

Life Course Transitions and Natural Disaster: Marriage, Birth, and Divorce Following Hurricane Hugo

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Change in marriage, birth, and divorce rates following Hurricane Hugo in 1989 were examined prospectively from 1975 to 1997 for all counties in South Carolina. Stress research and research on economic circumstances suggested that marriages and births would decline and divorces would increase in affected counties after the hurricane. Attachment theory suggested that marriages and births would increase and divorces would decline after the hurricane. Time-series analysis indicated that the year following the hurricane, marriage, birth, and divorce rates increased in the 24 counties declared disaster areas compared with the 22 other counties in the state. Taken together, the results suggested that a life-threatening event motivated people to take significant action in their close relationships that altered their life course.

Natural disasters affect individuals, families, and entire communities. Most research on natural disasters has focused on individuals' mental health outcomes. The present research expands that focus by examining whether an environmental stressor is related to family development, namely the transition to marriage, childbirth, and divorce. We examined these outcomes in South Carolina with respect to Hurricane Hugo, which hit on September 22, 1989.

Hurricane Hugo bisected the state as it traveled northeast from the Atlantic Ocean. In the week following the Class 4 storm (the maximum is Class 5), the 24 counties constituting the eastern half of the state received a Presidential Declaration of Disaster (Office of the Governor, 1989). The economic costs were staggering. As of 1998, the Federal Emergency Management Agency ranked Hurricane Hugo fourth in natural disaster relief costs. Physical damage was estimated at over \$6 billion, approximately \$3 billion of

which was unreimbursed losses. Forty percent of residences were damaged and included most of the unreimbursed losses. A year later, half of the affected counties reported lower employment compared with prestorm levels (Office of the Governor, 1991). Subjective views also reflected the storm's magnitude as many felt it was a life-threatening event (Norris & Uhl, 1993).

To date, the primary focus of disaster research has been on identifying the mental health consequences for individuals following natural and technological disasters. Research demonstrating bidirectional longitudinal relationships between individual and marital functioning (e.g., Beach & O'Leary, 1993a, 1993b; Fincham, Beach, Harold, & Osborne, 1997) suggests that an exclusive focus on mental health outcomes will underestimate the effect of disaster. Given that the consequences for many adult disaster victims unfold in the context of close relationships, a next step for disaster research is to go beyond disaster as an individual-level phenomenon to investigate ways that disasters might affect couples.

The purpose of the present study is to examine how a severe stressor, Hurricane Hugo, affected three major life course transitions resulting in significant, enduring changes for individuals, couples, and families—getting married, having a baby, and getting divorced. Using longitudinal vital statistics data across 23 years, from 1975 to 1997, we examined marriage, birth, and divorce rates for all counties in South Carolina. We compared prestorm with poststorm rates across all 46 counties collectively and between the 24 counties declared disaster areas and the 22 other counties. In the year before the hurricane (1988), there were approximately 1,900,000 citizens in the affected counties and 1,600,000 citizens in the other counties. The perspective offered by aggregate-level time-series data complements other disaster research, which typically involves individual-level data gathered after the event. The prospective design provides a baseline before the hurricane against which to

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compare marriage, birth, and divorce rates following the storm. The large sample allows us to examine change in major family transitions that occur relatively infrequently in small samples. A trade-off of using aggregate-level data is that we could not directly assess processes at the individual level that may have led to the family transitions we examined. Using a multidisciplinary perspective, we drew on the psychological and sociological literatures to make predictions about changes in marriage, birth, and divorce rates at the community level. We conceptualized change in family outcomes from three perspectives: stress research, attachment theory, and research on economic circumstances.

Stress and Adjustment

Research on stress and marriage shows there is a dynamic relationship among stress, individual functioning, and marital functioning. The rationale for examining the stress process in marriage is derived from research indicating that in stressful times spouses are the primary sources of support, and support from others does not compensate for support missing from a spouse (Brown & Harris, 1978; Stroebe, Stroebe, Abakoumkin, & Schut, 1996). A partner's support may buffer the negative effects of stress on the spouse's mood (Cohen & Wills, 1985). But the stress process is not so simple. There is evidence that stress leads to negative consequences for spouses' mood, perceptions of the relationship, and relationship functioning. For example, Tesser and Beach (1998) showed that when partners reported more negative life events, they reported more depressive symptoms and lower marital satisfaction 6 months later. Two routes through which disaster might affect couples are mental health and communication.

Stress and Mental Health

There is robust evidence that community-wide disasters lead to mental health problems. In a meta-analysis of 52 studies examining the mental health consequences of natural and technological disasters, Rubonis and Bickman (1991) found that rates of psychopathology increased by 17% following a disaster compared with predisaster or control-group levels. The most common problems were anxiety, somatic complaints, alcohol problems, phobic reactions, and depression. One particular anxiety problem, posttraumatic stress disorder (PTSD), increases following natural disasters, including hurricanes (Ironson et al., 1997; Norris, 1992; Shore, Tatum, & Vollmer, 1986). PTSD symptoms like estrangement from others, irritability, and restricted range of affect are relevant to interpersonal functioning because they may impede communication and contribute to increased conflict. Symptoms like anxiety and depression that are associated with disasters are also associated with poorer marital quality (McLeod, 1994) and marital communication (Biglan et al., 1985; Davila, Bradbury, Cohan, & Tochluk, 1997). The time course for mental health problems following a disaster is generally 1–3 years (Adams & Adams, 1984; Freedly, Kilpatrick, & Resnick, 1993; Norris & Kaniasty, 1996; Shore et al., 1986), but most

studies have not followed disaster victims beyond several years.

Stress and Marital Functioning

Communication behavior (e. g., problem solving, support exchanges) is the most commonly studied interpersonal process to explain the life events–marriage link. Life events may exacerbate preexisting marital conflicts or generate new ones (Christensen & Pasch, 1993). Spouses' abilities to resolve a problem in their marriage have been shown to moderate the relationship between stress and marital adjustment such that adaptive problem-solving skills mitigated and poorer skills exacerbated marital distress and spouses' depressive symptoms (Cohan & Bradbury, 1997; Conger, Rueter, & Elder, 1999). Stress can also interfere with the exchange of social support. Support providers give less help to those who express more distress (Bolger, Foster, Vinokur, & Ng, 1996; Silver, Wortman, & Crofton, 1990). And spouses were less effective at soliciting and providing support to their partners when they reported more negative events (Cohan, Pasch, & Bradbury, 1998).

