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Attentional Bias and Complicated Grief: A Primed Dot-Probe Task with Emotional Faces

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Abstract

We used a dot-probe task to examine attentional biases toward emotional stimuli among three groups: conjugally bereaved1.5-3 years post-loss with or without Complicated Grief (CG) and a sample of demographically similar married participants. Each trial was preceded by a subliminal prime of the spouse's name or the spouse's name scrambled (neutral). Only CG participants demonstrated significant attentional biases. When primed with their (deceased) spouse's name, CG participants attended away from closed-mouth sad faces, and in the neutral condition attended away from happy faces. Because over half of the CG participants also met criteria for MDD (*n* = 14), we repeated these analyses examining co-morbid MDD with CG. The same findings emerged for sad faces in the deceased condition and happy faces in the neutral condition. These findings extend previous research on CG, demonstrating that CG and co-morbid CG with MDD involves distinct attentional problems specifically related to grief symptomatology.

Keywords: Selective attention; Attentional bias; Chronic grief; Depression; Emotion; Facial expressions

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Introduction

The death of a loved one is nearly a ubiquitous life event that leads to significant long-term problems in functioning for 10-15 % of bereaved individuals (Bonanno, 2004, 2005; Bonanno et al., 2007; Horowitz et al., 1997). Recently researchers and theorists have begun to conceptualize these difficulties in terms of a unique diagnostic entity referred to as prolonged or complicated grief (CG; Horowitz et al., 1997; Prigerson et al., 1999). Because CG has only recently been articulated, little is known about the cognitive and emotional processes associated with this pattern. This study attempts to address this deficit by examining selective attention to emotional stimuli (e.g. facial expressions of emotion) using a modified dot-probe paradigm in three groups: bereaved groups with and without CG and a comparable group of asymptomatic married individuals. The bereaved participants in this study were recruited at later stages of bereavement, which we expected would highlight the distinction between those who were functioning at normal or near-normal levels and those who continued to struggle with elevated psychopathology, including complicated grief and possibly also elevated depression.

The Facial Dot-Probe Paradigm

MacLeod, Mathews, & Tata (1986) developed the dot-probe paradigm to measure how clinically anxious individuals allocated their visual attention in the context of emotional stimuli. In the original dot-probe paradigm, participants were exposed to a generally positive or negative word paired with a neutral word. Recent research has focused on better understanding the role of specific negative and positive emotions, such as fear and happiness, in the emergence and maintenance of clinical disorders. Subsequently, recent studies employed the dot-probe paradigm with specific emotional faces (Bar-Haim, Lamy, Pergamin, Bakersmans-Kranenburg & van Ijzendoorn, 2007; Mogg, Millar, & Bradley, 2000; Mogg, Philippot, & Bradley, 2004). Research indicates that facial expressions are more reliable measures of selective attention to emotion and are more likely to elicit emotion from the viewer than emotional words or other images (Bar-Haim et al., 2007; Mogg et al., 2000). Using facial expressions of emotions in the dot-probe paradigm also allows for a more naturalistic study of selective attention to different emotions (Bradley et al., 1997). Faces are important social and emotional cues, and how individuals respond to different facial expressions of emotion in the dot-probe paradigm provides insight into how individuals attend to social emotional information in their daily lives.

In the dot-probe paradigm, participants fixate on a cross and then as quickly and accurately as possible attempt to detect the location of a small dot, presented on either the right or left side of the cross. In the dot-probe paradigm with emotional faces, prior to the presentation of the dot, participants are exposed to pairs of faces. The face pairs always include one photograph of a face with an emotional expression and one photograph of the same face with a neutral expression. Response times to the dot-probe in the context of different facial expressions of emotions serve

as a measure of allocated attention. A faster response to the probe that replaces the emotional face indicates an attentional bias toward that emotion while a faster response to the probe that replaces the neutral face signifies an attentional bias away from the emotion (MacLeod et al., 1986). Exposure to emotional stimuli may impair reaction time on attention tasks because exposure intensifies negative affect states, suggesting that individuals maintain different thresholds for specific emotions (MacLeod, 1986). An attentional bias toward particular emotional stimuli suggests "vigilance" or in other words a cognitive emotional preference or preoccupation (Mogg et al., 2004). An attentional bias away from particular emotional stimuli is referred to as attentional avoidance. The implication is that preferential attention towards specific affective stimuli may inhibit attention toward other affective information and that avoidance inhibits affective processing of a specific emotion, thus creating a biased or subjectively skewed sense of the world.

