



# The mediating role of rumination in the relation between self-compassion, posttraumatic stress disorder, and posttraumatic growth among adolescents after the Jiuzhaigou earthquake

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## Abstract

Previous studies indicated that self-compassion can alleviate posttraumatic stress disorder (PTSD) and promote posttraumatic growth (PTG). Rumination is a cognitive process in which individuals repeatedly think about traumatic events and their consequences, which includes invasive rumination (IR) and deliberate rumination (DR). IR is a process of thoughts over traumatic event that invades the cognitive world in an undesired state, whereas DR is an individual's conscious and repeated thinking on events. IR and DR have also been shown to have effects on PTSD and PTG. Studies have examined the relationship between self-compassion, IR, deliberate rumination DR, PTSD, and PTG, respectively, but only a few studies have examined their combined roles in PTSD and PTG among adolescents who have experienced an earthquake. In addition, recent studies have shown that the positive and negative components of self-compassion have different effects on post-traumatic stress responses, but few studies have explored the mechanisms of positive and negative self-compassion on PTSD and PTG in adolescents who experience earthquakes. This study examines the mediating roles of rumination in the relationship between self-compassion, PTSD and PTG among Chinese adolescents after the Jiuzhaigou earthquake. Ten months after the Jiuzhaigou earthquake, a questionnaire survey was conducted among 621 middle school students in Jiuzhaigou county. The participants were assessed by using the following systems: Trauma Exposure Questionnaire, Self-Compassion Scale, Event-Related Rumination Inventory, PTSD Checklist for DSM-5, and Posttraumatic Growth Inventory. When we controlled for the gender, age, and trauma exposure in the direct effect model, positive self-compassion (PSC) had a negative effect on PTSD and a positive effect on PTG. Moreover, negative self-compassion (NSC) had a positive effect on PTSD, but the effect on PTG was nonsignificant. In the indirect model, PSC had an indirect and positive effect on PTSD and PTG via deliberate rumination (DR). NSC had an indirect and positive effect on PTSD and PTG via invasive rumination (IR), whereas NSC also had an indirect and negative effect on PTSD and PTG, as well as via an indirect path from IR to DR on PTSD and PTG. Findings indicated that increased PSC may reduce PTSD and be beneficial for PTG. NSC may exacerbate PTSD. Rumination plays a significant mediating role between self-compassion, PTSD, and PTG.

**Keywords** Posttraumatic stress disorder · Posttraumatic growth · Self-compassion · Rumination · Adolescents

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Earthquakes, as major natural disasters, often have a huge impact on people's psychology, leading to many post-traumatic reactions (Ayub et al., 2015; Wang et al., 2015; Ying et al., 2014). The important thing is that adolescents are at critical stage of physical and mental development, and traumatic events can have a huge effect on their mental health (Good & Willoughby, 2008). Therefore, it is crucial to view the effects of earthquakes on the psychological development of adolescents from a dialectical perspective, and to explore its influencing factors and internal mechanisms.

## Posttraumatic Stress Disorder (PTSD) and Posttraumatic Growth (PTG)

PTSD has been found to be the prevalent type of negative psychological reactions after an earthquake among adolescents (Wu et al., 2015a). PTSD refers to the development of specific negative symptoms after exposure to one or more traumatic events. This symptom clusters presentation may include fear-based re-experiencing, emotional and behavioral changes, dysphoric moods, and negative effects on cognition (American Psychiatric Association, 2013). Previous studies have shown that earthquakes can have long-term effects on teenagers in disaster areas (Jin et al., 2018). Three years after the earthquake in Wenchuan, the rate of PTSD was still 29.6% (An et al., 2013a).

However, positive outcomes, such as posttraumatic growth (PTG), have also been reported. Tedeschi and Calhoun (2004) defined PTG as “a positive psychological change experienced after struggling with a traumatic event or situation”. Previous studies have found that PTG should reflect positive changes in self-awareness, interpersonal experience and the value of life; for example, people reported feeling better connected to the people around them and taking more pleasure in the small things in life (Calhoun & Tedeschi, 1999; Joseph & Linely, 2006). An investigation found that the incidence of PTG among adolescents 1 year after the Wenchuan earthquake was up to 62.76% (Jia et al., 2015). Similarly, the incidence of PTG was 51.1% among adolescents who experienced earthquake (Jin et al., 2014).

Considering that PTSD and PTG are two types of post-traumatic psychological reactions with high incidence in post-traumatic earthquakes, they tend to coexist among adolescents who have experienced traumatic events (Tedeschi & Calhoun, 1996). Therefore, this study combines PTSD and PTG to explore their common influencing factors and underlying mechanisms.

## Self-Compassion Affects PTSD and PTG

A large number of studies have supported the influence of factors such as environment, personality, and cognition on post-traumatic reactions (An et al., 2018; An et al., 2013b; Zhou et al., 2014). But few studies have explored the mechanism of self-attitude on PTSD and PTG. The risk factor model of Freedy, Resnick, and Kilpatrick (1994) emphasized that as a pre-disaster influence factor, self-attitude may be a predisposition factor leading to individual post-traumatic physical and mental responses, which has an important impact on PTSD and PTG. Therefore, in the present study, we focus on one particularly important self-attitude of growing theoretically (Neff & Germer, 2013), namely, self-compassion.

According to Neff (2003a), self-compassion refers to the care and tolerance for oneself. Individuals with a high level of self-compassion will accept their own shortcomings and regard their suffering as the possible experience of all mankind, thus objectively viewing setbacks and pain themselves (Neff, 2003a). Conceptually, Neff (2003b) defined self-compassion in terms of three bipolar components: (a) self-kindness vs. self-judgment, (b) common humanity vs. isolation, and (c) mindfulness vs. over-identification. Self-kindness refers to the ability of treating oneself with care and understanding as opposed to harsh self-judgment. Common humanity refers to the recognition that imperfection is a shared aspect of the human experience, as opposed to feeling isolated and alone by one's failures and imperfections. Mindfulness involves holding and accepting one's present-moment experience as opposed to getting involved with the emotion.