The limited information on disasters and marriage also shows deleterious consequences. For example, the Mount Saint Helens volcano eruption was followed by increased domestic violence (Adams & Adams, 1984). After Hurricane Hugo, greater injury, life threat, and financial loss predicted increased marital stress. In turn, more marital stress was related to more depressive symptoms, anxiety, and hostility (Norris & Uhl, 1993), suggesting bidirectional relationships between intra- and interpersonal functioning following severe stress.

Hypotheses Derived From Stress Research

Stress research indicates that marriages are vulnerable to normative and nonnormative stressors. When spouses are taxed emotionally, marital problems increase, and the quality of support exchanges decreases. Integration of research showing that (a) stress is associated with poorer marital communication and increased domestic violence with other research showing that (b) poorer marital communication and domestic violence are related to marital instability (Karney & Bradbury, 1995; Pasch & Bradbury, 1998; Rogge & Bradbury, 1999) suggests that stressful events may initiate or exacerbate processes contributing to marital instability. Thus, stress research suggests that severe stress is divisive and affects marriage and divorce rates in opposite directions. A stress perspective suggests divorce would increase following a natural disaster. Further, if stress-related intrapersonal and interpersonal problems that affect married couples have a similar effect on dating couples, then dating couples, the source of future marriages, will be more likely to break up. If dating relationships are more likely to break up after a disaster, then marriage rates would decline. Regarding birth rates, the third outcome of interest, there is little in stress research to inform a hypothesis directly. But we hypothesize that severe stress may have an indirect effect on birth rates via intra- and interpersonal problems.

To the extent that stress, depression, and anxiety are related to decreased sexual desire or functioning (according to the *Diagnostic and Statistical Manual of Mental Disorders* [4th ed.], American Psychiatric Association, 1994), birth rates are expected to decline following disaster. Likewise, increased marital conflict may lead to decreased sexual activity between spouses and thus fewer pregnancies and births.

Stress and Attachment

In contrast to stress research, which suggests stress is divisive, attachment theory posits that stress engenders affiliation. Bowlby (1969) theorized that in response to threat, universal behavioral strategies evolved for human infants to maintain proximity to their caregivers for the purpose of security, safety, and survival. Behaviors such as smiling, visual tracking, and crying help infants to keep the caregiver near for protection. In addition to satisfying needs for physical closeness or proximity, the attachment system regulates two other basic needs for the infant. The caregiver is a safe haven, providing comfort and support, and a secure base, from which the infant explores the environment (Hazan & Shaver, 1994). Bowlby (1988) maintained that the attachment system is active throughout the life span. Similar to children, adults exhibit proximity and support seeking in response to stress that can be conceptualized as manifestations of attachment needs (Hazan & Shaver, 1994). Field and laboratory research with adults supports that proposition.

Three contextual factors that are derived from attachment theory—availability of the attachment figure, degree of threat, and relationship length—informed predictions about family transitions following natural disaster. First, Bowlby (1969) observed that when the caregiver was available, infants expressed low-intensity attachment behaviors, like smiling, to maintain proximity. But when the caregiver was not available, infants responded with high-intensity behaviors, like crying. Adults also exhibit increased arousal when faced with separation from an attachment figure. Before an imminent separation at an airport, adult couples in which one partner was traveling away were observed to express more proximity seeking, caregiving, and sexual contact (e.g., intimate kissing, sexual touching) compared with couples traveling together and not separating (Fraley & Shaver, 1998). When faced with a laboratory stressor, insecurely attached college students exhibited more physiological arousal when their dating partner was absent compared with when the partner was present (Feeney & Kirkpatrick, 1996).

Second, the magnitude of threat should covary with the intensity of proximity seeking. Greater threat is associated with greater proximity seeking in infants (Bowlby, 1969, 1973). Compared with when they were primed with a non-stress word, college students primed with a stress word exhibited more cognitive activation of proximity-related thoughts, regardless of individual differences in attachment style (Mikulincer, Birnbaum, Woddis, & Nachmias, 2000). To investigate the relationship between threat and attachment styles in adult dating couples, Simpson, Rholes, and Nelligan (1992) observed support seeking and provision

after the female partner was led to believe she would be exposed to an anxiety-provoking experimental procedure. Securely attached girlfriends sought more comfort when they were more fearful; securely attached boyfriends provided more reassurance when their girlfriends were more fearful. Regarding severe threat, Bowlby posited that danger triggers efforts to be physically close to “a trusted person” (1969, p. 207). Further, he said that affiliation is comforting during disaster and that family members will stay in close proximity for “days or weeks” following a disaster (Bowlby, 1973, p. 167). Likewise, Hill and Hansen (1962) speculated that families would cling together following disaster:

When sirens scream of approaching disaster, minds turn to loved ones. If they are near enough, mothers run to protect their children, and men seek their families. They huddle together and support one another through the stress, and when it has passed, they rescue and nurse those they love. (p. 186)

In sum, Bowlby as well as Hill and Hansen suggested that at extreme levels of danger, proximity seeking is the modal response for adults and children.

Length of relationship is a third contextual factor shaping the activation of attachment behavior. In childhood, proximity seeking is pronounced through age 3 and then declines abruptly. Over time, separation is less threatening and proximity needs are less urgent because children learn to understand why separation occurs and that the caregiver will return (Bowlby, 1969). Similarly, in the study of airport separations, adult partners in longer relationships exhibited fewer attachment behaviors (e.g., seeking and maintaining contact), less caregiving, and less sexual affection (Fraley & Shaver, 1998).