Depression, Anxiety, and Grief

While the dot-probe was originally developed to measure how clinically anxious individuals allocated their attention in the context of a emotional stimulus (MacLeod et al., 1986), it has been used to examine attentional biases associated with a wide range of clinical problems, such as depression (Joormann & Gotlib, 2007; Scher, Ingram, & Segal, 2005), social phobia (Chen, Ehlers, Clark, & Mansell, 2002; Mogg et al., 2004), and eating disorders (Blechert, Ansorge, & Tuschen-Caffier, 2010). This paradigm is rooted in evolutionary and cognitive theory, positing that certain information is likely to be more salient depending on the population under study. Evolutionary theory posits that threatening information elicits attention for survival reasons (LeDoux, 1996; Ohman, Flykt, & Lundqvist, 2000; Panksepp, 1998), and relatedly, cognitive theory posits that mood and anxiety disorders develop due to mood-related cognitive biases (Beck, 1976). Research on attentional biases substantiates cognitive theory of mood and anxiety disorders by evidencing that individuals tend to selectively attend to facial expressions of emotions that mimic their own state, demonstrating mood-congruent or disorder-specific attentional biases (Hankin, Gibb, Abela & Flory, 2010). In general, anxiety disorders are associated with preferential attention or vigilance toward threat-related information, specifically angry facial expressions (Bradley, Mogg, Falla & Hamilton, 1998, Bradley, Mogg, Millar, Bonham-Carter, Fergusson, Jenkins & Parr, 1999; Fox, Russo, Bowles, & Dutton, 2001; Mogg & Bradley, 1999; Mogg et al., 2004), and major depression is associated with a selective attention or vigilance toward sad facial expressions (Gotlib, Krasnoperova, Yue, & Joorman, 2004; Joormann & Gotlib, 2007), and a reduced vigilance for positive stimuli (Gotlib, McLachlan, & Katz, 1988) or happy facial expressions (Joormann & Gotlib, 2007; Leppanen, 2006; Scher et al., 2005).

The dot-probe paradigm has not yet been used to examine how complicated grief may impact selective attention. Similarly to depression, sadness is a primary emotion related to CG and we thus anticipated that attentional biases among CG participants would also occur in response to sad stimuli. However, while CG shares some features of depression, the etiology of CG contrasts with depression in at least one important way. Whereas depression is characterized by a global preoccupation with negative attributions, the preoccupations of CG revolve more clearly around a specific object: the lost loved one. As a result, the cardinal symptoms of CG reflect that preoccupation with the lost loved one. These symptoms, including intense yearning for the deceased, intense preoccupation and distress about the loss, guilt about one's own behavior toward the deceased and marked avoidance of thoughts and feelings associated with the loss, significantly distinguish complicated grief from depression. Thus an important aspect of the current study explored attentional biases with and without the context of a loss reminder. We anticipated that attentional biases for sad faces among CG participants would only occur in the context of a loss reminder. Indeed, bereaved persons with CG have been shown to have an attentional bias toward loss-related stimuli, which likely relates to separation distress and ruminative processes about the loss (Maccullum & Bryant, 2010). However, a primary feature of CG also involves the avoidance of the reality of the loss. Thus, an alternate hypothesis also seemed plausible; specifically, we anticipated that CG participants might also demonstrate an attentional bias away from sad faces in the context of a loss reminder. In sum, we hypothesized that CG participants would show an attentional bias related to sad faces, and that this attention bias would be evident only in the context of a reminder of their loss. Because of competing hypotheses about the source of this bias, we did not predict whether the bias associated with CG would direct attention toward or away from the sad facial stimuli. Finally, because of ongoing issues in the diagnosis of CG, we explored how bereaved people who presented with MDD as well as CG responded to sad faces with and without the context of a reminder of their loss.

Mood disorders have been linked to deficits in the processing of positive emotion as well as negative emotion. Specifically, some research suggests that depressed individuals allocate less attention towards positive stimuli (Gotlib et al., 1988; Joormann & Gotlib, 2007; Leppanen, 2006; Scher et al., 2005). Recent research suggests that the processing of positive emotion may be distinctly different for CG than depression. Neuroimaging research, for example, has begun to evidence that CG symptoms activate areas of the brain associated with reward (O'Connor et al., 2008). As CG, in contrast to depression occurring outside of bereavement, is associated with a preoccupation with the loss and an avoidance of its reality, we predicted that CG participants will demonstrate an attentional bias related to happy faces only when reminded of their loss.

The Current Investigation

As the dot-probe paradigm has not yet been used to examine how complicated grief may impact selective attention, the current study expanded upon prior research to examine the unique clinical problem of complicated grief. The valence and content specificity of experimental stimuli is a key issue, and until recently, many studies have not been tailored to address both (Mineka, Rafaeli, & Yovel, 2003). Recently, Maccullum and Bryant (2010) used an emotional Stroop paradigm to show that bereaved participants with CG, in contrast to bereaved participants without CG, evidenced an attentional bias toward death-related words (Maccullum & Bryant 2010). Extending this research, in the current study we explored the object-specific nature of CG by incorporating a subliminal stimulus of the deceased spouse's name into the dot-probe task. We chose to use the spouse's name because it would serve as a reminder of the loss for bereaved participants, thus allowing for comparisons between bereaved with and without CG, but also because it was a broad enough stimulus to be of relevance to married individuals, thus allowing for comparisons between bereaved participants and non-bereaved participants. More specifically, we were interested in examining differences in the way the bereavement status groups (CG, asymptomatic bereaved, and married) attended to emotional stimuli when primed with their spouse's name (target prime) versus their spouse's scrambled name (neutral prime).

