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Bereavement Outcomes as Causal Systems: A Network Analysis of the Co-Occurrence of Complicated Grief and Posttraumatic Growth

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Abstract
Bereavement can lead to negative outcomes such as complicated grief (CG), but some mourners with symptoms of CG often experience positive sequelae of loss such as posttraumatic growth (PTG) as well. We propose that grief and growth co-occur and change one another because they alternately reinforce and weaken each other at the level of their respective constituent elements. We investigated the structure of a network of CG and PTG elements to elucidate how grief and growth can co-occur within a potentially causal system in bereaved young adults. Challenges to control and identity disturbance ranked as the most highly central symptoms in the CG network; the discovery of a new life path and greater personal strength were similarly central elements of PTG. Finally, the degree of disruption and change in mourners' worldviews emerged as the element that most strongly bridged the two domains, suggesting a pivotal connection between grief and growth.

Keywords
complicated grief, posttraumatic growth, network analysis, open materials

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In the wake of the loss of a loved one, what determines how we adapt? Loss is a universal human experience, and most people adjust fairly well, returning to a level of normal functioning several weeks later (Bonanno, 2004). For some, however, this distress is markedly more intense, and results in considerably more functional impairment than that experienced by the majority of the population. This outcome has been termed *complicated grief* (CG; Shear et al., 2011), *prolonged grief disorder* (PGD; Prigerson et al., 2009), or *persistent complex bereavement disorder* (PCBD; American Psychiatric Association, 2013) and will be formally incorporated into the 11th edition of the World Health Organization's International Classification of Disease (ICD-11) in 2018. Approximately 7% of all bereaved individuals will experience CG (Kersting, Brahler, Glaesmer, & Wagner, 2011). CG symptoms and associated impairments have been conceptualized in various ways, but one phenomenon common to these accounts is an intense and debilitating yearning for the deceased. This symptom also distinguishes CG from other outcomes such as depression and posttraumatic stress disorder (PTSD; Boelen, van de Schoot, van den Hout, de Keijser, & van den Bout, 2010; Prigerson, Vanderwerker, & Maciejewski, 2008). Other hallmark symptoms of CG include an inability to care about others, identity confusion, and difficulty accepting that the loss has occurred (Prigerson et al., 2009; Shear et al., 2011).

Losing a loved one may also foster markedly positive changes in some people, outcomes termed *personal growth* (Hogan, Morse, & Tason, 1996), *positive psychological change* (Yalom & Lieberman, 1991), or *posttraumatic growth*[1] (PTG; Tedeschi & Calhoun, 2008), all

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signifying the mourner's discovery of a deeper sense of purpose and meaning in life. PTG's hallmark features include perceptions of increased personal strength, a greater ability to relate to others, the realization of new possibilities in life, deepening of spiritual understanding and connection, and enhanced appreciation of life (Tedeschi & Calhoun, 1996). Rather than representing growth that occurs "in spite of" a loss, PTG is typically perceived by the mourner as being a direct result of having experienced a loss (Tedeschi & Calhoun, 2008). PTG is not properly termed a syndrome, and therefore, its "prevalence" in the wake of loss is unknown. However, correlates of higher levels of PTG have been identified and validated, such as deliberate rumination style (Taku, Cann, Tedeschi, & Calhoun, 2009), social support availability (Hogan & Schmidt, 2002), sudden or violent cause of death (Currier, Holland, Coleman, & Neimeyer, 2007), and alignment between the mourner's grieving style and cultural understandings of grief (Bellet, Holland, & Neimeyer, 2018; Neimeyer, Klass, & Dennis, 2014).

Appearances notwithstanding, PTG and CG are not incompatible. In fact, mourners rarely experience growth without experiencing at least a moderate level of grief-related distress (Calhoun, Tedeschi, Cann, & Hanks, 2010). Currier, Mallot, Martinez, Sandy, and Neimeyer (2012) found that adults bereaved by violent death (suicide, homicide, and fatal accident) scored higher on both PTG and CG than did those losing loved ones to natural death and nonbereaved controls. Buchi and colleagues (2007) noted a positive association between level of grief and level of growth, whereas Currier, Holland, and Neimeyer (2012) found evidence for a curvilinear association, with the highest levels of growth occurring at an intermediate level of CG severity. These findings suggest that some degree of distress is necessary to instigate growth but not so much as to impede it (Currier, Holland, et al., 2012).

There are several theories that attempt to explain how a mourner can experience both distress and a "new lease on life." Hogan and Schmidt's (2002) Grief to Personal Growth Model explains the co-occurrence of CG and PTG by positing that they spring from the same cause: shattered assumptions. A loss has the potential to shatter assumptions about the mourner's world that were previously untested, such as the benevolence of God, the mourner's sense of self-worth, and the world's controllability (Janoff-Bulman, 1992). The struggle to come to terms with these compromised assumptions can challenge one's personal identity and foster the view that the world is meaningless and threatening without the decedent, and this process may manifest as the yearning, mistrust, and avoidance associated with CG. However, the successful resolution of these challenges can also result in a deepened sense of meaning, greater ability to relate to others, and a more stable self-concept associated with postloss growth (Hogan & Schmidt, 2002). Key to the promotion of growth in this model is the seeking (or offering) of social support as a result of the difficulties the mourner finds in coming to terms with the loss.

Other models emphasize additional processes. Nerken's (1993) Grief and Reflective Self Theory emphasizes grief as an impetus for the mourner's construction of a new identity and the establishment of a "continuing bond" with the deceased, resulting in a new way of life experienced as growth. Calhoun and Tedeschi's (1998) Posttraumatic Growth Model posits that the style of rumination (intrusive versus deliberate) is a key determinant of whether a loss leads predominantly to the passively experienced intrusion symptoms of CG or the active change identified with PTG. Neimeyer's (2016) Meaning Reconstruction Model emphasizes the role of making meaning of the loss and its associated distress, seeing the event narrative of the loss as disruption in the coherence of a mourner's larger self-narrative. Growth is experienced when a mourner is able to make meaning of the loss in a way that reconciles the event narrative with the self-narrative, giving it significance. Growth is further enhanced when mourners find some form of constructive life lesson in the experience, often revising their personal identity in light of it.

