Humanities & Social Sciences Communications

ARTICLE

https://doi.org/10.1057/s41599-024-03202-2 OPEN

Family communication patterns, self-efficacy, and adolescent online prosocial behavior: a moderated mediation model

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As technology has been developing by leaps and bounds, concerns regarding adolescent online behavioral patterns have garnered significant attention. Nevertheless, current research exhibits limitations in both perspective and depth. Consequently, this study introduces a moderated mediation model to investigate whether the mediating effect of self-efficacy and the moderating effect of emotional regulation strategies are valid in the relationship between family communication patterns and adolescent online prosocial behavior. A questionnaire survey encompassing 1183 adolescents across 12 schools in three cities of mainland China was conducted. The findings reveal that conversation orientation contributes to the augmentation of adolescents' self-efficacy and online prosocial behavior, whereas conformity orientation follows a reversed trend. Furthermore, self-efficacy serves as a mediator in the relationship between conversation orientation and conformity orientation, influencing adolescent online prosocial behavior in both positive and negative manners. Additionally, this study underscores the significance of emotion regulation strategies; cognitive reappraisal not only reinforces the positive effects of conversation orientation, but also mitigates the adverse effects of conformity orientation, while expressive suppression demonstrates the inverse effect. This research yields a comprehensive and insightful understanding of adolescent online prosocial behavior, furnishing a valuable theoretical foundation for future research and practice in family education.

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Introduction

The evolution of the internet has ushered in profound changes in the society people live in. As Negroponte (2015) succinctly put it, "Human learning, working, and entertainment methods, in short, human existence, have all become digitized." The advent of the internet has introduced novel behavioral and communicative paradigms (Gosling and Mason, 2015). According to the 52nd China Internet Development Status Report, as of June 2023, 13.9% internet users in China are aged 10–19, which accounted for approximately 150 million (China Internet Network Information Center, 2023). It is evident that adolescents are highly active in online social behaviors, like online information dissemination and collective behaviors. Current research has primarily focused on negative online behaviors among adolescents, such as cyberbullying, online sexual harassment, and cyber violence (Festl and Quandt, 2016; Taylor et al., 2019; Soriano-Ayala et al., 2022). However, research on positive online behavioral of adolescents also emerged, where they engage in knowledge sharing, mutual assistance (Zulkifli et al., 2020), and emotional support (Saling et al., 2019).

In contrast to offline prosocial behaviors, online prosocial behaviors disseminate faster, utilize a more diverse array of communication channels, and cater to a broader audience. Online prosocial behaviors foster a conducive online environment: countering the adverse effects of cyberattacks and rumor dissemination, while promoting the well-being of others, thus it facilitates a positive social development (Fan et al., 2020). Some research indicates that adolescent online prosocial behavior is not expected to receive spiritual or material rewards from external sources. However, this does not rule out the intrinsic rewards such as the sense of pleasure, satisfaction, and the achievement of self-worth that individuals may experience from doing good deeds (Zheng, 2013). These behaviors not only foster positive psychological traits in adolescents (Zheng et al., 2018) but also bolster their subjective well-being and sense of purpose (Post, 2005). Thus, adolescent online prosocial behaviors benefit individuals, communities, and the society at large, contributing to social harmony and development (Lemmens et al., 2009). Consequently, this study aims to delve into the multifaceted factors influencing adolescent online prosocial behaviors and elucidate the underlying mechanisms, thereby fostering a comprehensive understanding of this phenomenon.

In the antecedent variables affecting adolescent online prosocial behavior, family environmental factors cannot be overlooked. Family functions as a significant reference group for individuals during the decision-making process (North and Kotz, 2001), and "nowhere is its influence on individual behaviors more profound than in the area of communicative behaviors" (Koerner and Fitzpatrick, 2002b). Family dynamics imbue individuals with shared worldviews, values, and belief systems (Fitzpatrick and Ritchie, 1994; Reiss, 1981), which ultimately shape their perceptions, psychological states, and behaviors (Schrodt et al., 2008). Research indicates that parent-child communication significantly influences prosocial behavior. Deficient family communication patterns correlate with heightened problem behaviors among adolescents (Wang et al., 2004). Conversely, high-quality parent-child interactions not only fortify familial bonds but also instill a sense of life purpose, foster interpersonal relationships, and enhance social adaptability, thereby elevating individual prosocial levels (Jafary et al., 2011). Hence, family communication patterns serve as a promising avenue for investigating adolescent online prosocial behaviors.

Previous studies have highlighted environmental and individual factors as the primary influences of prosocial behavior. Family, as one of the primary socialization environments during adolescent development, particularly exerts significant influence on adolescent self-efficacy through the transmission of values and social norms by parents (Ajayi and Olamijuwon, 2019). Social cognitive theory underscores the critical role of self-efficacy in individuals' self-assessment of their capabilities (Caprara and Steca, 2005). Therefore, in exploring the relationship between family communication patterns and adolescent online behavior, introducing self-efficacy can deepen our understanding of the mechanisms through which individual factors operate in this process. However, very few research examined the impact of both family communication patterns and self-efficacy on adolescent online prosocial behavior. Thus, this study seeks to explore the relationship between various family communication patterns and self-efficacy, along with their interactive effects, to elucidate how the family environment shapes adolescents' perceptions of their abilities and consequently influences their online prosocial behavior.