Integration of Attachment and Mating Behavior in Adulthood

Beginning in late adolescence or early adulthood, attachment bonds are transferred from the primary childhood caregiver to a romantic partner. At this point, the attachment system (i.e., care seeking) interacts with the caregiving and sexual mating systems (Hazan & Shaver, 1994). In addition to providing comfort and safety, attachment in adulthood functions to develop pair bonds that will reproduce and nurture offspring (Belsky, 1999; Hazan & Zeifman, 1999). Viewed from a modern evolutionary perspective, attachment and reproductive behavior (e.g., mating, parenting) vary to maximize reproductive fitness depending on whether the ecological context is supportive or hostile (Belsky, 1999; Chisolm, 1993; Hazan & Zeifman, 1999). A resource-rich environment encourages “a reproductive strategy emphasizing parenting over mating,” that is, delayed mating, fewer offspring, and greater investment in each one (Belsky, 1999, p. 152). An environment with limited or unpredictable resources fosters a reproductive strategy focused on mating over parenting, with earlier and more frequent reproduction.

Hypotheses Derived From Attachment Theory

From an attachment perspective, we conceptualized marriage and divorce rates after Hurricane Hugo as objective indicators of proximity seeking in response to threat. We viewed birth rates as an indicator of mating behavior. Hypotheses derived from attachment theory are in the opposite direction of those from stress research. Considering that very threatening circumstances should activate the attachment system and motivate people to seek or maintain proximity to an attachment figure, we expected that marriage rates would have increased and divorce rates would have decreased in counties affected by Hurricane Hugo. In addition to threat, accessibility of the partner and relationship length may have encouraged more dating couples to transition to marriage in counties struck by the disaster compared with unaffected counties. Because dating partners are generally less accessible than married partners, we predicted that the threat of Hurricane Hugo would have motivated dating couples to marry, to increase the accessibility to a key attachment figure. Increases in marriage following disaster are also likely, considering that attachment behavior is activated more easily when the length of the relationship is shorter, a characteristic of many dating relationships. Drawing on modern evolutionary theory, we expected that birth rates in affected counties would have increased from premorbid levels, considering that hostile environmental conditions are thought to encourage more frequent reproduction.

Economic Circumstances

A third perspective is that natural disasters may affect family outcomes through their impact on economic circumstances. As described above, individuals, rather than the government or businesses, bore the brunt of the financial burden (i.e., income loss, unemployment, etc.) wrought by the storm. In turn, economic circumstances have been shown to delay the initiation of families and hasten the breakdown of established ones. First, a dominant perspective in the sociological literature is that marriage rates shift as a function of men's employment opportunities (e.g., Esterlin, 1978; Oppenheimer, 1988). The idea is that economic security facilitates the initiation of a household. When men's employment opportunities or real wages decline, they are less attractive as marriage partners, and marriage rates decline. Empirical research supports this pattern (for a review, see White & Rogers, 2000). Second, fertility rates are sensitive to economic determinants in a similar direction as marriage rates. Unemployment rates and harsh economic conditions are directly related to lower fertility rates (e.g., Kelly & Cutright, 1984; Rindfuss, Morgan, & Swicegood, 1988). Poor economic conditions also indirectly influence declines in fertility through declines in marriage rates (Kelly & Cutright, 1984). Third, significant loss of income and work hours and unemployment are related to increased risk of divorce (Attewell, 1999; Yeung & Hofferth, 1998).

To the extent that Hurricane Hugo led to income loss and

unemployment, the hypotheses from an economic perspective were that the affected counties would have experienced declines in marriage and birth rates and increased divorce rates after the storm. The hypothesized direction of effects based on an economic perspective was the same as those based on stress research. These two perspectives are compatible in that stress research suggests the mechanisms, such as increased mental health problems and interpersonal conflict, that may link economic stressors resulting from natural disaster to family outcomes. The hypotheses derived from attachment theory, suggesting that stress leads to affiliation, were in the opposite direction of the other two perspectives. It may be the case that under certain conditions the stress and economic hypotheses hold and under different conditions the attachment hypotheses hold. When people experience so much devastation that it overwhelms their ability to cope, the disaster may lead to relationship deterioration. On the other hand, when the dose of stress does not overwhelm them, affiliation may be the more common response. If the contrasting predictions hold under different conditions, then we expected that among the counties declared disaster areas, the most severely affected counties (i.e., the 7 counties first declared disaster areas) would exhibit more divorce and fewer marriages and births.

Method

Data

Vital statistics for marriages, births, and divorces for all 46 counties in South Carolina were obtained from the annual *South Carolina Statistical Abstract* (South Carolina Budget and Control Board, 1960–1997). Preliminary analysis of the data showed that secular trends for several outcomes changed dramatically during the 1960s and 1970s (e.g., divorce rates showed a stable secular trend prior to 1965, an increasing trend between 1965 and 1975, and a stable trend again following 1975). The time-series analyses used in this study assume a stable background trend, therefore we restricted our primary analyses to data from 1975 through 1997, during which all outcomes studied showed a stable secular trend (i.e., relatively constant incidence, or a steady increase or decline in outcome incidence).

Analysis

To adjust for differences in population size across counties, we expressed each of the three outcomes as a rate per 1,000 population members per year. We analyzed changes in outcome incidence over time using standard autoregressive integrated moving average (ARIMA) models for the statistical analysis of time series (Cryer, 1986). ARIMA models explicitly analyze the relationship among subsequent observations in a time series to eliminate the correlations among residuals that would otherwise violate the independence assumptions underlying statistical inference. Once autocorrelation among residuals is eliminated, accurate confidence intervals and significance levels can be calculated for regression coefficients summarizing the relationship between outcome incidence and time (i.e., the magnitude of secular trend, or a slow steady change in incidence over time) or between outcome incidence and a transient event such as Hurricane Hugo.

Under the ARIMA approach, outcome incidence is first plotted as a function of time to identify any features of the data that might

complicate modeling (e.g., changing patterns of secular trend, outliers, or changes in outcome variability over time). A preliminary model incorporating any visible secular trend is then fit to the data, and the residuals are examined for mutual independence using autocorrelation functions and partial autocorrelation functions (see Cryer, 1986). If residual autocorrelation is present, parameters are added to the model to capture that relationship in the deterministic portion of the model and thus remove it from the residuals. Two types of parameters are typically used: autoregressive (AR) terms (i.e., relating outcomes at Time t to those one lag back at $t - 1$, two lags back, or more) and moving average (MA) terms (i.e., relating residuals at Time t to those one or more lags back). Use of AR terms is suggested by partial autocorrelation among outcomes, and use of MA terms is suggested by partial autocorrelation among residuals. If a data series shows a consistent secular trend, or if changes in a series are of primary interest (rather than absolute level), analysis may focus on the integrated (I) series, which is obtained by taking the difference between each observation and the one preceding it (the first difference). Because different outcomes show different temporal behavior, different ARIMA models are appropriate for each outcome. When reporting results, we describe which ARIMA model was most appropriate in terms of the number of AR terms, the degree of integration, and the number of MA terms. Thus an ARIMA (2,1,0) model uses two AR parameters, is fit to the first difference of the I series, and uses no MA terms. The model selected as most appropriate was the most parsimonious one (i.e., had the fewest AR or MA terms) that fit the data well (i.e., no significant autocorrelation remained in the residual series).