Most researchers regard the six dimensions of self-compassion as a single structural variable. However, some scholars divided self-compassion into positive self-compassion (PSC) and negative self-compassion (NSC). This two-dimensional structure has been verified in studies (Montero-Marín et al., 2016). Some studies have shown that NSC can play an independent role in the physical and mental response of post-traumatic individuals (Montero-Marín et al., 2016). Specifically, PSC is strongly associated with positive psychological outcomes, whereas NSC is strongly associated with negative psychological outcomes (Gilbert et al., 2011; López et al., 2015; Muris & Petrocchi, 2017). Follow-up studies also found a significant positive correlation between PSC and NSC (Liu et al., 2020). This is also in line with the concept that self-compassion and self-criticism can coexist, as suggested by the dual processes of the soothing system (self-compassion) and the threat system (self-criticism) in the neurobiological perspective (Falconer et al., 2016; Gilbert et al., 2011; Longe et al., 2010). In order to explore the relationship between PSC and NSC and their effects on the individual's post-traumatic psychological response, our study also divides self-compassion into two dimensions: PSC and NSC.

Previous theoretical and empirical studies have shown that PSC can alleviate individual PTSD symptoms (Winders et al., 2020; Hiraoka et al., 2015). Individuals with PSC tend to care for and be kind to themselves in suffering, treat the frustration and pain caused by traumatic events with an objective attitude, thus adapting to the impact of trauma quickly and alleviating the symptoms of PTSD (Barnard & Curry, 2011). In the meantime, individuals with higher NSC may be more willing to engage with the memories and associated negative symptomatology related to their trauma without self-judgment. They may feel less threatened by their trauma-related thoughts and feelings and be more willing and resourced to soothe themselves during times of intense distress (Germer & Neff, 2015). This self-attitude can alleviate PTSD symptoms. In addition, self-compassion is also associated with adaptive

coping styles, including confronting problems directly, making reasonably realistic appraisals of problems, recognizing and changing unhealthy emotional reactions, etc. These adaptive coping strategies can prevent survivors from being greatly impacted by traumatic events, and help them actively and effectively cope with the negative effects of traumatic events, thereby reducing PTSD levels (Neff, 2003a; Seligowski et al., 2015; Kross & Ayduk, 2011). Previous studies supported this relationship. In a study on Iraqi soldiers with PTSD symptoms, Hiraoka et al. (2015) found that PSC negatively predicted PTSD. In a recent study of adolescents who had experienced an earthquake, PSC was found to be a significantly negative predictor of PTSD levels (Liu et al., 2020).

From the relationship between NSC and PTSD, the cognitive model of trauma posits that an individual who excessively focuses on trauma clues and potential threats around them will directly form negative emotions. Such focus will aggravate post-traumatic symptoms (Ehlers & Clark, 2000). NSC encourages an individual to focus on the traumatic event, which causes the traumatized individual to continue to be immersed in painful emotions. Negative emotions induced by NSC may further aggravate PTSD symptoms. At the same time, individuals with NSC tend to criticize the frustration and pain they experience during their suffering, and form a negative self-awareness. This is not conducive for the individual to effectively deal with the traumatic experience and may eventually exacerbate the PTSD symptoms (Mayou et al., 2002). In addition, NSC can make individuals feel isolated from the world, which makes people not good at seeking support and help from the outside world. The lack of supportive resources will further aggravate their post-traumatic symptoms (Shevlin et al., 2015). A study of adolescents after the earthquake found that NSC aggravated their PTSD symptoms (Liu et al., 2020).

Self-compassion also plays a role in PTG. The self in relation model indicated that an individual's attitude toward oneself is the key factor to recover from trauma and gain personal growth (Kaplan, 1986). Individuals with PSC are likely to acknowledge suffering as part of the common human experience (Heffernan et al., 2010; Neff, 2003a). This recognition can help people gain insights into publicly expressing their thoughts and feelings, re-examining the meaning of the disaster, and reflecting on the value of life, ultimately facilitating the implementation of PTG (Tedeschi & Calhoun, 2004). Meanwhile, PSC will help people to be more compassionate towards oneself (Neff, 2003a) and to soothe their pain, which can ultimately promote PTG. In addition, the mindfulness trait in PSC enables individuals to calmly and objectively respond to traumatic experiences, which is associated with higher levels of PTG (Hanley et al., 2017). A study of college students who experienced negative events found that PSC significantly and positively predicted PTG (Wong & Yeung, 2017).

From the relationship between NSC and PTG, individuals with NSC tend to regard themselves as the center of pain after

a disaster, resulting in a sense of isolation. This emotion will make individuals lose their basic sense of security and make it difficult to establish a good relationship with others and receive supportive resources (Neff, 2003a), which may hinder PTG. Individuals with higher levels of NSC also tend to self-criticize and self-blame, and higher levels of self-criticism will aggravate their negative emotions, which is not conducive to the realization of PTG (Turner et al., 2015). Previous studies have not separately explored how over-identification in negative self-compassion affects PTG. But we speculate that individuals with higher levels of NSC also tend to focus their cognitive resources on the negative effects of traumatic events, which makes it difficult for them to achieve.

## Mediating Role of Rumination

According to the results of previous theoretical and empirical studies, PSC and NSC, as different components of self-compassion, may have a direct effect on an individual's PTSD and PTG, respectively. Among them, PSC, as a post-traumatic protective factor (Neff, 2003a), may relieve the symptoms of PTSD (Winders et al., 2020; Hiraoka et al., 2015) and promote the realization of PTG (Wong & Yeung, 2017), while NSC, as a negative attitude towards self, may exacerbate individual PTSD symptoms (Ehlers & Clark, 2000; Liu et al., 2020), and hinder the realization of PTG (Turner et al., 2015). However, the relatively complicated relationship between them still lacks the exploration of internal mechanisms. Which potential mediating processes can explain the effects of self-compassion on PTSD and PTG? Previous empirical studies have shown that rumination, as a cognitive factor, mediates between self-compassion and psychological reaction after trauma (Raes, 2010; Brown et al., 2019). Rumination is a cognitive process in which individuals repeatedly think about traumatic events and their consequences (Watkins, 2008), which includes invasive rumination (IR) and deliberate rumination (DR). IR is a process of thoughts over traumatic event that invades the cognitive world in an undesired state, whereas DR is an individual's conscious and repeated thinking on events (Nolen-Hoeksema & Davis, 2004). Moreover, DR is an active and purposeful process of retesting and thinking about events and related clues (Calhoun et al., 2000).

