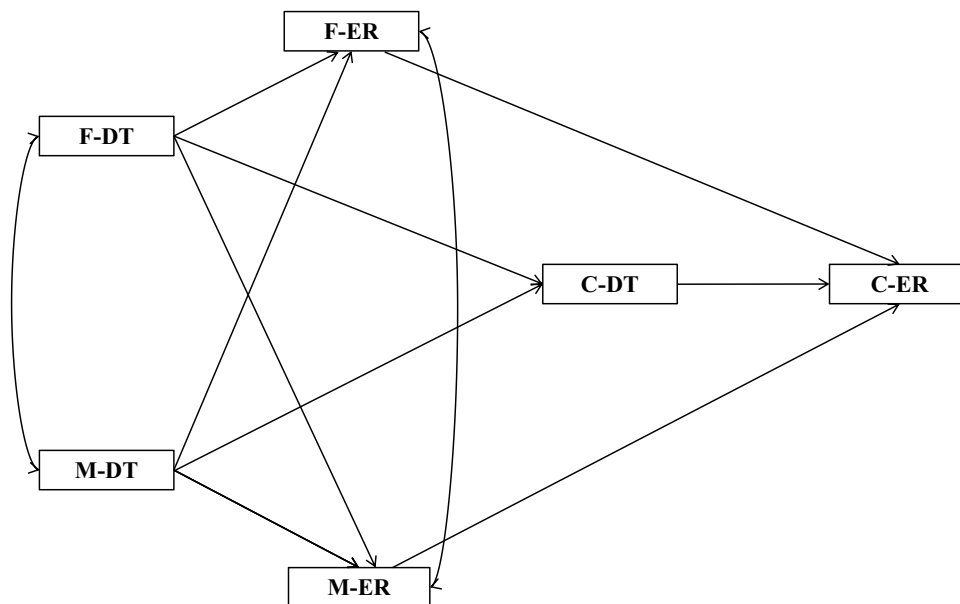


Figure 1 The theoretical model for the current study.

Abbreviations: F, Father; M, Mother; C, Children; DT, Dark Triad; ER, Emotion Reactivity; F-DT, Father's Dark Triad; M-DT, Mother's Dark Triad; C-DT, Children's Dark Triad; F-ER, Father's Emotion Reactivity; M-ER, Mother's Emotion Reactivity; C-ER, Children's Emotion Reactivity.

by the investigator personally about the purpose of the survey, the confidentiality and anonymity of the data with answers to questions raised by the students. Informed consent forms for the study were signed by the participants.

There were two versions of the questionnaire: a child version and a parent version. College students with consent for participation in the survey were given a web link to complete their responses through the online platform. Then, the parent version of the questionnaire would be sent by the students themselves to their fathers and mothers respectively. Each family would be provided with a number for data matching among family members. The researchers audited the data one by one following the completion of the investigation. Invalid data were removed depending on the following criteria: (1) the number could not be matched, (2) either of the family members did not complete the answer, or (3) either of the family members did not answer carefully, eg, all the options were identical.

A total of 486 valid family data were recovered from the study. In the sample of children, the age ranged from 17–22 years with an average age of 18.71 ± 0.81 years, of 137 boys and 349 girls. In the sample of fathers, the age ranged from 39–59 years with an average age of 46.81 ± 4.18 years. In the sample of mothers, the age ranged from 37–57 years with an average age of 45.17 ± 4.15 years.

Instruments

Emotion Reactivity Scale

The Chinese version of the Emotion Reactivity Scale (ERS)⁵ questionnaire was used as the research instrument in this study. There were 21 items in the ERS with three dimensions: emotion sensitivity, emotion intensity and emotion persistence. The emotion sensitivity dimension consists of 10 items, such as “My feelings get hurt easily”. The emotion intensity dimension consists of 7 items, such as “When I experience emotions, I feel them very strongly/intensely”. The emotion persistence dimension consists of 4 items, such as “When something happens that upsets me, it’s all I can think about it for a long time”. A Likert five-point scoring scale was used in which participants assessed their own emotion reactivity experience, choosing from “0 (not at all like me)” to “4 (completely like me)”. Scores of each item were summed to the total score. The higher the score, the higher the level of individuals’ emotion reactivity. The total score and Cronbach’s α coefficient of each dimension in this study were 0.92, 0.87, 0.79, and 0.70, respectively.

Dirty Dozen

The Chinese version of the Dirty Dozen (DD)⁶⁴ questionnaire was used as the research instrument in this study. A total of 12 items were included in this scale, including three dimensions of Machiavellianism, psychopathy, and narcissism. The Machiavellianism dimension consists of four items, such as “I tend to manipulate others to get my way”. The psychopathy dimension consists of 4 items, such as “I tend to be unconcerned with the morality of my actions”. The narcissism dimension consists of 4 items, such as “I tend to want others to admire me”. A seven-point scoring scale was used, ranging from “1 (disagree strongly)” to “7 (agree strongly)”. Scores on each item were added up to the dimensional score, and the higher the score, the higher the level of the individual’s Dark Triad. The total score and the Cronbach’s α coefficient of each dimension in this study were 0.83, 0.90, 0.76, and 0.85, respectively.

