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Original Article

Evolutionizing Grief: Viewing Photographs of the Deceased Predicts the Misattribution of Ambiguous Stimuli by the Bereaved

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Abstract: We propose a cognitive-evolutionary model of grief where the function of grief is to reunite a person with an absent partner where this is possible, and where it is not, to disengage and reorientate the individual from the lost agent. The present study investigates the potential factors that affect reunion-promoting symptoms by focusing on the misattribution of external stimuli to the deceased by the bereaved - which we term ‘false recognitions’. We propose three factors that relate to false recognitions: First, we propose that strong attachment to the deceased predisposes one to false recognitions; second, we predict that viewing photographs of the deceased (that were taken when the individual was alive) perpetuates false recognitions; and third, we propose that time elapsing since the death diminishes the frequency of false recognitions. In a survey of 164 recently bereaved (<25 months) pet owners in the U.S. and U.K., predictions concerning the association of the predictor and outcome variables were confirmed. The strongest predictor was the frequency of viewing photographic images of the deceased, a pattern consonant with our premise that, being evolutionarily novel, realistic photographs are treated as reliable cues that the agent remains a viable relationship partner. This research demonstrates the potential of evolutionary theory to inform mainstream bereavement research.

Keywords: Cognition, evolutionary psychology, grief, pet loss, bereavement, photographs

Introduction

Grief is the universal response to the deprivation of a valued relationship partner. In the context of death, grief typically consists of a series of cognitive-emotional symptoms including yearning for reunion, intrusive thoughts of the deceased, nostalgia, and intense sadness (Freed, Yanagihara, Hirsch, and Mann, 2009). To date, two divergent theories have been advanced in an effort to explain the evolutionary function of grief. The *reunion theory*

proposes that the proper domain of grief is the loss of a partner due to separation or estrangement rather than death (Archer, 2001; Bowlby, 1982). In this view, the function of grief is to motivate efforts at reunion; grief in the context of the death of a partner is thus understood as an unavoidable by-product of a separation response that evolved to maintain fitness-enhancing relationships. The *reorientation theory* posits that grief following the death of a loved one is a unique functional process that evolved to cope with a terminal loss by facilitating disengagement from the deceased and reorientation to a new status through a process of reassessing plans, priorities, and relationships, while simultaneously signaling a changed status to others (Freud, 1914/1951; Nesse, 2005).

While the reunion theory has been received relatively more favorably among clinical researchers than the reorientation account, neither has been well integrated into the mainstream bereavement literature. Aside from differences in research focus (i.e., proximate vs. ultimate factors) and objectives (i.e., reducing subjective distress vs. understanding the trait's evolution), bereavement scholars have argued that evolutionary theories have not been incorporated into bereavement research primarily because they lack conceptual clarity, and a corresponding absence of clearly defined testable predictions. Some scholars have challenged proponents of evolutionary accounts of grief to empirically test their proposals in order to further their integration with existing theories, but these calls have, to date, remained largely unaddressed (see Bonanno, 2001).

The aim of this paper is to showcase the potential contribution of an evolutionary approach to bereavement research by generating and testing novel predictions. Our goal is not to adjudicate between the two existing evolutionary theories of grief. This is because we believe that neither the reunion nor the reorientation account alone provides a sufficiently comprehensive explanation of the function of grief to accommodate all of the principal facets of the phenomenon. In our view, grief is a process that has two functions: First, in cases where reunion is possible, grief enhances the likelihood that it will occur, thus leveraging existing investments in a valuable relationship and avoiding the time, energy, and opportunity costs of establishing a replacement relationship. Second, in cases where reunion is not possible – death of the relationship partner being the most definitive variant thereof – grief facilitates the reconceptualization of the other as no longer a living, viable relationship partner, opening the door to investment in new relationships. Thus, grief may well consist of multiple mechanisms, each of which produces particular symptoms in particular contexts. This view of grief is consonant with large-scale longitudinal research showing that different symptoms are characteristically evinced at different times in the process of grief, e.g., yearning for reunion within the first 6 months, and acceptance between 7-12 months (Maciejewski, Zhang, Block, and Prigerson, 2007).

A cognitive-evolutionary account of grief

We propose that the reunion and reorientation theories of grief can be consolidated into a single cognitive account in which multiple evolved psychological mechanisms are deployed when an individual is separated from a valued relationship partner. These include both (1) mechanisms designed to promote reunion with a lost agent where this is possible (predominantly taking the form of symptoms such as yearning for reunion; see Bowlby, 1982), and (2) when there is evidence that the valued other is deceased, mechanisms designed to promote coming to terms with the permanent loss of the other by disengagement

and reorientation to a new status without him or her (predominantly taking the form of symptoms such as rumination and sadness; see Nesse, 2005).