Simultaneously, emotion, regarded as a core driving force in individual development (Campos et al., 1989), plays a pivotal role in influencing the adaptation to society and psychological well-being. Effective emotion regulation is imperative for maintaining individuals' social functioning and fostering interpersonal relationships (Gross and John, 2003). Emotion regulation strategies, an internal factor of individuals, have garnered attention in the study of family environmental factors and prosocial behavior (Song et al., 2013). Denham (1998) pointed out that the interaction between caregivers and children is a fundamental factor influencing children's emotional regulation, which is the root cause of individual differences in emotional regulation among young children. Parenting styles, such as communication patterns, significantly impact children's emotion regulation development (LaFreniere, 2000). Additionally, research has also found correlations between emotion regulation and prosocial behavior (Kwon and López-Pérez, 2021), as well as self-efficacy (Liu et al., 2011). Hence, this study aims to explore the role of emotion regulation strategies in the relationship between family communication patterns and adolescent online prosocial behavior.

In conclusion, to comprehensively investigate the mechanisms underlying the influence of family environmental factors and individual factors on adolescent online prosocial behavior, this study endeavors to construct a moderated mediation model. It examines the influence paths of family communication patterns, self-efficacy, and emotion regulation strategies on adolescent online prosocial behavior, as well as the interactions among these factors. Compared to previous studies, the innovation of this paper mainly manifests in three aspects: First, it explicitly discusses the impact mechanism of different types of family communication patterns on self-efficacy and adolescent online prosocial behavior; Second, it investigates the influence of self-efficacy on adolescent online prosocial behavior from a holistic perspective; Third, it introduces emotion regulation strategies for examination and verifies their mechanism of action in adolescent online prosocial behavior.

Literature review and research hypothesis

Definition of online prosocial behavior. Online Prosocial Behavior (OB) is a burgeoning phenomenon associated with the evolution of the Internet, particularly the widespread adoption of mobile devices such as smartphones and computers. Despite its increasing prevalence, the concept remains intricate with multiple interpretations. Scholars often delineate online prosocial behavior by drawing upon the unique characteristics of the Internet. For instance, Zeng et al., (2022) propose that, compared to offline environments, cyberspace affords users additional time and space to care for others. Similarly, Zheng et al., (2018) contend that the

anonymity provided by the Internet can alleviate users' social pressure, fostering a greater willingness to assist others. However, these perspectives emphasize the medium carrying online prosocial behavior and relatively overlook exploring the relevant elements and behavioral characteristics of online prosocial behavior itself.

To gain a profound understanding of OB, it is imperative to scrutinize the definition of prosocial behavior and subsequently delineate how OB diverges from it. In the 1980s, Eisenberg and Miller (1987) defined prosocial behavior as a voluntary action intended to benefit others, based on the outcome of the behavior. More recently, Pfattheicher et al. (2022) approach prosocial behavior from a motivational standpoint, characterizing it as actions intended to benefit others rather than oneself. In summary, this study defines OB as voluntary conduct in the online realm aimed at benefiting others, encompassing activities like offering comfort, sharing willingly, providing guidance, and so forth. In contrast to traditional prosocial behavior, OB not only retains the fundamental connotations of prosocial behavior but also extends its boundaries, presenting a more convenient alternative to offline prosocial behavior. Noteworthy instances during the COVID-19 pandemic spotlighted how adolescents globally shared experiences and offered emotional support through online platforms (Pavarini et al., 2020). Such positive initiatives by peers can contribute to positive emotions like adolescents' social tolerance and self-confidence (Repper and Carter, 2011), suggesting that OB holds the potential to assist adolescents in navigating challenges encountered in their personal growth. However, the current body of research on adolescent online prosocial behavior remains limited, with most studies concentrating on online prosocial behavior in adult samples (Hong et al., 2023). Consequently, this paper deems it imperative to specifically explore the driving factors and behavioral mechanisms underlying adolescent online prosocial behavior.

Self-efficacy and adolescent online prosocial behavior. Prosocial behaviors are influenced by individuals' assessment of their own abilities, such as self-efficacy (Zhan et al., 2023). "Self-efficacy," (SE) originating from Bandura's social cognitive theory, is a multidisciplinary phenomenon lacking a consistent definition (Drnovšek et al., 2010). For example, Bandura (1977) defines SE as "an individual's belief in one's capability to organize and execute the courses of action required to produce given attainments." Bieschke (2006) suggests that SE is the ability to assess one's capability in implementing specific behaviors to achieve expected outcomes. Thus, all psychological processes and behavioral functions are determined by individual mastery of conscious alterations (Maddux, 2013).

Social cognitive theory posits that individual behavior is influenced by both personal cognition and environmental factors, with the family being a significant environmental factor affecting individual behavior, and self-efficacy being a crucial cognitive force (Bandura, 2004). Personal cognition may impact preferences for knowledge acquisition, information processing, and decision-making. When individuals process information, they become aware of their ability to engage in action (self-efficacy) and the likelihood of engaging in action (intentions) (Barbosa et al., 2007). According to these views, individuals can control their thoughts, feelings, and actions, with this control heavily influenced by their SE. SE provides insight into the sources of efficacy judgments that subsequently influence behavior and goal attainment (Boyd and Vozikis, 1994). This close relationship between SE and behavior has been supported by abundant empirical evidence across various fields, such as start-up readiness (Adeniyi, 2023), and environmental conservation behavior (Merling et al., 2018).

From an agentic perspective, SE serves as a motivational factor for individuals' prosocial behaviors (Li et al., 2022). Individuals with high SE are more self-aware, comparing their existing knowledge and experiences with the current situation, and believing they have sufficient capability to address issues positively, thus being more inclined towards engaging in prosocial behaviors (Gong et al., 2021). Deng et al. (2018) conducted a survey among 768 first to third-grade middle school students in Shandong and Chongqing provinces, indicating that SE was the most predictive factor influencing prosocial behavior. Patrick et al. (2018) found that SE could predict certain types of prosocial behaviors, such as public behaviors, which may provide confidence for adolescents to engage in prosocial behaviors. In the realm of digital media technologies, researchers have discovered that bolstering self-efficacy facilitates individuals' engagement in online prosocial behavior (Leng et al., 2020).