Previous studies have shown a correlation between self-compassion and rumination. Individuals with PSC will pay more attention to their feelings and psychological needs after the occurrence of traumatic events, and treat themselves with an understanding and caring attitude. This prevents them from paying undue attention to thinking about situations and things related to traumatic events (Neff, 2003a). This positive self-attitude greatly reduces the likelihood of IR (Allen & Knight, 2005). Neff et al. (2007) provided the first evidence that greater PSC is related to less rumination, which focuses on negative

cues (Neff & Vonk, 2009). Leary et al. (2007) also indicated that people with PSC may experience fewer negative effects following a negative event because they have less IR. Moreover, individuals with PSC tend to deal with current painful emotions with a clear and calm attitude, which make them objectively evaluate the impact of the disaster and think about the meaning of traumatic events in an active attitude (Neff, 2003a; Wong & Yeung, 2017). Therefore, we hypothesize that PSC promotes DR.

On the contrary, individuals with NSC tend to adopt a self-judgment attitude after the disaster (Neff, 2003a), which can generate negative thoughts in individuals and think about the traumatic events repeatedly, thus leading to IR (Pedro et al., 2019). Individuals with higher levels of NSC tend to reject building relationships with others around them, depriving them of supportive resources after a disaster. This further causes them to focus on negative post-traumatic thoughts and increases the level of IR (Vanhalst et al., 2012). In addition, individuals with over-identification tend to magnify their own painful feelings and stays with them for a long time. Individuals troubled by painful emotions are likely to trigger IR (Selby et al., 2013). From the perspective of the relationship between NSC and DR, self-judgment in NSC will make individuals pay too much attention to and evaluate their own feelings in suffering, and develop negative perceptions of themselves, which prevents them from actively thinking about traumatic events (O'Connor & Noyce, 2008). Individuals with high levels of over-identification may remain in pain and sadness for a long time after a disaster. Individuals immersed in negative emotions will reduce the level of DR due to the large amount of cognitive resources being occupied (Thomsen et al., 2003; Gruber et al., 2011). Although previous studies have not explored the relationship between isolation and DR, we speculate that individuals with a high sense of isolation tend to close themselves up after a disaster, so that they cannot regain their cognition from communication and exchanges with the outside world. Therefore, it is more difficult for them to think about the meaning of traumatic events in a proactive way.

According to previous studies, rumination is an important factor that affects PTSD. In terms of the relationship between IR and PTSD, IR has a positive effect on PTSD. The shattered world assumption of Janoff-Bulman (2004) emphasized that the negative cognition of post-disaster individuals is an important factor leading to PTSD. IR, as a negative cognitive factor, will make an individual's cognition focus on the negative side of the traumatic event and increase the individual's negative evaluation of the traumatic event (Ehlers & Clark, 2000). This factor can sustain and increase existing negative perceptions (Nolen-Hoeksema et al., 2008) and lead to feelings of restlessness, tension, and helplessness, which can eventually exacerbate PTSD (Egan et al., 2014). On the contrary, a negative relationship exists between DR and PTSD. The cognitive

model of PTSD (Ehlers & Clark, 2000) emphasizes that DR on post-traumatic related clues can change an individual's adverse cognitive style, reduce the individual's negative post-traumatic reaction, and relieve the symptoms of PTSD (Wu et al., 2015b).

The relationship between IR, DR, and PTG has been investigated (Cann et al., 2011; Nightingale et al., 2010). IR is the invasion of cognition by a traumatic cue in an unwanted situation and is the negative cognition of traumatic events, which has a relatively complex relationship with PTG. Studies found that IR provides a basis for further cognitive processing of PTG, as it has a positive effect on PTG (Dunn et al., 2011; Park & Fenster, 2004; Taku et al., 2009). Some studies found no significant correlation between IR and PTG (Cordova et al., 2007; Morris & Shakespeare-Finch, 2011; Taku et al., 2008a; Taku et al., 2012). Other studies emphasized that IR makes individuals focus on the negative outcomes of traumatic events, ultimately impeding recovery and growth (Kuehner & Weber, 1999; Schmaling et al., 2002). Therefore, the relationship between IR and PTG is unclear. The relationship between DR and PTG is relatively clear in previous studies. The PTG model proposed by Tedeschi and Calhoun (2004) pointed out that individuals' DR of traumatic-related clues can help individuals think positively about the meaning brought by trauma, facilitate individuals to reconstruct their understanding of the post-traumatic world, and facilitate the realization of PTG. Previous studies also supported a positive correlation between DR and PTG (Affleck & Tennen, 1996; Cann et al., 2010; Taku et al., 2008a; Zhou et al., 2014; Wang et al., 2020).

Since both IR and DR may mediate between self-compassion, PTSD and PTG, is there a relationship between these two types of rumination? In view of the PTG model of Calhoun and Tedeschi (2004), after the occurrence of a traumatic event, an individual's IR occurs before DR, prompting the individual to actively think about the clues of the traumatic event, and ultimately promoting DR (Zhou et al., 2015). However, some researchers believe that IR may aggravate individuals' negative emotions and force them to think negatively about traumatic events, so that individuals' cognitive thinking is pessimistic and negative, so as to hinder the formation of DR (Egan et al., 2014). Thus, although previous studies on the relationship between IR and DR have yielded different results, they all suggest that IR may affect DR.