After describing the general behavior of an outcome series with an appropriate ARIMA model, we examined the effect of Hurricane Hugo in 1989 by adding to the model a dummy variable that took the value 0 prior to 1990 (i.e., 1975–1989), the value 1 during 1990, and returned to 0 thereafter (i.e., 1991–1997). The intervention time series analysis tested change 1 year after the hurricane because that time frame was suggested by preliminary inspection of the data. If a more protracted effect were suggested by the data, we would fit dummy variables of longer duration. Residual autocorrelations were examined following the addition of dummy variables to ensure that the final model continued to fit the data well.

For each of the three outcomes, two types of analyses were conducted. First, before examining change at the county level, we examined the statewide incidence of each outcome to document the magnitude of Hugo's effects. A significant change after Hugo across all 46 counties in the state suggests a fairly large effect but does not indicate whether it is unique to the counties affected by Hugo. Second, we therefore conducted dose-response analyses to rule out possible temporal confounding of Hugo's effects with other sociocultural events that might alter outcome incidence. Outcome patterns in the 22 comparison counties reflect any general sociocultural trends (e.g., steadily decreasing marriage rates) that might coincidentally covary with Hurricane Hugo. Effects are attributed to Hugo only if they are significantly more pronounced in 24 affected counties than in the 22 comparison counties. Two types of dose-response analyses were conducted. In the first, we examined outcomes averaged over all counties directly affected by Hugo (i.e., the 24 counties declared federal disaster areas) while controlling for outcome incidence in counties not heavily affected by Hugo (i.e., the 22 counties not declared federal disaster areas). The goal of the first dose-response analysis was to test whether there was a spatial effect of Hugo. In other words, were disaster counties affected more than nondisaster counties?

The second dose-response analysis referred to the severity of

damage among the federal disaster areas. The 24 affected counties were deemed federal disaster areas in five declarations over the span of a week. The declarations involved 7, 5, 5, 5, and 2 counties, respectively (Office of the Governor, 1989). Damage data indicated that the 7 counties in the first disaster declaration were the most severely affected of all South Carolina counties. Thus, the second dose-response analysis focused on outcomes averaged over the 7 counties in the first federal disaster declaration while controlling for outcome incidence in the 22 comparison counties. The goal of the second dose-response analysis was to test whether a subset of the most severely affected counties was at particular risk for change in family outcomes. Because the two dose-response analyses focused on different aggregations of South Carolina counties, the integrated series mean (i.e., secular trend in outcome incidence) will differ according to the counties' differing social characteristics. Further, it should be noted that the dose-response analysis is a conservative strategy and may underrepresent the true magnitude of Hugo's impact if psychosocial influences spill over from heavily affected counties to relatively unaffected ones. Because spillover effects may be "controlled away" in analyses of heavily affected versus relatively unaffected counties, the dose-response models are perhaps best interpreted as relating the magnitude of Hugo's physical impact to the magnitude of alteration in social outcomes.

We used the SAS PROC TIMEPLOT to examine the data and SAS PROC ARIMA (Brocklebank & Dickey, 1986) to estimate models by maximum likelihood or conditional least squares. For a more detailed description of ARIMA modeling, see Cryer (1986). All significance levels are based on two-tailed tests.

Results

Table 1 presents results from the ARIMA time-series analysis for South Carolina marriage, birth, and divorce rates from 1975 to 1997. The regression coefficients reflect the transient change in each outcome's incidence during the year following Hugo (i.e., a dummy variable taking the value of 1 during 1990 and 0 during all other years). All models were fit to the integrated time series (reflecting the change in incidence from each year to the next), and the average value of this series is reported in the "Mean integrated series" column in Table 1. The average integrated time-series value can be taken as an indication of the basal secular trend against which the strength of Hugo's effects is judged.

Marriage Rates

The statewide incidence of marriage rates across South Carolina declined steadily between 1975 and 1997 ($Z = -2.35, p < .05$). However, marriage rates increased significantly in 1990 (see Table 1), leading to a temporary reversal in the prior downward trend and a net increase in marriage rates the year following Hurricane Hugo. In the ARIMA model that best fit the data (a 0,1,0 model; see Table 1), the coefficient reflecting the effect of Hugo was .700 ($p < .05$), indicating that marriage rates increased by an average of .700 per 1,000 population members during 1990 across the state. Given the general trend toward declining marriage rates ($-.264$) and a temporary increase above this declining trend (.700), there was a net increase in marriage rates of .436 per 1,000 population members per

Table 1
Results of ARIMA Analyses for Marriage, Birth, and Divorce Rates in South Carolina, 1975–1997

| Outcome | Model | Z | Regression coefficients | | |
|------------------------|-------|---------|-------------------------|--------------|-------------------|
| | | | Mean integrated series | Raw (SE) | Standardized (SE) |
| Marriage rates | | | | | |
| Statewide incidence | 0,1,0 | 2.01* | -.264 | .700 (.348) | .119 (.059) |
| Dose-response analyses | | | | | |
| All 24 disaster areas | 0,1,0 | 2.06* | -.471 | 1.555 (.753) | .159 (.077) |
| First 7 disaster areas | 0,1,0 | 4.68*** | -.055 | .844 (.180) | .482 (.103) |
| Birth rates | | | | | |
| Statewide incidence | 2,1,0 | 2.01* | -.101 | .510 (.254) | .114 (.057) |
| Dose-response analyses | | | | | |
| All 24 disaster areas | 1,1,0 | 5.06*** | -.175 | 1.171 (.231) | .179 (.035) |
| First 7 disaster areas | 2,1,0 | 2.96** | -.222 | 1.011 (.342) | .125 (.042) |
| Divorce rates | | | | | |
| Statewide incidence | 0,1,0 | 2.19* | .041 | .300 (.137) | .302 (.138) |
| Dose-response analyses | | | | | |
| All 24 disaster areas | 0,1,0 | 3.57*** | .059 | .465 (.130) | .304 (.085) |
| First 7 disaster areas | 1,1,0 | 4.65*** | .048 | .687 (.148) | .531 (.114) |