Data Analysis

The survey data were entered and analyzed by SPSS 20.0. First, for the analysis of generational differences, paired sample *t*-test was used to examine the differences between “father-son” and “mother-daughter” in terms of Dark Triad and emotion reactivity. Second, in the analysis of gender differences, paired sample *t*-test was conducted to examine the differences between fathers and mothers on each variable, while an independent sample *t*-test was applied to examine the differences between college students of different genders. Third, linear regression analysis was performed to examine the intergenerational transmission effects of Dark Triad and emotion reactivity. The study standardized the variables for the reduction of multicollinearity. In addition, only one variable from the father or mother was included as an independent variable at a time in the regression analysis to examine the separate effects of the father or mother on the children.

Fourth, APIM was analyzed with the free online analysis program APIM_SEM.⁶⁵ In APIM, the actor effect and the partner effect need to be calculated first, from which the K value is calculated. In the analysis of dyadic patterns, k values, used to measuring dyadic patterns, are the ratio of the partner effect to the actor effect.⁶⁶ Only when the

standardized absolute values of the actor effect are higher than 0.10, and statistically significant can k values be computed. Although, dyadic relationships are distinguished by the role (Father vs Mother), but their actor and partner effects probably cannot be distinguished.⁵⁰ Accordingly, the actor and partner effects for fathers and mothers were set to be equal to examine whether the chi-square change values were significant. If the difference is not significant, the actor and partner effects may be indistinguishable.⁶⁶ If the confidence interval for the k value includes 1, the dyadic pattern is the couple pattern; the CI includes -1 as the contrast pattern; and the CI includes 0 as the actor-only. In order to test if gender makes a statistically significant difference, a model comparison is performed between a model with distinguishable members and a model with indistinguishable members. A chi-square test was utilized to examine whether the differences between the two models were significant. If $p < 0.05$, members can be statistically distinguished based on gender.

Fifth, the mediation model was tested with the AMOS 24.0. The independent variables were father's and mother's Dark Triad, the dependent variable was children's emotion reactivity, and the mediating variables were father's and mother's emotion reactivity and children's Dark Triad. The significance of the mediating effect was tested through repeated sampling 5000 times using the bias correction nonparametric percentile Bootstrap method. A significant mediating effect was indicated if the 95% confidence interval did not contain 0.

Results

Correlation Analysis of Each Variable

Correlation analysis results show that (Table 1), the Dark Triad and emotion reactivity scores of the parental generation were positively correlated with the scores of the offspring, satisfying the prerequisites for conducting intergenerational transmission effects analysis.

Analysis of Intergenerational Transmission Effect

As the results of the study suggested (Table 2), the three Dark Triad traits and emotion reactivity of fathers and mothers, respectively, had positive predictive effects on their children's three Dark Triad traits and emotion reactivity ($p < 0.001$), indicating that the intergenerational transmission effect of each variable was valid.

Analysis of Inter-Generational and Intra-Generational Differences in Each Variable

Results are presented in Table 3. The offspring scores were considerably higher than the parental scores in both Dark Triad and emotion reactivity, except for the non-significant difference in psychopathy scores between "mother-daughter". Then, fathers scored substantially higher than wives on psychopathy ($t = 2.62$, $p = 0.009$), and male college students scored significantly higher than female ones on Machiavellianism ($t = 2.80$, $p = 0.006$) and psychopathy ($t = 4.40$, $p < 0.001$).

Table 1 Results of Correlation Analysis of Each Variable

	1	2	3	4	5	6	7	8
1 Pa-Ma	1	0.67**	0.28**	0.38**	0.37**	0.23**	0.06	0.19**
2 Pa-P	0.76**	1	0.27**	0.44**	0.28**	0.32**	0.07	0.25**
3 Pa-N	0.28**	0.29**	1	0.33**	0.22**	0.12*	0.30**	0.20**
4 Pa-ER	0.59**	0.60**	0.30**	1	0.30**	0.28**	0.20**	0.39**
5 O-Ma	0.34**	0.33**	0.03	0.38**	1	0.62**	0.30**	0.49**
6 O-P	0.35**	0.29**	0.04	0.44**	0.71**	1	0.19**	0.49**
7 O-N	0.05	0.10	0.20*	0.05	0.22**	0.12	1	0.40**
8 O-ER	0.37**	0.37**	0.15	0.54**	0.56**	0.50**	0.35**	1

Notes: ** $p < 0.01$; The correlation coefficients for father and son are shown below the diagonal line marked by 1, while above this diagonal line are the correlation coefficients for mother and daughter.

Abbreviations: Pa, Parental; O, Offspring; Ma, Machiavellianism; P, Psychopathy; N, Narcissism; ER, Emotion Reactivity; Pa-Ma, Parental Machiavellianism; Pa-P, Parental Psychopathy; Pa-N, Parental Narcissism; Pa-ER, Parental Emotion Reactivity; O-Ma, Offspring's Machiavellianism; O-P, Offspring's Psychopathy; O-N, Offspring's Narcissism; O-ER, Offspring's Emotion Reactivity.