If the above approach is correct, it should be possible to disaggregate grief into evolutionary meaningful subtypes, based on the postulated functions of the symptoms themselves. In the present paper, we focus on factors that influence the operation of mechanisms designed to promote reunion with a lost agent. We propose that a mechanism that functions to detect agents in the environment becomes hypervigilant following the loss of a valued relationship partner, in order to detect whether reunification with a specific agent is possible. This hypervigilance leads to an increase in ‘false positives’: the extent to which environmental stimuli (e.g., sights, sounds) are misattributed as being caused by the lost agent. We term these phenomena *false recognitions* to distinguish these experiences, the attribution of stimuli to a specific agent, from the attribution of stimuli to a generic agent. We propose that false recognitions can be understood as an index that the bereavement process is incomplete, hindering the employment of mechanisms to disengage and reorient to a new status without the lost agent (see 2, above).

To sketch the logic of our enterprise in advance of the full exposition of our theoretical framework, here we investigate three factors which, we propose, will impact the experience of false recognitions. First, because the costs of failing to detect opportunities for reunion should scale with the value of the lost relationship, we predict that strong attachment to the deceased (a subjective proxy for relationship investment/value) will predispose the bereaved to experience false recognitions. Second, being hypervigilant is costly, and such costs mount over time. Paralleling this, *ceteris paribus*, the probability that reunification will occur declines as a function of the passage of time. Together, these two considerations lead us to predict that the passage of time will diminish the experience of false recognitions. Third, photographs depicting the deceased while alive constitute evolutionarily novel stimuli. Accordingly, we expect that such photographs are treated to some degree by evolved mechanisms as veridical input, and are thus processed as cues that the deceased is present. This leads to the prediction that viewing such photographs will increase the experience of false recognitions. Below, we lay out our theoretical framework in more complete detail.

Agent hypervigilance

Because of their myriad implications for fitness, people are unconsciously biased towards detecting cues of agency in the environment. The elicitation of agent-detection systems has been interpreted in terms of error management theory, which predicts that natural selection will bias the interpretation of ambiguous stimuli toward the less-costly error: whether the situation is agonistic or cooperative, failing to detect an agent who is present will generally be more costly than erroneously presuming that an agent is present when one is not, hence agent-detection mechanisms should be biased toward false positives (Barrett and Behne, 2005; Haselton and Buss, 2000; Haselton and Nettle, 2006; Johnson, 2000). In addition to the baseline sensitivity towards agency that operates for humans generally, grief motivates the bereaved to seek out information indicating whether reunion with a specific agent, a lost relationship partner, is possible (Archer and Winchester, 1994; Freed et al., 2009; Johnson, 1992; Shear and Shair, 2005). Bereaved individuals are thus expected to be exceptionally vigilant towards detecting cues of the presence of a lost agent, in order to make two decisions: first, whether the target is present in the vicinity, and second,

whether the target is alive and therefore still a viable relationship partner.

False recognitions

One postulated consequence of the hypervigilance to cues of agency is the over-detection of signs of the deceased agent in the environment. Recent neurobiological research supports this claim. For example, recently bereaved pet owners demonstrate attentional bias towards deceased-related words in Emotional Stroop tasks (Freed et al., 2009). Furthermore, anecdotal, descriptive and self-report data suggests that it is common for bereaved individuals to interpret sights and sounds as having been caused by the deceased followed by the disquieting realization then that the loved one is dead, especially in the first 12 months following bereavement (Archer and Winchester, 1994; Maciejewski et al., 2007; Olson, Suddeth, Peterson, and Egelhoff, 1985; Weisman, 1990). The experiences are not (at least in elderly European populations) associated with depression or other psychological negative symptoms, and are associated with long and happy relationships (Grimby, 1993). Despite these facts, these experiences have been largely overlooked in conventional theories of grief and have not been deemed worthy of investigation in their own right.