Building upon these insights, this paper posits that SE significantly forecasts adolescent OB; specifically, adolescents exhibiting elevated levels of SE are more inclined to actively participate in OB. Consequently, this paper advances the following research hypothesis:

H1 The higher the level of self-efficacy is, the higher level of online prosocial behavior adolescents will exhibit.

Family communication patterns, self-efficacy, and adolescent online prosocial behavior. Since its inception in the 1970s by American scholars McLeod and Chaffe (1972, as cited in Ritchie and Fitzpatrick, 1990), the Family Communication Patterns Theory (FCP) has been extensively utilized by researchers to delve into the dynamics of family communication, with ongoing refinements and evolution to its foundational theory. In the 1990s, Fitzpatrick and Ritchie (1994) classified FCP into two dimensions: Conversation Orientation (CV) and Conformity Orientation (CF). Within families emphasizing CV, there exists a heightened level of interaction and discussion on diverse subjects, fostering an environment where children can openly articulate their thoughts. Members engage in communication without constraints, and parents exercise minimal influence over their children's conduct and perspectives. Conversely, in families leaning towards CF, internal communication is limited, and children are expected to adhere strictly to parental expectations to avert discord within the family. Emphasis is placed on uniformity among family members, particularly regarding values and beliefs (Fitzpatrick and Ritchie, 1994). FCP posits that the predisposition of family communication patterns has the potential to shape the cognition and behavior of adolescents.

Current research findings suggest a negative correlation between CF and adolescent SE (Fu et al., 2022). Scholars elucidate the adverse impact of CF on SE, attributing it to its influence on adolescent psychological well-being. Studies reveal that adolescents in families with high CF are more prone to depression, hindering the development of positive beliefs and manifesting symptoms like heightened loneliness, self-deprecation, and diminished self-esteem (Zhou et al., 2022). Notably, not all family communication patterns impede adolescent SE. CV, for instance, is positively associated with adolescent SE (Matteson, 2020). Dorrance Hall et al. (2016) examination of FCP and their impact on students' SE, stress, and loneliness in the United States and Belgium reveals that CV positively influences SE among American students. In Belgium, significant correlations between CV and student SE were identified through the quality of social suggestions. Further research underscores that, in contrast to CF, CV provides higher social support, quality advice, and self-

efficacy for family members (Bevan et al., 2019). These enhancements contribute to improved academic and social performance among adolescents. For example, CV positively affects the athletic performance of student-athletes by boosting SE (Erdner and Wright, 2017). Adolescents raised in CV families demonstrate greater financial knowledge and enhanced financial self-efficacy (Hanson and Olson, 2018).

Building upon these theoretical foundations and empirical findings, this paper posits that family communication patterns influence adolescent self-efficacy. Accordingly, the following hypotheses are proposed:

H2a The more emphasis are placed on conversational orientation in families, the higher levels of self-efficacy adolescents will exhibit.

H2b The more emphasis are placed on conformity orientation in families, the lower levels of self-efficacy adolescents will exhibit.

In the process of adolescent growth, the family shoulders significant responsibilities in nurturing and guiding individuals. Previous research indicates that families favoring CV contribute to adolescents developing positive personality traits and projecting a more amicable demeanor in social interactions. For instance, a study conducted in the United States revealed that children raised in CV families displayed more prosocial behaviors compared to those from CF families (Wilson et al., 2014). Some scholars believe that FCP can affect adolescents' prosocial behaviors because when a family tends toward high-quality communication, it can effectively enhance the affinity and resilience levels of family members (Afifi et al., 2020). Further analysis by researchers suggests that CV not only impacts face-to-face interactions among parents and children but also significantly enhances children's interpersonal skills and the socialization process in technology-mediated online communication (Wang et al., 2018). Conversely, an increase in CF diminishes the quality of communication within the family, fostering disagreement and intensifying the marginalization of adolescents (EHall et al., 2022). This is detrimental to the development of adolescents' personal competencies, particularly in problem-solving, social cognition, and prosocial behavior. Building on prior research, this paper posits that adolescents raised in families favoring CV are more likely to exhibit pronounced personal characteristics, such as friendliness and solidarity, potentially leading to higher levels of online prosocial behavior. Conversely, adolescents from families emphasizing CF may demonstrate lower levels of online prosocial behavior. Consequently, the following hypotheses are proposed:

H3a The more emphasis are placed on conversational orientation in families, the higher levels of online social behavior adolescents will exhibit.

H3b The more emphasis are placed on conformity orientation in families, the lower levels of online social behavior adolescents will exhibit.