## Purpose of the Present Study

On the basis of theoretical and empirical research results, rumination (IR and DR) can mediate the relationship between self-compassion (PSC and NSC), PTSD, and PTG. The purpose of the present study is to examine the mediating role of IR and DR in the relationship between self-

compassion and PTSD/PTG. Considering that gender, age and trauma exposure may be the basic factors influencing the psychological response of adolescents after trauma, we took the above factors as control variables (Luxton et al., 2010; Boksztzanin, 2007; Caspi et al., 2008). After controlling for gender, age and trauma exposure, we propose the following hypotheses: (1) PSC exerts a direct and negative effect on PTSD and has a direct and positive effect on PTG; NSC exerts a direct and positive effect on PTSD and has a direct and negative effect on PTG; (2) intrusive rumination and DR respectively mediate the relationships of self-compassion with PTSD and PTG; (3) self-compassion (PSC and NSC) has significant effect on PTSD and PTG via an indirect path from IR to DR.

## Methods

### Participants

Previous studies have shown that in a shorter period of time after an earthquake, the participants' levels of post-traumatic psychological reactions such as PTSD and PTG are higher (Jin et al., 2014; An et al., 2013). In order to understand in time the mental health status of young people in the disaster area after the earthquake and its impact mechanism, we conducted this survey 10 months after the Jiuzhaigou earthquake. Data were obtained from 621 students enrolled in two middle schools in Jiuzhaigou, and all students agreed to participate. The mean age of the 621 participants were 13.77 (SD = 0.85), ranging from 12.0 to 16.0 years. Of the 621 participants, 299 were male (48.1%), 293 were female (47.2%), and 29 students (4.7%) did not report their gender. All participants experienced the Jiuzhaigou earthquake, 10.9% of participants were injured in the earthquake, 12.5% were trapped, and 36.6% of participants' families suffered serious property loss in the earthquake.

### Procedures

Before the formal investigation, we communicated with the local education department, informed them of our study methods and purpose in detail, and obtained approval. With the help of the principal and head teachers, we contacted two middle schools in the Jiuzhaigou disaster area. With the approval of the principal, we selected junior middle school students of two grade levels for the investigation. The research questionnaire was distributed uniformly by head teachers during class and tested collectively.

This study was approved by the research ethics committee of Beijing Normal University and was conducted with the permission of relevant leaders of participating schools. Before the investigation, each student signed a written

informed consent. The purpose of the study and the autonomy of subjects were highlighted before the survey, whereas the right of each subject to withdraw from the survey at any time was explained. The assessment was conducted under the guidance of graduate students majoring in psychological counseling. During the test, participants were asked to read the instructions carefully and fill out the questionnaire. After completing the questionnaire, all questionnaires were collected on the spot.

## Measures

### Trauma Exposure

The trauma exposure questionnaire developed by Qi et al. (2020) was adopted to measure the severity of Chinese adolescent survivors' traumatic experiences. The questionnaire consisted of seven items, including whether they had witnessed an injury or death, and whether they were informed afterwards of the injury or death of others. Each of the items was rated on a two-point scale, ranging from 0 (*No*) to 1 (*Yes*). The scores of all subjects were added as indicators of the degree of trauma exposure. The score range of this questionnaire was from 0 to 7. The internal reliability of the questionnaire in this study was acceptable (Cronbach's  $\alpha = 0.68$ ).

### Self-Compassion

The Self-Compassion Scale compiled by Neff (2003a) was used in this study. The scale consisted of six components, which were divided into PSC and NSC. PSC includes common humanity (eg., "*When I feel inadequate in some way, I try to remind myself that feelings of inadequacy are shared by most people*"), self-kindness (eg., "*I'm kind to myself when I'm experiencing suffering*"), and mindfulness (eg., "*When something upsets me I try to keep my emotions in balance*"), whereas NSC includes feelings of isolation (eg., "*When I think about my inadequacies it tends to make me feel more separate and cut off from the rest of the world*"), self-judgment (eg., "*I'm disapproving and judgmental about my own flaws and inadequacies*"), and over-identification (eg., "*When I'm feeling down I tend to obsess and fixate on everything that's wrong*"). Each of the 26 items was rated on a five-point Likert scale that ranged from 1 (*completely disagree*) to 5 (*completely agree*). The score range of this questionnaire was from 26 to 130. The applicability of this scale has been verified in post-traumatic Chinese adolescents (Liu et al., 2020; Zhang et al., 2020). In this study, the internal reliability of PSC (Cronbach's  $\alpha = 0.70$ ) and NSC (Cronbach's  $\alpha = 0.80$ ) was good.

## Rumination

The Event Related Rumination Inventory revised by Zhou et al. (2014) from Cann et al. (2010) was adopted in this study. The questionnaire included 20 questions, which were divided into two dimensions: IR (eg., “*Thoughts about the matter would run through my mind from time to time, and it was hard to stop*”) and DR (eg., “*I would actively think about whether I could find some benefit from that experience*”). This questionnaire consisted of 20 items, with each item scored on a four-point scale ranging from 0 (*not at all*) to 3 (*always*). The score range of this questionnaire was from 0 to 60. The reliability and validity of this version of the questionnaire have been verified in Chinese post-earthquake adolescents (Zhou et al., 2014). In this study, the overall internal consistencies of the questionnaire were good (Cronbach’s  $\alpha = 0.92$ ), and the internal consistencies of IR (Cronbach’s  $\alpha = 0.90$ ) and DR (Cronbach’s  $\alpha = 0.86$ ) were also good.

## PTSD

The PTSD checklist for DSM-5 was designed by Weathers (2013) and is a well-known measure in assessing post-traumatic stress symptoms. This checklist features 20 items and four subscales: intrusions (eg., “*Sad thoughts or images related to the earthquake would suddenly invade my mind*”), negative cognition and emotion alteration (eg., “*It’s hard to experience positive emotions*”), avoidance (eg., “*I try to avoid the activities, people and places that remind me of earthquakes*”), and hyperarousal (eg., “*I feel restless or irritable*”). Each item was rated on a five-point Likert scale ranging from 0 (*completely disagree*) to 4 (*completely agree*). The applicability of this questionnaire has been verified among post-earthquake adolescents in China (Liu et al., 2020; Zhou et al., 2018). The score range of this questionnaire was from 0 to 80. The internal reliability of the questionnaire in this study was good (Cronbach’s  $\alpha = 0.87$ ).

