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Untangling the disaster-depression knot: The role of social ties after Deepwater Horizon

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ABSTRACT

The mental health consequences of disasters, including oil spills, are well known. The goal of this study is to examine whether social capital and social support mediate the effects of exposure to the Deepwater Horizon oil spill on depression among women. Data for the analysis come from the first wave of data collection for the Women and Their Children's Health Study, a longitudinal study of the health effects of women exposed to the oil spill in southern Louisiana, USA. Women were interviewed about their exposure to the oil spill, depression symptoms, structural social capital (neighborhood organization participation), cognitive social capital (sense of community and informal social control), and social support. Structural equation models indicated that structural social capital was associated with increased levels of cognitive social capital, which were associated with higher levels of social support, which in turn were associated with lower levels of depression. Physical exposure to the oil spill was associated with greater economic exposure, which in turn was associated with higher levels of depression. When all variables were taken into account, economic exposure was no longer associated with depression, and social support and cognitive social capital mediated the effect of economic exposure on depression, explaining 67% of the effect. Findings support an extension of the deterioration model of social support to include the additional coping resource of social capital. Social capital and social support were found to be beneficial for depression post-oil spill; however, they were themselves negatively impacted by the oil spill, explaining the overall negative effect of the oil spill on depression. A better understanding of the pathways between the social context and depression could lead to interventions for improved mental health in the aftermath of a disaster.

1. Introduction

It has been well-established that disasters impact mental health in harmful ways (Norris et al., 2002; Gill et al., 2012). The Deepwater Horizon oil spill, which occurred in 2010 in the Gulf of Mexico off the coast of Louisiana, is now considered the largest accidental marine oil spill in history. Spilling 200 million gallons of crude oil into the Gulf of Mexico and covering 68,000 square miles of land and sea, this technological disaster has been linked to deleterious mental health effects (Gill et al., 2012; Grattan et al., 2011; Fan et al., 2015; Rung et al., 2016), echoing similar findings from earlier oil spills (Lyons et al., 1999; Palinkas et al., 1993a; Carrasco et al., 2007; Sabucedo et al., 2010). A conceptual framework for understanding how oil spills can result in poor mental health outcomes has been proposed as a result of the Exxon Valdez Oil Spill (Palinkas, 2012). Direct or environmental exposure to the oil spill, through damage to areas used for commercial or recreational activities, can lead to damaging economic consequences, both in the short term (e.g., temporary income loss) and in the long term (e.g., sustained unemployment, extended litigation); these in turn can impact community relations, which ultimately are

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associated with increases in a variety of mental health disorders (Palinkas, 2012).

Oil spills are distinct from other types of disasters in that the acute phase usually has a much longer duration, which often results in prolonged periods of acute distress and the development of corrosive communities (Palinkas, 2012). These communities are typically characterized by increased social conflict, a loss of social connection, increased uncertainty about long-term outcomes, and diminished trust in the ability of public institutions to mitigate these outcomes or prevent future disasters (Palinkas, 2012), and they provide a potential explanation for the persistent association between oil spill disaster exposure and poor mental health. Social support and social capital are elements of the community social environment that may be linked with mental health outcomes.

Social support is generally defined through subtypes of emotional, instrumental, appraisal, and informational support, and can involve both the giving and receiving of support as well as the simple perception of support (Berkman and Krishna, 2014). It has long been known to be a protective factor for poor mental health, particularly in the face of life crises such as widowhood or development of cancer (Kessler et al., 1985; Cobb, 1976). In a disaster context, loss of social support (e.g., deterioration in relationships with others) six years after the Exxon Valdez oil spill was consistently associated with depression, anxiety, and PTSD (Arata et al., 2000). Similarly, lower levels of social support were found to be associated with the most severe depressive symptoms 2–4 years after the DHOS (Gaston et al., 2016).