Table 2 Results of the Analysis of the Intergenerational Transmission Effect Between Dark Triad and Emotion Reactivity

Independent Variable	Dependent Variable	R	R ²	ΔR ²	β	F	p
F-Ma	C-Ma	0.378	0.143	0.139	0.353	40.276	< 0.001
M-Ma	C-Ma	0.360	0.130	0.126	0.334	36.047	< 0.001
F-P	C-P	0.323	0.104	0.101	0.239	28.126	< 0.001
M-P	C-P	0.353	0.125	0.121	0.278	34.416	< 0.001
F-N	C-N	0.241	0.058	0.054	0.103	14.835	< 0.001
M-N	C-N	0.234	0.055	0.051	0.086	13.998	< 0.001
F-ER	C-ER	0.465	0.217	0.213	0.461	66.806	< 0.001
M-ER	C-ER	0.448	0.200	0.197	0.442	60.515	< 0.001

Note: p, P-value.

Abbreviations: F, Father; M, Mother; C, Children; Ma, Machiavellianism; P, Psychopathy; N, Narcissism; ER, Emotion Reactivity; F-Ma, Father's Machiavellianism; M-Ma, Mother's Machiavellianism; F-P, Father's Psychopathy; M-P, Mother's Psychopathy; F-N, Father's Narcissism; M-N, Mother's Narcissism; F-ER, Father's Emotion Reactivity; M-ER, Mother's Emotion Reactivity; C-Ma, Children's Machiavellianism; C-P, Children's Psychopathy; C-N, Children's Narcissism; C-ER, Children's Emotion Reactivity.

Table 3 Results of Descriptive Statistical Analysis and Analysis of Variance

		F/M/F/S	S/D/M/D	t	p
F-S	Ma	6.79±4.86	8.88±5.45	-4.123	< 0.001
	P	7.49±4.87	8.84±4.82	-2.740	0.007
	N	14.30±7.00	15.99±6.47	-2.317	0.022
	ER	15.60 ±15.89	22.74 ±16.40	-5.417	< 0.001
M-D	Ma	6.19±4.04	7.41±4.57	-4.67	< 0.001
	P	6.47±4.04	6.83±3.74	-1.46	0.146
	N	13.53±6.36	15.60±5.84	-5.35	< 0.001
	ER	15.13 ±12.74	20.46 ±13.76	-6.78	< 0.001
F-M	Ma	6.47±4.29	6.31±4.19	0.72	0.472
	P	7.05±4.52	6.52±4.08	2.62	0.009
	N	14.09±6.63	13.59±6.52	1.51	0.132
	ER	14.58 ±13.27	15.47 ±13.45	-1.56	0.119
S-D	Ma	8.88±5.45	7.41±4.57	2.80	0.006
	P	8.84±4.82	6.83±3.74	4.40	< 0.001
	N	15.99±6.47	15.60±5.84	0.65	0.514
	ER	22.74 ±16.40	20.46 ±13.76	1.44	0.151

Notes: p, P-value.

Abbreviations: F, Father; M, Mother; S, Son; D, Daughter; Ma, Machiavellianism; P, Psychopathy; N, Narcissism; ER, Emotion Reactivity; F-S, Father and Son; M-D, Mother and Daughter; F-M, Father and Mother; S-D, Son and Daughter.

APIM Analysis

The APIM for the effects of Machiavellianism, psychopathy, and narcissism on emotion reactivity were constructed separately, with results shown in Table 4. In the effect of Machiavellianism on emotion reactivity, the actor effect value was 0.467 ($p < 0.001$, 95% CI [1.16, 1.81]) for fathers and 0.358 ($p < 0.001$, 95% CI [0.81, 1.48]) for mothers. When tested if the two actor effects are equal, the difference was found not to be statistically significant ($p = 0.182$, 95% CI [-0.17, 0.86]). The partner effect from mother to father is equal to 0.196 ($p < 0.001$, 95% CI [0.32, 0.95]), and the partner

Table 4 Parameter Estimates for Paths of the APIM

	Effect	Estimate	SE	95% CI	p
Ma	F-Actor	1.472	0.467	[1.156, 1.812]	$p < 0.001$
	F-Partner	0.617	0.196	[0.322, 0.946]	$p < 0.001$
	F-k	0.419		[0.191, 0.758]	
	M-Actor	1.127	0.358	[0.811, 1.481]	$p < 0.001$
	M-Partner	0.706	0.224	[0.424, 1.020]	$p < 0.001$
	M-k	0.627		[0.318, 1.128]	
P	F-Actor	1.339	0.432	[1.043, 1.671]	$p < 0.001$
	F-Partner	0.645	0.208	[0.300, 1.021]	$p < 0.001$
	F-k	0.482		[0.201, 0.894]	
	M-Actor	1.325	0.427	[0.966, 1.718]	$p < 0.001$
	M-Partner	0.483	0.156	[0.173, 0.794]	$p < 0.001$
	M-k	0.365		[0.110, 0.743]	
N	F-Actor	0.549	0.270	[0.370, 0.726]	$p < 0.001$
	F-Partner	0.299	0.147	[0.119, 0.484]	0.001
	F-k	0.545		[0.191, 1.133]	
	M-Actor	0.532	0.262	[0.338, 0.730]	$p < 0.001$
	M-Partner	0.288	0.142	[0.112, 0.472]	0.002
	M-k	0.541		[0.175, 1.167]	

Note: p, P-value; k, K-value.