Note. ARIMA = autoregressive integrated moving average.
 * $p < .05$. ** $p < .01$. *** $p < .001$.

year. Put another way, the hurricane was associated with an increase in marriage rates that was more than twice the magnitude of the general decline. During 1990, the statewide marriage rate increased by about 70 marriages per year over the basal decline of 26 per year per 100,000 people, for a net increase of approximately 44 marriages per 100,000 people in the population. The decline in marriage rates resumed in 1991.

Table 1 and Figure 1 show the dose-response analyses in which outcomes from the 24 counties directly affected by Hugo were analyzed in ARIMA models that controlled for general secular trends (e.g., societal changes in marriage incidence) by treating as covariates the same outcome in the 22 counties not declared disaster areas. We conducted a similar analysis for the 7 most severely affected counties, controlling for the pattern observed in the 22 comparison counties. The significant increase in marriage rates in 1990 remained after controlling for change in the 22 nondisaster counties, suggesting that the increase in marriage rates seen at the statewide level occurred in the 7 most affected counties and all 24 affected counties the year after the hurricane. The dose-response analyses indicated that the increase in marriage rates in South Carolina was both temporally and spatially specific to Hurricane Hugo's impact.

Birth Rates

Births across South Carolina showed a nonsignificant declining trend over the period from 1975 to 1997 ($Z = -1.14$, *ns*), with birth rates declining by about 10 births per 100,000 population members per year. However, following Hugo this downward trend reversed to produce a significant net increase of approximately 41 births per 100,000 popu-

lation members (see Table 1, .510 – .101) statewide during 1990. As shown in Figure 2, dose-response analyses examining the affected counties while controlling for birth rate changes in counties not declared disaster areas showed a significant increase in birth rates that was spatially specific to the impact of Hurricane Hugo. Thus like marriage rates, South Carolina birth rates showed a significant increase during the year following Hurricane Hugo, and the effects were significantly pronounced in all 24 counties directly affected as well as the 7 most severely affected.

Divorce Rates

In contrast to marriage rates, the period from 1975 to 1997 was associated with variable statewide divorce rates that did not show any statistically significant general trend toward increased or decreased levels ($Z = 0.70$, *ns*). However, similar to marriage rates, statewide divorce rates increased significantly during the year following Hurricane Hugo. During 1990, divorce rates increased by approximately 30 per 100,000 residents before returning to basal levels in 1991. Because the processes that mediate divorce (both personal and legal) evolve over a period of months, it was interesting to find the greatest alteration in divorce rates occurred relatively quickly, the year after the hurricane. Dose-response analyses shown in Figure 3 indicated a significantly greater increase in divorce rates among counties declared disaster areas after Hugo compared with those South Carolina counties not so declared. Thus, like the results for marriage and birth rates, ARIMA time-series analyses indicated that the increase in divorce rates was both spatially and temporally specific to Hurricane Hugo's impact. To summarize the results, marriage, birth, and di-

