

# Beyond Resilience and PTSD: Mapping the Heterogeneity of Responses to Potential Trauma

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The formal acceptance of posttraumatic stress disorder (PTSD) as a legitimate diagnostic category in the 1980 *Diagnostic and Statistical Manual of Mental Disorders* stimulated a torrent of research on psychological trauma. Not surprisingly, PTSD and its treatment had dominated that research. Another common approach has been to measure the average impact of different potentially traumatic events, as well as the factors that inform that impact. In this article, we consider the limitations of these perspectives and argue for a broader theoretical approach that takes into account the natural heterogeneity of trauma reactions over time. To that end, we review recent attempts to identify prototypical patterns or trajectories of trauma reaction that include chronic dysfunction, but also delayed reactions, recovery, and psychological resilience. We consider the advantages but also the limitations and ongoing controversies associated with this approach. Finally, we introduce promising new research that uses relative sophisticated advances in latent growth mixture modeling as a means of empirically mapping the heterogeneity of trauma responses and consider some of the implications of this approach for existing trauma theories.

*Keywords:* resilience, PTSD, trauma trajectories, grief

Bad things happen. Epidemiological data indicate that most people experience at least one and usually several potential traumas during the normal course of their lives (Breslau, Davis, Peterson, & Schultz, 2000; Copeland, Keeler, Angold, & Costello, 2007; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995; Norris, 1992). But not everyone confronted with such events reacts the same way. Some people are debilitated. Others struggle for months and then gradually recover. Some experience only temporary disruptions in functioning, and some cope remarkably well. That there would be a diversity of responses to potential trauma seems obvious. Yet, until recently, trauma researchers and theorists have paid relatively little attention to the full range of possible reactions exposed individuals might have (Bonanno, 2004).

This article is about individual differences. We begin by reviewing the two fundamental approaches to trauma outcome that have thus far dominated the field: the focus on psychopathology and on average levels of functioning. We consider the advantages and limitations of these approaches and then introduce a broader model of individual differences that focuses on common or prototypical trajectories of trauma response, including chronic dysfunction but also resilience to trauma. Although the trajectory approach has led to considerable advances in our ability to map the heterogeneity of trauma outcomes, there remain a number of key but unresolved definitional issues. Finally, we consider promising statistical ad-

vances that identify discrete and individually varying latent growth trajectories on an almost purely empirical basis. We close by reviewing several recent studies that have used the latent growth mixture modeling approach to identify heterogeneous patterns of stress responding.

## Traditional Approaches to Trauma Outcome

When bad things happen, people suffer. Some people require assistance and some require psychological intervention. Management of the treatment needs of those exposed to psychological trauma creates an obvious public health imperative. The trauma field has approached this need in two fundamental ways. The most prominent approach has been to focus on identification and treatment of trauma-related psychopathology. The second approach has focused on mapping the average response to traumatic events as a means of addressing their broader societal impact.

## Psychopathology

Folk theories about the origins of psychological trauma have existed for millennia (Daly, 1983; Shay, 1991); however, it was not until the late 19th century that formal theoretical models about the links between violent or life-threatening events and psychological and physiological dysfunction began to emerge (Ellenberger, 1970; Lamprecht & Sack, 2002). For most of the 20th century, trauma theory remained mired in controversy over definitional and etiological issues, especially in the context of war-related dysfunction where the possibility of malingering had been an ongoing concern (Lamprecht & Sack, 2002; Shepard, 2001). Initial theories about war trauma leaned heavily on the idea that trauma-related dysfunction resulted from personal weaknesses within the exposed individual, as for example in Kardiner's (1941)

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concept of *traumatic neuroses*. Over time, however, as medical research began to detail the caustic impact of extreme stress on normal human functioning (Selye, 1956), and as the scale of global conflicts in the 20th century increased awareness of the ways that war-related stress affects soldier's experience (Keegan, 1976), consensus gradually began to emerge that extremely aversive events by themselves could be a primary source of psychological trauma.

This trend culminated in 1980 when the American Psychiatric Association formalized posttraumatic stress disorder (PTSD) as a legitimate diagnostic category. The change filled a crucial gap in public health knowledge about the impact of trauma. In addition to its diagnostic relevance, the PTSD category also helped consolidate and promote a surge of new research on traumatic stress (McNally, 2003) and has greatly advanced our understanding of the etiology, prevalence, neurobiology, and treatment of extreme trauma reactions (Brewin, Andrews, & Valentine, 2000; Dalglish, 2004; Foa & Rothbaum, 1998; Ozer, Best, Lipsey, & Weiss, 2003).

The potency of the PTSD diagnosis to stimulate inquiry has come at a cost, however. Excessive reliance on a single diagnostic entity, for example, tends to exacerbate definitional controversies and problems. Following the third edition of the *Diagnostic and Statistical Manual of Mental Disorders (DSM)*; American Psychiatric Association, 1980), criteria for PTSD gradually expanded in an attempt to lend greater weight to the subjective experience of trauma. The expanded criteria lowered the threshold for PTSD, however, which potentially renders the diagnosis less valid (McNally, 2003). In a related vein, studies that have examined the latent structure of PTSD symptoms using taxometric analyses have consistently supported a dimensional rather than a categorical structure (Broman-Fulks et al., 2006; Ruscio, Ruscio, & Keane, 2002). These analyses make the compelling case that PTSD is best understood as a continuous dimension ranging from mild to severe trauma rather than as a discrete clinical category; thus, any diagnostic cutpoint we might use will to some extent be arbitrary.