While social support tends to encompass ideas of egocentric networks at the individual level, social capital embeds these individual social ties within a broader structure of social relationships (Kawachi and Berkman, 2001). Various definitions of social capital have been proposed in the literature, but most empirical studies in public health define it as levels of trust, community participation, and community/individual networks (Whitley and McKenzie, 2005). A further distinction of social capital is that it encompasses two components: structural and cognitive social capital (Harpham et al., 2002). The structural component includes the extent and intensity of associational links or activity (that is, what people “do” in terms of social relations), while the cognitive component comprises perceptions of support, reciprocity, sharing, and trust (or what people “feel” in terms of social relations. (Harpham et al., 2002).

Studies of social capital and mental health show evidence of an inverse relation between cognitive social capital and common mental disorders (De Silva et al., 2005; Ahnquist et al., 2012; Ehsan and De Silva, 2015), while the evidence for an inverse relationship between structural social capital and common mental disorders is more varied, with some studies reporting an inverse relationship and others observing no association (De Silva et al., 2005). One large population-based study found that structural social capital was protective for psychological distress only for men (Ahnquist et al., 2012), while a recent review found no association between structural social capital and depressive and anxiety disorders (Ehsan and De Silva, 2015).

Within a disaster context, when individuals often experience several life stressors concurrently, it is important to understand the mechanisms relating social capital and social support to mental health. In contrast to the stress-buffering theory of social support, whereby social support protects individuals from the potentially harmful influences of stressful events (Cohen and Wills, 1985), the social support deterioration theory emphasizes a different mechanism: a stressor, in this case a disaster, negatively impacts social support (Kaniasty and Norris, 1993). For example, declines in social support have been linked to increased exposure to the Exxon Valdez Oil Spill (Palinkas et al., 1993b), the 1999 flood and mudslides in Mexico (Norris et al., 2005), and the 2004 Southeast Asian tsunami (Arnberg and Melin, 2013). In other words, the disaster has a negative impact on mental health both directly, through immediate loss and trauma, and indirectly, through deterioration of social support (Kaniasty and Norris, 1993).

Limited research has described the relationship between social capital and mental health among disaster survivors. A study of earthquake survivors in Peru found that cognitive social capital was negatively associated with chronic PTSD, while structural social capital was not (Flores et al., 2014). A study of flood-affected respondents in England revealed that cognitive social capital was related to less PTSD, anxiety, and depression, while structural social capital was related to more anxiety (Wind et al., 2011). There have been even fewer studies that have expressly looked at the relationship between both social capital and social support among disaster survivors (Wind and Komproe, 2012).

Using as a framework the Social Support Deterioration Model (Wheaton, 1985), the goal of the present study is to determine whether 1) social support is a consequence of social capital, 2) how exposure to the Deepwater Horizon oil spill is related to depression, and 3) whether social support mediates the effect of oil spill exposure on depression among women living in southern Louisiana, USA, using structural equation modelling. Specifically, we hypothesize that higher levels of structural social capital lead to increased cognitive social capital, which leads to increased social support. Higher levels of social support lead to less depression. However, in a disaster context, greater exposure to the oil spill, specifically its economic consequences, erodes social support, ultimately suppressing its beneficial impact on depression. Understanding the role social ties play in this relationship can help point to interventions to mitigate the consequences of oil spill disasters.

2. Methods

2.1. Study design and population

The Women and Their Children's Health (WaTCH) Study is a longitudinal study of women in seven southern Louisiana parishes to assess the health effects of the Deepwater Horizon Oil Spill (DHOS). Women were selected as the target population because they represent an influential yet vulnerable and understudied population. They are often central to decision-making processes within families and households, particularly with respect to decisions regarding health, support, diet, and child rearing; and they have remained relatively understudied with respect to the DHOS. Data for the present analysis were from the first wave of interviews conducted between July 2012 and August 2014, and women were interviewed on average 3.1 years (SD 0.38) after the oil spill. Details of the study are presented elsewhere (Rung et al., 2016; Peres et al., 2016). Briefly, women were randomly recruited through an address-based sampling frame. Women were eligible to participate if they were between 18 and 80 years old and lived in the study area at the time of the oil spill. Subjects were administered a 60-min computer-assisted telephone interview, comprised of questions on medical, social, emotional, and behavioral domains. Study data were collected and managed using Research Electronic Data Capture (REDCap) electronic data capture tools (Harris et al., 2009). 2852 women completed the telephone interview. The response rate, as defined by the American Association for Public Opinion Research, was 45% (AAPOR, 2011). The study was approved by the Louisiana State University Health Sciences Center institutional review board.