In addition to direct influences, FCP can also indirectly affect adolescents' OB through their SE. Social cognitive theory suggests that individual cognition, environment, and behavior are interconnected, mutually influencing one another (de la Fuente et al., 2023). On one hand, the family serves as a crucial environment for adolescent development, constituting a significant microsystem that influences their growth. As a fundamental aspect of the family system, interpersonal communication among family members serves as a primary socialization medium, imparting basic interpersonal skills and norms to adolescents by fostering a shared sense of reality (Koerner and Fitzpatrick, 2002; Ritchie and Fitzpatrick, 1990), thereby significantly influencing individual self-efficacy. On the other hand, individual behavioral choices are shaped by individual cognition, and changes in cognition lead to different behavioral decisions. Furthermore, attentional focus theory suggests that the situational context can alter individuals' moods, consequently affecting their behavioral outcomes (Chen and Yang, 2020). Therefore, self-efficacy, resulting from individuals' assessment and evaluation of their capabilities, is likely a proximal factor in determining individuals' choices of online prosocial behaviors, while other environmental factors (such as FCP) may act as distal factors, influencing adolescents' online prosocial behaviors through the mediating role of proximal factors. Specifically, adolescents nurtured in families favoring CV are likely to exhibit elevated SE levels, fostering a greater willingness to engage in OB. Conversely, adolescents from families with a preference for CF may experience lower levels of SE, potentially resulting in diminished participation in OB. Previous studies have also found that children raised in high CF families often manifest lower SE, leading to challenges in social integration. In contrast, those from CV families demonstrate heightened SE, and equip them with more flexible social coping skills, making it easier for them to live more actively and inspiring them to display increased prosocial behaviors both online and offline (Dorrance Hall et al. (2020); Segrin et al., 2022). Building on this premise, the paper proposes the following research hypotheses:

H4a Self-efficacy plays a positive mediating role between conversation orientation and adolescents' online prosocial behavior.

H4b Self-efficacy plays a negative mediating role between conformity orientation and adolescents' online prosocial behavior.

The moderating effect of emotion regulation strategies. Emotion regulation involves the process of individuals influencing which emotions they experience, when they experience them, and how they express these emotions (Gross, 1998). Within this process, individuals initially assess the generation, alteration, or response state of their emotions and subsequently employ diverse emotion regulation strategies to achieve specific objectives. Emotion regulation (ER) strategies primarily fall into two categories: Cognitive Reappraisal (CR) and Expressive Suppression (ES) (Gross and John, 2003). CR is a cognitive change strategy, involving individuals altering their interpretation of events or situations. This may entail viewing negative events from a more positive cognitive perspective or rationalizing the evaluation of events to regulate their emotions. For example, if a netizen doesn't promptly respond to an urgent request for assistance, an individual might interpret this delay as the netizen being busy, thereby reducing feelings of disappointment or sadness. On the other hand, ES involves an individual suppressing or concealing emotional expression that is occurring or imminent. For instance, if someone feels anger toward another person, those employing the ES may avoid interacting with that person to conceal their true feelings.

Prior studies have demonstrated that emotions play a moderating role in the correlation between individual cognition and behavior (Cristofaro, 2020). Consequently, we posit that diverse emotion regulation strategies may yield distinct effects on the association between family communication patterns and adolescents' online prosocial behavior. ES can reduce adolescents' desire to share and express, leading to lower levels of social support, which negatively affects the socialization of adolescents, while CR can reduce negative emotions and enhance the psychological recognition and behavioral presentation of positive emotions, thereby having a positive effect on individuals' interpersonal communication (Hein et al., 2016; Laghi et al., 2018). These research findings suggest, to some extent, that CR is more likely than ES to contribute to the manifestation of prosocial behavior in adolescents.

This paper endeavors to investigate the moderating role of ER strategies in the correlation between FCP and adolescents' OB. Specifically, when adolescents from CV families face emotionally challenging events, employing the CR strategy enables them to perceive the causes and outcomes of stressful events with more positive emotions (Robazza et al., 2023), thereby stimulating their online prosocial behavior. Similarly, the CR strategy may buffer the negative impact of conformity orientation on adolescents' online prosocial behavior. In other words, CR empower adolescents to make positive cognitive evaluations of stressful events, thereby reducing the occurrence of antisocial behavior. Furthermore, adolescents raised in high CF environments, where their emotional expressions and opinions are undervalued by parents, may further diminish their OB when employing the ES. Similarly, adolescents from CV families using the ES during stressful events might compromise their ability to express themselves actively and empathize (Li et al., 2020), resulting in passive behaviors like silence or avoidance.

In summary, this paper posits that emotion regulation strategies play a moderating role in the relationship between family communication patterns and adolescents' online prosocial behavior. Building upon this premise, the paper proposes the following research hypotheses:

H5a Cognitive reappraisal enhances the positive effect of conversation orientation on adolescents' online prosocial behavior.

H5b Cognitive reappraisal weakens the negative effect of conformity orientation on adolescents' online prosocial behavior.

H5c Expressive suppression weakens the positive effect of conversation orientation on adolescents' online prosocial behavior.

H5d Expressive suppression enhances the negative effect of conformity orientation on adolescents' online prosocial behavior.

This paper also focuses on the moderating role of ER strategies in the relationship between FCP and adolescents' SE. Adolescents raised in families where there is stronger parental control and emotional neglect may find the use of ES detrimental to establishing open and free communication relationships. This leads to an increased tendency towards depression and aggression in them, which in turn lowers their SE (Hong et al., 2018). In other words, they do not believe in their ability to handle negative emotions well when faced with stress (Di Giunta et al., 2022). Conversely, the positive association between CR and adolescents' SE (Zyberaj, 2022) enhances individuals' positive emotions and augments their adaptability to diverse environments. This can strengthen the cognitive levels of adolescents from families with a preference for CV, enabling them to interact more amicably with the others and the whole society, and thus reduce the occurrence of conflict events (Curran and Allen, 2016). Building upon this premise, the paper posits the following hypothesis:

H6a Cognitive Reappraisal enhances the positive effect of Conversation Orientation on adolescents' self-efficacy.

H6b Cognitive Reappraisal weakens the negative impact of Conformity Orientation on adolescents' self-efficacy.

H6c Expressive Suppression weakens the positive effect of Conversation Orientation on adolescents' self-efficacy.

H6d Expressive Suppression enhances the negative effect of Conformity Orientation on adolescents' self-efficacy.

