

Relationship between Traumatic Exposure and Posttraumatic Stress Disorder among Flood Victims: Roles of Fear and Self-Disclosure

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Abstract

Background: Posttraumatic Stress Disorder (PTSD) is one of the most prevalent psychopathologies experienced by victims following natural disasters. The severity of traumatic experience may be a critical risk factor for the development of PTSD. Nevertheless, other factors may also lead to PTSD. We propose that fear and self-disclosure could be two important factors. Previous studies have examined their unique roles in PTSD, but their combined role in PTSD has been rarely assessed. To fill this gap, the aim of this study was to examine the relationship between severity of traumatic exposure, fear, self-disclosure, and PTSD among victims following flood disaster.

Methods: one hundred ninety-nine participants completed self-report questionnaires. Descriptive statistics were obtained using SPSS 17.0 and Pearson correlation coefficients were calculated to obtain correlations between major variables.

Results: results indicated that severity of traumatic exposure not only had a direct effect on PTSD, but also it had an indirect effect on PTSD via activating victims' fear. Moreover, self-disclosure played a buffering role between fear and PTSD. However, the role of fear in PTSD may decrease with increases in levels of self-disclosure.

Conclusions: Traumatic exposure had positive predictive effects for PTSD and fear. Self-disclosure had negative predictive effects for PTSD. Fear played a mediating role between severity of traumatic exposure and PTSD, self-disclosure played a moderating role in the relationship between fear and PTSD. Psychological interventions should focus on the regulation of fear and improvement of self-disclosure following traumatic exposure.

Background

Between June and July 2016, continuous heavy rainfall in the middle and lower reaches of the Yangtze River in China caused extremely severe flooding. Wuhu City (Anhui Province), located in this area, was heavily affected by the disaster. Over 1,960,000 people directly experienced the flood, 130,000 people needed to be urgently transferred to safety, and over 2,447 buildings were destroyed. The flood not only caused a devastating loss of human life and property, but also led to various psychological problems among the afflicted victims (Quan, Zhen, Yao, & Zhou, 2017; Zhen, Quan, Yao, & Zhou, 2016). Posttraumatic stress disorder (PTSD) is one of common negative psychological consequences following the experience of trauma, including flood disaster (Stanke, Murray, Amlôt, Nurse, & Williams, 2012; Dai et al., 2016). For example, Xiong et al. (2016) found that the incidence of PTSD after the flood disaster was in the range of 26–50%. Quan et al. (2017) found that after the flood disaster, the incidence of PTSD among the victims was as high as 25.1%. The high incidence of PTSD triggered further research aiming to identify the factors which may influence its development (Quan et al., 2017).

Studies found that various factors influence the development of PTSD and they can be divided into pre-trauma (e.g., sex, age), intra-trauma (e.g., degree of exposure to the disaster), and post-trauma (e.g.,

responding method) factors, based on posttraumatic risk factor model (e.g., Freedy, Resnick, & Kilpatrick, 1992). By definition, exposure (to disaster or any other traumatic event) is a precondition for the occurrence of PTSD (e.g., Tracy, Norris, & Galea, 2011; Boden, Fergusson, Horwood, & Mulder, 2015; McGuire et al., 2018; Zhou, Wu, Fu, & An, 2015). Here, the shattered assumptions theory (Janoff-Bulman, 1992, 2010) proposes that a traumatic event has the potential to diminish the degree of optimism in the assumptions of the world (assumptive world), which could lead to negative attitudes about self, others, and the world, and in turn lead to negative outcomes such as the development of posttraumatic stress disorder.

In the cognitive model of persistence of PTSD (Ehlers & Clark, 2000), traumatic exposure has both direct and indirect predictive effects on the development of PTSD by certain mediators. Fear is one of the important mediators in this model. It is proposed that following trauma such as flooding, for example, an individual may feel threatened, worry about the house being destroyed by rushes of water, crops being submerged, families and/or friends getting hurt, worry about some terrible things happening again, and as a consequence, cannot live a normal life (e.g., Foa, Riggs, Massie, & Yarczower, 1995; Zhou et al., 2015, 2016). Janoff-Bulman (2010) also emphasized that once trauma survivors' assumptions are severely challenged, they become unstable and lose a sense of perceived control or predictability in the world. This would lead survivors to experience more fear (Mikkelsen & Einarsen, 2002; Janoff-Bulman, 2010).

Furthermore, the mnemonic model of PTSD proposes that PTSD is developed and maintained through a "pathogenic memory" of a traumatic event, fear plays a central role in the development of PTSD symptoms (Rubin, Berntsen, & Bohni, 2008; Greene, et al., 2019). Traumatic events may lead to the development of conditioned fear responses to specific trauma-related clues (e.g., Heinrichs, Wagner, Schoch, Soravia, Hellhammer, & Ehler, 2005), induce an invasion of trauma-related memories (e.g., Fani et al., 2012), and finally result in PTSD. Fear can also suppress the ability to accurately recall traumatic experiences. This suppression can make it difficult to piece the trauma memory together, which may also increase the possibility of developing PTSD (e.g., Farnsworth & Sewell, 2011). Some studies have also found that traumatic fear can lead to higher levels of PTSD (e.g. Brown et al., 2016; Kleim et al., 2013; Najavits et al., 2006; VanElzakker et al., 2014; Wang, Wu, & Lan, 2020; Zalta et al., 2014). Therefore, traumatic exposure may have an indirect effect on PTSD via fear. These findings were also approved in our previous study (Quan et al., 2017).