The nearly exclusive focus on PTSD in both the lay and professional literatures also has tended to obscure the broader diversity of responses people exhibit following potentially traumatic events. For example, PTSD typically evidences marked comorbidity with other forms of psychopathology, most notably depression. How and why these different diagnostic indicators might covary over time is poorly understood, and there are not yet sufficient data to adjudicate among competing explanations. Some evidence suggests, for example, that depression and PTSD can originate from the same etiological source (e.g., Breslau et al., 2000). However, depression may arise subsequent to PTSD as a reaction to the failure to recover (Gilboa-Schechtman & Foa, 2001). It is plausible as well that depressive cognition may precede and in some cases play a causal role in the development of PTSD (Bryant & Guthrie, 2007).

The dominant emphasis on PTSD also meant that much of the existing literature on trauma has been couched in relatively simplistic terms as a binary distinction between pathology versus the absence of pathology. Not only does this kind of simplified view tell us little about normative reactions to trauma, it has had the additional consequence of limiting data gathered on broader aspects of adjustment. When research questions are operationalized in terms of the binary presence or absence of pathology, the types of data that might help flesh out the broader aspects of normative

trauma reactions (e.g., data on continuous symptom and adjustment measures across a range of different levels of exposure) are likely to be ignored. As a result, until recently relatively little was known about the nature of the distribution of posttraumatic stress reactions across time or whether the relative absence of trauma reactions was best understood as an aberration or as a form of superordinate health (Bonanno, 2004).

### Average Trauma Reactions

A common alternative approach used to understand trauma and other stressful life events is to compare group differences in the average response on a continuous measure of trauma-related adjustment. Typically, such comparisons cut across exposed and nonexposed groups. Although this approach is relatively uninformative at the level of "caseness" for PTSD, the use of continuous measures is parsimonious and avoids some of the conceptual and statistical limitations of the PTSD category.

One potentially useful application of averaged scores on a continuous measure is in estimation of the duration of the post-traumatic impact. The prevalence of survivors meeting criteria for PTSD typically declines precipitously during the first year after the antecedent event and then gradually tapers to a persistent minority of individuals who suffer from chronically elevated symptoms (Breslau, 2001). Continuous measures of PTSD symptoms and PTSD-related distress also evidence a tapering pattern. However, the greater variability in continuous data allows for more fine-grained predictive analyses over time. For example, a study of Italian earthquake survivors reported that 10 years after the disaster, PTSD-like symptoms were greater among survivors who experienced physical damage or had been evacuated as a result of the earthquake compared with survivors who did not experience these kinds of exposure (Bland et al., 2005).

A variant on the average approach is to examine within-group predictors of variability on continuous measures of trauma-related adjustment. This approach is useful, for example, in treatment efficacy studies (e.g., Brady et al., 2000; Paunovic & öst, 2001) and in studies determining aspects of trauma exposure or other risk factors that promote the development of PTSD symptomatology (e.g., Vogel & Marshall, 2001; Wagner, Heinrichs, & Ehler, 1998). Analyses of continuous predictors of trauma severity and impairment have proved to be particularly informative in meta-analyses that summarize data across multiple studies (e.g., Norris et al., 2002).

As was the case with the binary PTSD category, however, the assessment of trauma reactions in terms of average responses on continuous measures also has its limitations. For example, like the PTSD diagnosis, comparison of average levels of adjustment provides relatively little information about the distribution of trauma reactions. In the absence of additional statistical data, means and standard deviations by themselves are uninformative and potentially misleading, often with potentially serious real-world consequences. For example, in the study of earthquake survivors discussed above, it was reported that 10 years after the earthquake, 30% of the highly exposed survivors still "reported symptoms of Posttraumatic Stress Disorder (PTSD)" (Bland et al., 2005, p. 420). In the absence of normative data on distribution of PTSD symptoms in this population, however, the meaning of "having symptoms" of PTSD is unclear. A number of the individual PTSD

symptoms listed in the *DSM* are nonspecific with reference to the target event (e.g., difficulty sleeping), and even in the absence of a recent stressor, some people will nonetheless report these symptoms (Bonanno, Galea, Bucciarelli, & Vlahov, 2006). Thus, the observation that one group has some “symptoms” of PTSD carries relatively little meaningful clinically information.

### Prototypical Trajectories of Trauma Outcome

When we examine the full range of trauma-related adjustment across multiple points in time, a very different picture begins to emerge. Indeed, the variability in how people adapt to traumatic events suggests that the term *traumatic* is something of a misnomer. To underscore this variability, we advocate using the phrase *potentially traumatic event* or PTE (Bonanno, 2004; Norris, 1992) because, in fact, most people exposed to PTEs cope remarkably well (Bonanno, 2004, 2005; Bonanno & Mancini, 2008). Although some do in fact endure lasting emotional difficulties, the vast majority of people exposed to extreme adversity recover a semblance of their normal level of functioning within several months to several years after the event, and many if not most show little evidence of more than transient disruptions in functioning.