Abbreviations: F, Father; M, Mother; Ma, Machiavellianism; P, Psychopathy; N, Narcissism; ER, Emotion Reactivity; SE, Standardized Effect; F-Actor, Father's Actor Effect; F-Partner, Father's Partner Effect; F-k, Father's K-value; M-Actor, Mother's Actor Effect; M-Partner, Mother's Partner Effect; M-k, Mother's K-value.

effect from father to mother is equal to 0.224 ($p < 0.001$, 95% CI [0.42, 1.02]). When tested if the two partner effects are equal, the difference was found not to be statistically significant ($p = 0.711$, 95% CI [-0.56, 0.37]). The study further calculated k values, which showed that the k value for fathers was 0.419 with a 95% CI from 0.19 to 0.76, between 0 and 1. The k value for mothers was 0.627 with 95% CI from 0.32 to 1.13, containing 1, indicating that it is a dyadic pattern. Besides, the two k values showed no significant difference ($p = 0.488$, 95% CI [-0.86, 0.33]). To examine whether APIM has gender differences, distinguishable and indistinguishable models were compared, with the results showing that $\chi^2(6) = 12.361$, $p = 0.054$. Suggesting that the predictive effect of fathers' and mothers' Machiavellianism on emotion reactivity was statistically indistinguishable dyad members by gender.

In the effect of psychopathy on emotion reactivity, the actor effect value was 0.432 ($p < 0.001$, 95% CI [1.04, 1.67]) for fathers and 0.427 ($p < 0.001$, 95% CI [0.97, 1.72]) for mothers. When tested if the two actor effects are equal, the difference was found not to be statistically significant ($p = 0.959$, 95% CI [-0.54, 0.55]). The partner effect from mother to father is equal to 0.427 ($p < 0.001$, 95% CI [0.97, 1.72]), and the partner effect from father to mother is equal to 0.156 ($p < 0.001$, 95% CI [0.17, 0.79]). When tested if the two partner effects are equal, the difference was found not to be statistically significant ($p = 0.552$, 95% CI [-0.36, 0.71]). The study further calculated k values, which showed that the fathers' k value was 0.482, with 95% CI ranging from 0.20 to 0.89, between 0 and 1. The k value for mothers was 0.365 with 95% CI from 0.11 to 0.74, between 0 and 1. Besides, the two k values showed no significant difference ($p = 0.688$, 95% CI [-0.46, 0.69]). To examine whether APIM has gender differences, distinguishable models were compared with indistinguishable models, with the results indicating that $\chi^2(6) = 23.41$, $p < 0.001$. Suggesting that the predictive effect of fathers' and mothers' psychopathy on emotion reactivity was statistically distinguishable dyad members by gender.

In the effect of narcissism on emotion reactivity, the actor effect value was 0.270 ($p < 0.001$, 95% CI [0.37, 0.73]) for fathers and 0.262 ($p < 0.001$, 95% CI [0.34, 0.73]) for mothers. When tested if the two actor effects are equal, the difference was found not to be statistically significant ($p = 0.908$, 95% CI [-0.26, 0.29]). The partner effect from mother to father is equal to 0.147 ($p = 0.001$, 95% CI [0.12, 0.48]), and the partner effect from father to mother is equal to 0.142

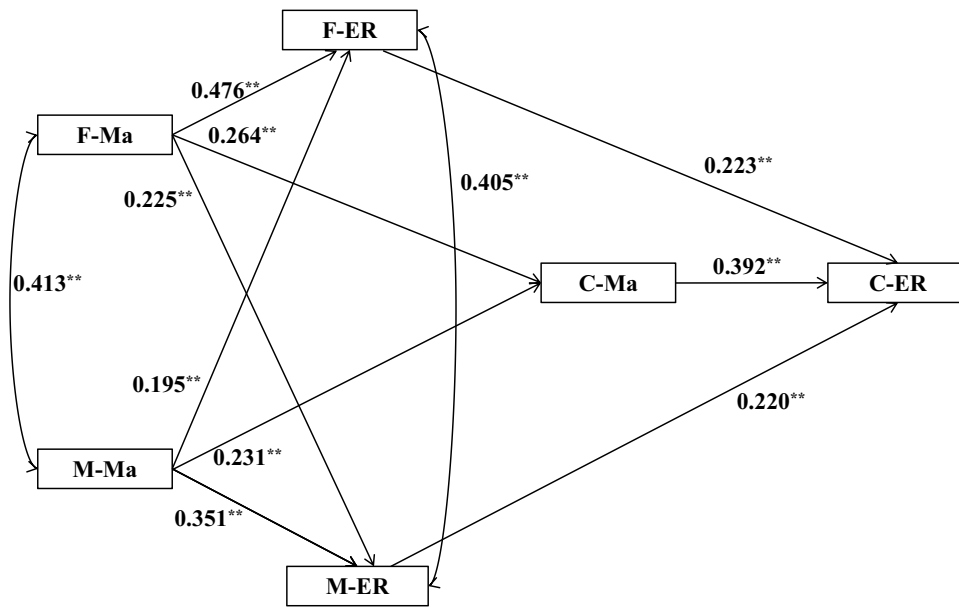


Figure 2 Mediation model for the influence of parental Machiavellianism on children's emotion reactivity.

