INTRODUCTION

In Mourning and Melancholia, Freud proposed a model of the grieving process that involved de-cathecting, or emotionally “neutralizing”, individual memories of the deceased. Contemporary psychiatry has abandoned these ideas as anachronistic folk psychology rooted in the metaphysics prevalent during the Nineteenth Century. Meanwhile, contemporary evidence-based treatments of complicated grief (CG) have taken a cognitive behavioral therapy (CBT) approach, which are empirically effective but lack a strong conceptual foundation. Here we apply contemporary models of learning theory in conjunction with decision theory (DT) and game theory (GT) to bridge these seemingly incommensurate approaches to understanding the grieving process. Our first model takes a reward learning approach to understanding attachment formation and its mirror image: the grief reaction to loss. This model captures elements of both Freudian and contemporary theories of grief. It sees the grieving process as looking backward and forward simultaneously. Looking forward it serves as a series exposure / habituation exercises that allows for a re-attribution that transforms the expectations of negative utility for future experiences into more tolerable experiences. Looking back, it allows for piecewise detachment from the totality of the relationship.

In our second model, one agent, The Future Self (FS), seeks to restructure her life by returning to herself as the independent agent that preceded the relationship. The other agent, the ghost (G) plays a denial position and attempts to hold on to the relationship. We show that under certain circumstances this model can lead to a prisoner’s dilemma-like game which manifests as the trap of CG.

Freud pioneered the concept of using psychopathology to understand normal psychic phenomena – in today’s engineering terms, this amounts to looking at failure modes to understand the structure and function of a mechanism. Interestingly, little has been done to link the Psychoanalytic observations of the grief process to the Biology of attachment and separation. Using contemporary cognitive/information-processing approaches in conjunction with DT & GT allows us to present two models - both of which bridge Freud’s phenomenal observations to contemporary cognitive schema. These models postulate that Complicated Grief arises either from a failure to decompose the relationship into manageable episodic memories or an incapacity to coordinate the transformation of the competing internal identities / agents.

REWARD LEARNING MODEL

Our first model takes a reward learning approach to understanding attachment formation and its mirror image, the grief reaction to loss. This model captures elements of both Freudian and contemporary theories of grief. It sees the grieving process as looking backward and forward simultaneously. Looking forward, towards future experiences, serves as a series of exposure / habituation exercises that allows the bereaved to transform their negative utility expectations for future experiences. Looking back allows for piecewise detachment from the totality of the relationship.

In our first model, a single bereaved agent struggles to deal with the loss of their partner. We postulate that this loss actually has two separate phenomenological manifestations. First, due to previous reward-learning around specific experiences shared with the deceased, there exists a negative expectation for each of these particular experiences in the future. Secondly, there is an emergent, generalized loss across all shared experiences after the death, which is the more commonly described aspect of grief and “attachment” loss. We refer to this model as the Zipper Theory of attachment and loss. Zippers attach only one tooth at a time, but through this piecewise process, an emergent bond forms.

Attribute Extraction & Reward Learning for Occasions and Relationships

Characterize the consumptive utility (CU(O)) of an occasion J as a function from an N-vector of attributes into R:
CU(O_j) = CU(A_{1j}, A_{2j}, ... A_{nj}), where A_{ij} is the i'th attribute of occasion J

e.g. CU(Tom’s Restaurant) = CU(cuisine_{Tom}, location_{Tom}, music_{Tom}, size_{Tom})

After reward learning, an agent has an Expected utility for an Occasion: EU(O_j)

In relationship formation, the occasion J that is shared with Ryan has an additional attribute, and if Ryan adds to the experience J: CU(R_j, A_{1j}, A_{2j}, ... A_{nj}) > CU(A_{1j}, A_{2j}, ... A_{nj}), and after awhile ...

EU(R_j, A_{1j}, A_{2j}, ... A_{nj}) > EU(A_{1j}, A_{2j}, ... A_{nj}), Also denoted EU(R_j, O_j) > EU(O_j)

Reciprocity and Reflected Utility in Relationships

Forming a reciprocal relationships involves learning that you enjoy something more if the other person is present, but also if the other person is enjoying it. We term this Reflected Utility and hence total utility is: EU_{Sally}(R_j, O_j) + r EU_{Ryan}(S_j, O_j), where r is a weighting factor of reciprocal (altruistic) utility and S_j is the original agent Sally at the occasion J. Thus the value of the relationship is greater than the expected sum of Ryan-enhanced occasions: \sum_j [EU(R_j, O_j)]

Absence Makes the Heart Grow Fonder: Expected Utility Gap

If this person is not able to attend occasion J now experience a gap

\Delta EU_{Sally}(O_j) = EU_{Sally}(O_j) - EU_{Sally}(R_j, O_j) - r EU_{Ryan}(S_j, O_j)

If person P dies, however then any experience in which that person was expected provokes an anticipated CUMULATIVE utility loss composed of ALL future utility gaps which is an overwhelming loss given by The Grief Equation:

\sum_i \Delta EU_{Sally}(O_j) = \sum_j [EU_{Sally}(O_j) - EU_{Sally}(R_j, O_j) - r EU_{Ryan}(S_j, O_j)]

Note the similarity to Generalization of Fear Learning in PTSD, as the agent generalizes over all future Occasions.