The failure of traditional trauma theory to accommodate the full range of adjustment in the aftermath of acute adversity can be attributed at least in part to misconceptions about the nature of the underlying variability in change across time. Traditional approaches to trauma, including the binary distinction between pathology versus the absence of pathology, are rooted in the assumption that aversive life events produce a single *homogeneous* distribution of change over time (Duncan, Duncan, & Strycker, 2006; Muthén, 2004). Noncategorical approaches to trauma, such as those that assess variability in average levels of functioning, as discussed earlier, nonetheless also tend to carry forth this same assumption that the underlying distribution is homogeneous.

In recent years, however, that picture has begun to change. In stark contrast to traditional assumptions of homogeneity, recent conceptual (Bonanno, 2004; Mancini, Bonanno, & Clark, 2009) and statistical (Curran & Hussong, 2003; Jung & Wickrama, 2008; Muthén & Muthén, 2004) advances have dramatically underscored the natural *heterogeneity* of human stress responding. This research has identified multiple, unique trajectories of adjustment in the aftermath of PTEs. The initial research on trajectories relied on relatively simple deductions about change based on the statistical properties of the normal distribution. Subsequent research, which we describe later in this article, adopted more sophisticated computational techniques that made it possible to derive latent trajectories of growth across time. Despite the simplicity of the initial forays, however, the same basic longitudinal and prospective patterns emerged across the different methods and across different kinds of target stressors, including the death of a loved one (Bonanno, Moskowitz, Papa, & Folkman, 2005; Bonanno et al., 2002; Bonanno, Keltner, Holen, & Horowitz, 1995), terrorist disaster (Bonanno, Rennicke, & Dekel, 2005), and radiation treatment for breast cancer (Deshields, Tibbs, Fan, & Taylor, 2006).

Empirical studies using the basic trajectory approach indicate that most of the variability in response to PTEs across time can be captured by four prototypical trajectories: chronic dysfunction, gradual recovery, delayed reactions, and a relatively stable trajectory of

healthy functioning or resilience (Bonanno, 2004). We illustrate these trajectories graphically in Figure 1 and elaborate each below.

### Chronic Dysfunction

Estimating trajectories of chronic dysfunction in the aftermath of PTEs is relatively straightforward. The most common method of course is to assign chronicity using existing *DSM* diagnostic criteria for the relevant categories of psychopathology. It is well established, for example, that only a relatively small subset of those exposed to PTEs will eventually develop chronic pathological reactions. However, given the limitations and conceptual issues surrounding diagnostic categorization, discussed above, an alternative approach is to estimate chronic trajectories of dysfunction on the basis of the normal distribution of scores on relevant continuous measures of adjustment. For example, reliable and valid scales are available for the measurement of complicated grief (e.g., Inventory of Complicated Grief; Prigerson et al., 1995), depression (e.g., Center for Epidemiological Studies Depression scale; Kohut, Berkman, Evans, & Koronoi-Huntley, 1993), and posttraumatic stress (e.g., PTSD Symptom Scale, Self-Report; Foa, Riggs, Dancu, & Rothbaum, 1993), and these measures have well-established cutpoints for clinically relevant elevations.

The use of cutpoints on continuous measures of adjustment holds several advantages over diagnostic categorization. For example, the designation of the cutoff point represents a statistical rather than conceptual extreme. The boundary for elevated symptom levels can also be adjusted to fit the distribution of specific populations (e.g., Bonanno, Rennicke, & Dekel, 2005). In other words, if we accept that cutpoints are to some extent arbitrary (Davis, 1999; Robins, 1990), then it is defensible to tailor the boundary between normative and elevated dysfunction on the basis of a population of similarly exposed individuals. In this case, the cutpoint reflects elevated symptoms and distress *relative* to others who have endured the same event. Finally, the designation of a boundary for symptom elevations on a continuous measure does

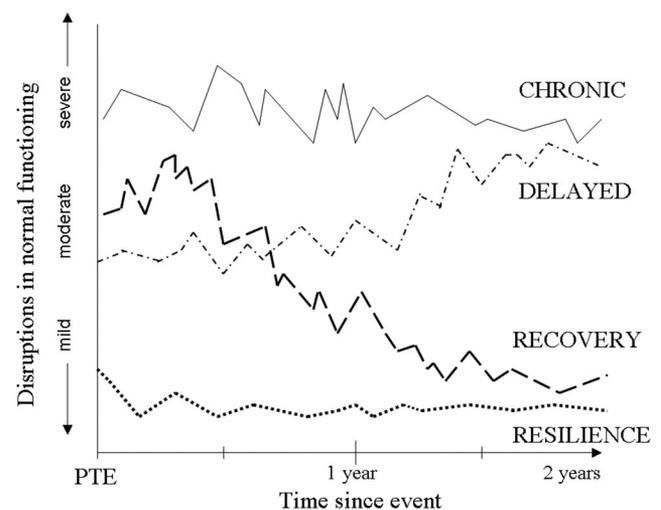


Figure 1. Prototypical patterns of disruption in normal functioning across time following potentially traumatic events (PTEs). Adapted with permission from Bonanno (2004).

not rely on or necessarily imply a taxometric classification. In other words, scores above a designated marker on a given measure can be conceptualized simply as chronically elevated levels of dysfunction rather than as conceptually and experientially distinct clinical syndromes with unique sequelae (Ruscio et al., 2002). We hasten to point out that the use of cutpoints does not deny the existence or relevance of clinically defined syndromes. Rather, this approach simply decouples the issue in favor of identifying statistically chronic dysfunction.