Although PTSD may be caused directly by traumatic exposure or induced by fear. Some studies found that traumatic exposure does not have a significant relationship with PTSD (Nygaard & Heir, 2012; Zhou, Wu, Yuan, Chen, & Chen, 2015). The question remains as to why some individuals who have experienced traumatic exposure develop PTSD but others do not. We propose that the direct or indirect relationship between traumatic exposure and PTSD is influenced by the regulation of other variables, in particular, self-disclosure.

Self-disclosure refers to the process by which one person verbally reveals information about himself or herself (including thoughts, feeling, and experience) to another person (Derlega, Metts, Petronio, &

Margulis, 1993). The theory of social sharing indicates that individuals will look for someone to share their feelings with when they experience a distressing event (Rime´, 1995). Self-disclosure and the roles it plays have been investigated in the context of trauma such as earthquake or war (Pennebaker & Harber, 1993), the death of a spouse (Pennebaker & O’Heeran, 1984) and found, for instance, that the disclosure of traumatic experiences can moderate pain (Paine & Hansen, 2002; Pennebaker, Zech, & Rimé, 2001), and alleviate PTSD symptoms (e.g., Davidson & Moss, 2008; Pietruch & Jobson, 2012).

The socio-interpersonal model proposes an interpersonal view of the processes that occur in the aftermath of a traumatic experience (Maercker & Horn, 2013), interpersonal or social phenomena, such as disclosure, have long been identified as important in PTSD (Bolton, Glenn, Orsillo, Roemer, & Litz, 2003). Existing studies have found that discussing traumatic experiences after many events, including combat, crime, accidents, and sexual abuse, can lead to a reduction in PTSD symptoms (e.g., Davidson & Moss, 2008; Mueller, Moergeli, & Maecker, 2008; Pennebaker & Harber, 1993; Ullman, 2003). Self-disclosure is often regarded as the core of psychotherapy process (Pals & McAdams, 2004) and the basis of many post-traumatic stress psychological treatments (Boasso, Overstreet & Ruscher, 2015; Purves & Erwin, 2004).

Theoretically, based on the perspective of Foa and Kozak (1986), talking about emotional experience after trauma can promote emotional processing and assist with the integration of trauma-related memories, which is critical for the recovery of PTSD following trauma. Thus, individuals with high levels of self-disclosure can consider and evaluate the traumatic event or their emotion by expressing their thoughts and feels about it, and in doing so buffer PTSD symptoms and/or recover more rapidly by seeking help and releasing psychological pressure (Currier, Lisman, Harris, Tait, & Erbes, 2013; Hoyt et al., 2010; Tedeschi & McNally, 2011).

Additionally, self-disclosure can also buffer the effect of fear on various post-traumatic outcomes. Everyday assumptions suggest that people feel better if they talk about problems, that is, disclosure about problems will have a positive impact on the adjustment (Semin & Gergen, 1990). These assumptions fit with theories suggesting that expressing negative feelings is cathartic and has emotional benefits (Derlega, 1984). According to the trauma theory, in order to recover from exposure to traumatic events, therapeutic intervention should include the opportunity to disclose and deal with fearful and stressful events. Disclosure of emotions, especially negative emotions (e.g. fear), was associated with decreases in their own PTSD/PTSS (Stein, Lahav & Solomon, 2017).

Fear could play a mediating role in the relationship between traumatic exposure and PTSD, whereas self-disclosure could play a moderating role. However, this proposal of direct and indirect effects has yet to be formally evaluated in victims who have experienced a flood disaster. Given the inherently unpredictable nature of natural disasters and that such traumatic events cannot be controlled, natural disasters are likely to severely impact upon the cognitions and assumptions of the victims (Ehlers & Clark, 2000). To reduce the incidence of PTSD after disasters, it is necessary to help victims adapt and adjust, and to understand the mediating and moderating factors associated with the development of PTSD. Thus, our

study tested the potential effects of fear and self-disclosure on the relationship between traumatic exposure and PTSD after the flood disaster in Wuhu City. Based on the existing literature, we made the following predictions: a) post-traumatic fear plays a mediating effect between traumatic exposure and PTSD: b) self-disclosure moderates the relation between traumatic exposure / fear and PTSD (Figure 1).

— *Insert Figure 1 here approximately*—

Methods

Procedures and Participants

This study was approved by the Research Ethics Committee of Anhui Normal University. We wanted to focus on individuals who had been severely affected by the disaster in Wuhu city and thus selected participants who had been transferred to makeshift shelters for safety following the flood. Participants consisted mainly of older adults and adolescents as most adults between 20–40 had migrated into the cities for work.