Note: ** $p < 0.01$. Standardized regression coefficients as shown in the figure.

Abbreviations: F, Father; M, Mother; C, Children; Ma, Machiavellianism; ER, Emotion Reactivity; F-Ma, Father's Machiavellianism; M-Ma, Mother's Machiavellianism; C-Ma, Children's Machiavellianism; F-ER, Father's Emotion Reactivity; M-ER, Mother's Emotion Reactivity; C-ER, Children's Emotion Reactivity.

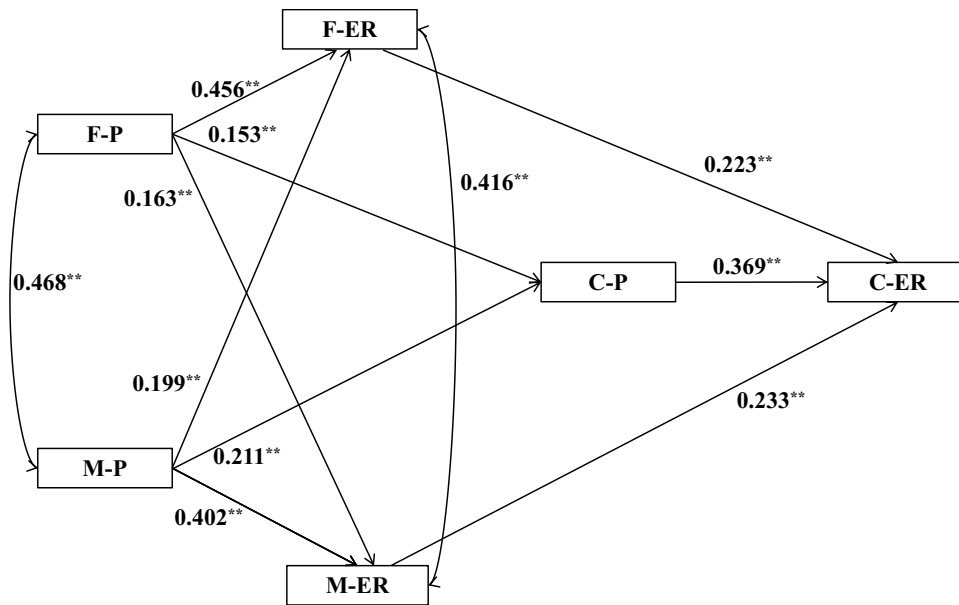


Figure 3 Mediation model for the influence of parental psychopathy on children's emotion reactivity.

Note: ** $p < 0.01$. Standardized regression coefficients as shown in the figure.

Abbreviations: F, Father; M, Mother; C, Children; P, Psychopathy; ER, Emotion Reactivity; F-P, Father's Psychopathy; M-P, Mother's Psychopathy; C-P, Children's Psychopathy; F-ER, Father's Emotion Reactivity; M-ER, Mother's Emotion Reactivity; C-ER, Children's Emotion Reactivity.

($p=0.002$, 95% CI [0.11, 0.47]). When tested if the two partner effects are equal, the difference was found not to be statistically significant ($p=0.935$, 95% CI [-0.26, 0.29]). The study further calculated k values, which revealed that the k value for fathers was 0.545 with 95% CI from 0.19 to 1.13, including 1, indicating a couple pattern. The k value for mothers was 0.541 with 95% CI from 0.18 to 1.17, including 1, suggesting a couple pattern. Besides, the two k values showed no significant difference ($p=0.991$, 95% CI [-0.83, 0.80]). To examine whether APIM has gender differences,