3. Measures

3.1. Depression

Depressive symptomology was assessed with the validated 20-item Center for Epidemiological Studies Depression (CESD) Scale (Radloff, 1977). Internal consistency for the whole scale was good. Depressive symptoms were modelled as a single latent variable consisting of four factors that had been previously identified (Knight et al., 1997): depressed affect (Cronbach's alpha = 0.90), somatic (Cronbach's alpha = 0.83), positive affect (Cronbach's alpha = 0.80), and interpersonal (Cronbach's alpha = 0.69). Cronbach's alpha for the overall scale was 0.93. Higher scores indicate more depressive symptoms. The measurement model had good fit ($\chi^2(2) = 5.899$, $p < 0.0524$, RMSEA = 0.026 (0.000–0.052), CFI = 0.999, TLI = 0.998).

3.2. Oil spill exposure

Exposure to the oil spill was measured using nine self-reported items with a yes/no or dichotomous format (see Table 2) that had been used in a previous study (Rung et al., 2016). It was modelled as two latent variables identified through confirmatory factor analysis: physical exposure (6 items) and economic exposure (3 items). Examples of physical exposure included "Oil spill caused damage to areas fished commercially" and "Oil spill directly affected recreational activities of household." An example of economic exposure included "Lost household income due to employment disruption because of oil spill." Higher scores indicated greater oil spill exposure. Cronbach's alphas were 0.51 and 0.56 for physical and economic exposure, respectively. The measurement model had good fit ($\chi^2(26) = 116.105$, $p < 0.0001$, RMSEA = 0.035 (0.029–0.041), CFI = 0.969, TLI = 0.957.

3.3. Structural social capital

Structural social capital was measured with nine items (see Table 2) using a yes/no response format assessing women's participation in nine different kinds of neighborhood organizations over the past year (Sastry et al., 2006). Example organizations included neighborhood meetings, business groups, and book clubs. Cronbach's alpha was 0.69. Structural social capital was modelled as a single latent variable with 9 items. Higher scores indicated greater structural social capital. The measurement model had good fit ($\chi^2(27) = 56.963$, $p < 0.0007$, RMSEA = 0.020 (0.013–0.027), CFI = 0.992, TLI = 0.989).

3.4. Cognitive social capital

Cognitive social capital was modelled as a single latent variable derived from two scales: the Sense of Community Index (Chavis et al., 1987) (12 items) and informal social control (Sampson et al., 1997) (5 items) (see Table 2). For sense of community, subjects were asked to indicate if statements were "mostly true" or "mostly false." Example statements included "I think my neighborhood is a good place for me to live" and "I can recognize most of the people who live in my neighborhood." Cronbach's alpha was 0.80. For informal social control, subjects were asked about the likelihood (very likely, likely, neither likely nor unlikely, unlikely, or very unlikely) that their neighbors could be counted on to intervene in various ways, including if children were skipping school and hanging out on a street corner, or if children were spray-painting graffiti on a local building. Responses of likely or very likely were considered to have higher informal social control. Cronbach's alpha was 0.82. Higher scores on both scales indicated higher levels of cognitive social capital.

3.5. Social support

Social support was modelled as a single latent variable (6 items with a yes/no response format) derived from items developed for the study to measure emotional, instrumental, appraisal, and informational support (see Table 2). Subjects were asked if there was anyone among their friends, family, acquaintances and neighbors they could count on for things like everyday favors or if there was someone they could talk to if they were having trouble with family relationships. Cronbach's alpha was 0.76. Higher scores indicated higher levels of social support. The measurement model had adequate fit ($\chi^2(9) = 25.119$, $p < 0.0028$, RMSEA = 0.025 (0.014–0.037), CFI = 0.997, TLI = 0.995).