We define false recognitions as the automatic misperception of external stimuli as being caused by a particular agent. To be clear, false recognitions are not hallucinations; they do not occur in the absence of external, or relevant, stimuli and they are attributed as a 'misperception' by the perceiver – the bereaved individual knows at a conscious level, after the initial experience, that the sight or sound has not been produced by the deceased agent (see Aleman and Larøi, 2008, for a sophisticated discussion of misperception). As we have outlined, in our view, false recognitions reveal the bereaved to be in a state of detecting whether reunification with the lost agent is possible, and therefore to not have fully reconceptualized the deceased as no longer a living, viable relationship partner. From a cognitive perspective, false recognitions can thus be understood as an index that the grief process is incomplete. It appears that cognitive mechanisms responsible for quick-and-dirty interpretation of stimuli, the so-called low-road aspects of perception, continue to represent the deceased as an agent capable of producing sights and sounds that impinge on the observer. At the same time, cognitive mechanisms responsible for slower, more reflective processing, the so-called high-road components of perception, no longer represent the agent in this manner – hence the disquieting conflict between the initial interpretation of sights or sounds as caused by the loved one, followed by the subsequent recollection that the loved one is dead, and realization that the initial interpretation must be erroneous. Eventually, however, representations of the deceased become so sufficiently reformulated that their influence on relevant aspects of cognition becomes uniform – the loved one is represented as no longer a viable relationship partner at all levels of representation, with the result that sights and sounds are no longer perceived as stemming from the loved one, and the experience of false recognition dissipates (Freed et al., 2009; Maciejewski et al., 2007; Prigerson et al., 1995). At this time, the bereaved will disengage and reorient him- or herself to a new status without the lost agent.

As noted in our initial sketch, holding aside questions of their influence on other aspects of the grief experience, we predict that three variables will impact upon the experience of false positives in recently bereaved pet owners: attachment to the deceased, time elapsed since death of significant other, and viewing images of the deceased depicting

them while alive. Below, we explain the logic of each of these predictions in more detail.

Attachment level to the deceased

From an evolutionary perspective, not all relationships are equal, and therefore, not all efforts to recover a relationship will be equal. For example, the losses of genetically related relationships, and losses that occur to an individual when reproductive value is high (i.e., adolescent children) have been found to be the most painful (e.g., for research, see Segal, 1998; Lasker and Toedter, 2000; Wijngaards-de-Meij et al., 2007). Another factor that should determine the level of grief response following bereavement is the amount of investment that has gone into the relationship (e.g., time, resources). Clinical research reveals that the level of attachment to the deceased – a subjective proxy for relationship investment – is a good predictor of overall grief intensity (Archer and Winchester, 1994; Freed et al., 2009; Shear and Shair, 2005). These measures focus on the overall experience of grief, whereas we are primarily interested in one cognitive component—false recognitions. We predict that the degree of relationship investment will also be a good predictor of the cognitive experience of grief.

From an evolutionary perspective, relationships are expensive. The start up costs for a new relationship are large and there is no certainty that a new relationship will be found. Therefore, hastily giving up on a relationship reduces fitness, and the more that has been invested in a relationship, the greater this reduction. More specifically, the start up costs for new relationships must be weighed against both the likelihood of reunification with the lost agent and the amount of investment that has gone into the relationship. Where investment in the relationship is especially high, replacement costs will likewise be high, and hence individuals highly attached to the lost agent are expected to be even more vigilant regarding cues of the agent's continued presence, and to engage in extended 'searching behaviors' (Archer and Winchester, 1994; Freed et al., 2009; Shear and Shair, 2005). Irrespective of their behavior following bereavement, individuals who have a high degree of investment in another are likely to be predisposed towards the experience of false positives. Therefore, we predict that the level of attachment (a proxy for investment) will positively correlate with the extent of misattributions of ambiguous stimuli to the lost agent, such that the experience of false recognitions will increase as a function of attachment.

Time elapsed since the onset of bereavement

Given the costs of both searching and going without a relationship partner, for any given level of prior investment in a relationship with a missing partner, there must be an inflection point beyond which efficiency demands that the relationship be abandoned and a replacement be sought. If a reunion-promoting adaptation exists, it must thus necessarily be the case that the mechanism calculates the probability of reunion based on events to date – without such capabilities, the postulated mechanism would be grossly maladaptive, endlessly motivating fruitless behavior. Indeed, bereavement research shows that individuals who continue to display attentional bias to reminders of the deceased after 18 months – i.e., 'complicated' grief (a condition affecting around 10% of the Western bereaved population) – incur significant physical and mental health problems and display impaired daily functioning (Maccallum and Bryant, 2010). We therefore predict that time elapsed since the onset of bereavement will constitute a diminishing factor, and thus will negatively correlate with the

extent of false recognitions.