Five makeshift shelters were selected with the help of related institutions. In each of the makeshift shelters, we gathered the victims together with the help of the administrators based there and introduced the purpose of our investigation. The voluntary nature of participation in the study was emphasized and, after ensuring that individuals understood the purpose of the study, we asked for volunteers to participate. Those who agreed were asked to complete a series of questionnaires. Because the participants included both adults and adolescents, informed consent was obtained from adult participants directly and from the parents/guardians of adolescent participants. The assessment was conducted under the supervision of trained individuals with master's degrees or associate professors in psychology. For participants with low levels of education and/or who had difficulties understanding the questionnaires, the researchers read the items aloud and recorded the participants' verbal responses. After the questionnaires were completed, compensation was provided (e.g., toothbrushes, teacups). Participants were also told that the researchers could provide some psychological/counseling services if needed. The research team consisted of psychological professional, counselors and therapists. For victims with severe PTSD symptoms, the researchers suggested that they participate in psychological counseling, appropriate and timely treatment or referral to psychological clinic were provided.

Based on the same sample as previous study (Quan et al., 2017), one hundred and ninety-nine flood victims participated in the study. Data from 12 participants were excluded from analyses due to invalid responses according to the simple, repetitive and incomplete answers. One hundred and eighty-seven valid questionnaire packages were obtained, indicating a valid response rate of 94.0%. Of the participants, 84 (44.9%) were female, 94 (50.3%) were male, and 9 (4.8%) did not report their gender. The mean participant age was 41.9 (SD = 19.32) years, and the age range was 13– 80 years. Among them, 29 (15.5%) were 13-17 years old, 115 (61.5%) were 18-60 years old, 36 (19.3%) were 61-80 years old, and 7 (3.7%) did not report their age.

Measures

Traumatic exposure. We used Quan et al., (2017) traumatic exposure questionnaire to assess the severity of traumatic exposure of flood victims. This questionnaire has six items (*e.g. our house was damaged by the flood, I have to move to another area because of the flood, I was injured during the flood, my life was affected severely by the flood, some members of my family were injured because of the flood, and my relatives or friends were injured by the flood*). Each item was rated on a 5-point Likert scale ranging from 0 (completely disagree) to 4 (completely agree). The questionnaire had good internal consistency ($\alpha = 0.75$).

PTSD. PTSD was assessed using the PTSD Checklist for Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013). This measure included 20 items engaging in assessing the occurrence and frequency of PTSD symptoms in relation to the most distressing event experienced by an individual perceived severity about this (*e.g., I have an exaggerated startle response*). This checklist has been used to investigate PTSD among Chinese survivors following natural disasters and has shown good reliability and validity (*e.g. Liu et al., 2016; Wang et al., 2015; Zhen et al., 2016*). In this study, we believe that extremely severe flooding is a traumatic event for our participants. The respondents rated the frequencies of symptoms during the last two weeks on a 4-point scale ranging from 0 (not at all) to 3 (almost always). The scale has four subscales: intrusions, negative cognitions and emotion alteration, avoidance, and hyper-arousal. An overall severity score is generated by summing the four symptom subscale scores. In this sample, the scale demonstrated excellent internal consistency ($\alpha = 0.96$).

Fear. Fear was measured using a modified subjective fear questionnaire. The original questionnaire was developed by Wu, Zhang, Lin and Zang (2013) to assess the degree of fear amongst earthquake victims. The questionnaire consists of items measuring fear or worry about the death or injury of the respondents' parents, or others (*e.g., I fear the death or injury of my parents*). Based on Wu et al.'s (2013) questionnaire, we carried out qualitative interviews with flood victims and found that in addition to fearing or worrying about the death or injury of themselves and family members, the flood victims also seemed to be worried about the loss of property, secondary flooding, and so forth. Based on Wu et al.'s (2013) questionnaire and the results of our interview, we developed a seven-item posttraumatic fear questionnaire (Quan, Zhen, Yao, & Zhou, 2017). Each item of this questionnaire was rated on a 5-point Likert-type scale ranging from 0 (completely disagree) to 4 (completely agree). The respondents rated the degree of fear associated with flooding. The questionnaire had good internal consistency ($\alpha = 0.93$) in this study.

Self-Disclosure. Self-disclosure was measured using the Distress Disclosure Index (DDI; Kahn & Hessling, 2001) which contains 12 items. All items are rated on 5-point Likert scale ranging from 0 (strongly disagree) to 4 (strongly agree). To consider the applicability of the measure for use with Chinese flood victims, In order to use the DDI with Chinese flood victims, we first translated the items into Chinese and then invited a psychology postdoctoral researcher from the Tel Aviv University in Israel to translate the Chinese DDI back into English. The back-translation suggested that the Chinese items retained the

original English meanings. Next, considering applicability for Chinese flood victims, we carried out an interview based on the translated DDI items, and then reworded some of the items according to these interview results. This ensured that all of the item meanings would be clear to participants. For this study, the internal reliability of the modified DDI was good ($\alpha = 0.60$).

Data Analysis Strategies

Statistical analyses were conducted using SPSS 17.0. Before statistical analyses, we conducted an analysis of missing data in variables to assess whether the data was missing at random (MAR), we conducted analyses for all variables, using Little's Missing Completely at random (MCAR) test. The analysis revealed that the data were indeed MAR, $\chi^2(44) = 58.87$, $p = 0.07$. We used lineal imputations to handle cases of missing data.

Descriptive analyses were conducted for all of the measures. Pearson correlations were calculated to examine the associations between the major variables. Statistical analyses were conducted using SPSS 17.0. Sex and age were used as covariates in the following analysis.