Although all of these potential explanations of the PTG/CG relationship offer viable ways to conceptualize the path from grief to growth, all also share a common limitation. Specifically, statistical inquiry into such theories has been compelled some to model them as a linear transition from a starting point (grief) to an ending point (growth) or a ratio between the two (how much growth versus how much grief is present). Such analyses necessarily fail to describe the substantive structure of the co-occurrence of grief and growth. This inability to reflect the full complexity of relations among the myriad aspects of grief and growth is an inherent limitation of the latent variable model.

A Network Approach to the Grief–Growth Relation

The network approach conceptualizes mental disorders as emergent phenomena arising from interactions among their constitutive symptoms, not as underlying entities that produce symptom emergence (Borsboom & Cramer, 2013). The symptoms constitute the disorder and co-occur because they reciprocally reinforce each other. In a network, symptoms are represented by "nodes," and their associations with one another are symbolized by "edges" connecting the nodes, which have thicknesses ("weights") corresponding to the

strength of the association between the nodes they connect. Visualizing CG in this way allows insight into the complex relations among its symptoms. Further, network analytic techniques can identify the symptoms that are most central (and likely to be influential) within the CG network. Central symptom nodes are those having many strong connections to other nodes, greater numbers of connections, and those that serve as hubs between disparate nodes (Freeman, 1978/1979). One recently developed way of assessing the centrality of a symptom to a disorder network is its "expected influence" (EI; Robinaugh, Millner, & McNally, 2016), which is calculated by summing all of a node's edge weights with other nodes, taking into account negative associations. Previous analyses have identified emotional pain and yearning as central symptoms in the CG network and have provided a more fine-grained understanding of how CG networks sustain their coherence (Maccallum, Malgaroli, & Bonanno, 2017; Robinaugh, LeBlanc, Vuletich, & McNally, 2014). Similarly, a network analysis and comparison of EI values for a PTG network would allow a closer look at the relationships between its elements, lending insight into what elements of this phenomenon are central to its coherence.

In addition to explaining the structure of a single psychological phenomenon, a network approach to the relationship between CG and PTG would allow a more nuanced and fine-grained view of the interplay between the two. In previous analyses, explanations of the relationship between grief and growth have relied on linear progressions from one construct (grief) to the other (growth). These analyses do not consider the intricate interplay of symptom-level associations between CG and PTG. In a network approach, this relationship between two psychological phenomena can be more closely examined. Previous network approaches to co-occurring psychological phenomena have predominantly examined comorbidity, or the co-occurrence of multiple disorders in individuals (Fried, van Borkulo, Cramer, Boschloo, Schoevers, & Borsboom, 2017). Similar to network analyses for single disorders, these studies view comorbidity as a function of causal relations between symptoms of different disorder "communities" (e.g., Cramer, Waldorp, van der Maas, & Borsboom, 2010; Heeren, Jones, & McNally, 2018; Levinson et al., 2017; McNally, Mair, Mugno, & Riemann, 2017). Symptom pairs that interact with each other across communities are identified as "bridges" that are theorized to substantially increase the probability of co-occurrence between disorders. Other researchers have examined the network interactions between mental disorders and protective factors (e.g., resilience; Hoorelbeke, Marchetti, De Schryver, & Koster, 2016). A similar approach could be applied to the co-occurrence of CG and PTG. In this way, the experience of the mourner can be considered as a network of mutually influencing grief symptoms and growth elements, rather than a conflict between two unfolding latent processes. A newly developed network metric, *bridge expected influence* (BEI; Jones, Ma, & McNally, 2017), identifies bridge nodes by examining the EI of a node, and only considering cross-community nodes as neighbor nodes. The use of BEI metrics can identify which nodes are key contributors to the co-occurrence of grief and growth. It is also possible that many bridges will consist of negative associations, lending insight into which nodes lessen the likelihood of co-occurrence between CG and PTG.

Such inquiry could lead to many theoretical clarifications. If, as Currier, Holland, et al. (2012) hypothesize, too much grief may prevent growth, we can examine exactly what bridge symptoms of CG might reduce the likelihood of PTG's emergence. If, as many growth theorists suggest, some amount of distress also is required for growth (Neimeyer, 2016), network analysis could allow a more detailed look at which symptoms of CG, if any, are associated with a higher likelihood of a growth network's emergence. Such a method could also examine which symptoms of growth are protherapeutically associated with less coherent CG networks. Answers to these questions could suggest potential causal mechanisms that address important clinical questions: Which symptoms could be leveraged to promote growth? Which symptoms militate against it? Which aspects of growth are most important to encourage when treating CG?

The Current Study

In the present study, we first computed two networks, one comprising the symptoms of CG and the other the elements of PTG, thereby enabling us to identify the central features of each system. Second, we computed a network consisting of both communities of nodes, thereby enabling us to identify the aspects of grief and growth that bridge the two phenomena.

Method

Participants and procedure

Our sample was obtained from an institutionally reviewed and approved project that examined the grief experiences of students at a large university in the southeastern United States. All participants had lost a loved one within the past 2 years. Recruitment was conducted via online advertisements, flyers, and in-class announcements. After finishing an informed consent process, a total of 741 participants completed an

online survey that asked questions about demographic and loss-related characteristics (mode of death, time since loss, relation to the deceased), psychosocial factors influencing their experience of bereavement, their resultant symptoms, and positive outcomes they had experienced as a result of their losses. As a result of different sets of measures being administered to different cohorts, only some participants completed measures of both CG and PTG, yielding a total sample of 485 participants for our analysis.