Viewing photographic images of the deceased

There are many cues in the environment that suggest that a particular agent is in the immediate vicinity—items of clothing, objects, agent smell, etc. Such cues vary in reliability. Stimuli that involve faces and eyes are likely to be processed as the most reliable. Consonant with the highly social nature of our species and the corresponding importance that social interactions hold for fitness, the human mind contains agent and face detection mechanisms (Johnson, 2000). Importantly, the effects of the input provided by these systems to other psychological mechanisms are at least partly independent of propositional knowledge and are likely to be highly reliable cues of agency. For example, in keeping with the importance in human societies of maintaining a positive reputation and avoiding punishment, a variety of experiments document that images of eyes can promote prosocial behavior and inhibit antisocial behavior (Nettle et al., 2012; Nettle, Nott, and Bateson, 2012). The nature of the stimuli used in such experiments makes it clear that individuals' behavior is altered despite the fact that, at an explicit level of consciousness, they are aware that drawings or posters of eyes are not real agents. Moreover, research suggests that stimuli that activate agent systems and facial detection mechanisms are treated as highly reliable cues that a familiar other is present. For example, neurobiological research reveals that viewing photographs of familiar others activates facial recognition systems (i.e., personal identification networks) as though the individuals viewed were physically present (Leveroni et al., 2000; Shah et al., 2001).

Input suggesting that the deceased is alive will enhance the conflict between the old representation of the loved one and the new representation to which the bereaved is transitioning. Correspondingly, if false recognitions are a symptom of the degree of incompleteness of this process, then input suggesting that the deceased is alive will exacerbate the experience of false recognitions. Because realistic photographs and other media were not components of the stimulus environment in which the mechanisms underlying grief evolved, they may be processed at least to some degree as veridical. It therefore follows that exposure to such images will positively correlate with the experience of false recognitions. Just as in the case of images of watching eyes, the functioning of relevant mental mechanisms will be affected by these evolutionarily novel stimuli despite propositional knowledge that they are inanimate, producing input that interferes with the process of forming new cognitive representations of the deceased. Thus, frequently viewing realistic photographs of the deceased is likely to be a perpetuating factor in the experience of false recognitions, and hence this behavior will positively correlate with such experiences.

Interactions between attachment, image-viewing behavior, and time elapsed

Thus far, we have outlined the predicted individual relationships between attachment level, elapsed time since the onset of bereavement, and viewing behavior on the extent of false recognitions, a cognitive symptom of grief. However, if we are to fully test the core predictions generated by our hypothesis, we must also consider the possible relationships of these three factors to each other.

First, we expect attachment level and frequency of viewing behavior to be positively correlated. As we have outlined, those highly attached are likely to be more motivated to seek out cues of the deceased. Thus, they are more likely to engage in viewing images of the

deceased, when alive. We do not, however, expect attachment to perfectly correlate with the frequency of viewing images. Bereavement research has shown that while the majority of those highly attached to their deceased loved ones are more likely to engage in ‘searching behaviors’ (which we presume, here, would include revisiting photographs of them when alive), a significant minority avoid all reminders of the deceased – including viewing photographic images of them (see Archer and Winchester, 1994; Freed et al., 2009).

Second, as we have outlined, elapsed time is a proxy for the probability of reunion, and thus engaging in reunion-seeking behaviors becomes increasingly maladaptive as time passes. Correspondingly, we expect a negative correlation between time and the frequency of revisiting reminders of the deceased, including images. Likewise, to the extent that transitioning from hypervigilance to disengagement occurs over time, the passage of time should be negatively correlated with attachment level.

Predictions

To summarize the above discussion, our core predictions concerning the relationships between the predictor variables (frequency of viewing images, attachment, time elapsed) and the key outcome variable (false recognitions) are as follows:

1. Level of attachment will positively correlate with the extent of false recognitions.
2. The frequency of viewing images will positively correlate with the extent of false recognitions.
3. Time elapsed since the onset of bereavement will negatively correlate with the extent of false recognitions.

Our secondary predictions concerning the relationships between the predictor variables (frequency of viewing images, attachment, time elapsed) are as follows:

4. Attachment level and frequency of viewing behavior will be positively correlated.
5. Time elapsed since the onset of bereavement will negatively correlate with the frequency of viewing images.
6. Time elapsed since the onset of bereavement will negatively correlate with attachment level.

It is important to note that, while our theory proposes a causal relationship between the key predictor and outcome variables, our predictions concern only the associations between these variables, due to the naturalistic methodology we employ. While an association in the predicted direction is necessarily part of the causal story we propose, of course, correlation does not equal causation. In this paper, we make a preliminary contribution to the testing of the causal claims by focusing on the correlations; namely, the effect of viewing photographs of the deceased, when alive, on the extent of false recognitions up to 24 months after the death of a loved one using a survey of bereaved pet owners. We address this limitation in more detail in the discussion section.