## PTG

Posttraumatic Growth Inventory, which was adopted in this research, is the revised version of Zhou et al. (2014) study aimed at adolescents after the earthquake in China. The original Posttraumatic Growth Inventory was developed by Tedeschi and Calhoun (1996), which consisted of the following subscales: personal strength, new possibilities, relation to others, appreciation of life, and spiritual change. The revised questionnaire has three subscales: perceived changes in oneself (eg., “*I discovered that I’m stronger than I thought I was*”), a changed sense of relationship with others (eg., “*A sense of closeness with others*”), and changed life philosophy (eg., “*An*

*appreciation for the value of my own life*”), and added one item – “*I better understand the existence of some uncontrollable force in life*”. The revised questionnaire consisted of 22 items, in which each of the items is scored on a six-point scale ranging from 0 (*no change*) to 5 (*a very high degree of change*). The reliability and construct validity of the scale were verified in adolescents after the earthquake in China (Zhou et al., 2014). The internal reliability of the modified inventory in this study was good (Cronbach’s  $\alpha = 0.96$ ).

## Statistical Analyses

The statistical analyses were conducted using SPSS 24.0 and AMOS 17.0. We evaluated the missing data before testing the hypothesis. The missing data at the item level were minimal in this study (i.e., less than 1.5% missing on each individual measure). We adopted Little’s Missing Completely at Random test to check missing data pattern. The results revealed that data were missing in a specific way. Therefore, the robust maximum likelihood estimator was used in this study to process the missing data (Schafer & Graham, 2002).

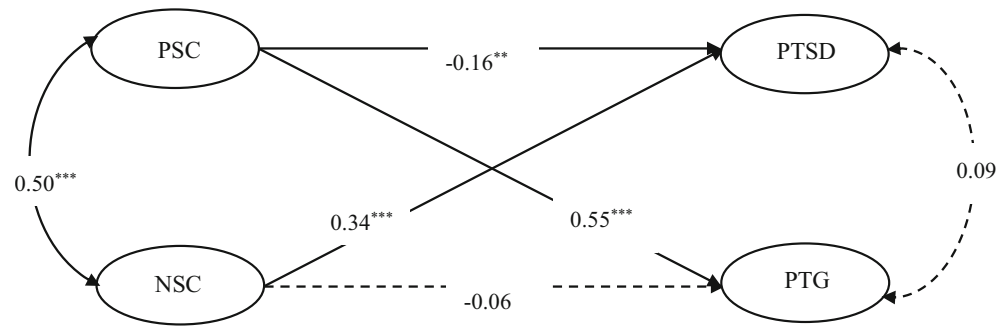
This study adopted the self-report measure, as Harman’s single-factor test was used to test the common method deviation. Results show that the variance explained by the unrotated and rotated first factor was 15.41% and 8.67%, respectively, both of which were less than the critical value of 40%, indicating no obvious common method deviation in this study.

Next, we applied the SEM (Structural Equation Model) approach to assess the following models: (a) a direct effect model with structural paths from self-compassion to PTSD and PTG (see Fig. 1); (b) an indirect effect model, with the mediators (IR and DR) inserted between self-compassion and PTSD and PTG. We added a correlation path between PSC and NSC and added a predictive path between PTSD and PTG. Considering that gender, age, and trauma exposure are necessary preconditions for post-traumatic reactions, we controlled for these factors in the analyses (see Fig. 2). Finally, to test the significance of indirect effects, we conducted bias-corrected bootstrap tests with a 95% confidence interval (see Table 2).

In this study, model fit was assessed by the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the root-mean-square error of approximation (RMSEA) and its respective 95% confidence interval. Acceptable fit is assumed by values greater than or equal to 0.90 for CFI and TLI and less than or equal to 0.08 for RMSEA (Little, 2013).

**Fig. 1** Indirect effects model.

Note: *PSC* Positive self-compassion, *NSC* Negative self-compassion, *PTSD* Posttraumatic stress disorder, *PTG* Posttraumatic growth. \*\* $p < 0.01$ , \*\*\* $p < 0.001$



## Results

### Descriptive Statistics and Correlations among Main Variables

Table 1 shows the results of the descriptive statistics and correlation analysis. Trauma exposure is significantly associated with NSC, IR, DR, and PTSD; PSC is significantly associated with NSC, IR, DR, and PTG; NSC is significantly associated with IR, DR, PTSD, and PTG; IR is significantly associated with DR, PTSD, and PTG; DR is significantly associated with PTSD and PTG; PTSD is significantly associated with PTG.

### Analysis of Mediating Effect

In this study, SEM was used to examine the mediating effect of rumination (IR and DR) between self-compassion (PSC and NSC), PTSD, and PTG.

### The Measurement Model

According to the suggestions of Anderson and Gerbing (1988), we first tested the measurement model. The measurement model that included four latent variable constructs: PSC, NSC, PTSD, and PTG. The PSC latent variable was evaluated using the scores for the three subscales of self-kindness, common humanity, and mindfulness. The NSC latent variable was evaluated using the scores for the three subscales of self-judgment, isolation, and over-identification. The PTSD latent variable was evaluated using the scores for the four subscales of intrusion, negative cognition and emotion alteration, avoidance, and hyperarousal. The PTG latent variable was evaluated using the scores for the three dimensions of perceived changes in oneself, a changed sense of relationships with others, and a changed philosophy of life. In this measurement model, correlations were specified among PSC, NSC, PTSD, and PTG. Factor loadings for the manifest indicators on their respective latent variables were freely estimated. According to

**Fig. 2** The model of mediating roles of rumination in the relationship between self-compassion and PTSD/PTG.

Note: All path coefficients were standardized coefficients. *PSC* Positive self-compassion, *NSC* Negative self-compassion, *IR* Intrusive rumination, *DR* Deliberate rumination, *PTSD* Posttraumatic stress disorder, *PTG* Posttraumatic growth. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