3.6. Unemployment

Unemployment was measured as a single indicator variable asking subjects whether they were currently employed.

3.7. Analysis

Structural equation modeling (SEM) was used to measure latent constructs and to describe how these constructs are related to each other. Analyses were conducted in Mplus (v7.2) (Muthén and Muthén, 2015). SEM estimates the extent to which the theoretical model is supported by sample data. Confirmatory factor analysis measurement models were constructed for the unobserved constructs of oil spill exposure, structural social capital, cognitive social capital, social support, and depression. To test our hypothesis, we developed structural models to examine 1) the relationship between structural social capital, cognitive social capital, and social support; 2) how physical oil spill exposure affects economic oil spill exposure and current unemployment; and 3) whether social support mediates the effect of oil spill exposure on depression. This third objective is based on the social support deterioration theory (Kaniasty and Norris, 1993) that states that stressors, in this case exposure to the Deepwater Horizon oil spill, erode social support, which negatively impacts well-being (i.e., depression). We expanded this theoretical model to include social capital as an additional coping resource that could be negatively impacted by the oil spill. Model fit was assessed through examination of the chi-square test of model fit, the comparative fit index (CFI), the Tucker Lewis Index (TLI), and the root mean square error of approximation (RMSEA). A CFI/TLI of 0.95 or greater and a RMSEA of 0.05 or lower were considered guidelines of good model fit (Schumacker and Lomax, 2010). We assessed mediation by testing for direct and indirect effects between depression and 1) economic exposure, 2) physical exposure, 3) structural social capital, and 4) cognitive social capital. We also assessed direct and indirect effects between social support and structural social capital. Mplus uses the delta method to examine mediation (Muthén and Muthén, 2015). We made adjustments to the model by removing non-significant paths and adding paths suggested by the modification indices until we arrived at a final model with more acceptable fit. The total sample size for the analysis was 2852 women, and complete data were available for 2003 women. Mplus accounts for missing data using Direct ML estimation (Muthén and Muthén, 2015). The minimum coverage of any missing data pattern was 0.845. The extent of missing data for each variable is shown in Tables 1 and 2.

Table 1
Participant characteristics of WaTCH study sample, N = 2852.

Characteristic	N (%)
Education	
Less than high school	327 (11.8)
High school graduate	1649 (59.3)
College or higher	804 (28.9)
Pre-Oil Spill Annual Household Income	
Less than $20,000/yr	645 (24.9)
$20,000 - $50,000/yr	763 (29.5)
$50,000 - $80,000/yr	545 (21.1)
Over $80,000/yr	636 (24.6)
Race/Ethnicity	
Non-Hispanic White	1522 (54.6)
Non-Hispanic African American or Black	945 (33.9)
Hispanic/more than one race/other	319 (11.5)
Marital Status	
Married/living with partner	1785 (62.7)
Widowed/divorced/separated/never married	1063 (37.3)
Current Unemployment	
Yes	1081 (40.9)
No	1562 (59.1)
Age, years (mean ± SD)	45.7 ± 12.04
Depression (CESD) Score (mean ± SD)	11.8 ± 12.46

Missing data: Education (n = 72); income (n = 263); race (n = 155); marital status (n = 4); current unemployment (n = 209); depression (n = 122).

4. Results

4.1. Participant characteristics

Table 1 presents characteristics of the WaTCH participants. Among the 2852 women, the mean age was 45.7 years (SD 12.04). The majority of women had graduated high school but not college (59%), were non-Hispanic White (55%), and were married or living with a partner (63%). Pre-oil spill household income was relatively evenly distributed among the four income groups, and 41% of women were currently unemployed. The average CESD score was 11.8 (SD 12.46). Using the standard cutoff of 16, over 28% of the women in the sample had depressive symptoms severe enough to warrant clinical intervention (not shown). Table 2 shows the characteristics and factor loadings for each latent variable, all of which were significant ($p < 0.0001$).

