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Stress generation: Future directions and clinical implications

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HIGHLIGHTS

- Provides review of main findings in stress generation literature
- Presents integrative theoretical model
- Highlights and discusses gaps in the empirical literature
- Considers clinical implications of stress generation

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ABSTRACT

Although the past two decades have seen increasing empirical interest in stress generation, the process whereby depressed or depression-prone individuals experience higher rates of life stress that are at least in part influenced by their own cognitive and behavioral characteristics, several important aspects of this phenomenon remain relatively unexamined, leaving open several promising opportunities for future advancement of the field. The current paper begins with a brief review of the extant literature on the influence of cognitive, behavioral and interpersonal, childhood maltreatment, and genetic factors on stress generation. An integrative theoretical model is then presented tying together these different lines of research in accounting for the stress generation effect and its potential depressogenic sequelae (i.e., depression recurrence and depression contagion). Drawing on this model, particular focus is given to the need to identify the behavioral processes through which cognitive factors confer risk for stress generation, as well as to the need for research assessing the full etiological chain posited by the stress generation hypothesis linking self-generated stress with subsequent depression. In addition, methodological issues of particular relevance to this area of research are discussed. The current review ends with a consideration of the clinical implications of the stress generation phenomenon.

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1. Introduction

Depression is associated with considerable impairment worldwide. Indeed, relative to all other illnesses and injuries, it has been projected to be one of the top two leading causes of global burden of disease by 2030 (Mathers & Loncar, 2006; World Health Organization, 2008). The high public health cost of depression may in large part be due to the fact that it is an often chronic condition, with rates of recurrence ranging from 50% for individuals with one previous episode of major depression, to 70% for those with two, and up to 90% for those with three or more past episodes (American Psychiatric Association, 2000; Burcusa & Iacono, 2007; Solomon et al., 2000). Moreover, despite significant advances in treatment options for this disorder, rates of relapse and recurrence after treatment remain relatively high, for example, ranging from 29% one year after cognitive therapy to 54% after two years (Vittengl, Clark, Dunn, & Jarrett, 2007). For these reasons, it is important to delineate the processes underlying depressive recurrence so as to inform future clinical interventions aimed at reducing the prevalence of this disorder and its attendant societal costs.

One theoretical model that has been proposed to account for the often recurrent nature of depression is the stress generation hypothesis (Hammen, 1991, 2006). The past two decades have seen a sustained growth of interest in this area, along with substantial empirical support (Hammen, 2006; Liu & Alloy, 2010). Nonetheless, several important gaps in the literature persist. The current paper begins by presenting a brief theoretical background and review of stress generation research. Only studies of stress generation that differentiated between dependent stressors (i.e., negative life events that are at least in part influenced by the individual's behavior, such as the dissolution of a romantic relationship) and independent ones (i.e., negative life events outside the control of the individual, such as the death of a loved one) have been included in the current review. Inasmuch as the stress generation hypothesis differs in its predictions regarding dependent and independent stressors, not to distinguish between these two forms of stressors would provide an unclear assessment of any putative stress generation effect. Studies that integrated subjective appraisals of stress in their assessments of life stressors were similarly excluded, given the focus in the stress generation hypothesis on objectively occurring stressors. Based on these criteria, an inspection of 527 articles in PsycINFO citing Hammen's (1991) original study in which the stress generation hypothesis is presented, and a literature search using the term "stress generation" in PsycINFO and PubMed yielded 91 studies relating to depression or depressogenic vulnerabilities.[1] Given that a comprehensive review of the stress generation literature is beyond the scope of the present article, the current effort aims instead briefly to describe some of the main findings to date. Drawing on these findings, an integrated model of stress generation is then presented, highlighting some important gaps in the extant literature. Particular consideration is then given to two of these gaps – the need for integrative research investigating the behavioral processes through which depressogenic cognitions lead to greater stress generation, and the paucity of studies focusing on clinically significant sequelae of stress generation – along with recommendations for future research in these areas. From here, a discussion follows regarding methodological concerns of particular relevance to this area of research. Finally, this article concludes with a consideration of the clinical implications of the stress generation effect.

2. Stress generation background and theory

It is now well established that stressful life events are associated with risk for first onset and recurrence of depression (i.e., stress exposure; Hammen, 2005), particularly when interacting with pre-existing depressogenic vulnerabilities (i.e., stress–diathesis; Morris, Ciesla, & Garber, 2008). Additionally, the nature of this association appears to change over the course of the disorder, such that first lifetime episodes of depression are more likely to be precipitated by severe life stressors than are subsequent recurrences (i.e., kindling; Monroe & Harkness, 2005). It is worth noting, however, that much early work in this area explicitly excluded dependent stressors from empirical consideration, instead focusing exclusively on independent ones. This decision was based on the then-prevailing assumptions that (i) individuals are largely passive recipients of their environment, rather than active forces shaping it, and (ii) the relation between life stressors and depression is unidirectional, with exposure to the former increasing susceptibility to the latter, rather than transactional. Hence, dependent stressors were viewed as largely a manifestation of an individual's psychopathology, rather than an important construct to be studied in its own right, and thus a methodological confound to be partialled out in determining the causal relation between life stressors and depression.

Although several researchers had previously argued for the importance of studying dependent stressors in addition to independent ones (e.g., Miller, Dean, Ingham, & Kreitman, 1986), Hammen (1991) provided the first theoretical framework for understanding the role of dependent stressors in the pathogenesis of depression. According to the stress generation hypothesis (Hammen, 1991, 2006), rather than being passive recipients to events in the world around them, individuals are active agents in shaping their environment and everyday experiences. In addition, Hammen (1991, 2006) observed that behavioral tendencies and cognitions characteristic of depression are likely to lead to greater experiences of stressful situations and events. Based on these premises, it then follows that depression-prone individuals, when compared to others, are more likely to experience dependent stressors, but also are not likely to differ in the occurrence of independent stressors. Furthermore, although stress generation in depression appears to be relevant to dependent stressors in general, including non-interpersonal dependent ones (e.g., achievement-related stressors), it was hypothesized (Hammen, 1991, 2006) especially to account for stressors that arise from within interpersonal contexts (i.e., interpersonal dependent stressors, defined as negative events that primarily involve an interpersonal relationship; Bifulco et al., 1989). Given that dependent stressors, relative to independent ones, may be associated with greater risk for depression (Hammen, Marks, Mayol, & DeMayo, 1985; Kendler, Gardner, & Prescott, 2002, 2006, but also see Harkness, Bruce, & Lumley, 2006), stress generation has been suggested to be an explanatory mechanism underlying depressive recurrence (Hammen, 1991, 2006). When taken together with stress exposure models of depression, the implication of the stress generation hypothesis is that life stressors and depression share a reciprocal relation, with life stressors increasing susceptibility to depression, and depression, in turn, being associated with greater likelihood of subsequent stressors.