Before performing regression analysis, we analyzed whether the sample data meets the linear regression conditions. According to the residual histogram, residual PP plot, and scatter plot trends, the residuals did not significantly deviate from normal, and the samples became a linear trend with positive correlation. The results of the homogeneity of variance test show that the homogeneity of the variance of the sample data and the Cook distance is less than 1 indicate that there are no outliers in the sample. There is no multicollinearity. In summary, the data are considered to meet the linear regression conditions, and stepwise regression analysis can be performed.

To test the moderated mediating effects, five regression equations were established by hierarchical regression (Zhou, Wu, Li, & Zhen, 2016) to examine the roles of fear and self-disclosure on the relationship between traumatic exposure and PTSD. In the first regression equation, we treated PTSD as the dependent variable and traumatic exposure as the independent variable, and our aim was to examine the effect of traumatic exposure on PTSD. In the second equation, we treated fear as the dependent variable and traumatic exposure as the independent variable, with the aim of assessing whether traumatic exposure significantly affected fear. In the third equation, we treated PTSD as the dependent variable and traumatic exposure, self-disclosure and an interaction term (traumatic exposure \times self-disclosure) as the independent variables, with the aim of assessing the direct impact of self-disclosure on PTSD as well as the moderating role of self-disclosure on the relationship between traumatic exposure and PTSD. The fourth equation was the same as the third with the addition of fear as an independent variable, and our aim was to examine the effect of fear on PTSD after controlling for traumatic exposure. This allowed us to examine whether fear played a mediating role in the relationship between traumatic exposure and PTSD. In the final equation, the dependent variable was PTSD and the independent variables were traumatic exposure, self-disclosure, fear and two interaction terms (traumatic exposure \times self-disclosure and fear \times self-disclosure). This equation allowed us to explore the moderating role of self-

disclosure on the relationship between fear and PTSD. All independent variables were centered on their respective means to reduce multicollinearity between the main effects and interaction terms, and to increase the interpretability of the coefficients on interaction terms (Cohen, Cohen, West, & Aiken, 2013).

To test the significance of the indirect effect of traumatic exposure on PTSD via fear, we conducted bias-corrected bootstrap tests with a 95% confidence interval. To test the significance of the moderating role of self-disclosure on the relationship between fear and PTSD, we used the test of simple slopes to further examine the significance of the interaction effect.

Results

Descriptive Statistics and Correlations Among Main Variables

The descriptive statistics of the main variables (flood exposure, fear, self-disclosure and PTSD) were shown in Table 1.

The results of Difference Tests showed that fear among female were higher than male ($t=-2.05$, $p<0.001$), but there were no significant gender differences in other variables. LSD results showed that adolescents group (13-17 years old) were lower than adults group (18-60 years old) among traumatic exposure ($SE=1.08$, $p<0.01$), fear ($SE=1.76$, $p<0.001$) and PTSD ($SE=3.16$, $p<0.01$), lower than older adults group (61-80 years old) among fear ($SE=2.01$, $p<0.01$) and PTSD ($SE=3.93$, $p<0.01$).

— *Insert Table 1 here approximately*—

Gender, age, and degree of traumatic exposure were controlled for in the correlations for PTSD with traumatic exposure, fear, and self-disclosure. The results of the Pearson correlation analyses are shown in Table 2.

Next, Pearson correlations among the main variables were calculated. These analyses found that age had significant positive correlations with fear and PTSD, but not with the other variables. Degree of traumatic exposure was positively related to fear and PTSD, fear was positively related to PTSD, and self-disclosure was negatively related to PTSD.

— *Insert Table 2 here approximately*—

Moderated Mediation Analysis

Table 3 showed the results of hierarchical regression. We found that equations 1 and 2 indicated that traumatic exposure had significant positive predictive effects for PTSD and fear ($\beta=0.31$, $p<0.001$; $\beta=0.19$, $p<0.05$). Equation 3 demonstrated that self-disclosure had a negative predictive effect for PTSD ($\beta=-0.30$, $p<0.001$), but the effect of the interaction term of self-disclosure and traumatic exposure was not significant for PTSD ($\beta=-0.08$, $p>0.05$). This indicated that self-disclosure did not buffer the predictive effect of traumatic exposure on PTSD. Equation 4 suggested that after controlling for the traumatic

exposure, self-disclosure, and their interaction term, fear had a positive predictive effect for PTSD ($\beta=0.27$, $p<0.01$), and traumatic exposure also had a positive predictive effect for PTSD ($\beta=0.31$, $p<0.001$). The results from Equations 4 suggested that fear played a mediating role in the correlation between traumatic exposure degree and PTSD (direct effect of mediation = 0.30, indirect effects of mediation = 0.08).

Equation 5 demonstrated that the interaction item of fear and self-disclosure had a significant negative predictive effect for PTSD ($\beta=-0.18$, $p<0.05$). Thus, self-disclosure played a moderating role in the relation between fear and PTSD. All the results indicated that traumatic exposure directly or indirectly led to PTSD by increasing fear. This mediating pathway was buffered by self-disclosure (Figure 2).