Considering the symptomatological overlap between complicated grief and both depression and anxiety, this study used angry, sad, and happy facial expressions to examine if CG participants showed similar attentional biases as demonstrated by depressed and anxious participants in prior studies.

This study also used facial expressions of disgust to explore how this emotion may impact attention resources among bereaved participants. Disgust has been implicated as the emotion most closely related to both mortality and morality (Cox, Goldenberg, Pyszczynski, & Weuse, 2007; Goldenberg et al., 2001; Rozin, Haidt, & McCauley, 2000). Disgust, for example, arises in reaction not only to toxic substances, but also to reminders of the animal nature of the human species, such as death (Cox et al., 2007; Goldenberg et al., 2001; Rozin et al., 2000). As this study is particularly interested in the affective processing of conjugally bereaved participants when primed with their deceased spouse's name, we explored whether the prime altered attention to disgust faces.

This study also used closed and open mouth versions of each emotion to more closely examine how specific emotion expressions impacted the visual attention of participants. The morphology of the lower face, such as specific muscle contractions, teeth showing, and tongue protrusions, distinguish emotions to the observer more explicitly than the morphology of the upper face, except in the case of sadness which cannot be distinguished by the lower face alone (Ekman & Friesen, 2003). Open-mouth expressions indicate more intense displays of a particular emotion and can also imply different meanings (Ekman & Friesen, 2003). For example, open-mouth disgust expressions that involve raising of the upper-lip and tongue protrusions are more intense, and more distinguishable as conveying the emotion of disgust as opposed to contempt or anger, which share similar facial displays as closed-mouth disgust. The open-mouth expression of disgust has been referred to as core disgust, which relates to visceral reactions to toxins, contaminated food, fecal matter or certain animals (Rozin & Fallon, 1987), and closed-mouth expression of disgust has been defined as social-moral disgust, which relates to more culturally bound ideas about social and moral transgressions (Haidt, Rozin, McCauley, & Imada, 1997). Closed and open mouth displays of other emotions have also been shown to communicate different messages. Infant development research, for example, posits that the open-mouth smiling communicates social playfulness and social engagement whereas the closed-mouth smile occurs more during object-focused play (Messinger, 2002). Messinger (2002) also documents that open-mouth sadness, like open-mouth happiness, communicates greater

intensity of emotion. Open-mouth sadness, involving a jaw drop in addition to the lowering of the lip corners, contraction of the chin and raising of the inner eyebrow, signals agony whereas a closed-mouth display of sadness communicates a resigned sadness or helplessness (Ekman & Friesen, 2003).

Considering the similarities and differences between grief and depression, we hypothesized that individuals suffering from CG would show an attentional bias either towards or away from sad facial expressions. However, owing to the object-focused nature of CG, we also hypothesized that the attention bias to sad faces among CG participants would only occur when they were primed with their spouse's name. We anticipated that the asymptomatic bereaved and married groups would not show unique attentional biases involving sad faces. As CG is associated with a preoccupation with the loss and an avoidance of its reality, we also predicted that CG participants will demonstrate an attentional bias away from happy faces when reminded of their loss. As an exploratory prediction, we also anticipated that CG participants would show a unique attentional bias towards disgust when primed with their deceased spouse's name.

Methods

Participants and Procedure

Two groups of middle-aged (25-55 years) participants were recruited: participants who had lost a spouse 1.5 - 3 years previously (Bereaved) and participants who were currently married and asymptomatic (Married). Bereaved participants were recruited through internet and newspaper advertisements, fliers, support group referrals, and letters mailed based on public death listings. Married participants were recruited through fliers and internet advertisements. Interested participants were encouraged to contact the researchers by phone or email and were then scheduled for an initial phone interview to establish eligibility. To create similar group demographically, we restricted analyses for this study using the following criteria: participants were between the ages of 25 and 55, had at least a high school education, an income level above $15, 000, and were married for at least 3 years. The three groups (CG bereaved, asymptomatic bereaved, married) did not differ significantly on any socioeconomic factors (e.g. family income level and education level), age, and length of marriage. A MANOVA to assess demographic characteristics (age, gender, level of education, length of marriage, and family income) between groups (bereaved with CG, asymptomatic bereaved, and married) found no significant differences, $F(10, 132) = 1.22$, $p = .282$. The bereaved with CG group comprised of 26 participants; the asymptomatic bereaved group included 18 participants, and the married group had 28 participants. The final sample had more women (61.3%) than men (38.7%), was primarily Caucasian (64.0%) and African-American (25.3%), had an average age of 45.3 (SD = 7.06), and an average income of 81,400 (SD = 67,822). Most participants attended (33.3%) or completed (30.7%) a college.