The past 20 years have seen a growing body of literature supporting the existence of this stress generation effect in depression. Indeed, evidence of the relation between depression and stress generation has been documented in a variety of samples, including children and adolescents (Harkness & Stewart, 2009; Uliaszek et al., 2012), adults (Davila, Hammen, Burge, Paley, & Daley, 1995; Hammen, Shih, & Brennan, 2004), the elderly (Moos, Schutte, Brennan, & Moos, 2005), different cultural and ethnic groups (Auerbach, Eberhart, & Abela, 2010; Starrs et al., 2010; Wingate & Joiner, 2004), and even breast cancer patients (Wu & Andersen, 2010) and individuals with chronic fatigue syndrome (Luyten et al., 2011).

As it has been argued that stress generation is not simply a product of depression, but likely a consequence of depressogenic cognitions and behavioral patterns that persist even during depressive remission (Hammen, 2006), increasing attention has been given to identifying these predictors of stress generation. Much of the research

[1] Although seven additional studies relating to other forms of psychopathology (e.g., anxiety disorders) or vulnerabilities not traditionally associated with depression (e.g., impulsivity) were identified in the literature search, they were excluded from the present review, given its focus on stress generation and depression.

in this area to date has focused on depressogenic cognitive and interpersonal or behavioral tendencies, although some studies have also considered other factors, including childhood maltreatment, and more recently, genetic influences. What follows below is a brief summary of findings in each of these areas, with particular emphasis given to studies featuring interview-based assessments of life stressors.

3. Stress generation risk factors

3.1. Cognitive factors

Several studies utilizing interview-based measures of life stressors, and applying different operationalizations of cognitive vulnerability, have found evidence of stress generation. For example, in an adult sample assessed over a six-month period, Safford, Alloy, Abramson, and Crossfield (2007) found evidence of a stress generation effect for depressogenic cognitive styles, based on a composite of dysfunctional attitudes, as conceptualized in Beck's (1967, 1987) cognitive theory, and negative inferential styles, as defined by the hopelessness theory of depression (Abramson, Metalsky, & Alloy, 1989). Gender was observed to moderate this association, such that the effect of negative cognitive styles on stress generation appeared to be specific to women. As for studies focusing on distinct forms of cognitive risk, separate from other risk factors, one found negative inferential styles to predict interpersonal dependent stressors over a one-year period in the children of parents with a history of depression (Shih, Abela, & Starrs, 2009). In contrast to the previous study, however, no moderation by gender was found. Another study (Simons, Angell, Monroe, & Thase, 1993), utilizing a cross-sectional clinical sample of adults with depression, found negative attributional style to be associated with higher rates of dependent, but not independent, stressors prior to the index depressive episode. This association only held, however, for those with first-onset depression. Additionally, no association was observed between dysfunctional attitudes and dependent stressors. Although, there is some evidence of trait-like stability in these cognitive vulnerabilities during adulthood (Romens, Abramson, & Alloy, 2009), some researchers have cautioned against assuming temporal immutability in cognitive vulnerability factors (Just, Abramson, & Alloy, 2001). For these reasons, the temporal precedence of the life stressors relative to measurement of cognitive vulnerability renders it difficult to determine the degree to which these findings reflect stress exposure or stress generation. Finally, one cross-sectional study of Chinese adolescents (Starrs et al., 2010) found evidence for a relation between stress generation and cognitive vulnerability, as conceptualized in Cole's (1990, 1991) competency-based model of depression. Although this study is important in being the first to assess this cognitive model of depression within the context of stress generation, interpretation of these findings is constrained by the cross-sectional design, particularly given that self-perceived competence appears to be malleable during early adolescence (Tram & Cole, 2000), mediating the relation between life stressors and depression, and in some measure this remains the case during early adulthood (Uhrlass & Gibb, 2007). Nevertheless, the extant studies utilizing life stress interviews appear to be largely supportive of a relation between depressogenic cognitive styles and stress generation.

3.2. Behavioral and interpersonal factors

A variety of depressogenic behavioral and interpersonal styles have been implicated in the stress generation effect. Among studies employing interview-based assessments of life stressors, one found dismissive and preoccupied attachment styles to predict interpersonal stressors over a three-month interval in mildly depressed adults (Bottonari, Roberts, Kelly, Kashdan, & Ciesla, 2007). A more recent study reported an interpersonal stress generation effect for anxious attachment and excessive reassurance-seeking over a four-week period in a community sample of adult women (Eberhart & Hammen, 2009). Similarly, excessive reassurance-seeking has been observed to predict interpersonal dependent stressors over a one-year-interval in a sample of children of parents with a history of depression (Shih et al., 2009). Problematic interpersonal behavioral tendencies, in the form of excessive dependency/difficulties being assertive, aggressiveness, and excessive caring were also assessed in study with a non-clinical sample of adult women, and excessive caring, but not the other two interpersonal behavioral styles, were found to predict interpersonal dependent stressors over a six-week period (Shih & Eberhart, 2008). Another study, similarly examining problematic interpersonal behavioral tendencies (i.e., aggressiveness, excessive openness, excessive concern for others, excessive dependency, and hard to be supportive), found excessive dependency to predict interpersonal dependent stressors over a six-week interval (Shih & Eberhart, 2010). There was, however, a gender effect, with excessive concern for others being associated with stress generation in women but not in men. Dependency was also found to be associated with dependent stressors in a cross-sectional study with a community sample of Chinese adolescents (Starrs et al., 2010). In a community sample of late adolescent women, poor interpersonal problem-solving skills were associated with greater interpersonal stress generation (Davila et al., 1995). A notable limitation common across prior studies is the heavy reliance on self-report measures of interpersonal tendencies and behaviors. Insofar as stress generation is an action theory, emphasizing the role of behavioral characteristics in creating stressors (Hammen, 1991, 2006), and to the extent individuals nonetheless have imperfect insight into the processes underlying their behaviors (Nisbett & Wilson, 1977), the relative lack of studies utilizing direct measures of these behaviors as predictors of stress generation is an especially critical one. In one of the few studies in this area to utilize behavioral observation (Davila, Bradbury, Cohan, & Tochluk, 1997), social support behavior was prospectively associated with stress generation over a one-year follow-up in newlywed wives.