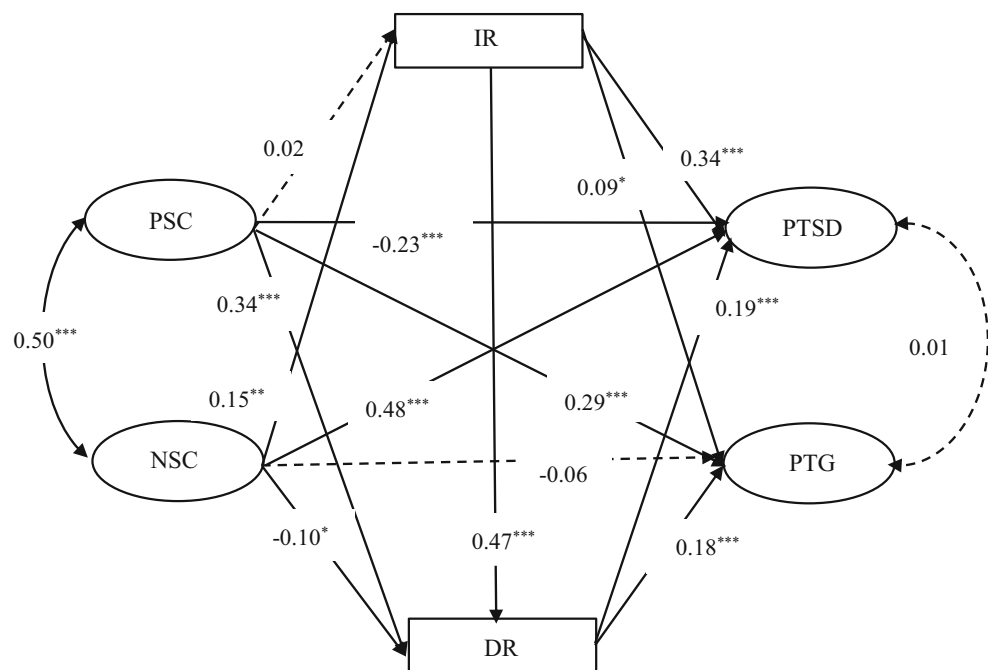


**Table 1** Means, standard deviations, and correlations of main variables

|                       | 1        | 2     | 3       | 4      | 5      | 6      | 7      | 8     | 9     |
|-----------------------|----------|-------|---------|--------|--------|--------|--------|-------|-------|
| 1 Gender <sup>a</sup> | 1        |       |         |        |        |        |        |       |       |
| 2 Age                 | −0.17*** | 1     |         |        |        |        |        |       |       |
| 3 Trauma exposure     | 0.09*    | 0.08  | 1       |        |        |        |        |       |       |
| 4 PSC                 | 0.02     | 0.01  | 0.03    | 1      |        |        |        |       |       |
| 5 NSC                 | 0.04     | 0.02  | 0.11**  | 0.41** | 1      |        |        |       |       |
| 6 IR                  | 0.03     | 0.01  | 0.22*** | 0.09*  | 0.16** | 1      |        |       |       |
| 7 DR                  | 0.09*    | −0.04 | 0.21*** | 0.30** | 0.17** | 0.60** | 1      |       |       |
| 8 PTSD                | 0.08*    | 0.04  | 0.20*** | 0.02   | 0.23** | 0.46** | 0.35** | 1     |       |
| 9 PTG                 | 0.12**   | 0.02  | 0.04    | 0.43** | 0.19** | 0.16** | 0.32** | 0.08  | 1     |
| <i>M</i>              | —        | 13.76 | 1.74    | 38.72  | 37.53  | 10.38  | 12.09  | 29.61 | 57.54 |
| <i>SD</i>             | —        | 0.84  | 1.70    | 7.29   | 7.30   | 6.08   | 5.97   | 13.12 | 17.41 |

a\*\*\*\*\* Note. Coded: 1 = male, 2 = female; *PSC* Positive self-compassion, *NSC* Negative self-compassion, *IR* Intrusive rumination, *DR* Deliberate rumination, *PTSD* posttraumatic stress disorder, *PTG* Posttraumatic growth.  $p < 0.05$ ,  $p < 0.01$ ,  $p < 0.001$

the suggestions from Anderson and Gerbing (1988), we tested the measurement model and found that the model fitting index was acceptable:  $\chi^2/df = 4.60$ , CFI = 0.94, TLI = 0.92, RMSEA (90%CI) = 0.076 (0.067–0.086). A further structural model analysis is possible.

### Direct Effect Model

After controlling for gender, age, and trauma exposure, we analyzed the direct effects of self-compassion on PTSD and PTG and added two correlative paths, such as PSC and NSC, as well as PTSD and PTG. Factor loadings for the manifest indicators on their respective latent variables were freely estimated. Results show that the direct effect model fits well:  $\chi^2/df = 4.37$ , CFI = 0.93, TLI = 0.91, RMSEA (90%CI) = 0.074 (0.065–0.082). The results of the path analysis are shown in Fig. 1. PSC has a direct and negative effect on PTSD ( $\beta = -0.16$ ,  $p < 0.01$ ), but has a direct and positive effect on PTG ( $\beta = 0.55$ ,  $p < 0.001$ ). NSC has a direct and positive effect on PTSD ( $\beta = 0.34$ ,  $p < 0.001$ ) and has a non-significant effect on PTG ( $\beta = -0.06$ ,  $p > 0.05$ ).