Pet loss

Cultural beliefs and practices shape exposure to dying individuals, the preparation of the remains of the deceased, interactions with the remains, representation of the deceased in the afterlife, and exposure to photographs and films of the deceased. Likewise, beliefs and

practices also influence both the expression of grief and the appropriateness of death, dying, and grief as topics of discussion (see Rosenblatt, 1993). Compounding these complexities, these factors likely covary with hospice and funerary practices (see Walter, 2005). As a consequence of these considerations, it may well prove difficult to tease out the independent effects of exposure to different types of stimuli on the frequency of false recognitions predicted by the above framework. Accordingly, the present enterprise is best served by sidestepping these matters to the extent possible.

Bereavement following the death of a beloved pet offers a pragmatic solution to the above methodological problem. Approximately 62% of U.S. households own a pet (McConnell, Brown, Shoda, Stayton, and Martin, 2011), around 70% of owners carry a photograph of their pet on their person (Archer, 1997), and many report mistaking sights and sounds for their deceased pet during bereavement (Weisman, 1990). Archer (1997) argues that pets can be understood as exploiting human responses that evolved to facilitate human relationships, primarily (but not exclusively) those between parent and child. While accepting this general framework, we would temper it somewhat by noting the long history of mutualism between humans and domesticated animals (dogs being perhaps the paramount case), suggesting a degree of mutualistic co-evolution rather than simply unidirectional parasitism (see Serpell, 1996). Although there are substantial differences between human-human and human-companion-animal relationships, what is important for the present study is the extent to which both the investment process and the grief response are similar in both relationship types. A wealth of research supports the claim that these two processes are remarkably similar, and, accordingly, much clinical research on bereavement uses pet loss as a proxy for human grief. Specifically, people form strong attachments to their pets, such that the death of a pet can elicit a grief response similar to that experienced following the loss of a family member (Clements, Benasutti, and Carmone, 2003).

Despite this, at least at the national level, Western culture does not contain any normative practices concerning the death of a pet, nor are there any mores concerning discussion of this topic; indeed, the absence of both institutionalized practices and explicit recognition of the impact of pet death on pet owners constitutes a positive affordance from the perspective of research, as, lacking other avenues with which to manage their distress, many bereaved owners express a desire to share their experiences with others, as evidenced by pet loss forums and virtual pet cemeteries on the Internet.

Methods

Participants

Volunteers for an unpaid online survey on experiences associated with the death of a pet were recruited through pet loss websites and forums (87%), and via flyers displayed in waiting areas in veterinary practices in Belfast and Los Angeles (13%). Two hundred and forty-seven individuals participated; 83 participants were excluded because they failed to complete the online survey or did not meet the minimum criteria (were below the age of 18, resided in a country other than the U.S. or U.K., had owned their pet for less than 6 years, had owned a pet other than a cat or dog, did not regard their pet as a ‘companion animal’, had lost their pet more than 24 months prior to participation or did not have any photographs of their pet). This left a sample of 164 bereaved pet owners (133 female, 31 male; age range

18–67, mean age 35); most participants lived in the United States (72%; United Kingdom, 28%). See Table 1 for participant descriptive information.

Materials

The survey was created using the platform SurveyMonkey. Survey items addressed demographic information about the participants and their pet, and the circumstances surrounding their pet's death. All participants included in the study possessed photographs of their pet that were taken when the pet was alive. Participants were asked whether, and how often, they viewed these images after their pet's death (on a 5 point scale: *daily, weekly, monthly, on special occasions, never*). Participants also completed the 23-item Lexington Attachment to Pets Scale (LAPS; Johnson, Garrity, and Stallones, 1992), responding to items on a 4-point scale (ranging from *definitely applies to me* to *definitely does not apply to me*) that measures emotional attachment to a pet, with a higher score denoting a higher level of subjective attachment; this scale has high internal validity and is the most popular questionnaire amongst clinical researchers for the assessment of pet attachment.