4.2. Structural models

The hypothesized structural model is presented in Fig. 1. This model had adequate fit (χ^2 (425) = 1412.647, $p < 0.0001$, RMSEA = 0.029 (0.027–0.030), CFI = 0.934, TLI = 0.928), but modification indices suggested the addition of four more paths: from physical exposure to structural social capital, economic consequences to cognitive social capital, and unemployment to both structural social capital and social support. These modifications went into the next model (Fig. 2), which had better fit ($\chi^2(421) = 1097.382$, $p < 0.0001$, RMSEA = 0.024 (0.022–0.025), CFI = 0.955, TLI = 0.950) and was therefore retained as the final model.

Table 3 shows a summary of the total, direct, and indirect effects on depression for our final model. The total and indirect effects of economic consequences of the DHOS on depression were significant, while the direct effects were not. Specifically, social support and cognitive social capital (though not unemployment) explain 71% of the effect of economic exposure on depression, suggesting that the economic exposure-depression relationship is completely mediated by social support and cognitive social capital. Cognitive social capital is negatively associated with depression; when social support is introduced as a mediator, the effect decreases, though still remains significant. Specifically, cognitive social capital has a direct effect on depression, and 27% of the effect is explained by the indirect path through social support. Physical exposure to the DHOS is positively associated with depression, but once the mediators of economic exposure, unemployment, cognitive social capital, structural social capital, and social support are considered, this effect is reduced though still significant, suggesting that these variables partially mediate the effect of physical exposure to the oil spill on depression (31% of the effect is explained by these variables).

5. Discussion

This study examined the relationships among exposure to the Deepwater Horizon oil spill, social capital, social support, and depression in women living in southern Louisiana. We observe that structural social capital, in the form of neighborhood organization participation is associated with higher cognitive social capital, which is also associated with increased social support. We also find that higher levels of both cognitive social capital and social support are protective against depression.

Although few studies have attempted to distinguish between cognitive and structural social capital, our findings are consistent with those that have observed cognitive social capital to be more strongly associated with depression than structural social capital. For example, Harpham and colleagues showed that among Colombian youth, cognitive social capital (in the form of trust in people) was weakly associated with mental health, while structural social capital (group participation) was not associated at all (Harpham et al., 2004). Similarly, Ahnquist found that among Swedish women, structural social capital (in the form of social participation) appeared less important to psychological distress than cognitive social capital (in the form of interpersonal trust), and those associations disappeared altogether once economic hardship was added to the model (Ahnquist et al., 2012). Conversely, Berry found that both structural (community participation) and cognitive (personal social cohesion) social capital were related to better general mental health in a nationally representative Australian study (Berry and Welsh, 2010). None of these studies, however, looked at social capital in the context of an oil spill or other disaster, making the results of the present study particularly instructive. While it has been suggested that the cognitive aspects of social capital are more closely related to mental health than the structural aspects (Harpham et al., 2004), our findings suggest that the cognitive aspects of social capital may actually be a consequence of the structural aspects, as hypothesized earlier by Engström (Engström et al., 2008). Structural social capital in our model is more distally located from depression and appears to operate primarily through its effect on cognitive social capital and social support, offering one possible explanation for why its relationship with depression is weaker.

We also observe a positive relationship from physical exposure to the DHOS to economic exposure, suggesting that more direct, physical contact with the oil spill leads to subsequent economic consequences. Total effects suggest that economic consequences lead to increased levels of depression, but significant indirect effects suggest an intervening pathway. While unemployment is associated with increased levels of depression, economic exposure does not appear to be related to increased levels of unemployment. It is possible that other factors in the economy account for unemployment's effect on depression.

Other studies of the DHOS have found associations between oil spill exposure, economic loss, and poor mental health outcomes. For example, Grattan et al. observed that greater oil spill-associated income loss was associated with greater depression, anxiety, and

Table 2
Characteristics and factor loadings for measurement models, N = 2852.