### Indirect Effect Model

On the basis of this direct effect model, we inserted rumination (IR and DR) between self-compassion and PTSD/PTG, and added one predictive path from IR to DR, thus establishing an indirect effect model (see Fig. 2). The fitting index of the indirect effect model was good:  $\chi^2/df = 3.97$ , CFI = 0.93, TLI = 0.91, RMSEA (90%CI) = 0.069 (0.062–0.077). The path analyses revealed that after controlling for gender, age, and trauma exposure, PSC positively predicts PTSD and PTG through IR ( $\beta = 0.65$ ,  $p < 0.001$ ;  $\beta = 0.61$ ,  $p < 0.001$ ). NSC positively predicts PTSD and PTG through IR ( $\beta = 0.051$ ,  $p <$

0.001;  $\beta = 0.01$ ,  $p < 0.05$ ), whereas NSC negatively predicts PTSD and PTG via DR ( $\beta = -0.02$ ,  $p < 0.01$ ;  $\beta = -0.02$ ,  $p < 0.01$ ). NSC also have a positive effect on PTSD and PTG through a mediating path from IR to DR ( $\beta = 0.01$ ,  $p < 0.05$ ;  $\beta = 0.01$ ,  $p < 0.05$ ).

We used bias-corrected bootstrap tests with a 95% confidence interval to evaluate the significance levels of the indirect effects. After 5000 samples, the results of the bias-corrected bootstrap tests are shown in Table 2. The 95% confidence interval for the indirect paths from PSC to PTSD and PTG via DR, from NSC to PTSD and PTG through IR, and from NSC to PTSD and PTG via DR, as well as from NSC to PTSD and PTG from IR to DR did not include 0. The indirect paths are significant, whereas the indirect effect accounted for 20.25% of the total effect. These results further indicated that the eight indirect paths in Fig. 2 are significant.

**Table 2** Bias-corrected bootstrap tests of mediating effects

| Path           | Standardized $\beta$ | Standardized 95% CI |        |
|----------------|----------------------|---------------------|--------|
|                |                      | Low                 | High   |
| NSC-IR-PTSD    | 0.051***             | 0.006               | 0.112  |
| NSC-IR-PTG     | 0.014*               | 0.003               | 0.033  |
| PSC-DR-PTSD    | 0.065***             | 0.017               | 0.125  |
| PSC-DR-PTG     | 0.061***             | 0.016               | 0.126  |
| NSC-DR-PTSD    | −0.019**             | −0.014              | −0.002 |
| NSC-DR-PTG     | −0.018**             | −0.012              | −0.002 |
| NSC-IR-DR-PTSD | 0.013*               | 0.001               | 0.055  |
| NSC-IR-DR-PTG  | 0.013*               | 0.001               | 0.055  |

\*\*\* Note: *PSC* Positive self-compassion, *NSC* Negative self-compassion, *IR* Intrusive rumination, *DR* Deliberate rumination, *PTSD* Posttraumatic stress disorder, *PTG* Posttraumatic growth.  $p < 0.05$ ,  $p < 0.01$ ,  $p < 0.001$

## Discussion

### The Effect of Self-Compassion on PTSD/PTG

This study is the first to examine the mediating role of rumination in self-compassion, PTSD, and PTG among adolescents following an earthquake. After controlling for gender, age, and trauma exposure, the direct effect model results indicated that PSC negatively predicts PTSD. This result supported previous studies (Maheux & Price, 2015; Hoffart et al., 2015; Seligowski et al., 2015), indicating that adolescents with PSC tend to care for and be kind to themselves in their suffering (Neff, 2003a), and be tolerant of the frustration and pain of traumatic events, thus adapting to the impact of traumatic events (Barnard & Curry, 2011) and eventually alleviating PTSD symptoms. In contrast to PSC, individuals with high levels of NSC may exacerbate PTSD symptoms. This result supports the cognitive model of PTSD (Ehlers & Clark, 2000). NSC encourages individuals to focus on negative cues of traumatic events, which causes post-earthquake adolescents to remain immersed in post-disaster distresses and form negative cognitions, thereby exacerbating PTSD symptoms (Dunmore et al., 2001).

Moreover, PSC has a positive effect on PTG. These results support oneself in the relation model (Kaplan, 1986) and indicate that a PSC is an important factor for individuals to recover from traumatic experiences and gain psychological growth. Specifically, adolescents with PSC are likely to acknowledge suffering as part of the common human experience to view it more rationally and peacefully (Heffernan et al., 2010; Neff, 2003a). This tendency can help people gain insights into publicly expressing their thoughts and feelings, re-examining the meaning of the disaster, and reflecting on the value of life, ultimately facilitating the implementation of PTG (Tedeschi & Calhoun, 2004). Meanwhile, PSC will help people to be more compassionate towards oneself (Neff, 2003a) and to soothe their pain, which can ultimately promote PTG. However, NSC has a non-significant effect on PTG, and this result is inconsistent with our hypothesis. This may be because as a type of negative attitude, NSC cannot independently play a role in PTG, but needs to be processed by cognitive factors, and this view has been verified in previous studies (Wong & Yeung, 2017).

### The Mediating Role of Rumination

In the indirect effect model, these findings indicated that PSC has a positive effect on PTSD via DR, which was partly inconsistent with previous research results (Wu et al., 2015b; Wang et al., 2020). Adolescents with PSC tend to deal with current painful emotions with a clear and calm attitude, which make them objectively evaluate the impact of the disaster and

think about the meaning of traumatic events in an active attitude (Neff, 2003a; Wong & Yeung, 2017). This positive self-attitude leads to thinking actively about the meaning of traumatic events and ultimately promoting DR (Raes, 2010). However, adolescents with high levels of DR are likely to be exposed to a traumatic experience, in which they can also induce negative psychological reactions in a short time after an earthquake (Dekel et al., 2013), thus aggravating PTSD. Furthermore, PSC has a positive effect on PTG through DR, which supports previous studies (Raes, 2010; Calhoun & Tedeschi, 2006). At the same time, a higher level of DR can enable adolescents to actively expose their psychological trauma and try to reconstruct their perceptions of life and the world (Affleck & Tennen, 1996; Cann et al., 2010; Taku et al., 2008b; Zhou et al., 2014; Wang et al., 2020). Positive thinking and cognitive reconstruction after trauma can promote the realization of PTG.