This sample was predominantly female (n = 393, 81.0%) and consisted mostly of African American (n = 223, 46.0%) and White (n = 211, 43.5%) participants. The mean age was relatively young (M = 21.53 years, SD = 6.21 years). Although bereavement due to natural, expected causes was the most common mode of loss (n = 197, 40.6%), many participants had experienced sudden losses (n = 102, 21.0%) or losses due to homicide (n = 30, 6.2%), suicide (n = 13, 6.0%), or accidental causes (n = 82, 16.9%). The decedent's relationship to the participant was distributed among members of the nuclear family (n = 109, 22.5%), members of the extended family (n = 257, 53.0%), and friends or other relationship types (n = 164, 33.8%). The highest level of educational attainment for participants' families was predominantly at least a 2-year associate's degree or trade school (n = 303, 62.5%).

Measures

Inventory of Complicated Grief–Revised (ICG-R). The ICG-R (Prigerson & Jacobs, 2001) is a 35-item self-report questionnaire designed to assess the severity of CG symptoms. For the purposes of our analysis, we used 13 scalar response items that assessed symptom severity; 10 of these items were selected to approximate the criteria for diagnosis of PGD identified by Prigerson and colleagues (2009).[2] An additional three items were selected on the basis of their previously theorized importance to the relation between grief and growth. For example, the item stating "I feel that the death has changed my view of the world" addresses the shattered assumptions essential for instigating meaning-making efforts that could lead to growth (Hogan & Schmidt, 2002; Neimeyer, 2016). For each item, subjects rated the degree to which they had been experiencing a symptom (e.g., "I feel myself longing and yearning for [the deceased]") in the past month on a 5-point Likert-type scale (1 = *almost never*, 5 = *always*). The ICG-R's convergent validity and diagnostic utility is evinced by its high rate of agreement with a well-established semistructured interview for PGD (Barry, Kasl, & Prigerson, 2002), and it has demonstrated discriminant validity in its relationship with measures of related but distinguishable psychological phenomena such as major depressive disorder (MDD) and PTSD (Prigerson et al., 2009). The ICG-R items used for our analysis demonstrated excellent internal consistency (α = .91).

Posttraumatic Growth Inventory–Short Form (PTGI-SF). The PTGI-SF (Cann, Calhoun, Tedeschi, Taku, et al., 2010) is a 10-item questionnaire that assesses perceptions of positive change in life as a result of a stressful life event. Its items cover the five domains of PTG propounded by Tedeschi and Calhoun (1996), with two items per domain. We chose to consider each item as a distinct node, as the items were chosen by the authors of the measure to span theoretically distinct aspects of each domain (e.g., gaining better understanding of spiritual matters and having perceptions of possessing a stronger religious faith being distinct but related aspects of the domain of spiritual growth). For the purposes of the present study, we asked participants to answer these items in reference to the loss they had experienced. For each item, participants indicated the degree to which they had experienced a specified element of PTG (e.g., "I developed new interests") on a 6-point Likert-type scale (0 = *I did not experience this change as a result of my loss*, 5 = *I experienced this change to a very great degree as a result of my loss*). The PTGI-SF has displayed convergent validity with measures of rumination style, stressor severity, and core belief disruption, as well as displaying equivalent psychometric properties to those of the original PTGI (Cann, Calhoun, Tedeschi, Taku, et al., 2010), which has been widely used to assess postbereavement growth (Buchi et al., 2007; Currier, Holland, et al., 2012; Engelkemeyer & Marwit, 2008). The PTGI-SF items demonstrated excellent internal consistency in our sample (α = .92).

Plan of analysis

Intracommunity analyses. We first computed descriptive statistics for our sample, including demographic variables as well as specific mourner and loss-related characteristics that can affect grief outcomes. We also calculated univariate statistics for all items used as nodes in our networks. We then computed separate regularized partial correlation networks for both CG and PTG and used EI metrics (Robinaugh et al., 2016) to identify which aspects of these phenomena are most central to CG and PTG, respectively.

Graphical LASSO. In order to compute and visualize regularized partial correlation networks, we used a graphical LASSO (Least Absolute Shrinkage and Selection Operator) algorithm in R with the *glasso* (Friedman, Hastie, & Tibshirani, 2010) and *qgraph* (Epskamp, Cramer, Waldorp, Schmittmann, & Borsboom, 2012) packages (R Core Team, 2017). R code for all analyses appears in Script S1 of the Supplemental Materials available online. The graphical LASSO algorithm first

computes partial polychoric correlations between variables and then applies an L1 penalty to drive trivially small edges to zero, thus returning a "sparse" network comprising the edges that are most important, as they are most likely to be observed above chance. For example, in the CG network, each node represents a symptom, and each "edge" represents the regularized partial correlation between two symptoms after adjusting for the influence of associations with all other symptoms. The magnitude of the correlation is signified by the thickness of an edge (depicted as a line joining the symptoms); thicker edges indicate regularized partial correlations of greater magnitude. We selected a gamma (γ) hyperparameter of 0.5 for the graphical LASSO in the interest of ensuring the specificity of our networks (Epskamp & Fried, 2018; Foygel & Drton, 2010).

This method of network analysis allows the examination of relationships between symptoms while controlling for the influence of other symptoms (McNally, 2016). Additionally, this method allows an examination of which nodes are more central to the CG network. The PTG network was computed analogously to the CG network, with nodes signifying elements of PTG.

EI. To identify which aspects of CG and PTG appear most central to their respective communities, we calculated one-step EI (Robinaugh et al., 2016) by using the *networktools* package (Jones, 2017). EI is preferable to other centrality measures when networks include negative edges, as was the case in our analyses (Robinaugh et al., 2016). One-step EI is a measure of node centrality that determines the strength of a node's association with other nodes while taking into account negative correlations. Each node is given a value consisting of the sum of its edges, retaining the positive or negative sign of these edges in the sum. Thus, nodes with higher absolute values are considered more central, and the type of overall association (positive or negative) on neighboring nodes is retained (Robinaugh et al., 2016). Importantly, the term *EI* does not imply causal direction from the node measured to other nodes but rather speaks to the node's *potential* influence on a network due to the strength and number of its associations with other nodes. For each network, we used the *bootnet* package (Epskamp & Fried, 2017) to perform 1,000 case-dropping bootstraps in order to determine the proportion of cases that could be eliminated while retaining a correlation of at least 0.7 with the original centrality estimates within a 95% confidence interval. This number is defined as the correlation stability (CS) coefficient. This metric was calculated for both edge weights and EI values in order to verify the stability of these estimates (Epskamp & Fried, 2018). The *bootnet* code was modified to accommodate the estimation of EI CS coefficients (see Script S2 in the Supplemental Material for this modified code).