Construct and indicators	Missing data	N (%)	Standardized loading	Number on figure
Physical exposure to the oil spill				
Oil spill caused damage to areas fished commercially	19	195 (6.8)	0.72	1
Any smell exposure	142	1016 (37.5)	0.55	2
Worked on any oil spill clean-up activities	0	55 (1.9)	0.43	3
Came into physical contact with oil in other ways (e.g., during home, recreation, hunting, fishing, or other activities)	28	624 (22.1)	0.59	4
Oil spill directly affected recreational hunting/fishing/other activities of household	20	972 (34.3)	0.72	5
Any property lost or damaged due to oil spill or clean-up	4	72 (2.5)	0.70	6
Economic exposure to the oil spill				
Lost HH income due to employment disruption/closing of business because of oil spill	11	743 (26.2)	0.76	7
Hit harder by oil spill compared to others in community	62	167 (6.0)	0.68	8
Oil spill had somewhat or very negative influence on HH financial situation	44	1064 (37.8)	0.85	9
Structural social capital				
Neighborhood or block organization meeting	45	552 (19.7)	0.58	10
Business or civic group	44	412 (14.7)	0.79	11
Nationality or ethnic pride group	45	102 (3.6)	0.73	12
Local or state political organization	44	289 (10.3)	0.73	13
Volunteered in a local organization	44	1020 (36.3)	0.81	14
Veteran's group	44	173 (6.2)	0.47	15
Labor union	44	55 (2.0)	0.56	16
Literary, art, study, book club, or discussion group	45	469 (16.7)	0.64	17
Fraternity, sorority, or alumni group	44	264 (9.4)	0.67	18
Cognitive social capital				
Sense of community scale (mean ± SD)	331	9.6 ± 2.56	0.90	19
Informal social control scale (mean ± SD)	218	16.8 ± 3.17	0.64	20
Social support				
Received social support	62	2307 (82.7)	0.66	21
Provide everyday favors	36	2323 (82.5)	0.80	22
Take care if sick	55	2517 (90.0)	0.70	23
Lend money for medical emergency	69	2056 (73.9)	0.86	24
Talk about relationship troubles	38	2577 (91.6)	0.80	25
Locate housing if had to move	89	2203 (79.7)	0.87	26
Depressive symptoms	122			
Depressed affect (mean ± SD)	74	3.4 ± 4.95	0.83	27
Positive affect (mean ± SD)	81	2.4 ± 3.15	0.71	28
Somatic activity (mean ± SD)	81	5.4 ± 5.15	0.85	29
Interpersonal (mean ± SD)	87	0.6 ± 1.28	0.56	30

Note: All factor loadings significant at $p < 0.0001$.

other mental health consequences (Grattan et al., 2011). In addition, Gill et al. reported that Alabama residents with greater exposure to the oil, greater economic loss, and commercial ties to natural resources also experienced high levels of psychological distress (Gill et al., 2012). Our study shows that unemployment is indeed related to higher levels of depression, although we are unable to link unemployment back to oil spill exposure.

We find that both cognitive social capital and social support were mediators for the oil spill exposure-depression relationship. That is, the impact of economic consequences of exposure to the DHOS on depression is explained by its negative impact on both cognitive social capital and social support. These results fit well with the deterioration model of social support, which suggests that a stressor (e.g., disaster) erodes coping resources (e.g., social support), which accounts for the resulting impact the stressor has on well-being (e.g., depression) (Kaniasty and Norris, 1993; Wheaton, 1985). Findings from the present study extend this deterioration model to include the additional coping resource of cognitive social capital. We find that the stressor, economic consequences stemming from the DHOS, erodes both cognitive social capital and social support, which in the absence of the stressor would normally have a beneficial effect on depression. In other words, the detrimental effect of economic exposure on depression is explained almost entirely (67%) by economic exposure's detrimental impact on social resources. These results provide another example of the corrosive communities that result from oil spills. Environmental disasters give rise to a loss of natural resources, which may be particularly relevant for people who rely on them for recreational or subsistence activities that bring social groups together (Palinkas, 2012). Moreover, there often is an unequal distribution of economic impacts and availability of clean-up employment or other resources that lead to social disparities within a community, leading to increased social conflict and reduced social support (Palinkas, 2012). Indeed, research on the post-DHOS compensation process suggests that perceptions of randomness and lack of transparency in the distribution of claims resulted in negative social comparisons and competition that led to a corrosive effect in the community (Mayer et al., 2015). Such characteristics of corrosive communities may explain why we observe a negative impact of the oil spill on cognitive social capital and social support.