Our findings indicated that NSC exerted an indirect and negative effect on PTSD and PTG, respectively, through DR, which confirms our hypothesis. Adolescents with NSC may remain in pain and sadness for a long time after a disaster and impede cognitive processing (Thomsen et al., 2003; Gruber et al., 2011), which prevents them from actively thinking about the meaning of the traumatic event, and reduces their level of active DR. Less DR leads to less exposure to trauma cues to relieve PTSD symptoms among traumatized adolescents but also reduce the opportunity for further cognitive processing of traumatic events (O'Connor & Noyce, 2008). Thus, NSC can negatively affect PTSD and PTG by reducing DR.

Nevertheless, PSC had no significant and indirect association with PTSD and PTG via IR. A potential explanation exists for this result. In previous studies, PSC as a positive pre-disaster factor (Freedy et al., 1994) has led survivors to experience less IR (Neff & Vonk, 2009; Allen & Knight, 2005), thereby relieving negative post-traumatic reactions. However, after experiencing a major emergency such as an earthquake, adolescents may not be able to self-regulate in a short time to recover from a traumatic event. As a result, even adolescents with a high level of positive self-compassion cannot cope with the post-traumatic psychological response by reducing IR in the short term after the traumatic event.

Consistent with previous studies (Neff et al., 2007; Spasojević & Alloy, 2001; O'Connor & Noyce, 2008; James et al., 2015), the present study found that NSC had a positive effect on PTSD via IR. Adolescents with NSC have a negative self-perception after experiencing a disaster, which made them more inclined to focus their cognitive resources on the negative effects of traumatic events, which in turn increases the level of IR (Michael et al., 2007). IR causes adolescents to unconsciously think about traumatic memories that tend to make them pain, thus prolonging sadness and developing a negative response to the disaster (Nolen-Hoeksema

et al., 2008; Moberly & Watkins, 2008; Baschnagel et al., 2009), which ultimately aggravates the symptoms of PTSD (Egan et al., 2014). In addition, NSC can promote the development of PTG through IR, which is consistent with previous studies (Taku et al., 2009; Nightingale et al., 2010). In view of the PTG model of Calhoun and Tedeschi (2004), IR can provide adolescents with traumatic clues and opportunities for further cognitive processing of the traumatic event, which results in PTG. Therefore, NSC can also further promote the realization of PTG in adolescents by increasing IR levels.

We also found a significant two-mediator indirect relationship of NSC to PTSD/PTG through IR to DR. According to the PTG model of Calhoun and Tedeschi (2004), IR can provide traumatized survivors with traumatic clues and opportunities for further DR. Moreover, IR may elicit psychological stress (Nolen-Hoeksema et al., 2008), which creates sufficient cognitive dissonance for positive recurrent thoughts on traumatic clues. Therefore, IR was supposed to be an impetus for DR. As a result, NSC has a positive effect on PTSD and PTG via an indirect path from IR to DR.

This study also validates the rationality of dividing self-compassion into a two-dimensional structure of PSC and NSC, and supports the hypothesis that the negative and positive components of self-compassion can have different effects on individuals after trauma (Muris & Petrocchi, 2017; Montero-Marín et al., 2016). PSC has a stronger predictive effect on the positive psychological outcomes of post-traumatic individuals, which indicates that PSC may be a protective factor for post-traumatic individuals (Neff, 2003a). Conversely, NSC has a stronger predictive effect on the negative psychological outcome of post-traumatic individuals, which indicates that NSC is a risk factor for post-traumatic psychological reactions (Dunkley et al., 2009). It is worth mentioning that in this study, the positive and negative dimensions of self-compassion are positively correlated, which is consistent with some previous research results (Seligowski et al., 2015; Liu et al., 2020), and also verifies the hypothesis that NSC and PSC are not opposites (López et al., 2015; Neff et al., 2008). A possible explanation is, when suffering sudden traumatic event, the psychological impact and the change of environment may activate adolescents' negative self-compassion, but the motivation of inner growth would drive individuals to try to actively understand treat themselves, when negative self-compassion reaches certain level (Neff et al., 2008). However, whether the relationship between PSC and NSC would change base on the subject group, the time from the trauma or the traumatic event remains to be further verified in future research.

## Limitations and Implication

Limitations in research design and measurement methods were encountered. First, cross-sectional data were used in this study; thus, findings do not indicate causality or a temporal sequence. Samples can be tracked in future studies to explore the causal

relationship between variables. Moreover, the measurement methods used in this study were all self-reported scales, which mean that the variables may be affected by common-method variance. At the same time, self-reported measures may also lead to a certain degree of social desirability bias. In future studies, we should try different methods of measurement, so as to reduce the social desirability bias as much as possible.

Despite these limitations, this study is the first study to examine the role of adolescent cognitive processes in self-attitude and post-traumatic psychological response, which has a certain theoretical and practical significance. The results of this study indicated that self-compassion plays an important role in the post-traumatic responses of post-earthquake adolescent. In previous studies, self-compassion-related therapy such as Mindful Self-Compassion (MSC), Compassion Focused Therapy (CFT) and Loving-Kindness Meditation were proven effective on relieving negative post-traumatic psychological reactions (Jin et al., 2020). The findings indicate that the post-disaster psychological aid workers can apply self-compassion-related therapy to improve adolescents' self-compassion level in psychological intervention, as adolescents can learn to care for themselves and treat themselves well, thus forming a good self-compassion attitude to relieve the symptoms of PTSD and promote PTG. Furthermore, both types of rumination play a mediating role between self-compassion, PTSD, and PTG. Within a short time after the disaster, in addition to helping middle school students face the negative influence brought by the earthquake and change their negative attitude toward traumatic events and their consequences, we should guide them toward thinking about traumatic events appropriately to avoid aggravating negative psychological reactions.

**Code Availability** SPSS 24.0, Amos 22.0.

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**Data Availability** The processed data required to reproduce these findings cannot be shared at this time as the data also forms part of an ongoing study.

## Declarations

**Conflicts of Interest/Competing Interests** The authors declare that they have no conflict of interest.

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