### Delayed Reactions

Delayed reactions to extreme stress have traditionally been assumed to be a consequence of inhibition or denial. In the bereavement literature, for example, it is widely assumed that when there is an absence of overt signs of grieving, the grief will eventually surface in the form of delayed grief reactions (Bowlby, 1980; Deutsch, 1937; Osterweis, Solomon, & Green, 1984; Parkes & Weiss, 1980; Rando, 1993; Sanders, 1993). Despite the prevalence of this belief, solid empirical evidence for delayed grief has yet to be produced (Bonanno & Kaltman, 1999; Wortman & Silver, 1989), even in longitudinal studies explicitly designed to capture the phenomenon (Bonanno & Field, 2001; Bonanno et al., 2002; Middleton, Burnett, Raphael, & Martinek, 1996). By contrast, delayed PTSD reactions following PTEs, although infrequent, have been empirically verified (Bonanno, Rennie, & Dekel, 2005; Buckley, Blanchard, & Hickling, 1996). However, in contrast to the traditional idea that delayed reactions follow a pattern of complete denial to full-blown pathology, the longitudinal pattern associated with delayed PTSD is more accurately characterized as subthreshold PTSD that tends to worsen over time (Andrews, Brewin, Philpott, & Stewart, 2008; Bonanno, Rennie, & Dekel, 2005; Buckley et al., 1996).

### Recovery

Although it goes without saying that most people eventually regain some semblance of normalcy following the disruption caused by psychological trauma, the actual pathway by which people “recover” has received surprisingly little empirical study. Typically, recovery has been discussed at the global level, for example, as the gradual decline over time in either caseness for PTSD (e.g., Breslau, 2001; Rothbaum, Foa, Riggs, Murdock, & Walsh, 1992) or average symptom levels (e.g., Port, Engdahl, & Frazier, 2001). However, as informative as these data may be, they tell us little about individual trajectories of recovery.

Bonanno (2004) provided one possible definition of individual recovery as “a trajectory in which normal functioning temporarily gives way to threshold or subthreshold psychopathology (e.g., symptoms of depression or Posttraumatic Stress Disorder (PTSD)), usually for a period of at least several months, and then gradually returns to preevent levels. Full recovery may be relatively rapid, or may take as long as one or two years” (p. 20).

### Resilience

The dominance of trauma theory by the focus on PTSD and on average levels of PTSD symptoms meant that until recently relatively little was known about psychological resilience to trauma. In

the absence of data on the normal distribution of trauma reactions, it was widely assumed that people who with only minimal response to loss or potential trauma were rare and either dysfunctional (e.g., Osterweis et al., 1984) or exceptionally healthy (e.g., Tucker et al., 2002). It is now unambiguously clear that neither of these assumptions is correct. Recent research into the nature of resilience has consistently shown that resilient people are neither exceptional nor pathological, and that the ability to maintain normative or baseline levels of functioning is not rare but often the most common response to potential trauma (Bonanno, 2004, 2005; Bonanno & Mancini, 2008).

The idea that resilience in the face of adversity might be a characteristic of normal human functioning is not new. Developmental theorists have been espousing this view for decades. Since the 1970s, in fact, pioneering researchers have been documenting the large number of children who managed to reach normal healthy developmental milestones despite growing up in caustic socioeconomic circumstances (e.g., poverty, chronic abuse; Garnezy, 1991; Murphy & Moriarty, 1976; Rutter, 1979; Werner, 1995). A surprising feature of this work was that resilience in at-risk children turned out to be common (Masten, 2001). Whereas traditional deficit-focused models of development had assumed that only children with remarkable coping ability could thrive in adverse contexts, a growing body of evidence began to suggest that resilience is a result of normal human adaptational mechanisms (Masten, 2001). Although most of this research focused on enduring aversive contexts, rather than isolated PTEs, the implications for adult resilience are obvious.

During the later half of the 20th century, there were scattered reports of widespread resilience in the adult trauma literature (e.g., Janis, 1951; Rachman, 1978). It is important to note, however, that as the construct of adult resilience gained currency, the differences between resilient outcomes in adults and children have become more apparent (Bonanno, 2004, 2005). One of the key differences hinges on the temporal and sociocontextual characteristics of stress and adaptation at different points in the life span. For developing children, healthy adaptation is a complex issue (Luthar, Cicchetti, & Becker, 2000; Masten, 2001). At-risk children may evidence competence in one domain but fail to meet long-term developmental challenges in other domains (Luthar, Doernberger, & Zigler, 1993).