Similar findings were observed after a severe 1981 flood in Kentucky. Using structural equation modeling with a longitudinal design, Kaniasty et al. found that social support, as embodied by social embeddedness and non-kin support, was impaired by the flood, which ultimately accounted for the increase in disaster-related depressive symptoms (Kaniasty and Norris, 1993). While several studies have demonstrated inverse relationships between disaster stressors and social support, theirs was among the first to support the utility of the social support deterioration model in describing how environmental stress may operate to affect psychological health.

Of interest is the positive relationship we find between physical exposure to the oil spill and increased structural social capital. In contrast to the corrosive communities described above (Palinkas,

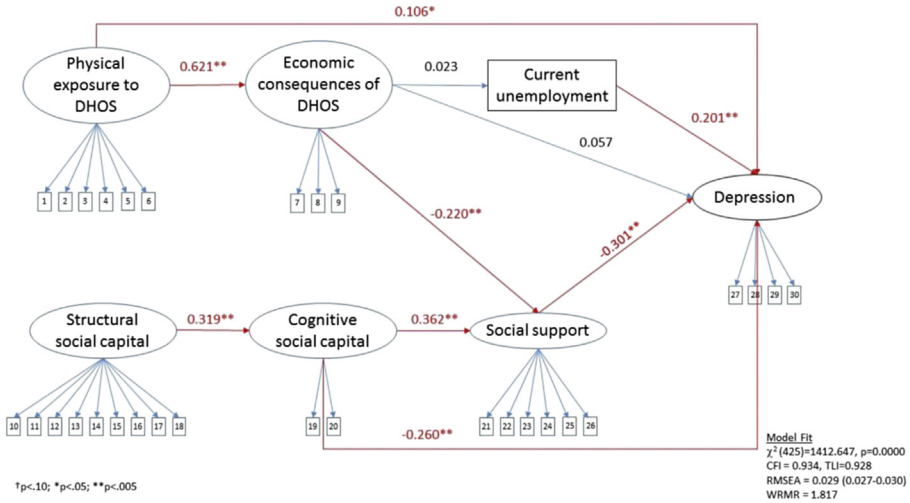

Fig. 1. Hypothesized structural model for oil spill exposure, social capital, social support, and depression.

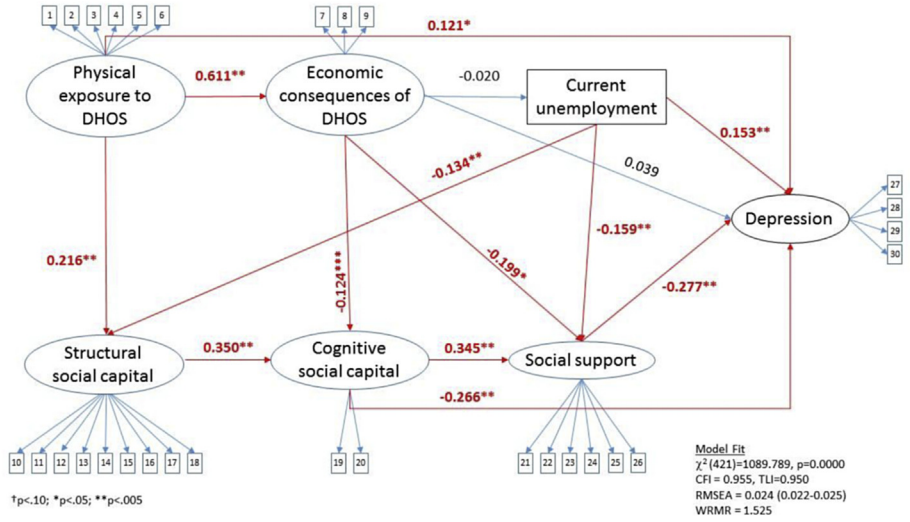

Fig. 2. Final structural model for oil spill exposure, social capital, social support, and depression.