Intercommunity analyses. We then computed a network that depicts the structure of interactions between elements of CG and PTG. We used a *spinglass* community detection algorithm from the *igraph* package (Csardi & Nepusz, 2006) with the number of communities set to 2 in order to determine whether the CG and PTG communities were nonoverlapping. To identify nodes that "bridge" the communities of CG symptoms and PTG elements, we computed BEI—a new metric that assesses the EI of a node from one community on nodes of another community and vice versa (BEI; Jones et al., 2017). To accomplish this end, BEI calculates one-step EI for a given node but only includes cross-community nodes as its potential neighbors. In other words, the BEI of a symptom of CG measures the degree to which that symptom potentially influences the PTG network, and the BEI of an aspect of PTG measures the degree to which that aspect of PTG potentially influences the CG network. CS coefficients for edge weight stability were calculated for the combined network as well.

Results

Intracommunity analyses

The CG network diagram and its nodes' one-step EI values appear in Figure 1. Table 1 provides a key of node names for all network analyses conducted as well as the univariate statistics for each node. Thicker edges in the network diagrams indicate stronger associations between nodes; positive associations are indicated by solid green lines, and dashed red lines indicate negative associations. Nodes with large EI values in the network diagram are indicated by capitalized blue text. A sense of having lost control was the CG symptom with the highest influence, as measured through associations with neighboring nodes (one-step EI). Identity disruption also displayed relatively high EI on the network. CS coefficients indicated an acceptable level of stability for both edge weight, *CS*(correlation [cor] = 0.7) ≈ .69, and EI, *CS*(cor = 0.7) ≈ .65 (Epskamp & Fried, 2018). The network and one-step EI values for PTG are depicted in Figure 2. The element of PTG displaying the highest one-step EI was having found a new path in life. Additionally, perceptions of greater personal strength following the loss displayed relatively high EI. CS coefficients for this network indicated an acceptable level of stability for both for edge weight, *CS*(cor = 0.7) ≈ .69, and EI, *CS*(cor = 0.7) ≈ .61 (Epskamp & Fried, 2018).

Intercommunity analyses

The combined CG and PTG network and the BEI values of all nodes appear in Figure 3. Nodes with large positive and negative BEIs are indicated in the network figure by

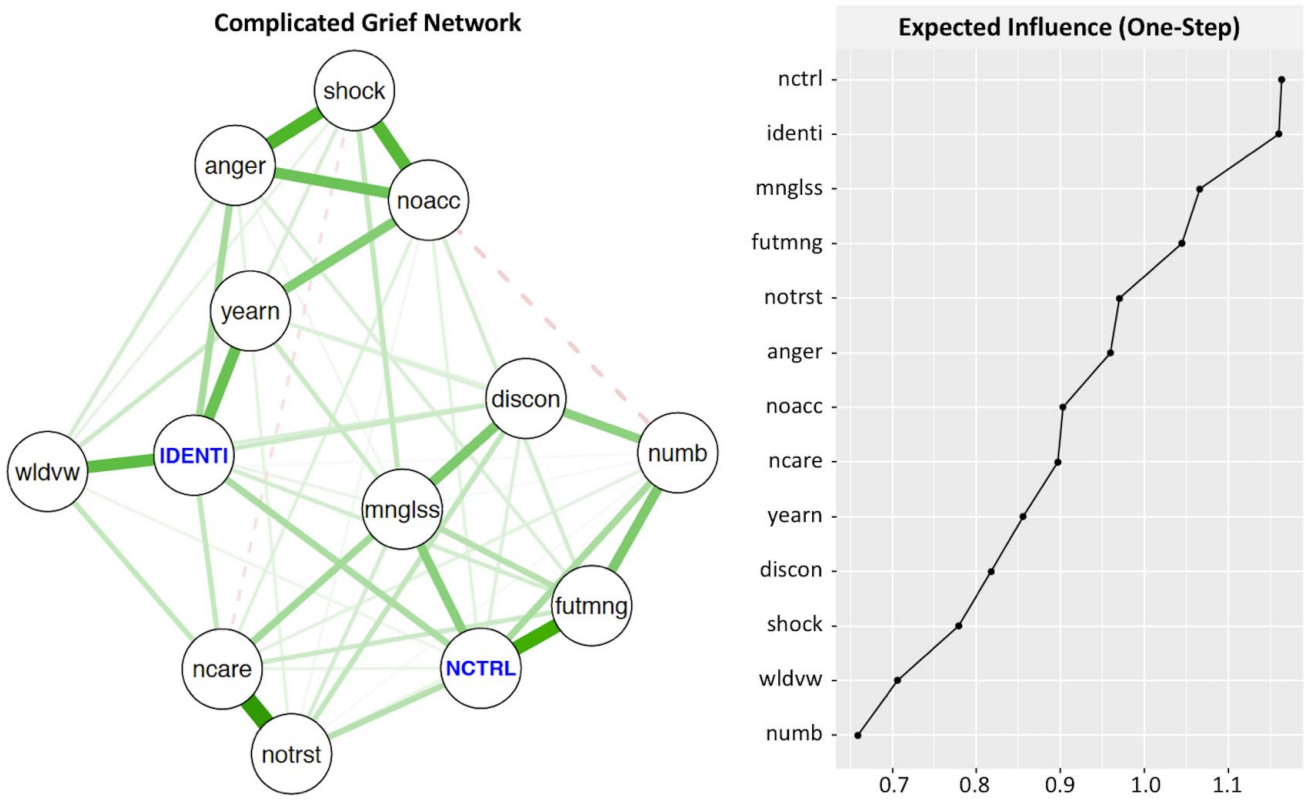

Fig. 1. Regularized partial correlation network for complicated grief (CG) and one-step expected influence (EI) values for each node. Each node represents a symptom. Each edge represents the regularized partial correlation between nodes. Edge thicknesses signify correlation magnitude, and edges line types signify the sign of the correlation (solid green = positive, dashed red = negative). Nodes with high EI are indicated by capitalized blue text.