3.3. Childhood maltreatment

Childhood maltreatment, particularly childhood emotional abuse, has been linked to depression (Gibb & Abela, 2008), and has received theoretical and empirical support as an antecedent to cognitive vulnerability to depression (Gibb, 2002; Rose & Abramson, 1992). Relatively recently studies have also begun to examine these relations within the context of stress generation. In the first of these to use an interview-based measure of life stressors (Harkness, Lumley, & Truss, 2008), an increase in interpersonal stressors was found over a three-month period following the index depressive episode in depressed adolescents with a history of childhood abuse and neglect. In the other study to date featuring a life stress interview, over a four-month period, this association with stress generation appeared specific to childhood emotional abuse in an adult sample with a history of depression (Liu, Choi, Boland, Mastin, & Alloy, in press). Although there is evidence that recall of negative childhood experiences tends to be fairly reliable (Bifulco, Brown, Lillie, & Jarvis, 1997), the findings based on retrospective assessments of childhood maltreatment in both of these studies await confirmation in future research adopting prospective evaluations of early experiences of abuse and neglect.

3.4. Genetic factors

Outside of the stress generation literature, there has been some indication of possible genetic influences on stress generation. In particular, one review of the research on the heritability of environmental factors found greater evidence of heritability for dependent than independent stressors (Kendler & Baker, 2007). Studies directly investigating potential genetic factors relevant to stress generation have begun to emerge only very recently. In a longitudinal study using a life stress interview, serotonin transporter gene polymorphism

(5-HTTLPR) interacted with depression in adolescents at age 15 to predict dependent stressors five years later (Starr, Hammen, Brennan, & Najman, 2012). Adolescents with at least one short allele, when compared to those with two long alleles, evidenced a stronger association between age-15 depression and subsequent dependent stressors. In another prospective study of adolescents featuring a life stress interview, the 5-HTTLPR genotype was found to interact with relational security, such that the short allele was associated with decreased dependent stressors in those with high security but increased stress generation in others with low security (Starr, Hammen, Brennan, & Najman, in press).

4. An integrative model of stress generation

Research on stress generation has extended beyond strictly documenting its relevance to depression to identifying enduring depressogenic cognitive and behavioral predictors, and relatively more recently, childhood maltreatment and relevant genetic factors. Despite continued progress in these areas, several significant gaps remain in the empirical literature. Perhaps chief among these is the current lack of theoretical framework integrating these relatively diverse lines of research into a more complete account of the stress generation process. Despite the increasing list of aforementioned risk factors that have been identified in association with stress generation, there is a paucity of studies directly addressing the question of how these risk factors may be linked in increasing risk for experiencing dependent stressors (e.g., mediational relationships). For example, although negative cognitive styles in general have received consistent support as a stress generation predictor, exactly *how* these negative cognitions lead to increased dependent stressors remains relatively unclear. In addition to advancing our current knowledge of the stress generation process, extending beyond single-risk-factor models of stress generation is particularly important insofar as such work may yield multiple promising points for clinical intervention.

Of the two stress generation studies thus far to examine potential mediational relations between multiple predictors in conferring risk for dependent stressors, one examined sociotropy and excessive reassurance-seeking within the context of stress generation (Birgenheir, Pepper, & Johns, 2010). Sociotropy is a cognitive style characterized by the tendency to based one's self-worth primarily upon social relationships (Beck, 1983). In this study, excessive reassurance-seeking was observed to mediate the relation between sociotropy and interpersonal stressors over a six-week period as measured with a life events checklist in an adult community sample. More recently, in a sample of adults with a history of depression, negative inferential styles were found to mediate the relation between past history of childhood emotional abuse and dependent stressors as assessed with a life events interview over a four-month period (Liu et al., in press).

Drawing on the existing empirical findings in support of various risk factors for stress generation, an integrated theoretical model is presented describing potential interrelations between these risk factors in the etiological chain leading to the generation of dependent stressors (see Fig. 1). Given that stress generation is an example of action theory, in that, rather than being passive respondent to stressors within their environments, individuals have an active role in shaping the events that occur around them (Hammen, 2006), the most proximal risk factors for stress generation in the proposed model are hypothesized to be behavioral ones. Consequently, it follows that cognitive risk factors exert their influence on stress generation indirectly through the mediational effect of these behavioral processes.

Risk factors more distally located in the etiological chain (e.g., childhood abuse) may exert their deleterious effects through shaping cognitive risk factors during youth. In addition to the previously mentioned study linking childhood emotional abuse to stress generation through the mediational effect of depressogenic cognitive styles, there is considerable theoretical and empirical support for a link between some of these distal risk factors and cognitive vulnerability to depression. For example, according to Rose and Abramson's (1992) extension of the hopelessness theory of depression, childhood emotional abuse is particularly likely to lead to the development of negative inferential styles because with this form of abuse, the perpetrator of abuse directly provides the victim with the negative attribution (e.g., "You are so stupid, you will never amount to anything"). Substantial empirical support for this position has emerged over the years (see Gibb, 2002 for a review).

Based on the emerging evidence of moderating genetic influences on stress generation, particularly 5-HTTLPR genotype interacting with relational attachment security (Starr et al., in press), genetic factors are hypothesized to moderate the effect of proximal behavioral risk factors. Additionally, as previously noted, stress generation has been proposed to function as a mechanism accounting for depressive recurrence (Hammen, 1991, 2006). The model provides an elaboration of this component of the stress generation hypothesis, highlighting both potential intrapersonal and interpersonal consequences of stress generation.

5. Future directions

5.1. Behavioral mediation of cognitive predictors of stress generation

Although the research to date directly examining mediational relations between multiple stress generation predictors is quite limited, they nevertheless validate the need for greater empirical consideration in this area. To discuss thoroughly the manner through which each of the various risk factors in the proposed model may interrelate to contribute to the stress generation effect is beyond the scope of the current effort. Instead, an illustrative example is provided below highlighting how two of the more well-studied predictors of dependent stressors may relate to each other within the etiological chain underlying the stress generation effect. That is, given that cognitive and behavioral stress generation predictors have received significant more empirical support than child maltreatment and genetic factors, specific consideration is given to how depressogenic cognitions may transition to maladaptive behaviors that lead to the generation of dependent stressors.