Research design

Data sources. The present study employed a questionnaire survey method to collect relevant data and to test the proposed research hypotheses. The sample of adolescent groups was selected through stratified cluster sampling. First, all provinces in China were classified into high, medium, and low levels based on the gross domestic product (GDP) rankings for the year 2022. From each level, one province was randomly selected from the eastern, central, and western regions, with Jiangsu Province, Henan Province, and Shaanxi Province chosen as samples. Then, the capital cities of these provinces, namely Nanjing, Zhengzhou, and Xi'an, were chosen as the study subjects. Secondly, from each city, one school was randomly selected from four categories: ordinary junior high school, key junior high school, ordinary senior high school, and key senior high school. Two classes were then randomly chosen from each school, ensuring a roughly equal number of junior high and high school students. In total, students from 24 classes across 12 schools were sampled. The questionnaires were distributed face-to-face by researchers during self-study classes, collected on the spot, with a total of 1300 questionnaires distributed, and 1183 valid questionnaires were recovered, resulting in a 91% response rate. Among the valid samples, there were 566 females, accounting for 47.8%, and 617 males, accounting for 52.2%, with a relatively balanced male-to-female ratio. Respondents ranged from 12 to 20 years old, with an average age of approximately 15 years old. 40.7% ($n = 482$) of the respondents' parents did not received education beyond high school, 44.2% ($n = 523$) had one parent with education beyond high school, and 15% ($n = 178$) had both parents with education beyond high school.

Variable measurement

Independent variable: family communication patterns. In this study, we referred to the Family Communication Patterns Instrument developed by Fitzpatrick and Ritchie (1994) and selected 17 items for measurement. This instrument includes two dimensions: Conversation Orientation (comprising 9 items, such as "My parents often say that every family member should have a say in decision-making."), ($M = 2.729$, $SD = 0.957$); and Conformity Orientation (comprising 8 items, such as "My parents sometimes get angry when I disagree with them."), ($M = 3.370$, $SD = 0.996$). Respondents answered using a Likert five-point scale (ranging from "strongly disagree" = 1 to "strongly agree" = 5). The scores for each item within the two dimensions were summed and averaged; higher scores indicate that the corresponding family characteristic is more pronounced.

Mediating variable: self-efficacy. In this study, the measurement of self-efficacy was based on the scale from the research by Kleppang et al. (2023), which contains 5 items such as "I am confident that I can handle unexpected situations" and "When faced with difficulties, I can stay calm because I know I can rely on my own abilities to solve them." Respondents answered using a Likert four-point scale (ranging from "strongly disagree" = 1 to "strongly agree" = 4). We calculated the average of the sum of scores for these 5 items, with higher scores indicating a higher level of self-efficacy among adolescents ($M = 2.510$, $SD = 0.718$).

Moderating variable: emotional regulation strategies. In this study, the Emotional Regulation Strategies Scale developed by Gross and John (2003) was employed. The scale consists of 10 items and includes two dimensions: Cognitive Reappraisal (which includes 6 items, such as "When facing stressful situations, I am capable of thinking about it in a calm way."), ($M = 2.459$, $SD = 0.800$); and Expressive Suppression (which includes 4 items, such as "I control my emotions by not expressing them."), ($M = 3.430$, $SD = 0.957$). Respondents answered using a Likert five-point scale (ranging from "strongly disagree" = 1 to "strongly agree" = 5). Scores for each item within the two dimensions were added and averaged, with higher scores indicating a greater

tendency of an individual to use a certain emotional regulation strategy.

Dependent variable: adolescents' online prosocial behavior. The scale for measuring adolescents' online prosocial behavior in this study is based on the research by Guo et al. (2018). We selected 13 items (e.g., "I share useful information such as my successful learning experiences and study insights with others online."). Respondents answered using a Likert five-point scale (from "never" = 1 to "always" = 5). We added and averaged the scores of the 13 items for each respondent, with higher scores indicating a stronger level of online prosocial behavior among adolescents (M = 2.381, SD = 0.864).

Data analysis techniques. This study utilized Smart PLS 4 software to execute partial least squares structural equation modeling (PLS-SEM) and to assess all hypotheses. PLS-SEM is a non-parametric technique that leverages the explained variance of latent dimensions not directly observable. This method exhibits greater modeling flexibility, is suitable for small sample sizes, does not necessitate multivariate normal distribution for the research sample data, and can integrate two types of indicators—formative and reflective—without encountering model convergence issues. Therefore, Smart PLS-SEM is apt for predicting linear correlations and analyzing intricate structural models (Irma Becerra-Fernandez, 2001), particularly in directly obtaining R^2 to maximize the explanation of variance in the dependent variable, thus aligning closely with the data, enhancing analytical accuracy, and yielding results with robust explanatory and predictive capabilities (Avkiran and Ringle, 2018). In terms of software utilization, both SPSS 24.0 and Smart PLS 4 software were employed for all statistical analyses. Firstly, descriptive statistical analysis of the research sample was conducted using SPSS 24.0 software, with an examination of common method bias. Secondly, Smart PLS 4 software was utilized to assess the reliability and validity of the research sample, and to scrutinize the main effects, mediation effects, and moderation effects of this study.

Research results

Measurement model. To evaluate the measurement model, we assessed indicator reliability, internal consistency, convergent validity, and discriminant validity (Hair et al., 2020) (refer to Tables 1 and 2). The values of Cronbach's α, rho_A, and composite reliability for all variables in this study surpassed 0.70, indicating robust construct reliability (Hair et al., 2017). Regarding indicator loadings, all reported values in this study exceeded 0.7 for outer loadings. The average variance extracted (AVE) values for all constructs were above 0.50, providing support for convergent validity (Hair et al., 2022). Since the square root of the AVE for each construct in the model exceeded the correlations with other constructs (Fornell and Larcker, 1981), and all Heterotrait-monotrait ratio (HTMT) values were below 0.85, this study exhibited strong discriminant validity (Kline, 2011). Furthermore, this study conducted Harman's single-factor test, which, under unrotated exploratory factor analysis, revealed 6 factors with cumulative explained variance of 36.277%, where the first factor's explained variance did not surpass the 50% threshold. Consequently, this study did not demonstrate significant common method bias.