Discretizing Grief to Counter Generalization

After death, two things occur: Loss of person/relationship and loss of enjoyment (utility) for anticipated future experiences. To adapt, the agent must use Context-specific Habituation to the Loss. In other words, the agent partitions the loss by context or ‘occasion’. Loosely speaking, this reverses the reward learning process. At first we only deal with individual occasions, and avoid summing over them in considering the loss. Instead, we gradually habituate to the expected gap and, by repeated exposures, we ‘extinguish’ the anguish over a single occasion (similar to extinction in fear learning). Secondly, doing this for enough different occasions allows us to un-zip the attachment at a more global level.

Thus at the N'th exposure we might have the expected utility gap diminished to:

Gap = EU_{Sally}(O_j) - f(n) [EU_{Sally}(R_j, O_j) - r EU_{Ryan}(S_j, O_j)] Where f(n) <1 and is strictly decreasing in n

Decathexis as Contextualized Exposure, Habituation and Reconsolidation

PAST Exposure to Past Memories in this context allow for a letting go of the PAST and the RELATIONSHIP. The Exposure to / Reconsolidation of past memories allows us to let go of the PERSON /RELATIONSHIP piece-by-piece (e.g. Ryan at the movies, Ryan at home, etc - “context by context”)

FUTURE Imaginal exposure to context without Ryan’s presence allows change anticipation of the occasions in future helping us to habituate us to the context specific situations so that the expected situation matches the future reality (allows \Delta UE to approach 0). Here we reclaim the FUTURE by habituating to the new world piece by piece (“context by context”). Thus, Freud was right in his observation. It is necessary to confront the loss incrementally.
This reward learning model is consistent with the need for social animals to have evolved a grief algorithm with these basic features. CG may thus result from an impaired ability to use this natural algorithm that normally promotes healthy grief by failing to contextualize each occasion and thus detach it from all other occasions and decompose the relationship into manageable episodic memories. This is congruent with literature indicating that PTSD is associated with failures of contextual fear learning and extinction.

**Game Theory Modeling approach**

As in all games, there are two or more agents. However, in our case there is just one individual, along with asymmetric information. The Future Self (FS) seeks to restructure her life by returning to herself as the independent agent that preceded the relationship. The other agent, the ghost (G) plays a denial position and attempts to hold on to the relationship, with a “haunting” response to the surviving Agent.

The first player decides whether to confront her life as an individual, to choose to live as Future Self (FS) or avoid the confrontation. The second player is the ghost of deceased and decides whether to haunt, that is – to demand being remembered on all new occasions, OR to let go and suffer the sense that the loss of the relationship is of insignificant importance to FS.

**Analysis of Utilities:**

Player 1 (FS):

0 : Player 1 confronts the loss (e.g. goes to the restaurant) and is still haunted by the loss. (*worst outcome*)

2 : Player 1 doesn’t confront the loss (e.g. does not go to the restaurant) but is still haunted by the loss.

3 : Player 1 confronts the loss but is not haunted by it.

4 : Player 1 doesn’t confront the loss and is also not haunted by the ghost (*best, but most unrealistic outcome*).

Player 2 (Ghost):

0 : Player 2 chooses not to haunt while player 1 doesn’t confront the loss. Player 2 gets no “remembrance.” (*worst outcome*)

2 : Player 2 chooses to haunt the surviving agent, but player 1 still does not confront the loss. Player 2 gets some form of remembrance but not as potent compared to player 1 actively confronting loss.

3 : Player 2 lets go of the surviving agent, but still achieves remembrance via Player 1 actively confronting the loss.

4 : Player 2 haunts the surviving agent while Player 1 confronts the loss. Player 2 gets remembrance in the present and does not relinquish future opportunities for remembrance.

**Implications for Future Directions in Psychiatry**

Psychiatry is a relatively young science that is complicated by inherent subjectivity. Our initial goal in developing these models was to reduce this subjectivity by translating descriptive psycho-pathology into well-defined and empirically measurable concepts.

Decision Science (DS) and Game Theory (GT) model how human agents metabolize and utilize reward/fear information efficiently in the service of reaching their (survival) goals (EDSC Theory, Flinn, 2005). Psychiatry can then be seen as a sub-discipline of DS and GT which focuses on ‘failure modes’. These approaches have been largely ignored in psychiatric research until recently because both the mathematical/computational approach and any rationalist modeling were seen as incapable of explaining the “irrational/emotional” phenomena of psychiatric interest.

Correctly understood, DS and GT can improve modeling in psychiatry and provide a conceptual bridge to various topics that exist at the interface of Rational Choice Theory, Agency Theory, and Philosophy of Mind.
Bibliography

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