Among depressogenic cognitive factors, negative inferential styles have been most consistently implicated in the stress generation process. According to the hopelessness theory of depression (Abramson et al., 1989), individuals with this cognitive vulnerability tend to attribute negative events to stable and global causes, and infer negative consequences and self-characteristics. Of the eight studies to evaluate this vulnerability factor, either alone or as a composite with other cognitive risk factors, in relation to stress generation, seven found evidence of this association (Calvete, 2011; Calvete, Orue, & Hankin, in press; Kercher & Rapee, 2009; Liu et al., in press; Mezulis, Funasaki, Charbonneau, & Hyde, 2010; Safford et al., 2007; Shih et al., 2009; Simons et al., 1993), whereas one did not (Gibb, Beevers, Andover, & Holleran, 2006). This relation holds true in youth and adults (Safford et al., 2007; Shih et al., 2009), and in clinical samples as well as individuals with a history of depression (Liu et al., in press; Simons et al., 1993).

Despite the robustness of this association, no studies as of yet have assessed the behavioral processes through which negative inferential styles contribute to stress generation. Insofar as such mediators exist, identifying these behavioral tendencies may inform the use of specific behavioral therapeutic approaches that may be applied in conjunction with cognitive ones for individuals with these negative inferential styles.

One interesting possibility is that, in a manner consistent with self-fulfilling prophecies, individuals possessing a negative inferential style may unknowingly act in ways consistent with their cognitions that ultimately confirm their original beliefs. For example, the inferences drawn in response to a poor midterm exam performance likely

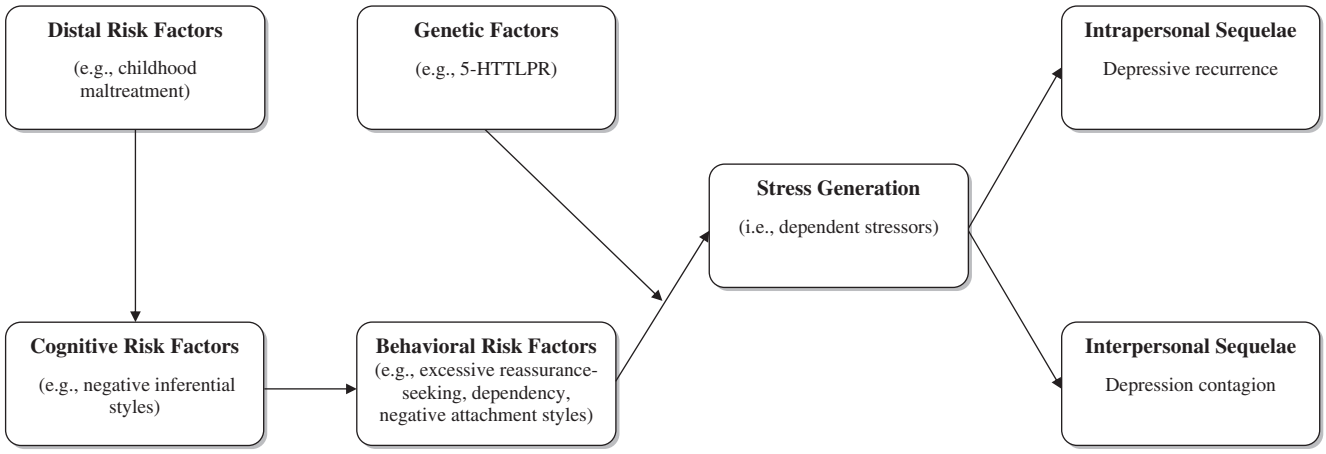

Fig. 1. An integrated model of distal and proximal risk factors, and pathogenic sequelae of stress generation in depression.

differ considerably between an individual with a negative inferential style (e.g., "I performed poorly because I am not smart enough") and another who has a more positive inferential style (e.g., "I performed poorly because I had the flu"). It is reasonable to suspect that these contrasting interpretations likely lead to very different outlooks and approaches for the next exam. The individual with a negative self-outlook may find little motivation to increase effort or to attempt a different strategy for studying for the next exam. Conversely, the less pessimistic individual, guided by belief in their ability to perform better, may redouble their efforts in the future. Although this possibility has not yet been examined within the context of stress generation, another cognitive vulnerability characterized by a fear of rejection by others has been found in one observational study of romantic partners to predict actual rejection in a manner consistent with self-fulfilling prophecies (Downey, Freitas, Michaelis, & Khouri, 1998).

5.2. Intrapersonal sequelae of stress generation

Of particular clinical relevance is the ability of the stress generation hypothesis to account for the often recurrent course of depression. That is, to the degree that dependent stressors, especially relatively to independent ones, are associated with greater risk for depression (Hammen et al., 1985; Kendler et al., 2002, 2006), stress generation may be an important mechanism underlying the homotypic continuity often observed with this disorder (Hammen, 1991, 2006). Furthermore, given the accumulating evidence, from several studies utilizing life stress interviews, that stress generation may be of greater relevance to women than to men (Davila et al., 1997; Hammen, Brennan, & Le Brocque, 2011; Rudolph & Hammen, 1999; Rudolph et al., 2000; Shih & Eberhart, 2010; Shih, Eberhart, Hammen, & Brennan, 2006), and to the extent that dependent stress does indeed confer greater risk for subsequent depression, it may similarly account for gender differences often observed in rates of this disorder.