— *Insert Table 3 here approximately*—

— *Insert Figure 2 here approximately*—

Bias-corrected bootstrapping was used to test the significance of the mediating effect of fear, and the results found that fear has a significant mediating role between traumatic exposure and PTSD ($\beta=0.20$, 95% CI= (0.02, 0.43). Simple slope test was used to test the significance of moderating role of self-disclosure. Then, the predictive effect of fear for PTSD was tested after the participants were divided into high self-disclosure (Means+1 Standardized Deviation) and low self-disclosure groups (Means-1 Standardized Deviation) (Figure 3). Results indicated that in the high self-disclosure group, fear did not have a predictive effect for PTSD (Simple slope=0.02, $t=0.07$, $p=0.944$). In the low self-disclosure group, fear had a significant positive predictive effect for PTSD (Simple slope=0.87, $t=2.29$, $p=0.027$) (Figure 3).

— *Insert Figure 3 here approximately*—

Discussion

In this study, we sought to examine the role of fear and self-disclosure in the association between traumatic exposure and PTSD among victims following flood. Firstly, traumatic exposure was found to have positive predictive effects for PTSD and fear, and self-disclosure had negative predictive effects for PTSD. Fear played a mediating role between severity of traumatic exposure and PTSD, self-disclosure buffered the effects of fear on PTSD.

To be specific, we found that traumatic exposure was positively associated with PTSD. This is consistent with previous studies (e.g. Bokszczanin, 2002; Sakuma et al., 2015; Steel et al., 2009; Zhou et al., 2015; Zhen et al., 2016). It suggested that the severity of traumatic exposure is an important factor influencing PTSD (Zhang et al., 2012; Rzeszutek, Oniszczenko, Schier, Biernat-Kaluza, & Gasik, 2016) including incidence, severity, and symptom manifestation (Lowell et al, 2018; Szogi & Sullivan, 2018).

Additionally, we also found that fear was a mediator between severity of traumatic exposure and PTSD, which indicated that the severity of traumatic exposure of flood victims also caused PTSD by increasing fear. Here, experiencing the flood natural disasters, victims may suffer from injury and the loss of properties, which may threaten their safety (e.g., Quan et al., 2017), and cause their fear relating to injury,

death, and in the case of flood victims, flood reoccurrence. The anxiety buffer disruption theory (Tom & Pelin, 2011) proposes that in fearful states, worry and fear will increase sensitivity of individuals to trauma-relevant clues, causing the appearance of intrusive symptoms, and finally may elicit the occurrence of PTSD.

In addition to the finding that fear mediated the traumatic exposure and PTSD, this study also examined the moderating role of self-disclosure between traumatic exposure/ fear and PTSD. Then, the results found that self-disclosure had a significant negative predictive effect for PTSD, which is consistent with previous studies (e.g. Schackner, Weiss, Edwards, & Sullivan, 2017; Stein, Lahav, & Solomon, 2017) and support the unified theory of repression (Erdelyi, 2006), which proposes that the repression of thoughts, feelings, and behaviors is an active process consuming physiological energy. In addition, researchers who are critical of the unified theory of repression argued that the most painful events are sometimes the most difficult to repress (Freyd, 2006), attempts to push unwanted thoughts out of awareness often backfire, enhancing their accessibility (McNally, 2006). Whereas the disclosure of previous traumatic experience decreases the possibility of occurrence of unhealthy psychological outcomes (Hunkin & Chung, 2012). Here, by disclosing the traumatic experiences or emotion, traumatized individual may talk about their experiences with others and reconstruct the understanding on posttraumatic world (Cordova et al., 2007; Lowe, 2006), regain a sense of control over their life (Ullman & Peter-Hagene, 2014), and finally relieve the severity of PTSD.

However, we found that self-disclosure did not significantly moderate the predictive effects of severity of traumatic exposure on PTSD. This may be attributed to the characteristics of the flood victims in this study. In our study, the participants were housed in a temporary shelter, wherein full of the negative emotional atmosphere due to the uncertainty of their life (e.g., Quan et al., 2017). This emotional atmosphere resulted in disclosure to peers with common traumatic experience in shelter, but disclosure of negative emotions to those with shared experience was associated with greater levels of PTSD (Hoyt, et al., 2010; Sippelle, 1992). This result was consistent with a nonspecific model of self-disclosure rather than a stress-specific, which suggests that the effects of self-disclosure are independent of stress exposure (Berg, 1987; Bolton et al., 2003). This finding is also consistent with previously proposed theoretical models (Fontana & Rosenheck, 1994).

Nevertheless, we found that self-disclosure buffered the effects of fear on PTSD. Specifically, in the high self-disclosure group, the predictive effect of fear for PTSD was not significant. This may be attributable to observations that individuals with high levels of self-disclosure were inclined to disclose their negative emotion (Hoyt, et al., 2010; Ullman & Peter-Hagene, 2014), wherein fear may be released, such that the effect of fear on PTSD may be reduced. Therefore, individuals with high levels of self-disclosure are more willing and able to express negative feelings, thus buffer the effect of fear on PTSD (Bolton et al., 2003). This is considerable evidence that disclosures during distressing times have a positive effect on health and wellbeing (Petronio, 2002). According to the catharsis theory (Derlaga & Berg, 1987; Nichols & Efran, 1985), victims of stress, trauma are less likely to become depressed if they confide their feelings in trusted others. Most modern analysts also believe that catharsis is a useful way to resolve symptoms

that derive from acutely traumatic incidents (Allen, 2008; Stiles, 1987). Exposure theory (e.g., Bootzin, 1997), cognitive-processing theory (Pennebaker, 1993), and the social integration model (Pennebaker & Graybeal, 2001) have attempted to explain the positive effects by suggesting that disclosure of trauma promotes habituation to trauma-related emotions.