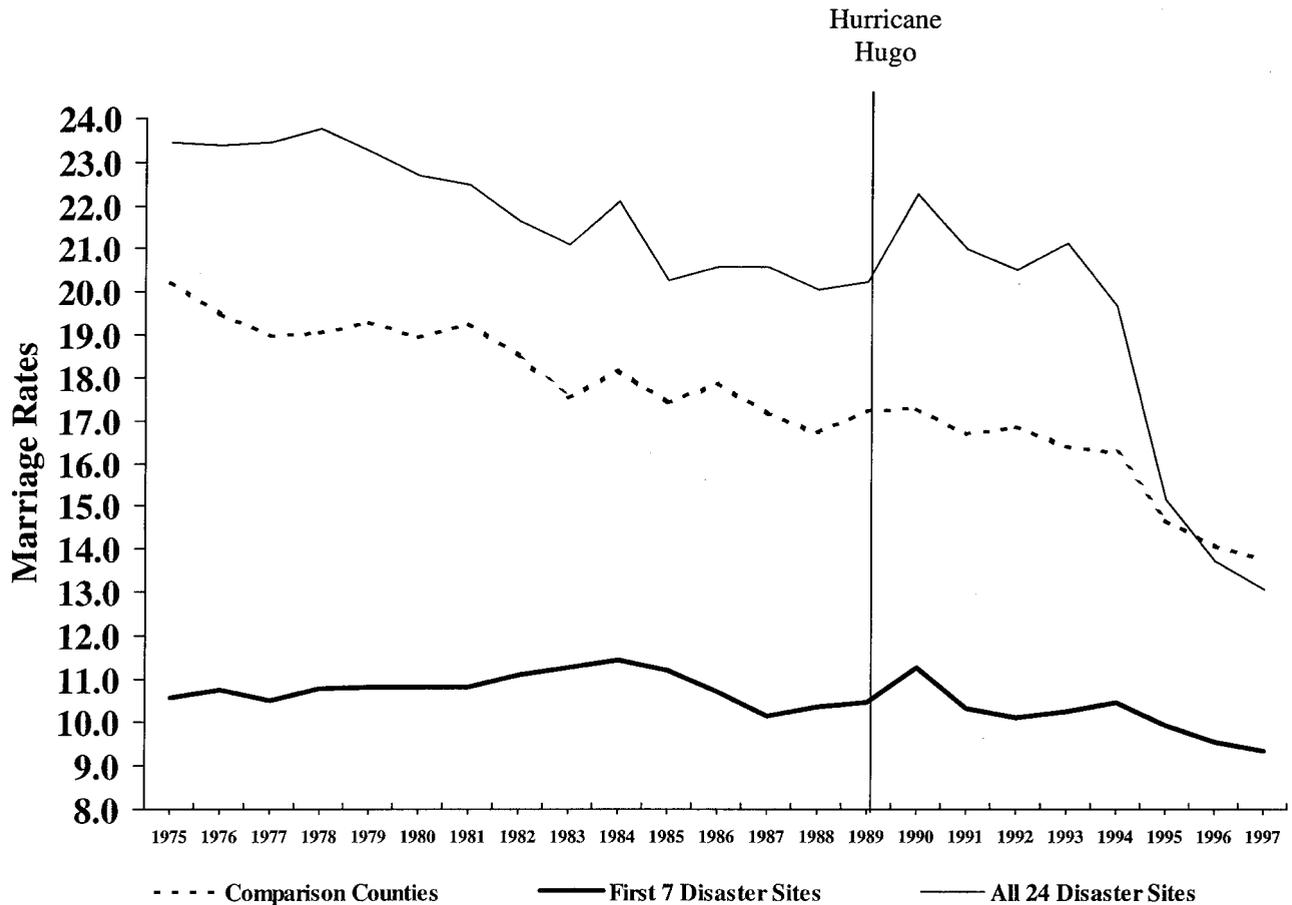


Figure 1. Marriage rates as a function of disaster status following Hurricane Hugo in South Carolina.

voice rates increased statewide across South Carolina in the year following Hurricane Hugo. The increases were significantly greater in the 24 counties declared federal disaster areas compared with the 22 counties not declared disaster areas. The dose-response analyses also indicated that increases in the outcomes occurred in the 7 most severely affected counties as well as all 24 affected counties collectively.

Getting married, giving birth, and getting divorced are largely age-dependent events. An alternative demographic explanation for the increases in marriages, births, and divorces in the year following Hurricane Hugo is that shifts in the age structure of the population because of in- or out-migration following the storm led to the observed changes rather than any real change in behavior. To test this possibility we examined changes in the age structure of the population for all counties in South Carolina between 1980 (the earliest year for which population age structure data were available) and 1997. There were small but statistically significant changes in the age structure of the population such that the fraction of the population between the ages of 18 and 45 (i.e., those most likely to experience marriage, childbirth, and divorce) increased slightly for two years following Hugo. This pattern was true for affected and unaffected counties. We recomputed the marriage, birth,

and divorce time-series analyses, controlling for change in the size of the 18–45-year-old cohort. Controlling for change in age composition of the population failed to significantly alter the original results (all $ps < .05$). These results refute the alternative demographic explanation and suggest that a real change in behavior occurred.

Discussion

Summary of Results

Considering that many adults who experience a natural disaster do so in the context of a romantic relationship, a goal of this research was to expand the traditional disaster literature focused on individual adjustment by examining family life course transitions. We examined three major family life course transitions—marriage, birth, and divorce—before and after a major natural disaster, Hurricane Hugo in 1989, for all 46 counties in South Carolina from 1975 to 1997. On the basis of stress research and economic circumstances research, we predicted that marriages and births would decrease and divorces would increase. On the basis of attachment theory, we predicted that marriages and births would increase and divorces would decrease.

Natural disaster predicted family development and disin-

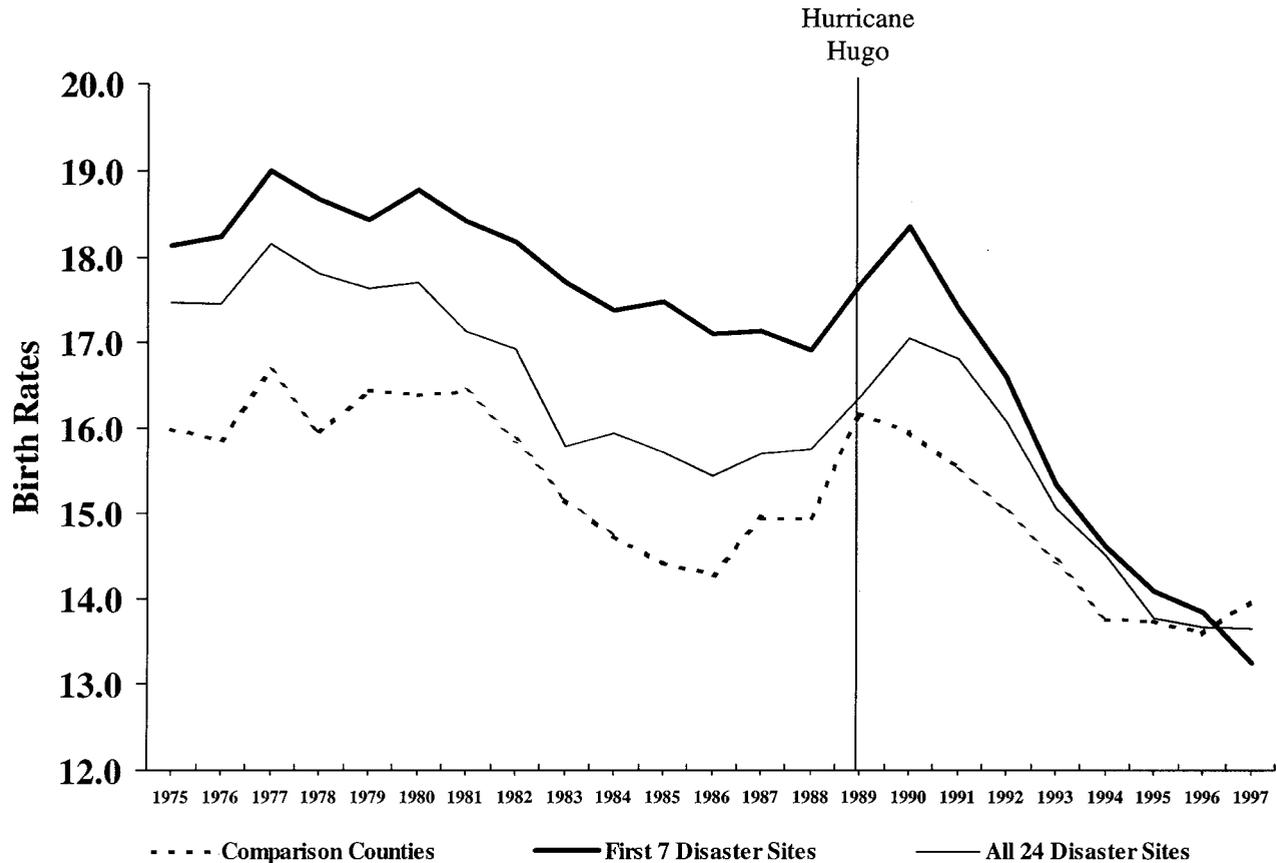


Figure 2. Birth rates as a function of disaster status following Hurricane Hugo in South Carolina.