Although much effort has been directed toward documenting the stress generation effect of depression and specific depressogenic risk factors, research investigating the relation between stress generation and subsequent psychopathology has been markedly scarce (Hammen & Shih, 2008; Liu & Alloy, 2010). That is, although several longitudinal studies utilizing both life stress checklists and interviews have examined stress generation as a mediator between depressogenic risk factors and later depressive symptomatology (e.g., Davila et al., 1997, 1995; Potthoff, Holahan, & Joiner, 1995), only one study to date (Bos, Bouhuys, Geerts, van Os, & Ormel, 2007) has examined stress generation as a mechanism accounting for recurrence of clinical depression. Using a sample of outpatients with recently remitted depression and a life stress checklist, this study found that incongruent non-verbal interpersonal behavior predicted shorter time to depressive recurrence, with prospective dependent stress mediating this effect. Thus, the extant literature collectively provides only a partial assessment of the etiological chain underlying the chronicity of depression articulated in the stress generation hypothesis, reflecting a need to extend research beyond the etiology of this phenomenon to include a similar emphasis on its effect on clinically relevant outcomes. In addition to depressive recurrence, stress generation may in like manner account for other aspects of depression chronicity, such as time to remission, and depressive relapse.

If stress generation does serve as a mechanism linking past depression to risk for future recurrence, the manner through which it exerts its pathogenic effect would also warrant examination. In a manner consistent with stress–diathesis models of depression, one possibility is that dependent stress may interact with the underlying depressogenic vulnerability that produces it, thereby elevating risk for depression beyond what may be accounted for by either variable alone. Given that the deleterious influence of depressogenic vulnerabilities may be activated or augmented by the presence of negative life events or attendant dysphoria, according to the mood-state dependent hypothesis (Persons & Miranda, 1992) and stress–diathesis models of depression (e.g., Abramson et al., 1989), vulnerabilities relevant to stress generation may produce the very stressors required to exert their own depressogenic effect.

5.3. Interpersonal sequelae of stress generation

If the study of the intrapersonal sequelae of stress generation to date is limited, the body of literature concerning its pathogenic effects on others within the individual's social environment is more modest still. Given the often interpersonal nature of stress generation (Hammen, 1991, 2006), however, this would be an important area for future investigation. Indeed, as is often all too salient in treatment settings, depression and its related risk factors frequently have a significant negative impact not only on the individual, but also on those in the individual's immediate social context, particularly family members, close friends, and significant others. This observation is congruent with evidence that depression may cluster within social networks, particularly in the case of females (Rosenquist, Fowler, & Christakis, 2011).

Several social psychological mechanisms have been proposed to account for this tendency for behavioral phenomena and health outcomes, such as depression, to aggregate within social networks. Perhaps of clearest relevance to stress generation, and the process that has received the most empirical attention thus far, induction, or depression contagion, refers to the tendency for depression, or related characteristics of the individual, to contribute to the development

of depression in others. This phenomenon has garnered considerable support (Prinstein, 2007; Rosenquist et al., 2011). Stress generation, particularly given its relevance to interpersonal dependent stressors, may be a potential mechanism underlying this effect. In a word, others within a depressed individual's social environment may be more prone to becoming depressed themselves in part as a function of the higher levels of interpersonal dependent stress to which they are exposed via their interactions with the depressed individual. One study utilizing a life stress interview with a community sample of women and their adolescent children (Hammen et al., 2004) provides preliminary evidence supporting this view of stress generation being involved in the interpersonal transmission of depression. Specifically, maternal interpersonal dependent stress assessed over a one-year interval was found to mediate the relation between maternal and child depression. Thus, stress generation may be an important mechanism accounting for the intergenerational transmission of depression. Additional research is required, however, to extend this finding to depression contagion among peers and other non-relatives in the social network.

Also in line with the possibility that stress generation may be involved in depression contagion, excessive reassurance-seeking, a process that features prominently in Coyne's (1976a) interpersonal theory of depression, has been implicated in both phenomena. That is, several longitudinal studies using both interview and self-report measures of life stress have demonstrated the stress generation effect of excessive reassurance-seeking across different age groups. In the earliest of these studies, utilizing a self-report life stress measure in an adult community sample, excessive reassurance-seeking predicted depressive symptoms five weeks later, and this effect was mediated (Potthoff et al., 1995). This finding has been replicated in another adult community sample with a life events checklist over six weeks (Birgenheir et al., 2010), over 14 days in a daily diary study in another non-clinical adult sample (Shih & Auerbach, 2010), and as previously mentioned, in children of parents with affective disorders over a one-year prospective interval (Shih et al., 2009). This maladaptive interpersonal process has also been found to produce a contagion effect in roommates of depressed college students (Joiner, 1994) and in romantic relationships (Katz, Beach, & Joiner, 1999). Thus, one interesting possibility for future exploration is whether dependent stress related to this interpersonal style may mediate its relation to depression in others in the depressed individual's social environment. Additionally, given the greater sensitivity to interpersonal difficulties found in females (Hankin & Abramson, 2001), and that females also experience more interpersonal dependent stress than do males (Rudolph & Hammen, 1999), this possibility may account for the finding that the relation between excessive reassurance-seeking and depression appears stronger in females than in males (Starr & Davila, 2008).

It is important to note, however, that according to Coyne's (1976b) theory, depression, or its related characteristics, also appears to lead to interpersonal rejection. Individuals who engage in excessive reassurance-seeking, in repeatedly attempting to confirm their self-worth and the care and interest of others, often eventually frustrate and cause themselves to be rejected by others (see Starr & Davila, 2008, for a review). Interestingly, the depression contagion effect of excessive reassurance-seeking does not appear to mediate its relation with interpersonal rejection (Joiner, Alfano, & Metalsky, 1992). This finding suggests that depression contagion and interpersonal rejection are relatively distinct consequences of excessive reassurance-seeking, with those within the depressed individual's social environment who bear this aversive interpersonal style and subsequently become depressed themselves being different from those who are less willing to tolerate it and choose instead to migrate to a more distal placement within this social network or to exit it altogether.

Thus, one may well see how stress generation may serve as a mechanism underlying the process of induction in conferring risk for depression in others within an individual's social network. Through this process, stress generation may be one factor accounting for the propensity for depression to cluster within social networks. Furthermore, the greater salience and engagement in social interactions that occurs in girls relative to boys during adolescence may similarly result in gender differences in the social process of induction, which in some measure account for the greater risk for depression in females that is observed during this period of development.

6. Methodological considerations

6.1. Measuring life stress

Despite the considerable growth of interest and attendant advancement in our knowledge of the stress generation process in recent years, several methodological limitations persist within much of the literature. Perhaps one of the most notable of these methodological concerns relates to the heavy reliance on traditional self-report checklists in assessments of stressful life events. Indeed, 52% of the 98 extant stress generation studies relied exclusively on self-report life stress inventories.