Structural model. First, we investigated collinearity within the structural model. All internal VIF values were below 5, indicating the model is unaffected by multicollinearity (Hair et al., 2019). Second, we assessed the weights of the path coefficients. As illustrated in Table 3, all beta coefficients are statistically significant

Table 1 Measurement model assessment.

Construct	Item	Loading	α	rho_A	composite reliability	AVE
Online prosocial behavior	OB1	0.785	0.951	0.952	0.957	0.631
	OB2	0.803				
	OB3	0.833				
	OB4	0.770				
	OB5	0.791				
	OB6	0.797				
	OB7	0.817				
	OB8	0.789				
	OB9	0.782				
	OB10	0.768				
	OB11	0.792				
	OB12	0.805				
	OB13	0.793				
Conversation orientation	CV1	0.831	0.947	0.948	0.955	0.704
	CV2	0.879				
	CV3	0.821				
	CV4	0.829				
	CV5	0.834				
	CV6	0.851				
	CV7	0.834				
	CV8	0.830				
	CV9	0.843				
Conformity orientation	CF1	0.823	0.938	0.938	0.948	0.697
	CF2	0.836				
	CF3	0.833				
	CF4	0.821				
	CF5	0.829				
	CF6	0.854				
	CF7	0.842				
	CF8	0.837	0.883	0.883	0.914	0.681
Self-efficacy	SE1	0.828				
	SE2	0.829				
	SE3	0.824				
	SE4	0.809				
	SE5	0.834				
Cognitive reappraisal	CR1	0.745	0.861	0.870	0.896	0.588
	CR2	0.791				
	CR3	0.748				
	CR4	0.788				
	CR5	0.756				
	CR6	0.773				
Expressive suppression	ES1	0.868	0.857	0.866	0.903	0.699
	ES2	0.790				
	ES3	0.859				
	ES4	0.825				

Table 2 Assessment of discriminant validity.

	CV	CF	SE	CR	ES	OB
CV	**0.839**	0.482	0.651	0.057	0.029	0.596
CF	−0.455	**0.835**	0.644	0.104	0.030	0.581
SE	0.596	−0.587	**0.825**	0.194	0.087	0.775
CR	0.050	−0.093	0.173	**0.767**	0.248	0.229
ES	0.014	0.008	−0.079	−0.211	**0.836**	0.153
OB	0.567	−0.549	0.711	0.211	−0.138	**0.795**

Fornell-Larcker criterion (below the main diagonal) and heterotrait-monotrait ratio (HTMT) (above the main diagonal). Main diagonal: in the bold square root of the AVE.

Table 3 Structural relationships and hypothesis testing.

Hypotheses	Path	Std beta	Std error	t Value	P	Decision
H1	SE → OB	0.367	0.028	13.172	0.000	Supported
H2a	CV → SE	0.403	0.023	17.793	0.000	Supported
H2b	CF → SE	−0.366	0.022	16.981	0.000	Supported
H3a	CV → OB	0.235	0.024	10.004	0.000	Supported
H3b	CF → OB	−0.190	0.025	7.574	0.000	Supported
H4a	CV → SE → OB	0.148	0.014	10.293	0.000	Supported
H4b	CF → SE → OB	−0.134	0.013	10.354	0.000	Supported
H5a	CR*CV → OB	0.115	0.021	5.563	0.000	Supported
H5b	CR*CF → OB	0.009	0.022	0.433	0.665	Not supported
H5c	ES*CV → OB	−0.134	0.020	6.577	0.000	Supported
H5d	ES*CF → OB	−0.066	0.021	3.081	0.002	Supported
H6a	CR*CV → SE	0.172	0.022	7.701	0.000	Supported
H6b	CR*CF → SE	0.102	0.022	4.677	0.000	Supported
H6c	ES*CV → SE	−0.225	0.022	10.093	0.000	Supported
H5d	ES*CF → SE	−0.135	0.022	6.175	0.000	Supported

with high corresponding t-statistics. OB is significantly influenced by SE ($\beta = 0.367$, $t = 13.172$, $p < 0.001$), CV ($\beta = 0.235$, $t = 10.004$, $p < 0.001$), and CF ($\beta = -0.190$, $t = 7.574$, $p < 0.001$). SE is significantly influenced by CV ($\beta = 0.403$, $t = 17.793$, $p < 0.001$) and CF ($\beta = -0.366$, $t = 16.982$, $p < 0.001$). Therefore, hypotheses H1, H2a, H2b, H3a, and H3b are supported. Finally, we evaluated the effectiveness of the structural model using the coefficient of determination (R^2), predictive relevance (Q^2), and GoF. The R^2 values for OB and SE were 0.604 and 0.573, respectively, both exceeding 0.26, indicating strong explanatory power. The Q^2 values for OB and SE were 0.377 and 0.386, respectively, both greater than 0, suggesting good predictive relevance. Moreover, the overall goodness-of-fit index (GoF) of the PLS-SEM was calculated to be 0.561, surpassing the standard value of 0.36, indicating good model fit validity.