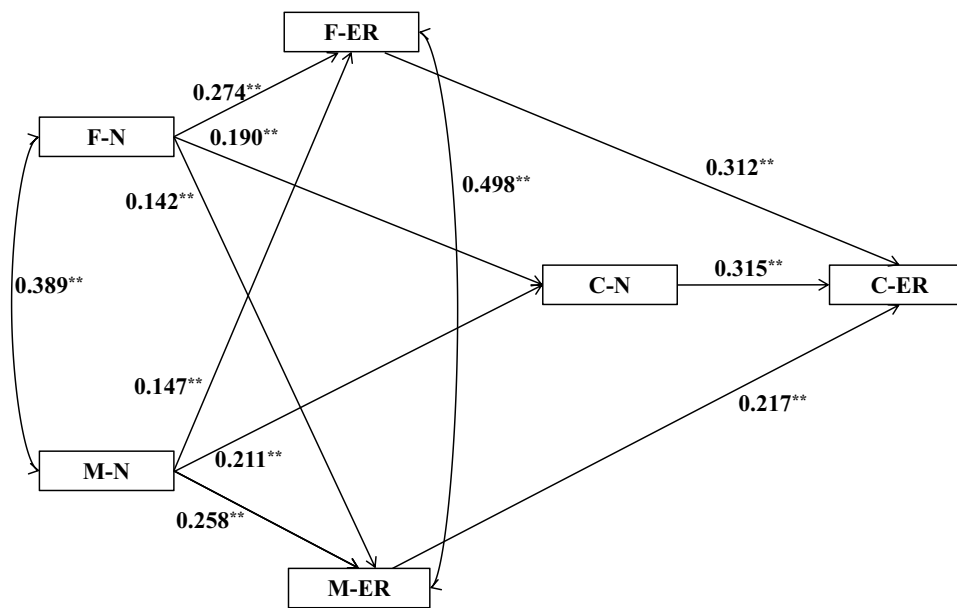


Figure 4 Mediation model for the influence of parental narcissism on children's emotion reactivity.

Notes: ** $p < 0.01$. Standardized regression coefficients as shown in the figure.

Abbreviations: F, Father; M, Mother; C, Children; N, Narcissism; ER, Emotion Reactivity; F-N, Father's Narcissism; M-N, Mother's Narcissism; C-N, Children's Narcissism; F-ER, Father's Emotion Reactivity; M-ER, Mother's Emotion Reactivity; C-ER, Children's Emotion Reactivity.

distinguishable models were compared with indistinguishable models, with the results indicating that $\chi^2(6) = 5.98$, $p = 0.425$. Suggesting that the predictive effect of fathers' and mothers' narcissism on emotion reactivity was statistically indistinguishable dyad members by gender.

Analysis of Mediating Effect

The mediation models of the influence of parental Machiavellianism, psychopathy, and narcissism on children's emotion reactivity were examined separately, each with the path coefficients shown in Figures 2–4. In the mediation model of the influence of parental Machiavellianism on children's emotion reactivity, all path coefficients were significant ($p < 0.01$). The model fit indices were: $\chi^2/df = 2.151$, RMSEA = 0.049, SRMR = 0.027, CFI = 0.995, TLI = 0.980, IFI = 0.995, GFI = 0.994.

In the mediation model of the influence of parental psychopathy on children's emotion reactivity, all path coefficients were significant ($p < 0.01$). The model fit indices were: $\chi^2/df = 3.177$, RMSEA = 0.067, SRMR = 0.029, CFI = 0.992, TLI = 0.961, IFI = 0.992, GFI = 0.994.

In the mediation model of the influence of parental narcissism on children's emotion reactivity, all path coefficients were significant ($p < 0.01$). The model fit indices were: $\chi^2/df = 2.535$, RMSEA = 0.056, SRMR = 0.025, CFI = 0.990, TLI = 0.962, IFI = 0.990, GFI = 0.993.

The mediation model was tested by the Bootstrap method with bias correction, with the results shown in Table 5. The Bootstrap 95% confidence interval for each mediation path was not including 0, which indicated that each mediation path was valid. The value of total indirect effect was 0.470 within the mediation model of parental Machiavellianism influence on children's emotion reactivity, in which the indirect effect value of the influence of fathers on children was 0.259, while that of mothers on children was 0.211. In the mediation model of the effect of parental psychopathy on children's emotion reactivity, the total indirect effect value was 0.412, in which the indirect effect value of the influence of fathers on children was 0.196, while that of mothers on children was 0.216. In the mediation model of the effect of parental narcissism on children's emotion reactivity, the total indirect effect value was 0.344, in which the indirect effect value of the influence of fathers on children was 0.176, while that of mothers on children was 0.168.

Table 5 Bootstrap Analysis of the Significance Test for Mediating Effect

	Effect	Boot SE	Boot CI Lower Limit	Boot CI Upper Limit
F-Ma → F-ER → C-ER	0.106	0.093	0.191	0.552
F-Ma → C-Ma → C-ER	0.103	0.081	0.206	0.524
F-Ma → M-ER → C-ER	0.050	0.051	0.083	0.294
M-Ma → F-ER → C-ER	0.043	0.050	0.071	0.274
M-Ma → C-Ma → C-ER	0.091	0.086	0.159	0.503
M-Ma → M-ER → C-ER	0.077	0.072	0.143	0.428
F-P → F-ER → C-ER	0.102	0.086	0.166	0.503
F-P → C-P → C-ER	0.056	0.075	0.048	0.346
F-P → M-ER → C-ER	0.038	0.047	0.044	0.234
M-P → F-ER → C-ER	0.044	0.061	0.060	0.304
M-P → C-P → C-ER	0.078	0.086	0.121	0.459
M-P → M-ER → C-ER	0.094	0.083	0.185	0.518
F-N → F-ER → C-ER	0.085	0.043	0.115	0.283
F-N → C-N → C-ER	0.060	0.036	0.068	0.211
F-N → M-ER → C-ER	0.031	0.026	0.027	0.130
M-N → F-ER → C-ER	0.046	0.037	0.037	0.184
M-N → C-N → C-ER	0.066	0.039	0.077	0.229
M-N → M-ER → C-ER	0.056	0.035	0.068	0.205