There is no standardized questionnaire that measures false recognitions exclusively. Researchers have included individual items in previous questionnaires that address aspects of our dependent variable, i.e., false recognitions – such as yearning for reunion and searching behaviors. Therefore, we used a combination of pre-existing items and novel items designed to measure false recognitions (see Appendix 1). Specifically, we assessed false recognitions using six statements addressing the extent to which, in the past two weeks, participants had interpreted ambiguous stimuli (e.g., sights, sounds) as the deceased pet. Items addressed experiences such as often believing that one saw or heard the pet, and often mistaking another pet for one's own. Three items were taken directly from the 29-item Pet Loss Questionnaire (PLQ) developed by Archer and Winchester (1994). To increase breadth, we added three novel items. Following the PLQ, participants responded using a 3-point scale, ranging from *applies to me* to *does not apply to me* (see Appendix 1). A higher score on the scale denotes the frequent experience of misperceiving stimuli as being caused by the deceased pet in multiple modalities (e.g., sight, sound). Although we did not measure the frequency of such experiences directly, agreement that experiences often happened was taken as a proxy for a high degree of multiple instances of false recognitions (e.g., sights, sounds, etc). Our six-item scale, which we term the False Recognition Questionnaire, has excellent internal consistency (Cronbach's alpha coefficient .92).

Results

Demographics

All participants had lost a pet through death within 24 months of completing the survey (study criteria). Most participants (100, or 61%) had lost their pet between 3 and 12 months prior to participation, and 64 participants (39%) had lost their pet between 13 and 24 months in the past. One hundred and seven participants (65%) had lost a dog and 57 participants (35%) had lost a cat.

Viewing images of pet

All participants possessed photographs of their pet taken before its death (study

criteria). Sufficient variance in the key independent variable existed for us to test our core prediction: while slightly more than half of the participants (95, 58%) viewed these images frequently – ranging from daily to weekly basis, many participants (70, 42%) viewed them infrequently or not at all – ranging from monthly, to special occasions, to yearly.

Lexington Attachment to Pets Scale

The maximum possible score on the LAPS is 69. Among U.S. pet owners in general, the average score is 45. The scale is more adept at measuring strong pet attachment because the majority of the items are indicators of intense attachment (Johnson et al., 1992); hence a score of 45 indicates a strong attachment to the pet. Participants’ scores on the LAPS questionnaire varied greatly (19-69), with a normal distribution of scores, but most participants were very strongly attached to their pet ($M = 52, SD = 11$). This is likely to have been a result of targeting participants via pet loss forums and websites, as individuals who frequent such sites are likely to have had strong emotional ties to their pets. Given that we employ bereavement in the context of pet death as a model system for bereavement in the context of human death, this bias is an asset, as it makes the sample more comparative to human loss in terms of attachment levels.

False Recognition Questionnaire

The maximum possible score on the False Recognition Questionnaire, assessing the extent of false recognitions, is 18. Scores on the False Recognition Questionnaire ranged between 6 and 18 ($M = 10, SD = 4$, with a normal distribution of scores). This suggests that many participants experienced false recognitions up to 24 months following their pet’s death.

Table 1. Participant related descriptive statistics ($n = 164$)

Variable	<i>n</i>	%
Sex		
Male	31	19
Female	133	81
Age		
18-40	73	45
41-67	91	55
Country of Residence		
USA	118	72
UK	46	28
Type of Pet that Died		
Dog	107	65
Cat	57	35
Months since Pet’s Death		
0-12	100	61
13-24	64	39
Frequency of viewing images		
Frequent	95	58
Infrequent/none	70	42

Statistical analyses

We first conducted tests for associations and relationships between the outcome and predictor variables using Pearson's r . Correlation coefficients were computed for continuous and categorical variables (categorical variables were dichotomized as displayed in Table 1). Important predictor variables were level of attachment, frequency of viewing images, and time.

Relationships between predictor and outcome variable

As Table 2 shows, several variables correlated significantly with scores on the False Recognition Questionnaire, and all relationships were moderate. As per Prediction 1, there was a positive correlation between attachment level, $r(162) = .357, p < .01$ and false recognition scores, $r(162) = .331, p < .01$. There was also a significant positive correlation between the frequency of viewing images and false recognition scores, $r(162) = .331, p < .01$, confirming Prediction 2. Time elapsed since pet's death was significantly negatively correlated with false recognition scores, $r(162) = -.199, p < .05$, confirming Prediction 3.

Relationships between predictor variables

In line with our secondary predictions, there were significant correlations between the three main predictor variables. As per Prediction 4, there was a moderate positive correlation between attachment scores and frequency of viewing images, $r(162) = .393, p < .01$. There was also a negative correlation between time elapsed and frequency of viewing images, $r(162) = -.260, p < .01$, and a negative correlation between time elapsed and attachment scores, $r(162) = -.213, p < .01$, supporting Predictions 5 and 6.

Multiple regression analyses

We examined the extent to which variance in scores on the False Recognition Questionnaire was predicted by a) frequency of viewing images, b) elapsed time since pet's death, and c) the level of attachment to pet. Multiple regression was used to analyze the contribution of each of the three variables to false recognition scores and to weigh the accuracy with which the frequency of viewing images predicts false recognition scores relative to the contributions of attachment and elapsed time.

Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity, and homoscedasticity. Using the enter method, a significant model emerged [$F(3), 160 = 11.977$], $p < .05$. Adjusted $R^2 = .168$. The total variance explained by the model was 16.8%. The frequency of viewing images made the strongest unique contribution ($\beta = .539$), which was statistically significant ($p < .01$); frequency of viewing images of the pet predicted higher false recognitions scores. The LAPS score also made a unique, albeit smaller, contribution ($\beta = .082$), which was statistically significant ($p < .01$); specifically, higher attachment scores predicted higher false recognitions scores. Time elapsed since pet's death was not a significant independent predictor of false recognitions scores ($\beta = -.040, p = .201$). Although the correlations among predictor variables were moderate, given the importance of the relationship between these to our account, we conducted collinearity diagnostics. Results suggested that there was no problem with collinearity in the data (all VIF levels were low, < 2.0).

Table 2. Correlation matrix of predictor and outcome study variables

	Sex	Age	Country	Pet Type	Time	FreqImages	LAPS	FRQ
Sex	1							
Age	-.133	1						
Country	.024	-.044	1					
Pet	.091	-.024	.086	1				
Time	.024	-.073	-.065	-.173*	1			
Images	.056	.151	-.065	-.173*	-.260**	1		
LAPS	.140	.077	-.054	-.111	-.213**	.393**	1	
FRQ	.080	.052	-.100	-.046	-.199*	.331**	.357**	1
Mean	1.81	34.98	1.56	1.35	10.78	.57	51.79	9.95
SD	.393	13.44	.901	.478	8.45	.496	10.83	3.59

** Correlation is significant at 0.01

* Correlation is significant at 0.05

Discussion

We have offered an evolutionary cognitive account of grief that reconciles previous accounts and disaggregates the main symptoms into evolutionarily meaningful subtypes, allowing us to begin investigating their postulated functions. We argue that distinct mechanisms have evolved that, on the one hand, promote reunion with the lost agent, and, on the other, when reunion is not possible, promote disengagement with the lost agent and reorientation to a new status without the agent. With this as an overarching theoretical framework, we investigated the functioning of one discrete cognitive mechanism—agent detection—that becomes heightened when an agent is lost, and serves, in this context, to determine whether a specific agent is in the vicinity and, therefore, still a viable relationship partner. We hypothesized that this agent detection hyperactivity leads to a commonly reported experience in those recently bereaved, namely that of misinterpreting ambiguous stimuli (sights, sounds) as having been caused by the deceased agent, a phenomenon that we term false recognition. We proposed that the frequency of false recognitions is an indication of the extent to which the mechanisms designed to promote disengagement with the lost agent and reorientation to a life without them have yet to be fully activated. In short, the continued presence of false recognitions is an index that a principal transition in the bereavement process, from the operation of reunification mechanisms to the operation of reorientation mechanisms, has yet to be achieved.

We sought to investigate the factors that affect the functioning of the agent-detection mechanism, enhancing or diminishing the experience of false recognitions, and thus potentially retarding the grief process. Using bereavement following the death of a pet as a model system, we examined three variables: attachment (a subjective proxy for relationship commitment/value), the frequency of viewing photographic images depicting the deceased while alive, and the time elapsed since the death of the deceased.

Attachment to the pet, frequency of viewing images of the pet, and the recency of the pet's death all positively predicted the frequency of the experience of false recognitions. Despite the complexity of the relationships between the variables examined, the strongest predictor of false recognition was the frequency of viewing photographs of the deceased. Viewing behavior made the largest unique contribution, such that level of attachment and time elapsed since death could be removed and this factor would still accurately, and

independently, predict scores on the false recognition questionnaire. This pattern is consonant with our premise that photographic images, being evolutionarily novel, are in part processed as veridical, serving as a cue that the bereaved is in the vicinity, and thus perpetuating the experience of false positive responses to more ambiguous stimuli. Further research is needed to examine the discrete effects of realistic images as compared to the influence on false recognitions of exposure to other reminders of the deceased or estranged agents (e.g., clothing, smells).