Mediation effects. We utilized the Bootstrapping technique to evaluate whether SE mediated the relationship between FCP and OB. When testing the mediating effects, it is crucial to initially ascertain the significance of each path coefficient and subsequently examine the variance accounted for (VAF) to determine whether the analysis indicates complete or partial mediation. The VAF index measurement is employed to determine the magnitude of the indirect effect relative to the total effect. ($VAF < 0.2$ indicates no mediation; $0.2 < VAF < 0.8$ denotes partial mediation; $VAF > 0.8$ signifies complete mediation). As depicted in Table 3, CV significantly indirectly influence adolescents' OB through SE ($\beta = 0.148$, $p < 0.001$, $VAF = 0.386$), indicating partial mediation. Similarly, CF significantly indirectly impact adolescents' OB through SE ($\beta = -0.134$, $p < 0.001$, $VAF = 0.350$), also indicating partial mediation. Therefore, research hypotheses H4a and H4b are supported.

Moderation effects. First, CR significantly moderates the relationship between CV and SE ($\beta = 0.172$, $t = 7.701$, $p < 0.001$), as well as OB ($\beta = 0.115$, $t = 5.563$, $p < 0.001$). This suggests that the stronger adolescents' ability in CR, the greater the positive effect of CV on their SE and OB. Second, ES significantly moderates the relationship between CV and SE ($\beta = -0.225$, $t = 10.093$, $p < 0.001$), as well as OB ($\beta = -0.134$, $t = 6.577$, $p < 0.001$). This implies that the stronger adolescents' ability in ES, the smaller the positive effect of CV on their SE and OB. Third, CR significantly moderates the relationship between CF and SE ($\beta = 0.102$, $t = 4.677$, $p < 0.001$). This indicates that the stronger adolescents' ability in CR, the smaller the negative effect of CF on their SE. Fourth, ES significantly moderates the relationship between CF and SE ($\beta = -0.135$, $t = 6.175$, $p < 0.001$), as well as OB ($\beta = -0.066$, $t = 3.081$, $p < 0.001$). This implies that the stronger adolescents' ability in ES, the greater the negative effect of CF on their SE and OB. Additionally, CR does not moderate the relationship between CF and adolescents' OB ($\beta = 0.009$, $t = 10.354$, $p > 0.05$). Therefore, hypotheses H5a, H5c, H5d, H6a, H6b, H6c, and H6d are all supported, while H5b is not supported.

Conclusion and discussion

Main conclusions of the study. Amidst the wave of digital socialization, online prosocial behavior among adolescents is gradually emerging as a pivotal element shaping their social interactions and self-development. This study explores the relationships among family communication patterns, self-efficacy, and emotional regulation strategies, while elucidating, through the analysis of 1183 valid questionnaires, how these factors interconnect to influence adolescents' prosocial behavior in the digital social environment.

This study revealed a significant correlation between FCP and adolescents' OB. These findings align relatively well with prior research (Carlo et al., 2017), emphasizing the pivotal role of the family environment in shaping adolescent social behavior and offering additional empirical support for family education and youth development. Specifically, FCP was subdivided into CV and CF, and the examination of prosocial behavior was extended online. The results indicate that adolescents from families emphasizing CV exhibit a higher frequency of OB compared to those from families with a CF. This implies that the proactive communication atmosphere in CV families offers adolescents more opportunities to express their opinions and feelings, thus cultivating a more open, confident social style, and a willingness to engage in prosocial behavior online. Conversely, in families leaning toward CF, where parents prioritize norms and subordination, adolescent social behavior may be constrained, resulting in lower levels of OB. Future research could delve deeper into guiding FCP to promote the healthy development of adolescents in the digital social environment.

The study has further identified that SE plays a mediating role in the connection between FCP and adolescents' OB. In other words, whether the family emphasizes CV or CF, SE acts as a conduit, transferring the impact of the family environment to adolescents' OB. Specifically, within CV families, where parents foster open communication and demonstrate comfort and assistance to their children, this supportive atmosphere contributes to the development of positive self-beliefs in children, thereby influencing their positive behavior. This aligns with

previous research findings (Hesse et al., 2017), indicating that heightened SE translates into more proactive online prosocial behavior, such as sharing learning experiences and providing support to others. On the contrary, in CF families, where parents emphasize discipline and obedience, adolescents encounter the challenge of diminished SE. Influenced by stringent regulations, these children may question their social interaction abilities and independence (Horstman et al., 2018), thereby impacting their online social initiative. This suggests that a decrease in SE might make them more cautious or hesitant to engage in prosocial behavior. These findings offer insights for intervening in adolescents' OB to better promote its development.

This study incorporates two ER strategies, CR and ES, expanding beyond prior research which predominantly focused on the influence of single-dimensional emotions on prosocial behavior (Davis et al., 2018). As a matter of fact, distinct emotional regulation strategies exhibit varying degrees of impact on individual attention and behavioral responses. First, the study reveals that in families that emphasize CV, CR exerts a positive moderating effect on adolescents' SE and OB. This finding highlight that: with increased use of CR, adolescents from CV families can exhibit stronger SE. The mechanism of CR lies in empowering adolescents to reassess and reflect on their environment, thereby reinforcing their confidence in crisis management and boosting their SE levels. Guided by this ER strategy, a more flexible emotion adjustment ability of adolescents can also facilitate active integration into online social behaviors. Eventually, it will significantly increase their frequency of online prosocial practices. However, in the context of conformity orientation, the positive moderating effect of CR is relatively limited. While it alleviates the negative impact of CF on adolescent SE to some extent, its moderating effect on prosocial behavior is not significant. This may be attributed to CR. Functioning as an active self-perception framework, it emphasizes individual capabilities and autonomy (McRae et al., 2012). Moreover, it also enhances adolescents' confidence in their abilities and mitigates the negative impact of CF on SE. Nevertheless, regarding prosocial behavior, individuals are influenced not only by CR but also by a combination of social motives (Hodge et al., 2022), like age, personality (Silvers et al., 2012), and other factors. Some studies suggest that when CR is combined with other effective interventions, its positive impact may not be significantly pronounced (Clark, 2022). This suggests that any ER strategy may not be universally beneficial or harmful, and subsequent research needs to consider the impact of cultural, environmental, and individual differences to enhance the universality of the findings.