Table 3
Total, direct, and indirect effects on depression for final structural model, N = 2852.

	Total Effect			Direct Effect			Indirect Effect			% of Effect mediated (Indirect/Total)
	Est	SE		Est	SE		Est	SE		
Economic consequences of DHOS[a]	0.13	0.04	**	0.04	0.04		0.10	0.02	**	71%
Cognitive social capital[b]	−0.36	0.02	**	−0.27	0.02	**	−0.10	0.01	**	27%
Physical exposure to DHOS[c]	0.18	0.03	**	0.12	0.04	*	0.06	0.03	*	31%

†p < 0.10; *p < 0.05; **p < 0.005.
[a] Relationship between economic consequences and depression mediated by unemployment, cognitive social capital, and social support.
[b] Relationship between cognitive social capital and depression mediated by social support.
[c] Relationship between physical exposure and depression mediated by economic consequences, unemployment, cognitive social capital, structural social capital, and social support.

2012), it is possible that "therapeutic communities" among the already tight-knit communities of the Louisiana Gulf Coast have developed as well, similar to a phenomenon observed following Hurricane Katrina in New Orleans. There, citizens came together to provide mutual support to confront common problems faced during recovery (Weil, 2010). Our results show a similar relationship, in that greater physical exposure to the oil spill was associated with increased participation in neighborhood organizations. The fact that the two types of oil spill exposure (physical and economic) each affect the two forms of social capital (structural and cognitive) in opposite directions underscores the need to differentiate each construct when examining these complex relationships.

While several studies have demonstrated relationships between disaster stressors and mental health (Gill et al., 2012; Grattan et al., 2011; Fan et al., 2015; Rung et al., 2016; Lyons et al., 1999; Palinkas et al., 1993a; Carrasco et al., 2007; Sabucedo et al., 2010) and inverse relationships between disaster stressors and social support (Palinkas et al., 1993b; Norris et al., 2005; Arnberg and Melin, 2013), few studies have explicitly looked at the role of social capital in these relationships or studied them in the context of an oil spill. A strength of this study is its ability to distinguish between different forms of social capital as well as different expressions of exposure to the Deepwater Horizon oil spill in the context of a large sample of women within a geographic setting that is particularly vulnerable to disasters.

The study does have a number of limitations. First, it uses self-reported cross-sectional data, precluding our ability to definitively rule out reverse causation. Related to this are the difficulties in directly attributing depression and available social support to the oil spill, as some time had passed since the beginning of the spill. On the one hand, it is possible that depressive symptoms arising from oil spill exposure were much greater earlier on, as perhaps were levels of social capital and social support due to insufficient time for deterioration; this lack of temporal distinction impacts our ability to accurately assess the magnitude of the different domains under study and potentially biases our results towards the null. Longitudinal analyses are an important next step. Second, we are only able to generalize to women living in southern Louisiana at the time of the DHOS; results may not apply to men. Finally, social capital was operationalized at the individual level, resulting in perceptions of social capital by subjects rather than a true collective phenomenon that exists at the neighborhood level.

6. Conclusion

Social capital and social support are coping resources that were found to be beneficial for depression post-disaster. However, they were themselves negatively impacted by the Deepwater Horizon oil spill, explaining the overall negative effect of the oil spill on depression. The findings suggest that social resources are not immutable and can be harmed by disasters, ultimately influencing a population's level of depression. Future research should explore whether these relationships hold over the long term and with other mental health outcomes. A better understanding of the pathways between the social context and depression could lead to interventions for improved mental health in the aftermath of a disaster.

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