Daydreaming with Intention: Scalable Blending-Based Imagining and Agency in Generative Interactive Narrative

[keywords]: intentionality, narrative imagination, and conceptual blending

Daydreaming is a creative human capacity to construct and run imaginative concepts through the mind in parallel with perception and awareness of the real world. Such experiences can be described in recent cognitive science terms as cases of "mirror network" or "double-scope" conceptual blending, the mental processes of integrating and dynamically executing concepts with shared or clashing underlying frames. [4, 12] In this paper, we present a system that generates sequences of blends as causal trails of association with the goal of producing aesthetic and creative daydreaming-like experiences for users in computational (generative and interactive) narrative applications such as described in [7-10]. Our system draws upon the framework of [10], which identifies, formalizes, and implements an algorithm for structural aspects of conceptual blending with applications to computational narrative. Conceived as a critical technical practice [1], and acknowledging cognitive linguistics critiques of computational approaches to cognitive modeling [2, 11], we view this work not an attempt to reduce daydreaming or creativity to a formal algorithmic process, but as developing systematic constraints based on empirical research on human conceptual blending and generating output collaboratively with users that can be perceived and narrated as daydreaming phenomena.

Our goal is two-fold. (1) We explore blending-based creative imagining through the narrative experience of daydreaming. An algebraic formalization of conceptual blending theory serves as the basis for generating narrative content. (2) We highlight variable perception of our system's intentionality as a tool to support creativity. As argued in [1], narrating a system's functioning as intentional is essential in the practice of implementing AI systems that involve, for instance, the AI keyword "planning." We add that, in parallel with narration of intentionality, user perception of a system's intentionality is also central to conveying system behaviors such as "daydreaming" and "creativity." We implement regulation of our system's function on a continuous scale between highly user-controlled behaviors that seem to transparently reflect the user's intentions and highly autonomous and generative ones that exhibit situated "aboutness" regarding the system's agency within its domain of operation. The end result is a system developed for the aesthetic effect of a perceived scale of system intentionality, a feature also useful as a design tool in applications such as educational "intelligent" tutoring software that balances creative user problem solving with system recommendation.

Primary components of our daydreaming model include systems for: (1) concept generation, (2) discourse generation, and (3) avatar mediated interaction. We present our approach to (1) and (2) as novel technical contributions, and (3) as a novel application. Concept generation is accomplished by formalizing conceptual spaces as algebraic theories with additional structure, morphisms between these structures as structure preserving mappings of the constituents of these conceptual spaces, and the executing a conceptual blending algorithm upon such structures. [6, 10] The blending algorithm functions by accepting an input diagram consisting of a generic space **G**, two input spaces $\mathbf{I_1}$ and $\mathbf{I_2}$, and morphisms $\mathbf{G \rightarrow I_1}$ and $\mathbf{G \rightarrow I_2}$. The algorithm outputs a blended space **B**, and two morphisms $\mathbf{I_1 \rightarrow B}$ and $\mathbf{I_2 \rightarrow B}$, integrating conceptual spaces based upon structural principles such as degrees of commutativity, typecasting, and preservation of sorts (types) and constructors from the input spaces in the blended space. Given our approach, tuning and augmented these optimality principles is a central research problems in generating daydreaming narratives. Discourse structuring is accomplished using a "probabilistic bounded transition stack machine," an automaton that allows an author to create grammars for narratives with repeating and nested discourse elements, and that accept and process user input. Appropriate discourse structuring helps to maintain causal coherence between generated blends.

A variable scale of perceived system intentionality is achieved by increasing or decreasing the degree of avatar autonomy through adjusting the level of "daydreaming" activity and associated action. At the lowest level of perceived intention the avatar generates no "daydreams" and responds to all user commands, whereas at the highest it may engage in behaviors unprompted by the user but clearly interpretable on the basis of "daydreaming" output. E.g., the avatar may visit a location triggered by activating a relevant "daydream" rather than another location specified by the user. Our "daydreaming" system is a major component of a computational narrative project in which the opposition of user versus system intentionality and agency is of central critical and aesthetic concern. The computational narrative system described in [10] is being used to implement an initial text-based version of this project.

The subjective nature of creative processes such as daydreaming makes it difficult to establish objective criteria for evaluating the effectiveness of systems like ours. In this paper, we propose a cross-disciplinary approach for evaluation. Based upon relevant theory and a comparative survey of perceived daydreaming rendered in more established media such as literature and film, we demonstrate our system's relative achievement of narrative causality, coherence, and regulation of arbitrary conjunctions of concepts. In other words, our generated sequences of blends should "make narrative sense." As future work, we plan to use analogy-based reasoning models [5] (closely related to work in conceptual blending as described in [3]), such as in case-based reasoning algorithms, to modify and generate discourse structures dynamically during runtime.

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