By contrast, for adults exposed to a PTE, this situation is arguably more straightforward. The majority of PTEs adults confront are isolated stressor events (e.g., a serious injury) that occur in a broader context of otherwise normative (i.e., low stress) circumstances. There may be concomitant stressors accompanying or extending the PTE (e.g., change in social network or financial situation), but this level of variability can typically be measured with a reasonable degree of reliability. These considerations, together with the fact that developmental variations are less pronounced in adults, mean that adult responses to PTEs can usually be assessed in terms of deviation from or return to normative (baseline) functioning (Carver, 1998) rather than in terms of more abstract developmental milestones.

Expanding on these considerations, Bonanno (2004) defined *resilience* in adults faced with PTEs as the ability of individuals “in otherwise normal circumstances who are exposed to an isolated and potentially highly disruptive event such as the death of a close relation or a violent or life-threatening situation to maintain rela-

tively stable, healthy levels of psychological and physical functioning . . . as well as the capacity for generative experiences and positive emotions” (pp. 20–21). A key point in this definition is that even resilient individuals may experience at least some form of transient stress reaction that will be mild to moderate in degree and will not significantly interfere with their ability to continue functioning (Bisconti, Bergeman, & Boker, 2006; Bonanno, Moskowitz, et al., 2005; Bonanno et al., 2002; Ong, Bergeman, Bisconti, & Wallace, 2006). For example, resilient individuals may have difficulty sleeping or experience intrusive thoughts or memories of the event for several days or even weeks, but they nonetheless continue to function at more or less normative (baseline) levels.

A crucial but as yet unresolved definitional issue in the empirical study of resilience to PTEs pertains to the temporal window used to identify the pattern. As we noted above, developmental researchers have tended to define resilient outcomes distally, in reference to milestones at nodal points in development. This approach necessarily allows for a broad temporal window. A child may be considered resilient even if he or she struggles for months or even years before finally achieving a healthy level of adjustment. By contrast, in research on adults faced with isolated stressors, resilience is defined in terms of the person’s ability to continue functioning at baseline or pre-event levels. This approach requires a more proximal temporal window.

A number of recent studies have addressed this issue. For example, in their study of high-exposure survivors of 9/11, Bonanno, Rennick, and Dekel (2005) defined a resilient trajectory in terms of consistently low levels of posttraumatic stress and depression. Unfortunately, because the initial assessments in that study were not carried out until 7 months after the attack, it was not possible to ascertain the extent to which participants may have struggled prior to that point. It is important to note, however, that participants were also assigned to trajectories on the basis of ratings from friend informants. The narrative description given to the friend informants for resilience specified that the participant being evaluated should have returned to his or her normal level of emotional and behavioral functioning “within one or two months after September 11th” (p. 998).

A similarly narrow temporal window for resilience was examined by Bonanno, Galea, Bucciarelli, and Vlahov (2006, 2007) in their study of resilience after 9/11. This study reported on the full range of trauma symptoms obtained on a representative sample of New Yorkers across the first 6 months after 9/11. Depending on their level of exposure, approximately one third to two thirds of sample could be reliably characterized as resilient. These data were based on cumulative PTSD symptom interviews conducted at 1 month, 4 months, and 6 months post-9/11. Although each wave of assessments used a different set of participants, the data across assessments were highly reliable across assessments and suggest that the proportion of resilience in the sample was relatively constant.

### Resilience Versus Resistance

The studies reviewed above, and in particular the findings reported by Deshields et al. (2006), clearly suggest that many exposed individuals are able to maintain a relatively stable trajectory of healthy resilience, and that even in the immediate aftermath

of a PTE these individuals will experience few or no symptoms of psychopathology. Some investigators have proposed recently that this pattern is more accurately labeled as *resistance* (Layne, Warren, Shalev, & Watson, 2007) and that the term *resilience* should be reserved for a pattern of “initial symptoms followed by recovery” (Hobfoll, Palmieri, et al., 2009, p. 139). We would suggest that this is little more than a semantic nuance. The conflation of resilience with recovery, which we have argued represents two distinct trajectories, most likely arises from conceptualizing trauma within the more distal temporal window typically employed in developmental models. Although we concede that there is merit in attempting to integrate the adult and child literature, the data on resilience in adults exposed to acute PTEs clearly suggest a different trajectory than we might expect from children exposed to chronic adversity. And indeed, the only empirical study (Hobfoll et al., 2009) we know of to use the term *resistance* to describe adult adjustment was in fact describing chronic rather than acute adversity.

There are no currently sufficient empirical data to resolve this issue. What is needed are studies that assess mental health and functioning repeatedly, beginning in the immediate aftermath of a potential trauma. We report below several studies that meet this criterion. These studies uniformly identify a single trajectory of stable healthy functioning. Whether this trajectory is best labeled *resilience* or *resistance* seems a minor issue. Indeed, until more data become available, we might refer to this trajectory as *resilience–resistance*. The crucial distinction, from our perspective, is that resilience–resistance can be distinguished from the more protracted recovery pattern characterized by moderate to severe disruptions in functioning followed by gradual return to baseline.