All eligible participants completed an extensive battery of questionnaires at home, and then visited the laboratory for two 2-hour sessions that comprised of clinical structured and semi-structured interviews and various computerized experimental tasks. Trained graduate students in clinical psychology conducted the experimental sessions. Participants received $40 for completion of the questionnaires, and $80 for each laboratory session.

Structured Clinical Interview

During the first laboratory session, participants were asked a series of questions corresponding to the DSM-IV (American Psychological Association, 1994) symptoms for Major Depressive Disorder (MDD; 9 items, $\alpha = .87$). Bereaved participants were also asked questions corresponding to symptoms associated with CG (Bonanno et al., 2007; Horowitz et al., 1997; Prigerson et al., 2009, Prigerson et al., 1999): strong yearning for the deceased; recurrent and intrusive recollections of the death event; intense distress over symbolic reminders of the loss; preoccupation with thoughts about the loss; recurrent regrets or self-blame about own behavior toward the deceased; difficulty accepting the finality of the loss; marked loneliness; pervasive sense that life is meaningless; unusual difficulty developing new relationships; efforts to avoid thoughts, feelings, or conversations associated with the loss; and efforts to avoid activities, places, or people that arouse recollections of the loss (11 items, $\alpha = .82$).

Interviews were conducted by a team of clinical psychologists and advanced doctoral candidates in clinical psychology blind to the goals and hypotheses of the study. Interviews were videotaped and each interviewer coded

a randomly selected set of 5 additional interviews. Inter-rater reliability for the symptom items was very high (average κ = .91). Bereaved participants were categorized in the CG group if they met criteria for at least 4 of the 11 CG symptoms. Bereaved and married participants who presented with fewer than 3 symptoms of MDD were included in the asymptomatic bereaved or married group, respectively.

As a validity check for the CG group, in an additional part of the interview bereaved participants were shown a graphic representation of four trajectories corresponding to common longitudinal patterns of bereavement outcome: resilience, recovery, chronic grief, and long-standing chronic depression (Bonanno, 2004; Bonanno et al., 2002). Each trajectory was accompanied by a brief narrative description and participants were asked to select the trajectory that best captured their experience of grief symptoms over time. Most participants (88.9%) who endorsed the Chronic Grief trajectory were in the CG group, $\chi^2(3) = 20.72$, $p < .001$.

Dot-probe Experimental Task

Participants were seated before a desktop computer while an experimenter instructed them in the procedures for the dot-probe task. The dot-probe task resembles the original dot-probe task (MacLeod et al., 1986), but incorporates facial stimuli of emotions as well as a manipulated prime condition. The prime condition included a subliminal presentation of the spouse's name for half of the trials (target prime), and a subliminal presentation of the spouse's name scrambled for the other half of the trials (neutral prime).

Materials for the dot-probe task consisted of a set of 64 photograph pairs of faces from the NimStim set as based on previous research, using 8 different actors (Tottenham et al., 2009). Facial stimulus pairs included an emotional (happy, sad, disgust, or anger in either open or closed mouth form) and neutral photograph of the same actor. The set consisted of picture pairs of 8 actors. Figure 1 provides an example of the open and closed-mouth sad faces used in the experimental task. Sixteen emotion-neutral face pairs were used for the practice trials, and 256 emotion-neutral trials were presented during the experimental task. Each trial began with the display of a white fixation cross in the middle of a black screen for 500 ms followed by the name prime (spouse's name or spouse's scrambled name). Name primes were presented for 20 ms and were followed by a pattern mask (500 ms) and then the facial stimulus pairs. The pair of pictures (the same actor displaying an emotional expression and a neutral expression) was presented for 1000 ms. Following the offset of the facial stimulus pair, a small gray dot appeared in the center location of where one of the pictures had been, and the dot remained visible until the participant indicated the location of the dot by pressing one of two response keys (right or left). The dot-probe was presented in each position – right or left side of the screen – with equal probability. The computer recorded the accuracy and latency of each response. The inter-trial interval was 500 ms.

Open Mouth Sadness	Closed Mouth Sadness
	

Figure 1: Examples of Open and Closed-mouth Sad Faces Used as Stimuli in the Dot-Probe Task.