Abbreviations: F, Father; M, Mother; C, Children; Ma, Machiavellianism; P, Psychopathy; N, Narcissism; ER, Emotion Reactivity; SE, Standard Errors; F-Ma, Father's Machiavellianism; M-Ma, Mother's Machiavellianism; C-Ma, Children's Machiavellianism; F-P, Father's Psychopathy; M-P, Mother's Psychopathy; C-P, Children's Psychopathy; F-N, Father's Narcissism; M-N, Mother's Narcissism; C-N, Children's Narcissism; F-ER, Father's Emotion Reactivity; M-ER, Mother's Emotion Reactivity; C-ER, Children's Emotion Reactivity.

Discussion

Taking family as the basic unit, a questionnaire survey was administered to both Chinese college students and their parents while adopting the ERS and the DD as the research tools in the current study. Drawing on the intergenerational transmission analysis of Dark Triad and emotion reactivity, the mediating mechanism behind the influence of parental Dark Triad on children's emotion reactivity was revealed in the study in combination with an exploration of APIM. The results of the data analysis, fitting with the hypotheses proposed in this study, have enriched the family system theory, which contributes to a greater understanding of the intergenerational transmission of Dark Triad and emotion reactivity along with their internal mechanism.

It was observed in this study that there was a remarkable intergenerational transmission effect of Dark Triad and emotion reactivity. What the study on Western people revealed was that intergenerational transmission existed between personality traits⁶⁷ and emotion reactivity.⁶⁸ Likewise, consistent findings were also reached in the study targeting Chinese people, both suggesting that there is cross-cultural consistency in the intergenerational transmission of personality traits and emotion reactivity. A relatively stronger sense of family is owned by China, in which parental and offspring generations share close connection, comparing to the western culture. Parents perceive themselves as responsible for the care, education, and guidance of their children, even after their children have reached adulthood. Previous studies of Western people have focused more on parental influence on children in childhood or adolescence. The present study examined the influence of parental personality traits and emotion reactivity on adult children, taking college students as participants, which equally evidenced the existence of intergenerational transmission effects.

Intergenerational differences between parents and their offspring were further examined on the basis of intergenerational transmission analysis, demonstrating that the scores of emotion reactivity and Dark Triad were both significantly greater in the offspring than in the parents, except for the non-significant difference in psychopathy scores of "mother-daughter". Although the emotion reactivity of individuals possesses relative stability, certain volatility is represented throughout their whole life course. Further, in general, emotion reactivity is stronger among individuals progressing through the stages of puberty and adolescence.⁶⁹ Similar conclusions have been uncovered in studies on Dark Triad, that

is, age is negatively correlated with levels of Dark Triad.⁴³ Individuals in early adulthood typically exhibit higher levels of Dark Triad traits than those in middle and older ages.⁷⁰ As individuals age, their levels of the three Dark Triad traits decrease to varying degrees,⁷¹ which is consistent with the principle of individuals gradually maturing and stabilizing.

It is identified in the gender difference analysis that higher male psychopathy than female is exhibited in both parents and offspring, which is in line with the outcome of previous studies.^{72,73} Typically, high-impulsivity, low-empathy, and low-responsibility characteristics are presented in males, which is consistent with psychopathy.⁷⁴ There were no significant gender differences in the dimension of narcissism between parental and offspring generations, which is in accordance with the previous observation that “gender differences in narcissism are close to zero”.⁷⁵ Personality traits such as egocentricity and superiority may be present in both sexes.⁷⁶ Interestingly, in Machiavellianism, which can be affected by external environmental factors, there are no gender differences found in the parents, while only in the offspring it is concluded that scores are dramatically higher in males than in females.⁷⁷ Unlike the offspring, however, the couple living in the same family environment creates a strong bond with more shared experiences, consequently exhibiting comparable characteristics in terms of Machiavellianism.⁷⁸ In addition, individuals are more likely to choose couples of the opposite-sex who have similar personality traits to themselves to raise children much similar to themselves to a greater extent.⁷⁹ The significantly higher Machiavellianism scores of males than females in the offspring may be attributed to the fact that males differ distinctively from females concerning gender socialization. In accordance with the psychoanalytic theory of gender socialization, the gender division of labor involved in the individual socialization process is closely associated with the level of Machiavellianism.⁸⁰ Besides, males are in a dominant position with respect to income and social authority, which is prone to developing higher levels of Machiavellianism under the long-term effects of identity recognition.⁸¹

Furthermore, no significant gender differences in emotion reactivity were found for either the parental generation or the offspring, which is inconsistent with the research hypothesis. Most studies have concluded that the emotion reactivity of women is higher than that of men.^{46,47} Nevertheless, some studies have also inconsistently determined that individuals of different genders do not differ substantially in their emotion reactivity.⁵ It is believed in Chinese collectivist culture that excessive emotional expression can damage interpersonal relationships and that individuals need to learn to hide, control, and regulate their emotions to better maintain interpersonal harmony.⁸² Emotion suppression is a preferable approach to emotional expression. Both men and women need to learn to regulate their emotion reactivity in adulthood, keeping it within appropriate limits and not violating etiquette norms. This may be one of the reasons why gender differences in emotion reactivity are not significant.