### Modeling Latent Growth Trajectories

The semantic debate over whether a trajectory of stable healthy adjustment in the aftermath of a PTE might more aptly be termed *resilience* or *resistance* points to an ongoing methodological conundrum: The form such a trajectory takes depends to a large extent on how it is defined. Given the admittedly primitive operational definitions that have characterized the initial research forays on resilience, one can easily imagine this question devolving into an endlessly circular debate. Fortunately, recent advances in statistical procedures for modeling growth across time provide a ready solution. It is now relatively simple to identify prototypical trajectories of change on an almost purely empirical basis. In other words, the trajectories emerge from the data rather than being imposed on them by a priori conceptual models. This approach then makes it possible to identify naturally occurring trajectories of both resilience–resistance and chronic dysfunction, as well as trajectories of change across time, including various possible patterns of recovery or delayed reactions.

Our research team has recently begun to employ latent growth mixture modeling (LGMM; Muthén & Muthén, 2004), a sophisticated statistical approach that is uniquely suited to identifying multiple unobserved trajectories in the data. LGMM extends conventional latent trajectory approaches (Curran & Hussong, 2003) by identifying groups or classes of individuals, each of which represents a distinct multivariate normal distribution. In effect, LGMM tests whether the population under study is composed of a mixture of normal distributions, each of which describes a sub-

population with a distinct trajectory of functioning across time that can in some cases diverge sharply from the mean trajectory. For example, nonlinear growth patterns may emerge in some classes but not others, and LGMMs permit these divergent patterns to be modeled separately within class. Because LGMMs relax the assumption of a single homogeneous distribution, they can tailor growth parameters (e.g., intercept, slope, and quadratic) and other model specifications to fit the data with unusual precision. A variety of fit indices, along with theoretical salience and interpretability, allow the researcher to adjudicate the fit of varying model specifications and of varying class solutions. A final point is that the LGMM approach is particularly well suited for field studies or difficult-to-manage samples, such as trauma survivors, because it employs a robust maximum likelihood estimation procedure that can accommodate missing data. In short, the flexibility of the LGMM approach provides the most powerful and supple means yet developed of identifying population heterogeneity.

LGMM modeling involves a number of iterative steps, with the final model determined by fit statistics as well as interpretability and conceptual rationale (Jung & Wickrama, 2008). Initially, the LGMM procedure identifies a univariate single-class growth model without covariates. Next, increasingly more complex models with greater numbers of unconditional classes (i.e., classes without covariates) are tested for relative improvements in fit. The models are then tested for inclusion of relevant covariates as predictors of class membership.

LGMM has been applied to a wide variety of longitudinal phenomena, including drinking among college students (Greenbaum, Del Boca, Darkes, Wang, & Goldman, 2005), childhood aggression (Schaeffer et al., 2006; Schaeffer, Petras, Ialongo, Poduska, & Kellam, 2003), acclimation to retirement in late life (Pinquart & Schindler, 2007), and developmental learning trajectories (Boscardin, Muthén, Francis, & Baker, 2008). In the studies we describe below, we have used the LGMM approach to test for latent trajectories following PTEs.

We first used the LGMM approach to investigate patterns of psychological health among hospitalized survivors of the recent epidemic of severe acute respiratory syndrome (SARS) among residents of Hong Kong (Bonanno, Ho, et al., 2008). Research in China associated SARS with high levels of fear and distress, among both health care providers (e.g., Ho et al., 2005; Tam, Pang, Lam, & Chiu, 2004) and the general population in the most highly exposed areas (Shi, Fan, et al., 2003; Qian, Ye, & Dong, 2003; Huang, Dang, & Liu, 2003). Prospective studies that compared psychological adjustment before and during the outbreak associated SARS with increased depression and emotional distress in the general population (Yu, Ho, So, & Lo, 2005) and with greater rates of suicide (Chan et al., 2006).

The psychological toll was more severe for people who had been infected and hospitalized for SARS. On average, hospitalized survivors of the SARS epidemic in Hong Kong were found to be more distressed than a matched group of healthy controls from the same geographic area (Chua, Cheung, et al., 2004). Other studies reported that 35% of hospitalized survivors in Hong Kong experienced “moderate to severe” levels of anxiety and depression (Cheng, Wong, Tsang, & Wong, 2004), and that 16% of hospitalized survivors met criteria for depression and that 10% met criteria for PTSD (Yan, Dun, & Li, 2004).

Bonanno, Ho, et al. (2008) followed a majority of the hospitalized survivors ( $n = 997$ ) in Hong Kong at 6 months, 12 months, and 18 months after their release using the 12-item Short-Form General Health Survey, a standardized measure of mental health that has shown relatively similar norms in both the United States and Hong Kong (Lam, Tse, & Gandek, 2005). LGMM of these data revealed that the best-fitting model was a four-class solution that included covariates representing physical health at 6 months posthospitalization, age, gender, social network size, social support, and SARS-related worry (Bonanno, Ho, et al., 2008). Graphs of the adjusted mental health means for the four classes revealed obvious and readily interpretable trajectories of chronic dysfunction, recovery, delayed reactions, and resilience–resistance.