tegration. All three outcomes changed in the year following the disaster. Increases in marriages, births, and divorces were spatially and temporally related to the storm. The results partially supported predictions based on stress research, attachment theory, and economic circumstances research. Consistent with attachment theory, intervention time-series analyses indicated that marriages and births increased the year following the hurricane in 1990 compared with prior levels in the affected counties. Consistent with stress research and economic circumstances research, divorces increased in 1990 in the affected counties compared with prior levels. Among the counties declared federal disaster areas, there was no evidence for a differential impact on the basis of severity.

Implications for Theory

When we consider that all three outcomes increased, the pattern of results suggests a fourth perspective, that a natural disaster mobilized people to take action. A life-threatening stressor appeared to be the catalyst for some to take significant and relatively quick action in their personal lives that altered their life course. For some, natural disaster may have hastened a transition they were already moving toward, but at a slower pace. For others, natural disaster may have led to a transition that might not have occurred if not for the

disaster. Life-threatening and uncontrollable events like natural disasters challenge and violate the common assumption that the world is a benevolent and ordered place (Janoff-Bulman, 1992). To resolve discrepancies between the survivor's old assumptions that the world was safe and predictable with their new reality of danger and randomness, people are motivated to revise old schemas and establish new ones. To find meaning in the event and to establish a sense of control, survivors are motivated to reevaluate their priorities about what is important and to take action, respectively (Janoff-Bulman & Frantz, 1997; Taylor, 1983). In the present study, dating couples formalized their relationship and got married, women got pregnant and gave birth, and married people got divorced. An implication of the present results for stress and coping research is that the actions people take following a disaster are nontrivial and have real-world consequences.

Increased marriage and birth rates also have implications for expanding disaster and mental health research. Traditionally, this area examines negative intrapersonal outcomes like depression. But increases in marriages and births highlight the importance of outcomes that are interpersonal in nature and that suggest personal growth rather than deterioration. The personal growth model of stress (Holahan & Moos, 1990; Park, Cohen, & Murch, 1996; for a review, see

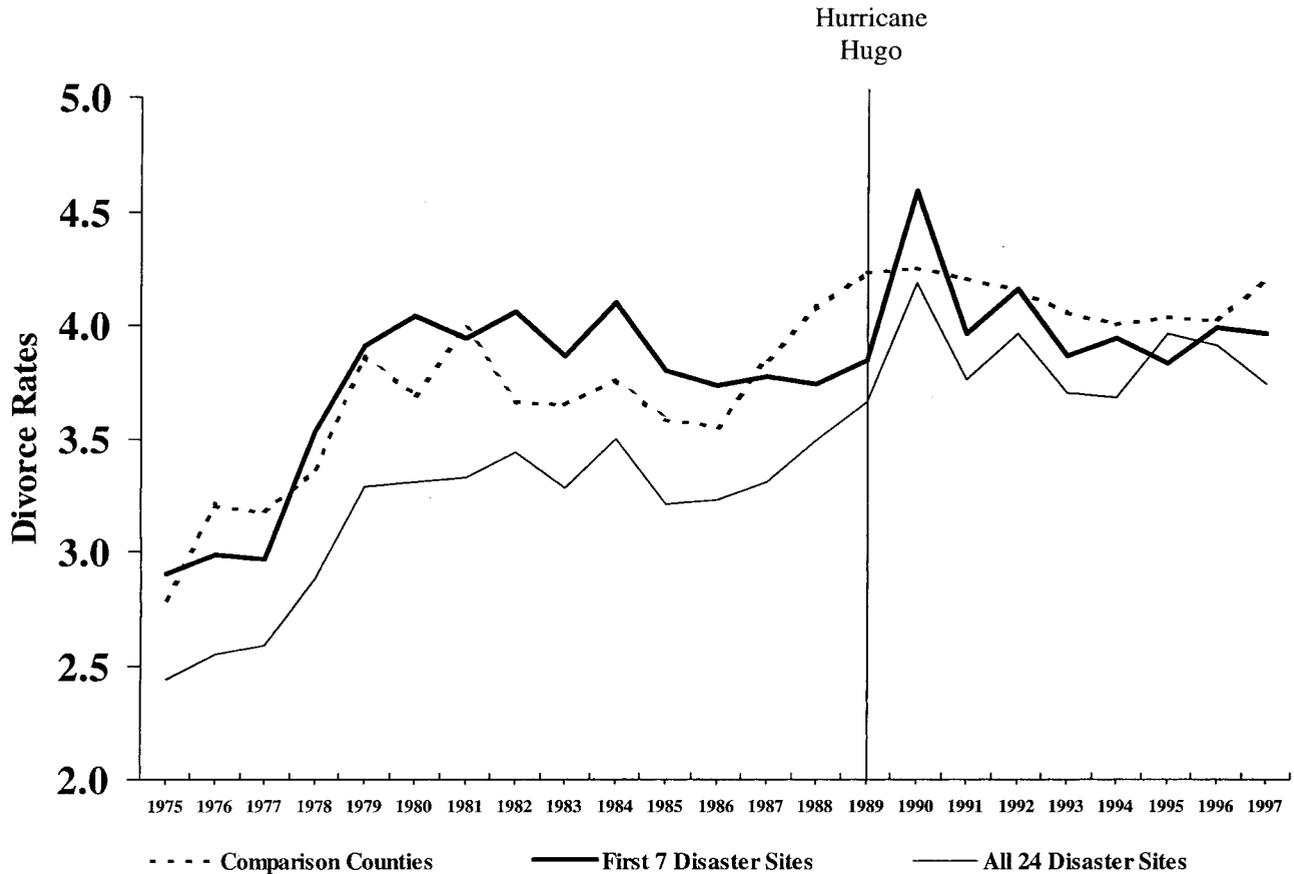


Figure 3. Divorce rates as a function of disaster status following Hurricane Hugo in South Carolina.