Results

Data reduction

For each participant, average response latency scores (RLs) were calculated for each emotion type (open mouth sad, closed mouth sad, open mouth happy, closed mouth happy, open mouth angry, closed mouth angry, open mouth disgust, and closed mouth disgust) in the different conditions (location of the dot-probe and prime). As previous research suggests (Gotlib et al., 2004; Joorman & Gotlib, 2007), RLs under 100 ms were considered anticipation errors and RLs above 1000 ms were considered concentration lapses, and were thus excluded from analyses. Employing this criterion entailed the loss of only 0.03 % of the data.

Following previous research (Bradley et al., 1998), response times were converted into attentional bias scores to examine how participants allocated their attention when presented with different emotional faces in each name-prime condition. An attentional bias score for each type of emotional face was calculated by subtracting the mean RLs for dot-probes appearing in the location of the emotional face (sad, angry, happy, and disgust) from the mean RL for dot-probes appearing in the location of the neutral face for each prime condition (the spouse's name versus scrambled name). Attentional bias scores indicate a selective allocation of attention. A positive score indicates that a participant responded more quickly to the dot-probe when it appeared in the location of an emotional face and/or less quickly when it appeared in the location of a neutral face. A negative score indicates that a participant responded less quickly to the dot-probe when it appeared in the location of an emotional face and more quickly when it appeared in the location of a neutral face.

Bereavement Status Groups using CG

We first examined RLs in a mixed design analyses for the between-subjects effects of bereavement status group (CG, asymptomatic bereaved, and married) crossed with priming condition (spouse's name, spouse's name scrambled), emotion (anger, disgust, sad, and happy), and mouth (open-closed). This analysis revealed a marginal main effect for bereavement status group, $F(2, 67) = 2.52$, $p = .08$, a significant 3-way interaction of group × condition × emotion, $F(6, 132) = 2.10$, $p = .05$, and a significant 3-way interaction of condition × emotion × mouth, $F(3, 65) = 2.71$, $p = .05$. Most importantly, these effects were qualified by a significant 4-way interaction of group × condition × emotion × mouth, $F(6, 132) = 2.34$, $p < .05$.

To further probe the 4-way interaction, we conducted a mixed design analyses (group × emotion × mouth) separately for the deceased and scrambled conditions. The analysis for the deceased condition revealed a significant group × mouth × emotion interaction $F(6, 132) = 3.08$, $p = .007$, and no other significant effects. We followed up this analysis with one-way ANOVAs for each emotion-mouth combination. The only significant effect emerged for closed-mouth sad faces, $F(2, 67) = 4.01$, $p < .05$. Post-hoc comparisons of means using Student-Newman Keuls test ($p < .05$) indicated that the CG group evidenced significantly greater bias with closed-mouth sad faces than the other two groups. One-sample t-tests against the hypothetical mean of zero (no bias) (Gotlib et al., 2004; Joorman & Gotlib, 2007) indicated that the CG group showed a significant bias away from closed-mouth sad faces ($M = –31.4$), $t(24) = –2.6$, $p = .015$) whereas the other two groups did not evidence significant bias.

The analysis for the scrambled condition revealed a significant group × emotion interaction $F(6, 134) = 3.01$, $p = .009$, and no other significant effects. Since no mouth effects were observed for the scrambled condition, we conducted follow-up ANOVAs for each emotion, collapsing across mouth. This analysis revealed significant effects for angry, $F(2, 68) = 3.27$, $p < .05$ and happy faces, $F(2, 68) = 6.81$, $p = .002$. Post-hoc comparisons ($p < .05$) were significant only for happy faces, and indicated that the CG group had significantly greater bias than the other two groups. One sample t-tests were significant only for the CG group, which showed a bias away from happy faces ($M = −39.7$), $t(24) = –3.24$, $p = .003$).

Alternative Categorization of CG

Because an agreed-upon formal diagnosis does not yet exist for CG, we explored whether the specific RT biases associated with sadness would still be evident using other diagnostic criteria. Following Prigerson et al. (1999), we

created an alternative CG category that required in addition to the criteria specified in the methods section (at least 4 CG symptoms) that participants have at least 1 symptom of separation distress (e.g., yearning, preoccupation, regrets). Using this alterative diagnostic category we again conducted one-sample t-tests comparing attentional bias scores against a hypothetical mean of zero (no bias) within each group (CG, asymptomatic bereaved, and married). The results were identical to the previous analyses. The CG group again demonstrated a unique attentional bias away from expressions of closed-mouth sadness when primed with their deceased spouse's name (M = –30.66, $t(19)$ = –2.182, p < .05) and a unique attentional bias away from expressions of open-mouthed happiness following the scrambled (neutral) prime (M = –46.27, $t(19)$ = –3.11, p < .01).