In the low self-disclosure group, the stronger the experience of fear and the more severe PTSD was found to be. This may be explained by arguments that low disclosure of negative emotion can increase arousal levels (Freed & D'Andrea, 2015), induce generation of negative emotions (Maercker & Horn, 2013), and damage cognitive function (Ponnamperuma & Nicolson, 2016). Individuals with low levels of self-disclosure tend to repress and avoid negative experiences and emotions (e.g., fear) (Tedeschi & Calhoun, 2004; Purves & Erwin, 2004), the repression of traumatic cognitions and negative emotions will reduce an individual's ability to effectively regulate emotions, and thus, increase the stress of traumatized individual with more fear, and thus may increase the opportunity of the occurrence of PTSD. This is consistent with previous studies (e.g. the fever model) that emphasize the failure or inhibition of the disclosure of emotional material is related to poorer health outcomes (Stiles, 1987; Esterling, L'Abate, Murray, & Pennebaker, 1999).

Several limitations to the present study should be noted. First, as a cross-sectional study, the results cannot test whether there were causal relationships between the variables. Second, although the study have a randomized recruitment, some victims worried about the stigmatization of participating in the survey because of the limitation of their educational level. Therefore, we only selected voluntary participants to participate in this study, which made our sample small and self-selective. Third, for Distress Disclosure Index (the instrument of self-disclosure), we calculated a Cronbach's alpha of 0.6, it may be related to the responses of the participants. Moreover, except for "flood traumatic exposure", participants' other/previous traumatic events/experiences have not been assessed in this study. There may be a dose-response relationship between a history of traumatic experiences and the current PTSD score, future studies with larger samples should integrate history of traumatic experiences and other possible influencing variables in multivariate analyses.

Notwithstanding these limitations, this study contributes to extant knowledge concerning the relationship between traumatic exposure and PTSD. Our findings expand upon those from previous research by exploring the combined effects of fear and self-disclosure. This study also highlights important implications for survivors of flooding from a clinical and health-enhancement perspective. Psychological counseling or psychotherapy should focus on the regulation of fear and improvement of self-disclosure following traumatic exposure. Thus, government and social organizations should provide information about disasters to alleviate uncertainty and fear (Koivula, Paunonen, Tarkka, Tarkka, & Laippala, 2002), which in turn can lead to less PTSD. It is necessary to eliminate the atmosphere of fear experienced by people following natural disasters such as floods. These findings suggest that the efficacy of interventions for trauma may be improved by incorporating techniques and principles from emotion-focused therapies to address fear of emotion (Lis et al., 2020). Meanwhile, encouraging victims to

express their feeling and increasing their levels of self-disclosure are very important for the success of interventions.

Conclusions

1. Traumatic exposure had positive predictive effects for PTSD and fear.
2. Self-disclosure had negative predictive effects for PTSD.
3. Fear mediated the relationship between trauma exposure and posttraumatic stress disorder, whereas self-disclosure moderated the relationship between fear and posttraumatic stress disorder. Trauma exposure has a direct positive impact on PTSD, but also indirectly affects PTSD through fear. Moreover, fear positively predicted PTSD under conditions of self-disclosure, whereas this effect was not significant when self-disclosure was high.
4. From a clinical and health-enhancement perspective, interventions or psychotherapy for survivors of flooding should focus on the regulation of fear and improvement of self-disclosure following traumatic exposure.

Abbreviations

Posttraumatic stress disorder = PTSD

Distress Disclosure Index = DDI

Declarations

-Ethics approval and consent to participate

This study was approved by the Research Ethics Committee of Anhui Normal University.

We gathered the victims together with the help of the administrators based there and introduced the purpose of our investigation. The voluntary nature of participation in the study was emphasized and, after ensuring that individuals understood the purpose of the study, we asked for volunteers to participate. Because the participants included both adults and adolescents, their verbal informed consent was obtained from adult participants directly and from the parents/guardians of adolescent participants. On the one hand, most of the volunteers who participated in the experiment were not very high-educated or so young, and could not write their own names, we have obtained the consent of their parents or guardians. On the other hand, because the written consent was given, the participants felt that confidentiality was difficult to guarantee. Therefore, the professional testers have adopted the method of obtaining verbal consent instead of written consent.

-Consent to publish

Not Applicable

-Availability of data and materials

For the data of this study, the authors do not want to share them.

Because the authors promise that the volunteers who participate in the research will not use their results for other purposes than academic research, and the share of data will not guarantee that the users' use is in line with our commitment to the participants.

In addition, the data involved in this paper are part of a large research database. The publication of relevant data in this paper will affect the innovation and confidentiality in later research.

The datasets used during the current study are available from the corresponding author (Professor Qingsong Sang) on reasonable request.