A considerable number of self-report checklists have emerged over the last few decades, and, reflecting their enduring popularity, self-report inventories have been utilized in the majority of extant studies on life stress. These trends are, in large part, due to several clear and significant advantages inherent in these measures relative to interview-based approaches. In contrast to interview-based approaches, no training is required for the administration of life-stress inventories. Moreover, the burden in terms of time and effort to both researcher and respondent is very minimal in the case of checklist inventories, but often quite substantial for interview-based methods. Indeed, whereas life stress inventories usually require a few minutes to complete, administration of some interview-based instruments can often last over an hour, and is relatively more taxing to the respondent, who is required not only to recall whether an event has occurred, but also to report relevant narrative details regarding the event and to date its occurrence. In addition to the administration of the interview, several interview-based instruments require a post-interview rating team to provide stress severity ratings for each life event based on the narrative details collected. This process alone can require a considerable investment of time and effort, particularly in the training of raters and in ensuring against drift over time in the stress severity ratings for comparable life events (e.g., rating a job loss as relatively mild for one participant but a comparable job loss for a later participant as more severe).

Although the benefits of economy and reduced participant burden inherent in the use of traditional self-report inventories cannot be denied, they are also qualified by several psychometric limitations (Hammen, 2005; Monroe, 2008). Specifically, traditional life stress checklists are vulnerable to idiosyncratic or subjective interpretative biases (Brown & Harris, 1978; Johnson & Roberts, 1995). Moreover, depression-prone individuals tend to interpret ambiguous situations in a consistently negative manner (Beevers, 2005; Mathews & MacLeod, 2005), which may be one factor leading to an over-reporting of negative life events. Depressogenic personality traits, such as neuroticism may also affect subjective assessments of life stressors (Espejo et al., 2011). Of particular relevance to stress generation research, the hopelessness theory of depression (Abramson et al., 1989) argues that individuals with a depressogenic cognitive style are more likely to interpret negative situations as being dependent on their behavior. Additionally, Krackow and Rudolph (2008) have found that, when compared to asymptomatic peers, depressed adolescents tend to overestimate their contribution to negative events measured with a life stress interview. Therefore, a reasonable concern with self-report inventories is that they may result in artificially higher reported rates of dependent stressors in those with depressogenic vulnerabilities relative to healthy peers, skewing findings relevant to stress generation. Furthermore, individuals susceptible to depression are often more physiologically reactive

to life stressors (Gotlib, Joormann, Minor, & Hallmayer, 2008), which may systematically inflate their reports of what they deem notable on life stress checklists. Thus, responses on self-report checklists may to some degree reflect underlying personality, as well as cognitive and physiological vulnerabilities in addition to the actual occurrence of the stressors they are intended to measure. As subjective appraisals of life events, and the processes that influence them, are important constructs in their own right (Park, 2010), by confounding life stress with related depressogenic variables, the use of self-administered life stress measures may render problematic interpretations regarding the precise relations between life stress, vulnerability factors, and depression (Espejo et al., 2011; Spaccarelli, 1994).

These limitations of self-report checklists may be largely circumvented through the use of interview-based approaches, which allow for a more standardized and objective determination of qualifying life events and their severity ratings. Life stress interviews, such as the Life Events and Difficulties Schedule (LEDS; Brown & Harris, 1978), offer the considerable advantage of a more sensitive context-based assessment of life events, with, as noted above, post-interview independent raters coding events and their severity based on the impact they would have on a typical individual under identical circumstances. In addition to allowing for the elicitation of concrete indicators that reported events accurately reflect actual occurrences rather than catastrophization or misinterpretation of ambiguous information, the extensive probes embedded in these interviews provide independent raters with individual-specific contextual information to aid their determinations of "objective" event severity (i.e., based on behavioral information rather than on subjective response) and event dependence ratings (i.e., the degree to which the individual influenced the occurrence of the event), the latter being of particular importance to stress generation research. For example, the severity of losing a parent differs significantly for an estranged middle-aged adult and an orphaned child, and likewise, dependence ratings for job loss would differ if it were the result of downsizing during an economic downturn rather than being fired for poor performance. Such nuanced determinations are possible with life events interviews but outside the scope of self-administered checklists. Finally, interview-based assessments also allow for more accurate dating of events through the use of calendars and temporal anchors. It is for these reasons that interview-based approaches to assessing life events have come to be regarded as the gold standard in the field (Hammen, 2005; Monroe, 2008).

In several studies directly comparing self-report to interview-based assessments of life stress, a discrepancy between the two has been consistently observed in event rates, with a tendency for higher endorsement of items with the former relative to the latter. Specifically, Hammen et al. (1985) compared a 120-item adaptation of several widely used life stress checklists (i.e., the Life Stress Inventory; Cochrane & Robertson, 1973; the Psychiatric Epidemiology Research Interview [PERI] Life Events Scale; Dohrenwend, Krasnoff, Askenasy, & Dohrenwend, 1978; and the Life Experiences Survey; Sarason, Johnson, & Siegel, 1978) to the UCLA Life Stress Interview (Hammen & Brennan, 2001). A pattern of response inflation was found with the self-report measure, with endorsement of several items sometimes in actuality reflecting the same single event (e.g., a car accident resulting in physical injury being double-counted with two separate items on car accidents and getting injured). In two studies comparing the PERI Life Events Scale with a life stress interview, the LEDS (Brown & Harris, 1978), greater rates of life events were endorsed with the former relative to the latter (McQuaid, Monroe, Roberts, & Johnson, 1992; Simons et al., 1993). What is more, these differences appear, at least in part, to be accounted for by depressogenic cognitive styles (Simons et al., 1993). One study comparing the Questionnaire on Recently Experienced Events (Oei & Zwart, 1986) to Paykel's Interview for Life Events (Paykel, Prusoff, & Myers, 1975) also found generally higher reporting of life events with the self-report instrument (Oei & Zwart, 1986). Finally, another study in a community sample of young adults found that approximately two-thirds of events endorsed on a 33-item adaptation of several widely used life stress checklists met criteria on an interview adapted from the LEDS (Lewinsohn, Rohde, & Gau, 2003).