Most likely due to the intensely distressing nature of illness in the context of a bioepidemic with no known cure, the chronic dysfunction trajectory was the most prevalent, with an unusually larger proportion of the sample (42%) fitting the trajectory. Average mental health levels for this group were more than 2 standard deviations below the Hong Kong normative mean at each assessment point. Despite the high proportion of chronically low mental health, however, almost as many survivors, 35% of the sample, appeared to be resilient–resistant. The resilient–resistant group had levels of mental health that were similar to the normative mean for Hong Kong; in other words, their mental health was similar to what we would expect in the absence of a major stressor. The two remaining trajectories identified by LGMM, gradual recovery (10%) and gradual worsening of mental health or delayed reactions (13%), were at proportions similar to other studies (Bonanno, 2005).

In another recent study, we applied the LGMM approach to investigate the impact of acute relationship change (marriage, bereavement, divorce) on subjective well-being (Mancini, Bonanno, & Clark, 2008). The data were obtained from the German Socioeconomic Panel Study (Haisken-De New & Frick, 2003), a nationally representative study of German households identified through a multistage random sampling method ( $N = 16,795$ ). We focused our analyses on a subset of the sample that reported widowhood, divorce, or marriage from 1985 to 2003. For each of these events, we analyzed nine annual waves of data beginning 4 years prior to the event and ending 4 years after the event.

LGMM of the participants who were bereaved during the course of the study ( $n = 464$ ) resulted in a four-class solution with age, health dysfunction, and change in income included as covariates. The most prevalent trajectory, assigned to a majority of the sample (59%), was a resilient–resistant trajectory of stable, high subjective well-being. By contrast, fewer participants evidenced the typical recovery pattern (21%), in this case indicating high subjective well-being followed by a sharp dip at the time of the spouse’s death and then gradually increasing toward baseline levels, and the typical chronic dysfunction pattern (15%), in this case indicating chronically low subjective well-being. Although the dependent measure indexed global mental health rather than psychiatric symptoms, the shape and proportions of these trajectories were highly similar to those observed in other bereavement studies (Bonanno, Boerner, & Wortman, 2008). The remaining trajectory, evidenced by a small subset of the sample (5%), was characterized by poor baseline functioning and then improvement at the time of the spouse’s death, followed by a gradual return toward baseline levels. Although somewhat counterintuitive, similar patterns of

dysfunction followed by improvement have been observed and at approximately the same frequency as in previous bereavement studies (e.g., Bonanno et al., 2002; Schulz et al., 2001).

Our analyses of the divorce and marriage data, as comparative relationship change events, yielded three- and four-class solutions, respectively. The three-class solution for the divorced sample ( $n = 629$ ), which included health and education as covariates, is of particular relevance to our concerns in this article. Divorce is undoubtedly a potentially difficult stressor event and, not surprisingly, 19% of the sample was assigned to a trajectory of steadily deteriorating well-being over time. Nonetheless, despite this potential impact, the vast majority (72%) of the sample was accommodated by a trajectory of stable high well-being similar to the resilience–resistance trajectory observed during bereavement. Indeed, this group of divorced persons showed essentially no change over time, indicating that divorce had minimal effects on their life satisfaction. It is noteworthy that another recent published report on divorce using these same data concluded that divorce has an enduring negative impact on life satisfaction (Lucas, 2005). However, this study modeled the average response. As we argue here, this approach allowed persons with more problematic responses to weight the average, conveying a misleading picture that divorce has generally deleterious effects across participants. By contrast, the LGMM approach showed that these negative effects are confined to a relatively small subset of divorced persons.

In two recent collaborative projects, we used LGMMs to examine distress and psychiatric symptoms among individuals confronted with potentially traumatic medical events. The analyses were particularly relevant to the definitional issues discussed earlier in this article because the data in each study had been obtained almost immediately after a life-threatening medical procedure. The first study examined distress levels in 285 women hospitalized for breast cancer surgery (Lam et al., 2009). Initial distress measures were obtained during the participants' stay in the hospital, approximately 3 days after the surgery. Follow-up distress levels were obtained at 1 month, 4 months, and 8 months postsurgery. LGMM revealed that the best-fitting model was a four-class solution that included the following covariates: income, satisfaction with medical consultation, distress from physical symptoms, and perceived difficulties in treatment decision making. A robust majority of the women in the sample (66%) were assigned to a trajectory of stable low levels of distress, or resilience–resistance. Strikingly, despite the potentially traumatic nature of the surgery, the resilient–resistant group evidenced a very low mean level of distress immediately after surgery and maintained almost the exactly same low level throughout the study.