-Competing interests

The authors have no Competing interests to declare.

-Funding

No funding was associated with the preparation of this manuscript.

-Authors' Contributions

LQ designed the concept and drafted the manuscript.

BL confirmed that data/figures/materials/code presentation accurately reflects the original.

XZ analyzed and interpreted the data.

GH improved the expression of the article and revised the citations.

QS: corresponding author. He has ensured that all listed authors have approved the manuscript before submission, including the names and order of authors, and that all authors receive the submission and all substantive correspondence with editors, as well as the full reviews, verifying that all data, figures, materials.

All authors read and approved the final manuscript.

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Tables

Table 1 Difference Test in Gender and Age among Main Variables

	Gender			Age (years old)			LSD
	male	female	t	13-17 □	18-60 □	61-80 □	
Traumatic exposure	15.25±5.09	15.53±5.50	-0.34	13.07±5.42	16.32±5.19	14.47±4.80	□<□
Fear	19.59±8.37	22.12±5.20	-2.05*	15.20±8.91	21.61±6.33	21.21±7.83	□<□,□
Self-	25.87±9.03	26.58±9.65	-0.48	26.72±9.28	26.49±8.28	24.47±12.11	-
disclosure							
PTSD	18.42±14.87	22.19±14.79	-1.54	12.23±10.59	21.46±14.12	24.52±17.69	□<□,□

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Table 2 Correlation analyses for PTSD with degree of traumatic exposure, fear, and self-disclosure

	M±SD	1	2	3	4	5
1. Gender	--	1.00				
2. Age	41.16±19.37	0.00	1.00			
3. Traumatic exposure	15.38±5.26	0.02	0.07	1.00		
4. Fear	20.63±7.37	0.18*	0.18*	0.18*	1.00	
5. Self-disclosure	26.02±9.12	0.03	-0.07	0.08	-0.12	1.00
6. PTSD	20.52±14.51	0.13†	0.22**	0.32**	0.44**	-0.26**

Note: † $p < 0.08$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3 Test- series regression analyses of regulatory mediating effects

	Equation 1		Equation 2		Equation 3		Equation 4		Equation 5	
	PTSD		Fear		PTSD		PTSD		PTSD	
	β	<i>t</i>	β	<i>t</i>	β	<i>t</i>	β	<i>t</i>	β	<i>t</i>
Gender	0.13	1.84 [†]	0.14	1.64	0.18	2.47*	0.11	1.33	0.06	0.76
Age	0.22	3.09**	0.22	2.59*	0.18	2.48*	0.19	2.46*	0.17	2.20*
Traumatic exposure	0.31	4.30***	0.19	2.26*	0.31	4.33***	0.30	3.91***	2.29	3.91***
Self-disclosure					-0.30	-4.11***	-0.29	-3.87***	-0.29	-3.94***
Traumatic exposure × self-disclosure					-0.08	-1.10	-0.10	-1.26	-0.04	-0.55
fear							0.27	3.36**	0.30	3.83***
Fear × self-disclosure									-0.18	-2.32*
R^2	0.18		0.11		0.27		0.36		0.39	
F	11.43***		5.37**		10.36***		10.63***		10.22***	