Second, the study investigated the influence of ES on adolescent SE and OB within various family communication patterns. The results revealed that in families emphasizing CF, ES exacerbated the decline in adolescent SE and further restrained their engagement in online prosocial behavior. Specifically, ES reinforced negative emotions in adolescents from CF families, resulting in a diminished sense of self-worth (Tibubos et al., 2018), which subsequently lowers their self-efficacy levels. The utilization of this strategy also hindered adolescents' inclination to express themselves, impeding their participation in OB. Moreover, ES diminished the positive effects of CV on adolescent SE and OB. Under the influence of ES, adolescents became inhibited and less confident, undermining their SE and instilling doubt in their abilities, particularly in terms of independence and problem-solving. This tendency increased the likelihood of avoiding problems or adopting extreme behaviors (McLafferty et al., 2020), negatively impacting their OB. In summary, these research findings underscore the distinct roles of different emotional regulation strategies within the family environment and highlight the divergent impact of CR and ES on adolescent SE and OB. This comprehensive understanding contributes practical insights, especially for the development of family education and youth support strategies.

Research contributions

Theoretical contribution. This study contributes to three theoretical implications. First, while the impact of specific SE on prosocial behavior within particular tasks or situations has been established, our findings elucidate the multifaceted role of SE in a complex environment. By scrutinizing its influence on OB, we gain a nuanced understanding of adolescents' performance across diverse social contexts, transcending specific tasks or situations. This holistic perspective integrates social cognitive theory into adolescent education, enhancing comprehension of self-efficacy's overarching significance in the realm of adolescent internet socialization, thereby providing a more accurate explanation of their conduct in the online social sphere. Second, from an emotion management standpoint, the study explores individual differences in emotion processing by investigating the impact of two emotional regulation strategies, CR and ES, on adolescent OB. This theoretical extension deepens our insights into the role of emotions in family and online social interactions, offering more precise and actionable guidance for adolescents' emotional education. Third, within the context of the internet era, the study investigates the direct effects of various FCP on adolescents' OB. This broadens the research scope of family education and provides practical insights for steering adolescents toward positive OB.

Practical contribution. The practical significance of this study includes several aspects. First, in the adventure of the digital age, parents are the helmsmen guiding adolescents. The research results remind parents of the profound impact family communication patterns have on their children's development and call for their active participation and guidance in children's online behaviors. Parents should provide emotional support to make their children feel loved and respected, which is crucial for establishing a healthy, harmonious family environment and fostering socially skilled adolescents. Second, designers of online platforms can refer to this study to improve their applications. By understanding the impacts of different family communication patterns, self-efficacy, and emotional regulation strategies on adolescents, they can fine-tune platform design to encourage positive prosocial behaviors while developing effective mechanisms to maintain the safety and healthy development of the online community. Third, school education can also incorporate prosocial behavior and emotional education into the curriculum based on the study's findings, including empathy, cooperation, conflict resolution, and emotion management, allowing students to learn these skills through extracurricular activities and role-playing. Additionally, schools can work closely with parents to create a warm and loving atmosphere for students' growth, with both parties committed to cultivating positive and healthy digital citizens.

Research limitations and prospects. This study has three main limitations. First, this study is the predominantly localized nature of the research sample, which overlooks adolescents from regions characterized by lower levels of economic development and education. Consequently, the generalizability of the findings may be compromised. Future research endeavors could broaden the scope of the sample by encompassing a wider range of geographical regions, cultural contexts, and educational backgrounds. Second, although the research used self-reported data,

self-reporting may be subject to subjectivity and bias from social desirability. Future studies could integrate objective data collection methods to enhance the credibility of the results. Third, this study mainly focused on online prosocial behaviors in the short term and did not consider long-term effects. Future research could examine how online prosocial behaviors evolve over time and whether the impact of factors such as family communication patterns diminishes with time.

Data availability

The datasets generated during and/or analyzed during the current study are not publicly available due to ongoing research and analysis, but are available from the corresponding author on reasonable request.

Received: 3 January 2024; Accepted: 14 May 2024;
Published online: 23 May 2024

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Author contributions

Weizhen Zhan, and Zhenwu You: Conceptualization, Methodology, Software; Weizhen Zhan, and Zhenwu You: Data curation, Writing-Original draft preparation; Zhenwu You: Visualization; Weizhen Zhan: Investigation; Weizhen Zhan, and Zhenwu You: Software, Validation; Weizhen Zhan, and Zhenwu You: Reviewing; Weizhen Zhan, and Zhenwu You: Writing and Editing.

Competing interests

The authors declare no competing interests.

Ethical approval

This study followed local ethical guidelines for research involving human participants and complied with the Helsinki Declaration. Ethical approval was obtained from the School of Journalism and Information Communication at Huazhong University of Science and Technology. Importantly, the research did not entail medical procedures or human experimentation. Furthermore, prior to data collection, the researchers informed respondents that all gathered information would be strictly confidential and anonymized for research purposes only, and that their participation was based on informed consent.

Informed consent

Informed consent was obtained from all individual participants included in the study. Respondents' participation was completely consensual, anonymous, and voluntary.

Additional information

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