Bereavement Status Groups using CG and MDD

We also explored whether these effects might vary in relation to co-morbid diagnoses of CG and MDD. Fourteen participants met criteria for both MDD and CG (MDD-CG) while twelve participants met criteria only for CG (CG-only). Three participants exclusively met criteria for MDD, but were excluded from the analysis due to their small number. The asymptomatic bereaved and married groups in these analyses were identical to the groups used in the previous analyses.

As a preliminary step, we first examined whether co-morbidity was associated with greater problems in functioning, as measured by the GAF. A one-way ANOVA comparing the four groups (MDD-CG, CG-only, asymptomatic bereaved, married) revealed a significant group effect, $F(3, 68)$ = 39.8, p < .001. Post-hoc SNK comparisons revealed that the MDD-CG group had significantly lower functioning (M = 59.9) than the CG-only group (M = 65.6) and that both groups had poorer functioning than the asymptomatic bereaved (M = 76.4), who in turn had poorer functioning that married participants (M = 85.5).

Next we conducted a mixed design repeated measures similar to the analyses reported previously but comparing MDD-CG, CG-only, asymptomatic bereaved and married participants. This analysis yielded non-significant effects for group, $F(3, 66)$ = 2.01, p > .05, the 3-way interaction of group × condition × emotion, $F(9, 198)$ = 1.45, p > .05, and the 3-way interaction of condition × emotion × mouth, $F(3, 64)$ = 2.09, p > .05. Importantly, however, as in the previous analysis, the 4-way interaction of group × condition × emotion × mouth was significant, $F(9, 198)$ = 2.36, p < .05.

As previously, we again probed the 4-way interaction by conducting mixed design analyses (group × emotion × mouth) separately for the deceased and scrambled conditions. As previously for the deceased condition, the 3-way interaction of group × mouth × emotion was significant, $F(9, 198)$ = 2.33, p = .01, but no other effects reached significance. Follow up one-way ANOVAs for each emotion-mouth combination in the deceased condition again revealed a significant effect only for closed-mouth sad faces, $F(3, 66)$ = 2.74, p = .05. Post-hoc comparisons of means indicated that the MDD-CG group differed significantly (p < .05) and the CG-only group marginally significantly (p < .10) from the married group. The difference between MDD-CG and CG-only groups did not approach significance. One sample t-tests indicated that the MDD-CG group showed a significant bias away from closed-mouth sad faces (M = –37.5), $t(11)$ = –3.6, p < .005). The CG-only group did not show a significant attentional for closed-mouth sad faces (M = –25.4), $t(11)$ = –1.15, p > .10. Thus, bereaved participants with a co-morbid MDD and CG evidenced a stronger attentional bias when primed with the name of the spouse than those bereaved participants categorized only by CG.

The analyses for the scrambled (neutral) condition revealed, as in the previous analyses using only CG, a significant effect for emotion × group interaction $F(9, 201)$ = 2.05, p < .05, and no other significant effects. Since no mouth effects were observed for the scrambled condition, as previously we conducted follow-up ANOVAs for each emotion, collapsing across mouth. This analysis revealed significant effects for happy faces, $F(3, 67)$ = 4.51, p = .006. Post-hoc comparisons (p < .05) were significant only for happy faces, and indicated that the CG-only group and the MDD-CG group had significantly greater bias than the other two groups, but were not different from each other. Consistent with this finding, one sample t-tests indicated significant bias away from happy faces for both the CG-only (M = –43.4), $t(11)$ = –2.34, p < .05) and the MDD-CG group (M = –36.4), $t(12)$ = –2.16, p = .05).

Discussion

The current investigation explored the object-specific nature of CG by incorporating a subliminal stimulus of the deceased spouse's name into the dot-probe task. We examined how different bereavement status groups (CG, asymptomatic bereaved, and married) attended to emotional stimuli when subliminally primed with their spouse's name (target prime) versus their spouse's scrambled name (neutral prime). Additionally, the current study examined how bereaved participants responded to facial expressions of sadness, happiness, anger, and disgust in both the open and closed mouth form in the context of the subliminal primes. The most noteworthy finding was that participants with complicated grief exhibited a unique attentional bias away from closed-mouth sad faces, but only when primed with their deceased spouse's name. The CG group also attended away from open-mouth happy faces in the neutral condition. Together, these findings elucidate the possible underlying cognitive and emotional mechanisms of complicated grief. Previous studies using the dot-probe paradigm with non-bereaved depressed participants found that depression was associated with an attention bias to look toward sad stimuli. In the current study, however, participants with CG, and as we discuss below also those with depression in the context of grief, showed the opposite tendency. This tendency highlights the avoidance characteristics and object-specific nature of CG, as the bias for sad faces was only observed in the context of reminders of the loss (spouse prime). Thus, cardinal symptoms associated with CG, such as difficulty accepting the finality of the loss, estrangement, emotional loneliness, strong yearnings for the deceased, and avoidance of reminders of the deceased, may stem from an automatic tendency to avoid processing of sad stimuli related to the loss.