capitalized blue and red text, respectively. The two groups generated from the *spinglass* community detection algorithm indicated nonoverlapping groups, with all PTG elements in the first group and all CG symptoms in the second group. This network comprised both positive and negative edges between the communities. Accordingly, nodes in the BEI tables include negative values, which indicate negative cross-community influence. The node with the highest positive BEI was a CG symptom signifying that the death had changed the mourner's view of the world. The node with the largest negative BEI was a CG symptom of an inability to care about others. An acceptable level of stability was indicated by the edge weight CS coefficient, $CS(\text{cor} = 0.7) \approx .69$. The correlation matrix for all nodes appears in Matrix S3 in the Supplemental Material.

Discussion

This study is the first to examine PTG as a network, providing a fine-grained analysis of which elements of growth are important to maintaining its coherence as a system. This study is also the first to examine the symptom-level interactions between CG and PTG. Our results provide a causal systems assessment of the grief–growth relation and insight into which of their respective elements appear to increase the probability of their co-occurrence.

CG network

The CG network was centered on perceptions of lack of control, lending support to the Grief to Personal Growth (Hogan & Schmidt, 2002) and Meaning Reconstruction (Neimeyer, 2016) models of bereavement, wherein problematic bereavement arises in response to shattered assumptions that render the world random, uncontrollable, and meaningless for the bereaved person. Unsurprisingly, this node shared a strong edge with two other highly central nodes that tapped a sense of meaninglessness and the inability to imagine a meaningful future. The high importance of the mourner's inability to imagine a meaningful future reinforces the idea that much of problematic bereavement may be related to such deficits in prospection—that is, the inability to imagine a pleasant or fulfilling future

Table 1. Descriptions and Univariate Statistics for Network Nodes

Name	Symptom	*M*	*SD*
	Complicated grief symptoms		
noacc	Difficulty accepting the loss	2.61	1.31
yearn	Yearning	2.56	1.21
anger	Anger over the loss	2.35	1.26
shock	Shock over the loss	2.75	1.35
notrst	Difficulty trusting others	1.84	1.10
ncare	Inability to care about others	1.75	1.08
discon	Distress at discontinuing preloss activities	1.78	1.08
mnglss	Meaninglessness	1.91	1.13
numb	Numbness	1.59	.99
futmng	Meaningless future	1.57	1.05
identi	Perception that part of the mourner died	2.11	1.20
wldvw	Changed worldview due to loss	2.48	1.36
nctrl	Loss of sense of control	1.69	1.10
Name	Element	*M*	*SD*
	Posttraumatic growth elements		
chgpri	Changed priorities	2.30	1.99
applif	Heightened appreciation for life	2.93	1.70
spirit	Better understanding of spiritual matters	2.41	1.84
nwpth	Development of a new path for life	2.04	1.82
close	Interpersonal closeness	2.41	1.77
handle	Ability to handle difficulties	2.71	1.73
better	Perception that life is better	2.31	1.83
faith	Stronger faith	2.78	1.90
strgr	Perception of greater personal strength	2.78	1.78
people	Valuing other people more	2.48	1.77

without the decedent. Indeed, Robinaugh and McNally (2013) found that conjugally bereaved persons with CG displayed decrements in the ability to imagine specific pleasant future events without the decedent when compared to nonpathological mourners. It is understandable that this difficulty envisioning a future without one's partner could generate the hopelessness and identity confusion associated with CG (Robinaugh & McNally, 2013).

The importance of identity disturbance to the CG network is consistent with the Meaning Reconstruction (Neimeyer, 2016) and Reflective Self (Nerken, 1993) models' assertion that problematic grief arises largely as a result of challenges that loss presents to the mourner's self-narrative. This node's strong link to the symptom of yearning suggests that longing for the deceased may be related in part to the desire to regain the comparatively more coherent preloss identity. Our results differ from previous CG networks that identified emotional pain (Robinaugh et al., 2014) and yearning (Maccallum et al., 2017) as central symptoms. This difference is difficult to interpret as studies have involved different symptoms and different groups of bereaved individuals.

PTG network

The importance of the mourner's establishing a "new path" in life dovetails with Robinaugh and McNally's (2013) assertion that complications in bereavement may arise from difficulty envisioning one's future without the decedent. Being able to imagine a new way forward may enable growth to develop. The role of this factor is also concordant with the Grief and Reflective Self (Nerken, 1993) and Meaning Reconstruction (Neimeyer, 2016) models, which assert that the mourner's construction of a new identity or self-narrative is vital for other aspects of growth to occur.

The importance of greater personal strength in the PTG network is consistent with Calhoun and colleagues' (2010) formulation of growth whereby mourners' attempts to rebuild shattered assumptive worlds foster perceptions of greater agency that allow other elements of growth to emerge. The importance of this element also provides an important corollary to the assertion of Currier, Holland, et al. (2012) that an intermediate degree of distress is a prerequisite for growth to occur; the mourner's ability to adequately tolerate or manage such distress may be another important precondition for the emergence of growth. In contrast, other features of PTG such as the development of a greater appreciation of life and changes in priorities appear to be less central elements of such growth, perhaps better conceptualized as "fringe benefits" of the emotional resilience and reconstruction of life directions that are more pivotal to personal transformation.