Limitations and future directions

To our knowledge, this is the first study to investigate false recognitions as a cognitive component of the grief process and the determinants thereof. Likewise, to our knowledge, this is the first study to explore the effects on the bereaved of viewing photographic images of the deceased. For a number of reasons, our findings should be considered preliminary. Some of the limitations of this study are characteristic of bereavement research in general, and these are difficult to overcome in naturalistic studies (Stroebe, Stroebe, and Hansson, 1993). In addition to the use of pet loss as a model system, such limitations include using questionnaire methods that necessarily constrain our ability to understand the direction of causality. We have provided evidence for associations that may not be caused by our predictor variables in the hypothesized direction. For example, absent detailed chronologies, we cannot rule out the possibility that false recognitions cause the bereaved to seek out reminders of the deceased, leading to increased viewing of photographs. Future experimental research could begin to tease these apart by, for example, manipulating the amount of exposure to photographs and other cues of estranged agents while controlling or accounting for other variables.

Further, our sample is not representative of the general population of bereaved pet owners. It was limited to bereaved individuals in complex, English-speaking societies who have access to the Internet, many of whom were actively searching for opportunities to communicate with others about their loss, and who, correspondingly, were more attached to their pets than the general bereaved population. Such individuals may well have been drawn to seek out reminders of their deceased pets. Thus, perhaps we have missed an important section of the community who are highly attached and yet avoidant of reminders.

Following the precedent of prior instruments from which it was derived, our False Recognition Questionnaire employed self-reported agreement (i.e., *strongly applies to me*) in a range of situations depicting false recognitions (e.g., *sometimes, I hear my pet*). We did not, therefore, measure the exact frequency of false recognitions. Additionally, we did not measure situational variables that could have been accounted for, such as the extent to which the bereaved individual kept photos of the pet on display prior to the pet's death (making subsequent viewing of photographs a matter of habit rather than an outgrowth of grief), as well as features of the environment (e.g., the presence of other animals, etc.) likely to shape exposure to ambiguous stimuli.

The experience of false recognitions has largely been overlooked in the conventional grief literature. This may reflect a Western cultural bias where these types of experiences are stigmatized as abnormal despite evidence that they occur frequently during bereavement. Such stigma is likely culturally parochial (see, for example Yamamoto, Okonogi, Iwasaki, and Yoshimura, 1969, on bereavement in Japan), and thus cross-cultural research may allow

for more direct study of false recognition in the context of human, rather than pet, death.

Our theory of grief incorporates the tenets of the reunion theory. Correspondingly, we expect false recognition to occur during grief following the loss of a relationship for reasons other than death. For example, non-acrimonious dissolution of a romantic relationship or the extended separation of the parties (e.g., military families, etc.) should be accompanied by a yearning for reunion, with a corresponding increase in false recognitions. We expect this pattern to be exacerbated by frequently viewing images of the departed agent, and to cease when the individual returns.

Implications of our research

Although our findings should be considered preliminary, nonetheless, they provide reason for caution with regard to the clinical recommendation for the recently bereaved to revisit mementos (especially photographs) of the deceased when they experience yearning for reunion. Bereavement clinicians have actively prescribed such actions under a new paradigm that encourages ‘continuing bonds’ with the deceased (Klass, Silverman, and Nickman, 1996), despite what is, at best, only equivocal evidence that this has a positive effect on overall grief outcomes (Stroebe, Abakoumkin, Storebe, and Schut, 2011; Stroebe and Schut, 2005). Frequently revisiting mementos and viewing photographs of the deceased may indeed provide immediate reward, as neurobiological research suggests that this may activate dopamine release and therefore temporarily enhance feelings of well-being (Freed and Mann, 2007). However, our research suggests that such actions may delay the transition from a grief phase characterized by a yearning for reunion to a phase characterized by disengaging from representations of the deceased as a viable relationship partner, and reorientation to a new status that does not involve the lost agent but includes new relationships with the living. More than a century ago, Freud (1914/1951) fiercely argued for the removal of reminders of the deceased in order for the bereaved to successfully detach. Despite the profound problems with many aspects of his model of the mind, it appears that, in this instance, Freud may have been right after all.

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Appendix 1. False recognition questionnaire

The following questions refer to your thoughts and within the last two weeks.

	Applies to me	Slightly applies to me	Does not apply to me
At certain times, the image of my pet seems so strong that (even for a split second) I believed that I had seen or heard him or her in their usual place*.			
I have found certain habits hard to break (e.g., I have begun to feed my pet or call out to him or her)*.			
Sometimes I hear a sound and mistake it for my pet.			
Sometimes, for a moment, I mistake another pet for my pet.			
I sometimes feel the urge to look for my pet before realizing it is pointless*.			
Sometimes, I feel that the image of my pet is so strong that it seems he or she is alive.			

*Items taken from Pet Loss Questionnaire (Archer and Winchester, 1994)