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Figures

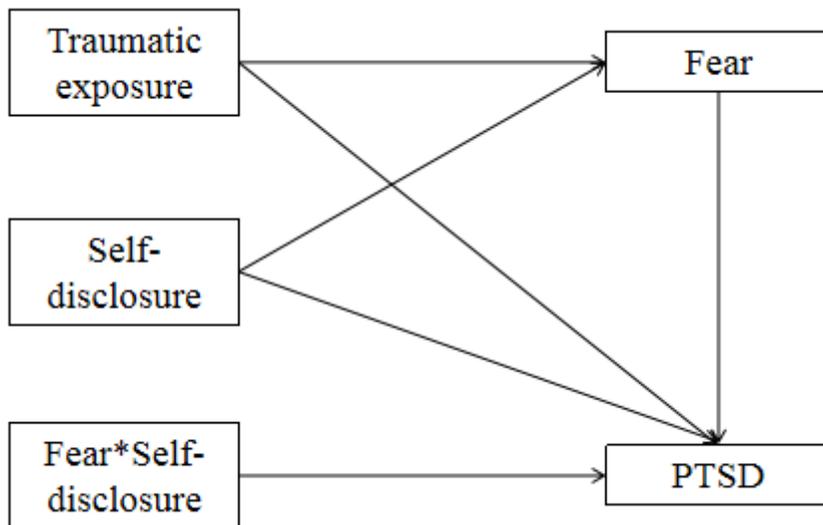


Figure 1

Proposed moderated mediation

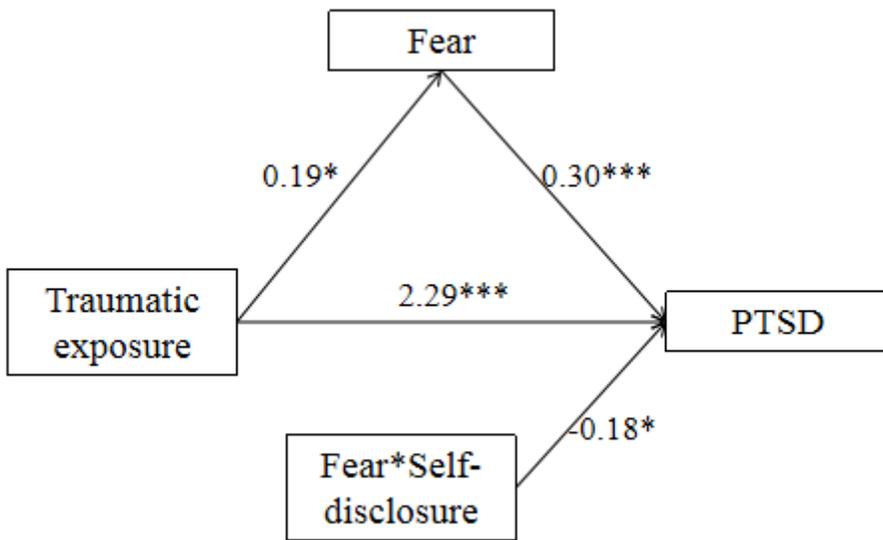


Figure 2

Moderated-mediation effect model among traumatic exposure, fear, self-disclosure, and PTSD PTSD = posttraumatic stress disorder; * $p < 0.05$, *** $p < 0.001$.

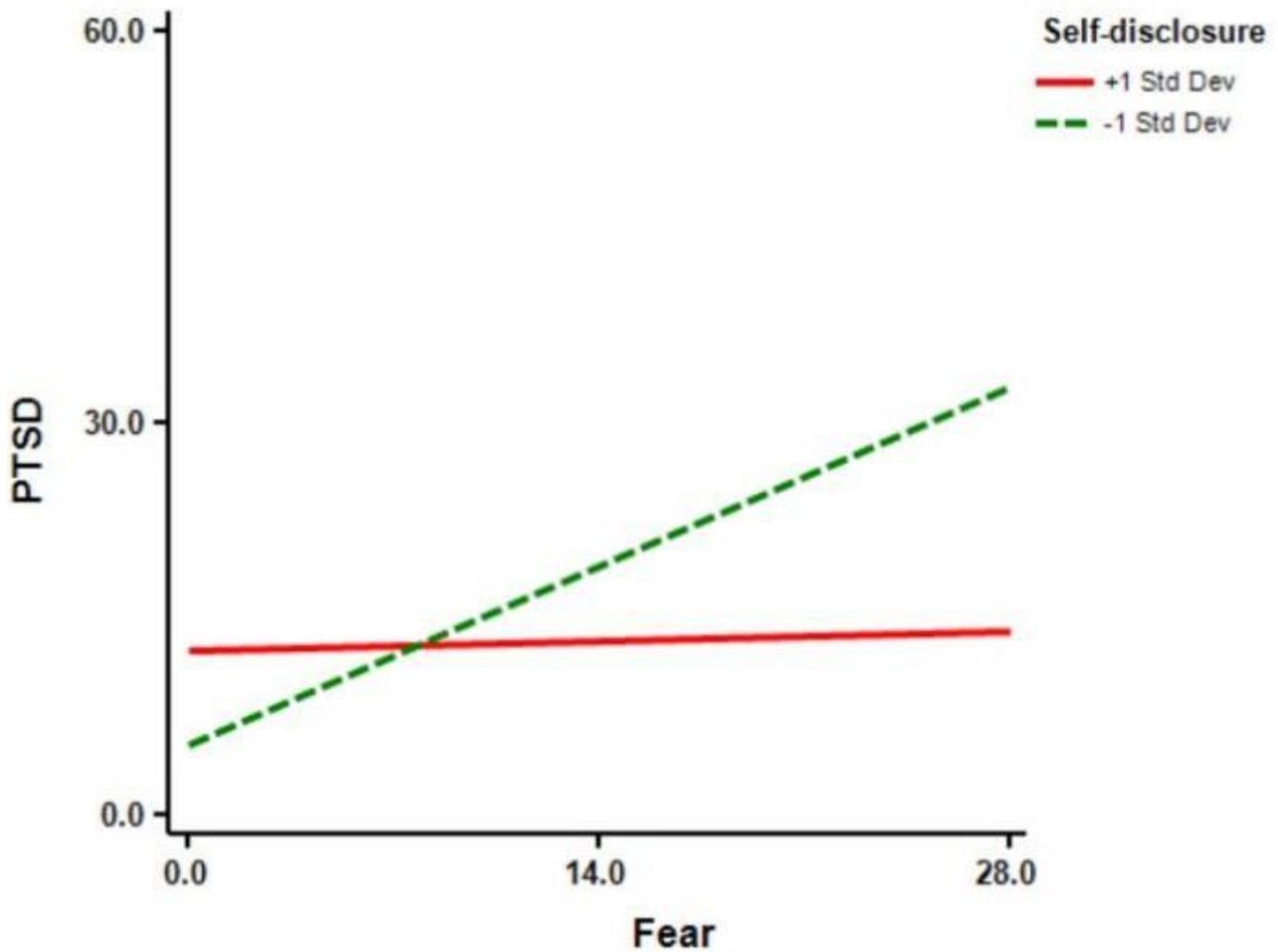


Figure 3

Predictive effect analysis of fear for PTSD under different self-disclosure levels