This is not to say, however, that self-report checklists are necessarily without a place in life stress research. Indeed, given the quite considerable burden inherent in interview-based approaches, their utilization may not always be feasible, particularly for large-scale multi-wave studies in which life stress is just one of several constructs of interest. Rather, the concern is not so much that self-report inventories are used at all, but that they are substantially overused when interview-based methodologies should be more seriously considered. That is, whenever possible, life stress interviews should be employed, and only when their use would tax the bounds of feasibility should the use of self-report checklists enter into consideration.

In such cases where life stress inventories are employed, care should also be taken in instrument selection and use. There is considerable variability in the quality of existing life stress checklists. First, in addition to requiring respondents to indicate whether any of a list of events has occurred, several older but still widely used self-report inventories explicitly request respondents to provide subjective stress ratings for each endorsed event, with these ratings often incorporated in the final variable value calculation (e.g., a summation of the subjective stress ratings of endorsed events). Given the aforementioned concerns regarding the confounding influence of underlying diatheses in perceived or subjective life stress ratings, this practice should be avoided. Second, and in response to the limitations of traditional life stress checklists, several "second-generation" checklists have been developed (e.g., the Traumatic Life Events Questionnaire; Kubany et al., 2000). These newer checklists differ from traditional ones in that, through more detailed and concrete item descriptions, they provide the respondent with definitions of what qualifies as events for each item, thus reducing the respondent's idiosyncratic and subjective interpretation of the item (e.g., "physical injury requiring surgery" is considerably less likely to be endorsed for an ankle sprain than the more vague "major physical injury"). These second-generation inventories have been found to be more reliable than traditional checklists (see Dohrenwend, 2006, for a more detailed discussion), and thus should be used in preference over the latter when more intensive life stress interviews are not a possibility. Nevertheless, research is required to evaluate them relative to gold-standard life stress interviews.

6.2. Temporality between stress generation and its predictors

Another not inconsequential consideration is the assessment of life stressors and depression, or other hypothesized predictor variables, in a manner that is temporally consistent with the stress generation hypothesis. Beyond the general limitations about inferring causality that is inherent in cross-section studies, not to assess putative stress generation predictors in relation to subsequently occurring stressors is especially problematic in this area of research because of the existence of an alternative explanation for which, in many cases, there is already much theoretical and empirical support. More specifically, in cross-sectional studies that assess depression or a related risk factor and life stressors over a retrospective time interval, interpreting the results becomes particularly challenging because their temporal relation is arguably more consistent with stress exposure models of psychopathology.

This issue is of particular concern in child and early adolescent samples, for which cognitive vulnerability to depression has been theorized and found to be relatively malleable rather than stable characteristics (Gibb & Alloy, 2006; Rose & Abramson, 1992; Tram & Cole, 2000). According to Cole's (1990, 1991) competency-based model of depression, for example, the development of a child's cognitive risk for depression is informed by negative life events,

particularly in the form of interpersonal dependent stressors, such as negative feedback from significant others (e.g., teachers, parents, and peers). Thus, the finding of a relation between cognitive vulnerability and temporally preceding interpersonal dependent stressors is entirely consistent with this stress exposure model of depression. To a lesser degree, this issue remains a concern in adult samples; as previously mentioned there is some theoretical basis for not assuming cognitive vulnerability characteristics to be completely immutable (Just et al., 2001). For these reasons, longitudinal prospective studies are required adequately to evaluate depressogenic cognitive and behavioral characteristics as predictors of stress generation.

As for clinical depression, of the 22 extant studies either assessing stress generation in relation to clinical depression or within a sample drawn from a treatment-seeking population, 55% either examined the index depressive episode in relation to life stressors temporally preceding its onset, or had substantial overlap in the time intervals covered in their assessment of both. Even in instances where an association is found between depressive episodes and temporally preceding dependent stressors, but not independent ones, interpreting these findings as supportive of stress generation is complicated by findings from several stress exposure studies indicating that dependent stressors may be more depressogenic than independent ones (Hammen et al., 1985; Kendler et al., 2002, 2006). Prospective studies employing assessments of clinical depression and life stressors at multiple time-points are ideal for resolving this complication. Even in cross-sectional studies, however, this issue may in some measure still be addressed. Specifically, in contrast to other psychological constructs (e.g., depressogenic cognitive styles), depressive episodes and episodic stressors have generally definable onset and offset dates. Thus, although it may be problematic to measure other psychological constructs retrospectively (e.g., having participants complete a measure of their cognitive vulnerability from six months ago), this is generally not the case for diagnostic interviews for depression and interview-based measures of life stressors, provided that the recall period employed is of a length that would allow for accurate recollection of onset and offset dates. In such cases where a cross-sectional evaluation of depressive episodes and life stressors is conducted, care should be taken to ensure temporal precedence of depression relative to stressors in testing for stress generation (e.g., assessing both constructs over the past six months, but excluding from analyses participants with depressive episodes occurring over the most recent three months, and including only stressors from the three months immediately following the occurrence of depression in the remaining participants).

7. Clinical implications

Depression is an often recurring condition. Indeed, a past history of depression has been consistently found to be one of the strongest predictors of its future recurrence (Lewinsohn, Rohde, Klein, & Seeley, 1999; Luijendijk et al., 2008). As previously noted, approximately 50% of individuals who experience a first lifetime episode of depression eventually develop a second episode, with 70% of these subsequently experiencing a third episode, and 90% of those with three past episodes going on to experience additional recurrences (American Psychiatric Association, 2000; Lewinsohn, Zeiss, & Duncan, 1989; Monroe & Harkness, 2005). In one epidemiological study (Hasin, Goodwin, Stinson, & Grant, 2005), a three-year lag was found on average between onset of depression and first treatment utilization for this disorder. In another study drawing on the National Comorbidity Survey Replication (NCS-R; Wang et al., 2005), only 37.4% of depressed individuals who initiated treatment did so within a year of first onset, with the median delay to first treatment utilization being eight years. What is more, delay in initial treatment seeking appears to be inversely associated with age of first onset (Kessler, Avenevoli, & Merikangas, 2001; Wang et al., 2005), with less than 50% of individuals with childhood or adolescent onset depression seeking treatment by age 18 (Kessler et al., 2001). Collectively, these findings suggest that a quite substantial proportion of depressed individuals in clinical settings present with recurrent depression, and are therefore at considerably high risk for future recurrences. Thus, in addition to facilitating the remission of current depression, a particularly important focus for treatment providers within clinical settings is the prevention of its future recurrence.