Emotion processing is fundamental to the maintenance of social relations and adjustment to major life events, and facial expressions are a key medium in which individuals communicate emotion to others. The facial expression of sadness is particularly important in that sadness elicits sympathy, understanding and help from others (Eisenberg et al., 1989). The finding that CG participants look away from or avoid sad facial expressions suggests that CG participants struggle to cope with their own as well as others' sad emotion in the context of their own grief. CG may thus be related to a heightened sensitivity or preoccupation with one's own sadness, and a resultantly reduced capacity to respond to the sadness of others when reminded of their own loss.

Importantly, because chronic bereavement-related psychopathology also often extends to depression, we examined whether bereaved participants with co-morbid MDD and CG would show a similar or more extreme pattern of attention biases as those meeting criteria for CG but not MDD. The co-occurrence of psychiatric diagnoses during bereavement, including MDD and PTSD, has been associated with greater severity of grief (Simon et al., 2007). In the current study, fifty-four percent of participants categorized as CG (n = 14) also met criteria for MDD. As anticipated the MDD-CG participants had significantly lower levels of global functioning than participants with CG only, and both groups had lower global functioning than the asymptomatic and married groups. Together, these results highlight that CG undermines well-being, and that CG when co-morbid with other psychopathology, specifically MDD, is associated with even worse functioning.

When we compared the MDD-CG and CG-only groups, we found that only the MDD-CG group evidenced the bias away from closed-mouth sad faces and as previously only when subliminally primed with the name of their deceased spouse. The MDD-CG and CG-only bereaved groups both showed a significant attentional bias away from happy faces in the neutral prime condition.

How do we make sense of these findings in the context of current debates about the uniqueness of grief-related pathology during bereavement? Convincing evidence has been provided to suggest that the symptoms of complicated grief carry unique predictive utility (Boelen, P.A., & van den Bout, J., 2008) and convergent validity (Bonanno et al., 2007). However, the bulk of this evidence pertains to early points in bereavement, when grief symptoms appear to be especially useful for as markers of diagnostic specificity and treatment choice (Shear et al., 2005). Depression is not uncommon among bereaved individuals with CG, and as noted above, co-morbidity is associated with greater severity of grief (Simon et al., 2007).As with mood and anxiety disorders, as CG persists the risk for co-morbidity with other forms of psychopathology may increase (Angst, 1996; Simon et al., 2007). The key finding of our study was that bereaved people with elevated psychopathology 1.5 to 3 years after the loss tended to show an attention bias away from sad faces when reminded of their deceased spouse. It is important to consider also that the bereaved MDD participants in our study behaved differently in the dot probe task than

depressed participants typically do when tested outside the context of bereavement. Clearly there is more to learn about the mechanisms that might underlay these two forms of bereavement pathology. One possible avenue, which we are currently planning to explore, would be to repeat the dot-probe study, again contrasting CG and MDD, but at an earlier point in bereavement when co-morbidity might be less prevalent.

We chose to examine attentional differences in the current study using samples of individuals bereaved at least 1.5 years so as to maximize differences between the CG group and the asymptomatic bereaved. However, a limitation of this approach is that it does not allow us to speculate about possible causal links between attentional biases and pathology. As research on emotion and pathology has progressed, it has become apparent that their intersection is bidirectional (Kring, 2008). More specifically, deficits in emotional processing can lead to dysfunction and pathology, especially in the aftermath of aversive life events, such as the death of a spouse (Bonanno, 2009; Coifman & Bonanno, 2010; Gupta & Bonanno, in press).

However, psychopathology and ongoing stress can also disrupt normal patterns of emotional processing. The data from the current study cannot adjudicate these alternatives. Thus, an important direction in future research would be to examine the selective attention patterns of bereaved participants over time, beginning soon after the loss, as well as at later periods of bereavement. Such an investigation would reveal, for example, whether CG participants might demonstrate a similar pattern of attentional biases early after a loss, and consequently whether such a bias might be a risk factor in a long-term CG outcome. Alternatively, it is possible that the type of attentional biases observed in the current investigation are more appropriately thought of as a product of CG, in which case we should not observe such biases early in bereavement.

Another interesting finding in the current study was that the attentional bias away from sad faces associated with CG and CG co-morbid with MDD was evidenced only for closed-mouth sad faces, and not open-mouthed sad faces. Extant research suggests that the facial region of the mouth communicates different aspects or intensity levels of an emotion; closed-mouth sadness communicates a resigned sense of sadness, in comparison to open-mouth sadness, which signifies a more extreme form of sadness akin to anguish (Ekman & Friesen, 2003). There are several possible explanations for the specificity of this finding. It may be that chronically symptomatic bereaved participants only demonstrated an attentional bias away from closed-mouth sadness because the resigned sense of sadness is most relevant to and therefore most aversive to people with extreme grief reactions. A compatible explanation is that open-mouth sadness or anguish is simply too extreme an emotion and perhaps less related to sadness and more related to distress. Such distress-laden expressions would perhaps be less of an ongoing concern for people at this later period in bereavement.