Combined network

PTG and CG emerged in the combined network as distinct communities that shared positive and negative edges. This result suggests that CG and PTG co-occur because they both reinforce and weaken each other, depending on which PTG element/CG symptom dyads are examined. The BEI metrics resulting from this network analysis pointed to some potential theoretical clarifications that could yield a finer grained understanding of how grief and growth interact.

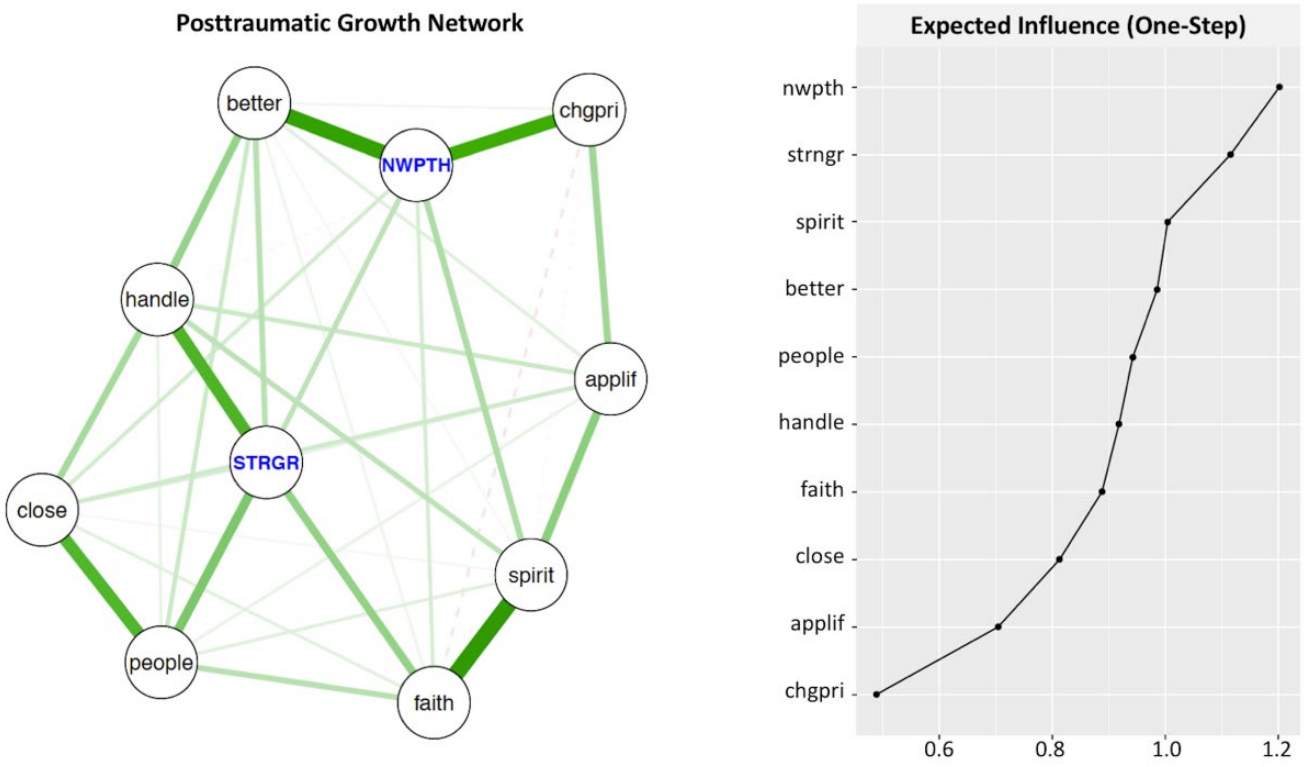

Fig. 2. Regularized partial correlation network for posttraumatic growth (PTG) and one-step expected influence (EI) values for each node. Each node represents an element of PTG. Each edge represents the regularized partial correlation between nodes. Edge thicknesses signify correlation magnitude, and edge line types signify the sign of the correlation (solid green = positive, dashed red = negative). Nodes with high EI are indicated by capitalized blue text.

The feature of CG that appeared to most promote the coherence of the PTG network was the degree to which the death had changed the mourner's view of the world. The indication that this feature of grief might have a positive influence on a PTG network is entirely concordant with the notion that the pain of shattered assumptions can stimulate growth by compelling a change in worldview (Hogan & Schmidt, 2002; Neimeyer, 2016). Indeed, researchers have found that disruptions of core assumptions as a result of adverse events have positive associations with both distress and PTG (Cann, Calhoun, Tedeschi, Kilmer, et al. 2010). Similarly, research indicates that event centrality, which involves an individual's sense of having been changed by a painful event, has positive associations with both postevent symptoms and PTG (Boals & Schuettler, 2011). It also is not surprising that one of this node's strongest cross-community edges was shared with the PTG element relating to different priorities in life, which speaks to Neimeyer's (2016) and Nerken's (1993) models of identity reconstruction being key to the transition from changed worldviews to growth.

The PTG element of greater ability to handle difficulty showed a negative EI on CG. Interestingly, this bridge element had an especially strong negative association with the symptom of prospection difficulties, which figured as highly central to the CG network. Perceptions of greater personal resilience may give the mourner the confidence needed to reconstruct a future that previously seemed foreclosed because of the specter of loss.

The symptom of an inability to care about others from the CG community displayed high negative EI on PTG. This bridge relationship seems to confirm Calhoun and Tedeschi's (1998) conceptualization of social support as key to promotion of PTG. It appears that symptoms that discourage interpersonal interactions impede the social support needed for growth. Notably, many of the losses experienced by our participants included homicide, suicide, and accidental deaths. Traumatic deaths make it especially difficult for mourners to extract meaning from such losses as they may find it difficult to connect emotionally with others who have not experienced comparable bereavement (Bellet et al., 2018; Jordan & McIntosh, 2011; Neimeyer et al., 2014). An inability to find others with whom to identify may be particularly important to an understanding of potential roadblocks to the promotion of PTG.