Inasmuch as stress generation may be a process accounting for the often recurrent nature of depression (Bos et al., 2007; Hammen, 1991), it has direct bearing on relapse and recurrence prevention efforts. Given that stress generation occurs not only during depressive episodes, but during periods of euthymia as well, an individual in treatment may still experience significant rates of dependent stress even after resolution of depression symptoms. It is interesting to note that, in one cross-sectional study, individuals with recurrent depression have been observed to experience more dependent stress, as measured using a life stress interview, than do those with first-onset depression (Harkness, Monroe, Simons, & Thase, 1999). To the extent that stress generation in recurrent depressives relative to first-onset counterparts may be similarly greater during euthymic periods, and to the extent that the elevated stress confers greater risk for depression recurrence, this finding is not inconsistent with the tendency for likelihood of recurrence to increase, and the duration between episodes to decrease, with each successive episode of depression (Lewinsohn et al., 1989).

Perhaps then, upon resolution of depressed patients' presenting symptoms within clinical settings, an assessment of the levels of dependent stress occurring within their lives may provide valuable prognostic information; insofar as these individuals continue to experience considerable dependent stress, they may be at significantly greater risk for eventual relapse or recurrence. Targeting potential stress generation mechanisms in such individuals may potentially help to stave off a return of depression. If one positive note may be derived from the general finding in the stress generation literature that depressed and depression-prone individuals tend to experience higher rates of dependent, but not independent, stress than do healthy peers, it is that dependent events, unlike their independent counterparts, are to some degree modifiable, and it should therefore be possible to reduce the frequency and severity of their occurrence. The potential benefit of reducing dependent stress is especially considerable for adolescents, given the observation that behavior-dependent, rather than naturally occurring or behavior-independent, events account for the greatest risk for negative mental health outcomes in this age group (Ozer, Macdonald, & Irwin, 2002).

One treatment approach that may hold promise in this area, given the relation between stress generation and poor social problem-solving skills (Davila et al., 1995), is problem-solving therapy. Not only have psychotherapies that target problem-solving deficits characteristic of depressed individuals been found effective in alleviating depression symptoms (Kennard et al., 2009; Klein et al., 2011), but they also have been associated with improvements in problem-solving ability, particularly in social domains (Klein et al., 2011). As maladaptive coping strategies (e.g., avoidant coping) have also been related to stress generation (Holahan, Moos, Holahan, Brennan, & Schutte, 2005), empirically validated psychotherapies that enhance coping abilities may similarly prove well-suited to decreasing the occurrence of dependent stress. Several studies have found cognitive–behavioral interventions to be effective for improving depression and coping skills (Compas et al., 2010), with the latter mediating decreases in depression severity (Compas et al., 2010). Through these intervention strategies, patients may develop skills effectively to manage the duration and severity of experienced stressors. The adoption of more adaptive approach-oriented coping skills in place of maladaptive coping styles (e.g., avoidance coping) may be generalizable to the prevention of future stressors as well, such as by proactively addressing a relatively minor issue before it becomes a major one. Behavioral activation, in

particular, aims to replace avoidant coping strategies associated with negative reinforcement with approach oriented ones linked with positive reinforcement. Given this emphasis on overt behavioral tendencies and its association with subsequent improved social support (Hopko et al., 2011), behavioral activation may potentially exert its antidepressant effect, in part, through reducing stress generation. Whether improvements in problem-solving and coping skills within treatment contexts translate into reductions in stress generation is an interesting possibility that would benefit from future research.

In addition to developing techniques to reduce the occurrence of dependent stress, it may be beneficial to augment skills to cope with this stress when it does occur. That is, given the higher rate of objectively occurring dependent stress in depressed individuals, it is also important to address the subjective or physiological experience of this stress from a clinical standpoint. Several therapies may especially hold promise in this regard. In particular, mindfulness-based stress reduction has been associated with lower perceived stress and physiological stress as measured with salivary cortisol (Jensen, Vangkilde, Frokjaer, & Hasselbalch, 2012). Acceptance and commitment therapy, with its emphasis on accepting and experiencing the present without judgment, may be similarly pertinent here. Indeed, this treatment modality has been found to decrease levels of subjective stress and burnout (Brinkman-Sull, Overholser, & Silverman, 2000). Such approaches may help depressed individuals develop the necessary skills to cope with the higher rates of objective dependent stress that may be occurring within their lives.

8. Summary

Considerable empirical support has emerged for the existence of cognitive and behavioral risk factors for stress generation. Relatively more recently, preliminary evidence has been found for childhood maltreatment and genetic influences on the stress generation effect. Despite the growing list of stress generation predictors that have been identified over the past two decades, several important aspects of this phenomenon remain to be explored. In particular, there is a need to move beyond single-predictor models of stress generation toward more integrative models examining the relation between multiple risk factors within the causal chain underlying the stress generation phenomenon. Not only would such research provide a more complete understanding of stress generation, but it would also hold potential to inform future treatment strategies by yielding multiple possible targets of clinical intervention that may be addressed concurrently. In an effort to guide future research toward that end, an integrative model was presented based on the extant findings to date on stress generation predictors. Also relatively understudied are the clinical sequelae of stress generation. That is, although the majority of stress generation studies to date have focused primarily on one half of the etiological chain outlined in the stress generation hypothesis (i.e., the link from risk factors to stress generation), the depressogenic sequelae of stress generation are critically important to establishing its relevance to the clinical course of depression and awaits future research. Additionally, although the pathogenic consequences of stress generation have generally been conceptualized within the context of depression recurrence and chronicity more generally, another interesting possibility is that it may similarly account for the tendency for depression to cluster within social networks. That is, stress generation may be an explanatory mechanism behind depression contagion. From a methodological standpoint, there is a need for more studies utilizing interview-based assessments of life stress, given the limitations of life stress checklists, and second-generation self-report inventories when the more rigorous interview-based approach is not possible. Another important methodological concern relevant to several studies is the need for clean separation of depression or related vulnerability factors and dependent stressors in a manner temporally consistent with the stress generation hypothesis. Failure to do so introduces considerable interpretative difficulties, raising the potential that stress generation is confounded with stress exposure. Finally, as our understanding of the role of stress generation in explaining depression recurrence matures, evaluating potential intervention strategies, such as those focusing on social problem-solving and approach-oriented coping, to reduce stress generation may become increasingly important for effectively addressing the often chronic course of this disorder.

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