Importantly, chronically symptomatic bereaved participants also showed an attentional avoidance of open-mouth happy faces in the neutral condition. Research on CG evidences how avoidance behaviors are common due to a difficulty in accepting the loss (Shear et al., 2007). Resultantly, individuals with CG tend to avoid previously valued and enjoyed activities, places, and people in an effort not to confront the psychological pain associated with the loss. In the current study, open-mouth happy faces, which signal social engagement, interest, and playfulness, present as threatening to those with CG. A major aspect of this finding is that the attentional avoidance occurred in the neutral condition, which indicates the pervasiveness of the avoidance behavior associated with CG. We also expected that CG participants would show the same bias away from happy faces when reminded of their loss (target prime). Future studies with a larger sample, as well as contrasting groups of participants without depression or depression without grief, would enable us to better examine how CG symptomatology may uniquely impact selective attention in regards to happy faces.

In this study, we also used disgust faces as the emotion of disgust has been shown to relate to feelings regarding mortality (Cox et al., 2007; Goldenberg et al., 2001; Rozin, Haidt, & McCauley, 2000). Specifically, we anticipated that bereaved participants would demonstrate an attentional bias in regard to disgust faces when primed with their deceased spouse's name. Bereaved participants, both CG and asymptomatic, however, did not show an attentional bias in relation to disgust faces in either condition. Future studies may benefit by examining disgust at early points in bereavement, as the poignancy of death itself may have been less relevant in the current study of bereaved who were 1.5-3 years post-loss.

In addition to constraints discussed above, there are several other limitations of this study that point to areas of future research. First, the dot-probe paradigm looks at attention during a specific time frame, which is determined by the length of time that participants are exposed to the specific prime stimuli. Studies vary on the length of exposure depending on the aim of the study. A 500 ms exposure time measures vigilance while a 1000 ms or greater exposure time measures sustained attention (Mogg et al., 2000; 2004). The current study used an exposure time of 1000 s, and thus focused on sustained attention. Future research would benefit by including both time frames to enable understanding about the relationship between initial orienting of attention and sustained attention. Some research examining the time course of selective attention among anxious participants demonstrates that anxiety is associated with a "vigilant-avoidant" pattern of selective attention; initially, preferential attention is shown toward the threatening stimulus, and then attention is preferentially directed away from the threatening stimulus (Mogg et al., 2000; 2004; for a review, see Bar-Haim et al., 2007). As CG, similar to anxiety, involves symptoms of preoccupation and avoidance, individuals suffering from CG may also maintain a "vigilant-avoidant" pattern of selective attention. In order to better examine the time course of selective attention in bereaved participants, future studies need to incorporate more time frames as well as others measures of cognitive processing, such as eye-tracking and event-related potentials, in addition to the manual reaction time measure. Such focused examinations of selective attention among bereaved individuals would promote greater understanding of the complex interplay of the symptoms associated with CG, which may in fact evidence cognitive emotional biases very distinct from clinical anxiety.

Second, the current study focused on bereavement status, and specifically focused on individuals who presented with complicated grief. While we were able to examine how depression in the context of CG impacted selective attention, our sample size was small, and the study would have benefited from having a comparison group of individuals who only presented with MDD. Adding comparison groups of individuals with major depression or clinical anxiety would greatly enhance our ability to compare the attention biases of these different groups. The current study provides evidence that CG involves a distinct pattern of selective attention. Further clarification of the distinct cognitive and emotional biases associated with CG in comparison to and when co-morbid with existing DSM-IV diagnosis, namely major depression and clinical anxiety, will enable researchers and clinicians alike to better suit treatment interventions to individuals whose functioning is uniquely impaired by deficits associated with CG.

In sum, the current results provide a nuanced examination of how CG and co-morbid CG with MDD impacts attention. Specifically, elevated CG and MDD symptomatology among bereaved participants was associated with attentional avoidance of closed-mouth sad faces when primed with their deceased spouse's name and an attentional avoidance of open-mouth happy faces in the neutral priming condition. These findings provide important insight into the underlying cognitive and emotional biases impacting individuals struggling 1.5 – 3 years following the loss of their spouse. In comparison to previous studies examining other related clinical issues, namely mood and anxiety disorders, these findings highlight the need for targeted study and treatment of CG. These findings also support the well-established basis for CG and co-morbid CG with MDD as a distinct clinical problem, and points to how attentional biases importantly play a role in the maintenance of CG.

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