We conducted a similar LGMM analyses using sample of people ( $N = 330$ ) who had received emergency surgery following a serious injury (deRoon-Cassini, Mancini, Rusch, & Bonanno, 2009). Arguably, this sample had experienced an even greater level of potential trauma because of the seriousness of their injuries (e.g., automobile accident, work-related injury, assault with a weapon, etc.) and to the emergency nature of their treatment. Data on both PTSD symptoms and depression were collected within 24 hr of surgery, and at 1 month, 3 months, and 6 months posthospitalization. The LGMM for PTSD symptom data revealed that the best-fitting model was a four-class solution that included as covariates human intentionality (i.e., whether the accident was caused by an intentional act of another person), level of education, re-

ported self-efficacy, and the experience of anger. The most common trajectory to emerge in this analysis was again a very robustly evident resilient–resistant group with consistently low levels of PTSD symptoms (60%). There was also a chronic dysfunction group with consistently elevated PTSD symptoms (22%), a recovery pattern of gradually increasing PTSD symptoms that abated by 6 months posthospitalization (12%), and a delayed group with moderate levels of PTSD symptoms that increased sharply at 6 months (6%). Analyses of the depression data likewise revealed a four-class solution with very similar trajectories. In the case of depression, the resilient–resistant group again comprised the majority of the sample (63%), but the group with chronically elevated depression symptoms characterized a small proportion of the sample (7%). A recovery group (23%) and a delayed group (7%) also emerged in these analyses. The high frequency of resilient–resistant outcomes across the symptom measures suggested that these analyses were capturing the same individuals. In fact, 57% of the sample was assigned to resilient–resistant trajectories for both PTSD symptoms and depression, indicating a remarkably high level of concordance across outcome measures in separate LGMM analyses.

### Implications for Trauma Theory

The elucidation of clear individual differences in response to PTEs suggests a number of implications for trauma theory. Some are obvious, as for example the dramatic failure of traditional medical models of trauma (pathology vs. nonpathology) to account for the wide range of individual differences that have been observed. Others point the way toward important but as yet understudied and poorly understood questions. Benight (this issue) suggested that stress–diathesis models (Rabkin, 1982) to some extent replicate the medical emphasis on vulnerability. However, when cast in the broader terms of multiple outcome trajectories, stress–diathesis models help illuminate a considerable gap in the literature regarding the factors that might discriminate individuals experiencing normative levels of distress from those who struggle toward recovery and from those whose responses signal the development of serious impairments requiring treatment (Monroe & Reid, 2009).

Other theoretical perspectives dovetail nicely with an individual differences framework in ways that we would argue have yet to be adequately explored. Theories of stress and coping, for example, are often implicated in trauma research. Unfortunately, the potential of these theories to illuminate the variability in trauma reactions is typically watered down to the relatively simplistic use of coping scales as predictors of PTSD or of mean levels of symptoms. From a broader individual differences perspective, however, stress and coping theory provides a handy explanation for the fact that resilient individuals may appraise a stressor event as less harmful (or less potentially traumatic), or that they might perceive themselves as better able to cope with the stress they do experience, compared with other more disturbed individuals. Stress and coping theory is also compatible with the growing evidence associating resilience with an inherent flexibility in both appraisal and response to PTEs (Bonanno et al., 2004; Ong et al., 2006) as well as with the links between rigid or context insensitive emotion and coping and the failure to recover from acute stress reactions

(Coifman & Bonanno, 2009, in press; Rottenberg, Gross, & Gotlib, 2005).

Perhaps the strongest implication of the individual differences perspective is that ultimately the most useful trauma theories will likely be those that best account for the heterogeneity of risk and protective factors. Just as outcome following PTEs appears to be heterogeneous, so do the various factors that contribute to or detract from healthy functioning in the aftermath of such events. Developmental theorists have for years argued that adjustment to aversive childhood contexts results not from a single dominant factor or even from several factors but rather from a cumulative mix of person-centered variables (e.g., disposition, personality) and sociocontextual (e.g., family interaction, community support systems) risk and protective factors (Garmezy, 1991; Rutter, 1999; Werner, 1995). Studies that have examined individual differences among adults exposed to PTEs have increasingly pointed toward this same crucial conclusion (Bonanno, 2005). Indeed, research on PTEs in adults has underscored the myriad transpersonal factors that are likely to come into play.

Here, we find resonance in Hobfoll's theory of conservation of resources (COR; Hobfoll, 1989, 2002; Hobfoll & Lilly, 1993). Central to COR theory is the idea that both the availability of resources and the change in resources that often results from highly disruptive events play a crucial role in human adaptability to extreme stress. Among such resources are economic and material resources (e.g., income and income loss), energy resources (e.g., the availability of health insurance and loss of health insurance), interpersonal resources (e.g., positive and negative interpersonal support, availability of affinity groups), and work resources (e.g., gainful employment or loss of employment). Although perhaps not as immediately compelling as more straightforward "psychological" factors, multivariate modeling of the rich patterns of association between resources and resource loss and diverse trauma outcomes provides an important testimonial to the efficacy of this approach (e.g., Bonanno et al., 2007).

A good deal of the research and theory we have presented in this article is new. The use of LGMM in particular is nascent. Yet, we see great promise in the empirical approach to trauma outcome, and we are optimistic that as more studies become available, basic questions about adjustment to PTEs will move beyond simple conceptions of resilience versus PTSD and toward more fine-tuned inquiry into the natural heterogeneity of both trauma outcome and the factors that inform it.

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