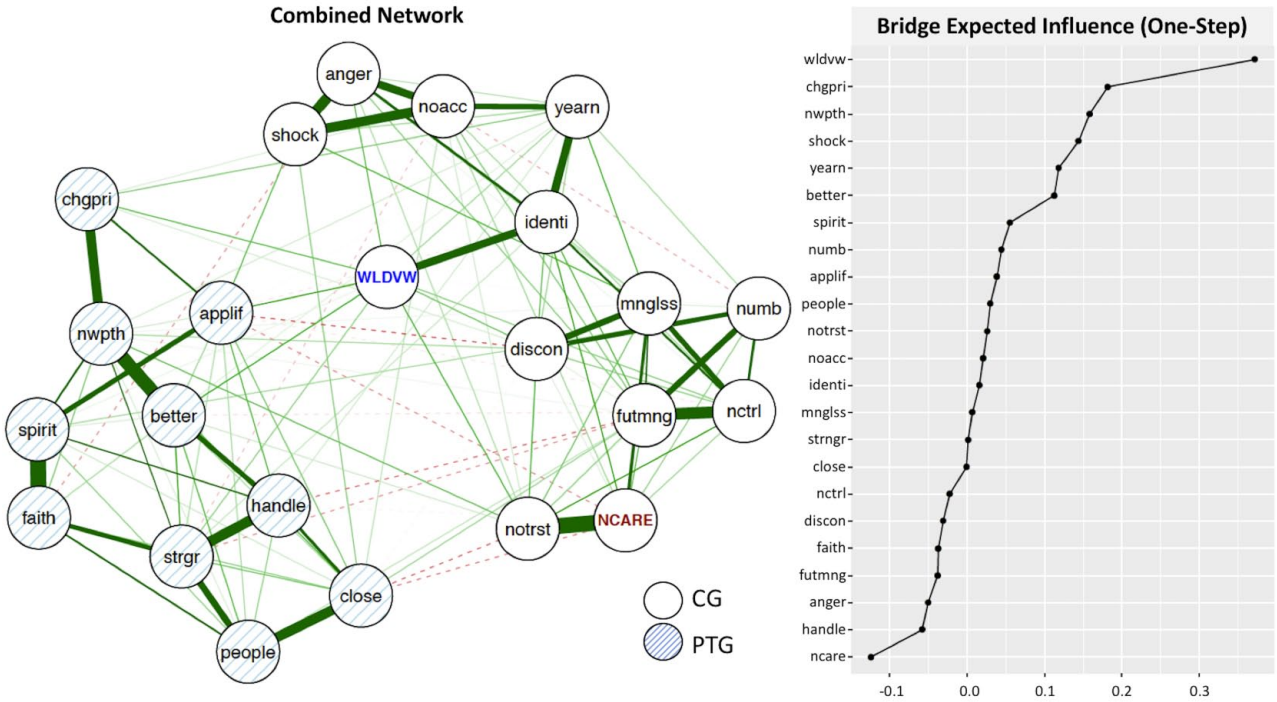

Fig. 3. Combined regularized partial correlation network for complicated grief (CG) and posttraumatic growth (PTG), with bridge expected influence (BEI) values for each node. Shaded nodes are PTG elements, and white nodes are CG symptoms. Each edge represents the regularized partial correlation between nodes. Edge thicknesses signify correlation magnitude, and edge line types signify the sign of the correlation (solid green = positive, dashed red = negative). Nodes with high BEI are indicated by capitalized text, and the sign of their BEI value is indicated by text color (blue = positive, red = negative).

Limitations, implications, and future directions

The symptoms used as nodes in our CG network were not limited to the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM–5*; American Psychiatric Association, 2013) diagnostic criteria for PCBD; rather, they were based on the formulation of PGD initially proposed by Prigerson and colleagues (2009), and included additional symptoms hypothesized to have a bearing on the grief–growth dynamic. This dissimilarity limits the extent to which we can compare our results to previous CG network analyses because of the effect of more nodes on network structural dynamics. However, this formulation does include a wider range of CG features and is conducive to a network approach, as it allowed us to examine a broader range of potentially influential symptoms not constrained by previous latent variable model-based conceptualizations of CG.

Another limitation was the use of a sample size that precluded the comparison of CG networks across causes of death. Differences between the present study's findings and previous network analyses may also be attributable to the frequency of losses due to unexpected, violent, and accidental causes. The distress that follows from more sudden or violent modes of loss may be especially likely to shatter a mourner's assumptions regarding the world's controllability and stability (Janoff-Bulman, 1992). Violent or otherwise sudden losses make it especially hard for survivors to make sense of their loss (Currier et al., 2007; Rozalski, Holland, & Neimeyer, 2017), thereby affecting symptom dynamics and presentation. Comparisons of CG networks across causes of death may substantiate this possibility.

The statistical approaches we used are exploratory in nature. We used CS coefficients to evaluate the stability of centrality estimates drawn from networks (Epskamp & Fried, 2018). Bootstrapping over 1,000 samples produced CS coefficients, which indicated acceptable stability in each network. Because our data are cross-sectional, causal relationships between symptoms of CG and elements of PTG can only be suggested. However, the major advantage of a network approach to the CG-PTG relation is that it points to specific elements and symptoms of interest within this relation that can be further examined and leveraged therapeutically. For example, instead of viewing PTG as a general panacea for grief, perceptions of being able to handle difficulty were identified as the aspect of growth that

displayed the highest negative influence on CG. Instead of generalizing distress related to a loss as an impetus for growth, our study was able to point specifically to impressions of one's view of the world having been changed as the symptom within CG that appears most generative of growth. Future research on the relationship between grief and growth should examine longitudinal data in order to further substantiate the causal directions suggested by our EI metrics. Time series analysis of intraindividual networks (Borsboom & Cramer, 2013) is one technique that could be germane to such inquiry. Randomized controlled experimental paradigms remain the best way of establishing causality. Network analyses such as the present study can help to identify specific nodes suitable as experimental targets.