As an innovation of this study, APIM was first adopted to examine the implications of fathers’ and mothers’ Dark Triad on their own and spouses’ emotion reactivity, providing an effective extension of family system theory and spousal interrelations theory.^{29,83} The findings revealed that Dark Triad and emotion reactivity were consistent within parents and that parental Dark Triad influenced not only their own but also their spouse’s emotion reactivity, validating research hypothesis 4 and research hypothesis 5. It demonstrated the non-independence of the data obtained between fathers and mothers on Dark Triad and emotion reactivity. The study used dyadic data processing, which effectively avoided the common bias of single data processing and improved the interpretation of the results of the relationship between Dark Triad and emotion reactivity between parents. Notably, although both the actor and partner effects for Dark Triad and emotion reactivity between parents were found to be valid, the partner effect was about half of the actor effect, which illustrated that the interaction between couples is partial rather than complete. It was previously shown that couples were interconnected and influenced by each other with respect to cognition, emotion, and behavior.⁸³ It was further extended in the present study by exploring the relationship between Dark Triad and emotion reactivity. Its findings are of certain value for marriage and family therapy. Personality factors warrant attention in the treatment of emotional problems. In addition, potential rewards may be derived from joint interventions on both the couple.⁸⁴

As indicated in the results of the mediation model test, all mediation path coefficients for parental Dark Triad on children’s emotion reactivity reach a considerable level. That is, the mediating effects of parents’ emotion reactivity and children’s Dark Triad are both valid throughout the influence of parents’ Dark Triad on children’s emotion reactivity. Over the course of previous research, it has been found that parental Dark Triad is associated with children’s negative outcomes, such as low well-being,⁸⁵ and high aggression.⁸⁶ It is unclear, however, what the internal mechanisms are for

the effects of parental Dark Triad on children. It is demonstrated that, on the one hand, one's own and their spouse's emotion reactivity is able to be influenced by parental Dark Triad, which in turn affects the emotion reactivity of their children via intergenerational transmission. On the other hand, the Dark Triad of children is influenced by the Dark Triad of their parents through intergenerational transmission, which further affects their emotion reactivity. The findings enrich the mechanism research on the influence of parental Dark Triad on children's emotion reactivity, allowing empirical evidence to be provided for related studies.

The current study has several limitations. Firstly, resorting to a cross-sectional survey prevents investigating the dynamic relationship between variables. Meanwhile, taking a self-report approach is vulnerable to recall bias with no way to avoid the social desirability effects. Secondly, there is the problem of insufficient representativeness of participants in the study. Only college students and their parents in Jilin Province were selected as the participants of the study with no inclusion of youngsters from different provinces as well as age groups. On top of that, further validation would be required for the general applicability of the study results. Thus, a larger sampling range is necessary in future studies to enhance the representativeness of participants. Thirdly, as there is a strong sense of family in China, closer ties are established between couples as well as between parents and children, which differs greatly from Western culture. As such, it remains to further test whether there are cross-cultural differences in the APIM and intergenerational transmission between Dark Triad and emotion reactivity. Finally, by taking a web-based survey, it is impossible to control the influence of the surrounding environment when parents respond, potentially affecting the accuracy of the study results.

Conclusion

A mediation model was proposed in this study grounded in family system theory combined with an analysis of APIM and intergenerational transmission effects, to examine the influence of parental Dark Triad on children's emotion reactivity. The findings indicate that there is an intergenerational transmission effect for both Dark Triad and emotion reactivity. Parental Dark Triad and emotion reactivity positively predict those of their children. In the intergenerational transmission analysis, Dark Triad scores are dramatically higher in men than in women, with no significant difference in emotion reactivity scores between both sexes. Both the actor and the partner effects of Dark Triad and emotion reactivity between parents established with fathers' and mothers' Dark Triad affecting both their own and their spouses' emotion reactivity. Further results of the mediating effect test reveal that parental emotion reactivity and children's Dark Triad play a mediating role in the effect of parental Dark Triad on children's emotion reactivity. The findings of this study carry some reference value for cultivating moderate emotion reactivity and contributing to addressing the problem of high levels of Dark Triad and emotion reactivity in college students. At the same time, it is inspired for parents to pay attention to their children's personality and emotion reactivity, adopt a reasonable parenting style and enhance communication and exchange with their children, so as to ensure the sound development of their children's personality and emotion reactivity.

Ethical Statement

This study was approved by the Ethics Committee of the Affiliated Hospital of Changchun University of Chinese Medicine (approval number: 2019YFC1709901). The study complies with the Helsinki Declaration.

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Disclosure

The authors report no conflicts of interest in this work.

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