Updegraff & Taylor, 2000) focuses on how adjustment may be enhanced in response to stress. According to this model, adaptive behavior enacted to cope with stressors “can create an opportunity for psychological growth” (Holahan & Moos, 1990, p. 910) by stimulating personal relationships, personal resources, or life priorities (Updegraff & Taylor, 2000). The hurricane may have given partners the opportunity to practice or learn problem-solving skills and to exchange support. This model would posit that successful navigation of the storm and its aftermath by the couple may have enhanced subsequent relationship satisfaction and cohesion that increased the likelihood of marriage or childbirth. Natural disasters in particular may stimulate personal growth related to personal relationships. McMillen, Smith, and Fisher (1997) found that victims of a natural disaster (e.g., a tornado) perceived more enhanced interpersonal closeness compared with victims of a technological and a criminal disaster. Whereas most of the positive growth research is based on self-report data (Updegraff & Taylor, 2000), a strength of our study was that we examined objective behavioral outcomes related to changes in social relationships.

The results support the utility of examining attachment behavior as a function of contextual factors like threat other than individual differences in attachment orientation, which is most commonly studied. The apparent behavioral re-

sponses were striking and extend research on affiliation-related thoughts primed by a laboratory task (Mikulincer et al., 2000). In addition to cognitive responses, stress-related activation of the attachment system results in behavioral responses. Increased marriage and birth rates were consistent with the attachment and modern evolutionary perspectives that the attachment system in adulthood has two strategies to maximize reproductive fitness—seeking comfort and facilitating the formation of pair bonds who will reproduce (Belsky, 1999; Fraley & Shaver, 1998; Hazan & Zeifman, 1999). An alternative explanation for the increased birth rates following the hurricane was that the stress caused people to forget to use contraception. However, considering that attachment processes are thought to operate largely out of conscious awareness, forgetting to use birth control is consistent with the evolutionary psychology perspective that harsh environments encourage increased reproduction.

It should be noted that the macrolevel data used in the analyses did not allow for a direct test of the psychological perspectives we used. We drew on the affective, cognitive, and interpersonal processes described by stress research and attachment theory to make predictions about the associations between natural disaster and marriage, birth, and divorce rates. Although the results are consistent with processes described in the theories we drew on, we cannot state

conclusively whether they operated, because we did not measure them.

Implications for Application and Public Policy

Increased rates of divorce in the affected counties indicated that not all couples were more likely to affiliate following natural disaster. The dose-response analyses showing increased divorce in affected but not in unaffected counties indicated that some couples got divorced who might not otherwise have done so that year if they had lived elsewhere. Not only are there negative consequences for spouses who divorce (Bloom, Asher, & White, 1978), but the marital conflict that often precipitates divorce has negative consequences for children (Fincham, 1998; Hetherington, Bridges, & Insabella, 1998). A next step in disaster research is to assess intra- and interpersonal processes following disaster, with respect to the transition to marriage, childbirth, and divorce. Future research may be guided by the ABCX family crisis model (Hill, 1949; McCubbin & Patterson, 1983), which provides a framework for understanding the nuances of how and when stressful events lead to positive outcomes for some people and negative outcomes for others. The model examines family adaptation to stress as a function of the magnitude of the stressor, resources for addressing the stressor, and subjective perceptions of the stressor. Such information could guide the application of services for disaster victims. Further questions include, Were couples who entered into a hasty marriage following the hurricane also more likely to divorce in the year following the hurricane? Did couples who married in the year after the hurricane also become pregnant that year? Because the vital statistics data we used did not identify the individuals who experienced each outcome, we were unable to examine whether more than one of the three outcomes occurred to the same people.

Future research may also examine length of marriage as a predictor of whether couples are more or less likely to remain married or to divorce following disaster. Three sources guide speculation about which couples are at greater risk for divorce. First, according to demographic data on the timing of divorce (National Center for Health Statistics, 1990), newer marriages may be more vulnerable to divorce following a severe stressor considering that, in general, the risk of divorce is elevated for the first 7 years of marriage. Second, attachment research on moderate stress suggests the opposite, that affiliation is stronger among relationships of shorter duration. Therefore it is possible that shorter marriages would be less likely to dissolve compared with longer marriages following severe stress. Third, research on disaster and mental health suggests that the marriages of middle-aged people may be at greater risk. Compared with younger and older adults, middle-aged adults reported more emotional distress and stressors following Hurricane Hugo (Thompson, Norris, & Hanacek, 1993) and more psychopathology following the Mount Saint Helens volcano eruption (Shore et al., 1986). Greater role strain from more family and financial responsibilities in middle age may explain the increased vulnerability for this group compared with other

adults (Thompson et al., 1993). There may be greater demands for middle-aged adults to provide emotional support to a spouse and children living at home and significant financial commitments like mortgages and children's education. Considering bidirectional influences between impaired psychological and marital functioning, one could speculate that the marriages of middle-aged disaster victims are more vulnerable. On the other hand, because the marriages of the middle aged are more likely to be longer and involve children, these stabilizing forces may mitigate the risk of divorce for this group (e.g., Heaton, 1990). The vital statistics data used in our analyses did not report divorce as a function of length of marriage. However, future examination of marriage length as a moderator of the likelihood of divorce following disaster can assist in directing services to the most vulnerable couples.

The results of this study suggest that services for disaster victims beyond immediate disaster relief and individual mental health counseling may be warranted in the year following disaster. Increased divorce rates suggest an increased need for marital interventions following disaster. In addition to preventing divorce among some couples following disaster, marital intervention may also reduce depressive symptoms typically seen after disaster. According to the marital discord model of depression (Beach, Sandeen, & O'Leary, 1990), marital problems can lead to depression. In these cases, treatment of the marital problems rather than an individually focused treatment is more likely to ameliorate the depression. The persistence of depressive symptoms can, in turn, contribute to further marital problems. Therefore, because severe stress affects intra- and interpersonal functioning and because of bidirectional influences between them, it is important to assess mood problems as well as marital problems following disaster and to target intervention at the individual and dyadic levels.

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