Network researchers recommend examining wider ranges of symptomatic outcomes that extend beyond diagnostic categories based upon latent variable models (Hofmann, Curtiss, & McNally, 2016). Although this article sample size was insufficient to examine other disorders as they relate to the grief–growth dynamic, its inclusion of an outcome other than CG as well as a wider range of CG symptoms are strengths. Future research should examine symptoms from multiple sequelae of bereavement, which include suicidality, depression, anxiety disorders, PTSD, and others (Stroebe, Schut, & Stroebe, 2007) in order to provide a comprehensive picture of PTG's causal relations with diverse bereavement outcomes. Further, the principle of integrative pluralism (Kendler, 2005) would suggest that a wide range of social, neurobiological, and individual difference factors likely influence the relationship between postbereavement symptoms and PTG. Indeed, theorists have posited many plausible factors that could affect the grief–growth dynamic, such as ruminative style (Calhoun & Tedeschi, 1998), cause of death (Currier et al., 2007), social support availability (Hogan & Schmidt, 2002), or larger cultural understandings of grief (Neimeyer et al., 2014). Further studies might also examine how networks vary as a function of these variables (e.g., expected/normative death versus unexpected/violent death).

The network approach cautions against simplistic interpretations of the relationship between emergent phenomena (CG and PTG) and their constituent elements, exemplified by the *fallacy of composition*, which assumes that "what applies to the individual necessarily applies to the group" (McNally, 2015, p. 197). Put another way, the principles that hold true for one level of analysis (such as symptoms in a patient) do not always hold at a different level of analysis (the patient's overall outcome in response to grief). For example, our study suggests that the presence of some CG symptoms may not inevitably be deleterious to overall grief outcomes; perceptions of having been changed by a loss may promote the development of growth. Just how this perception of change in worldview can best be promoted to facilitate growth is a promising area for further inquiry.

Treatment implications

From a clinical standpoint, the present study points out some potential pitfalls for therapists to avoid, as well as some possible points of leverage in promoting positive outcomes. For some patients, perceptions of lack of control may be a primary treatment target, as these may reinforce the stability and severity of a wide range of CG symptoms. Close attention to the context of the loss and individual reactions is warranted in identifying which symptoms to prioritize in treatment (Currier et al., 2007). Therapists may also do well to assist the mourner in generating possibilities for a fulfilling future, as progress in this regard could mitigate their CG symptoms, particularly perceptions of identity confusion and hopelessness (Robinaugh & McNally, 2013). Further, this promotion of the patient's ability to establish a new path in life may also be highly conducive to growth outcomes (Calhoun & Tedeschi, 1998). It is notable that Shear and colleagues' (2014) Complicated Grief Treatment specifically targets this domain through its focus on revising future goals in light of the loss.

We further suggest that some therapists may be able to leverage features of CG previously considered as symptoms by using them as an impetus for growth. A patient who presents with a sense of having been changed by a loss may be able to find in this circumstance an unsought opportunity to revise meaning systems and build a new life (Neimeyer, 2016). Caution is also advised regarding a patient's perceived inability to care about or identify with others, as this may be the feature of grief most prohibitive of growth; in such cases, fostering compassion for the suffering of others can facilitate personal development, while also offering support for others in the client's family or social system (Neimeyer & Cacciatore, 2016).

Regarding the maintenance of growth and positive outcomes, therapists may do well to encourage a sense of agency in the midst of distress by allowing patients "to take the lead" in making meaning of the loss in a way that repairs or adjusts shattered assumptions (Neimeyer, Burke, Mackay, & Stringer, 2010). If attempting to leverage the patient's existing perceptions of growth to destabilize CG, a therapeutic emphasis on the patient's intrapsychic and interpersonal resources may be particularly helpful in disrupting syndromic coherence for individuals who cannot find the inner

resources needed to reconstruct a hopeful future. A particular advantage of network-based inquiry into therapeutic implementation is the ability to examine mechanisms of therapeutic efficacy at the individual symptom level (Kazdin, 2007). Future network-based research on treatment of CG should examine more closely which specific symptoms of the CG network are most heavily influenced by PTG.

Conclusion

Taken together, the results of the present study provide a fine-grained examination of CG, PTG, and their interactions, indicating that positive as well as pathological sequelae of loss are conducive to network approach-based inquiry. PTG was revealed to demonstrate coherence as a causal system, which was particularly contingent upon the degree to which the mourner was able to envision a new path in life. At the intercommunity level, CG and PTG share a complex relationship that includes both negative and positive relationships between the different aspects of CG and PTG. This cross-sectional study was exploratory in nature, and so causal mechanisms within the grief–growth dynamic can only be suggested. However, our results point to exciting new directions in research on the treatment of CG and promotion of PTG when such outcomes are viewed as reciprocally influencing facets of a causal system.

Author Contributions

B. W. Bellet developed the study concept and wrote original and final drafts of the manuscript. P. J. Jones helped with concept development and conducted all statistical analyses. R. A. Neimeyer and R. J. McNally provided guidance on clinical and theoretical implications, respectively. All authors contributed to subsequent drafts of the manuscript and approved the final version for submission.

Declaration of Conflicting Interests

The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

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Notes

1. Throughout this article, we use the term *PTG* to denote these positive postloss outcomes even though bereavements producing growth do not invariably result from an objectively traumatic death.

2. Most of the suggested criteria for PGD as outlined by Prigerson and colleagues (2009) were addressed directly by items from the ICG-R. However, two items from their suggested criteria could only be approximated by very similar items; we used an item tapping perceptions of a meaningless future to stand in for PGD's "difficulty moving on" symptom and an item tapping distress at discontinuing preloss activities and social engagements to stand in for PGD's "avoidance" symptom. Because the causal systems approach does not consider CG as a unitary latent diagnostic entity and because these symptoms have not manifested high centrality in previous network analyses, these approximations are not problematic in light of our research aims.

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