Narratives as a Fundamental Component of Consciousness*

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Abstract

In this paper, we propose a conceptual architecture that models human (spatially-temporally-modally) cohesive narrative development using a computer representation of quale properties. Qualia are proposed to be the fundamental *cognitive* components humans use to generate cohesive narratives. The engineering approach is based on cognitively inspired technologies and incorporates the novel concept of quale representation for computation of primitive cognitive components of narrative. The ultimate objective of this research is to develop an architecture that emulates the human ability to generate cohesive narratives with incomplete or perturbated information.

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1 Introduction

Five decades of research in computational Artificial Intelligence (AI) have resulted in significant progress towards making our lives easier, safer and more interesting, but the state of AI technology is far from realizing the original vision that computers would by now be capable of *thinking* on par with humans over a broad range of subjects. For example, a computer model cannot reliably identify an enemy tank, isolate cancerous tissue in a mammogram or differentiate a computer virus from non-malicious code. Computer automated systems based on conventional approaches cannot account for situations that were not programmed in advance; a human is required to make a final determination. Humans can adapt to new situations and have the unique ability of 'gist' processing, which involves data compression for reasoning and making rational decisions in an environment of imprecision, incomplete information, uncertainty and partial truth [8, 3, 7]. We believe humans process information in terms of conscious narratives which allow us to generate a stable, consistent and useful representation of reality, hence, our interest in *advances in computational models of narrative*.

* The views expressed in this paper are those of the authors and do not reflect the official policy or position of the United States Air Force, the Department of Defense, or the US Government.

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This paper presents a computational architecture that emulates the human capability of identifying elements and solving problems with imprecise and incomplete information, interpreting stimuli qualitatively and operating with compressed data, or "gists" h[2].

Our contribution is two-fold. First, we propose to develop a computer representation that captures key *properties* of the fundamental cognitive component humans use to generate (spatially-temporally-modally) cohesive narratives, the quale (plural qualia).[1] Qualia are the primitive structures which provide cognitive imagery and emotions to narrative events. Clearly humans process information in a way that is different from traditional AI approaches, we therefore seek to model the properties of conscious experience which humans use to generate cohesive narratives.

Second, we propose an architecture designed to model narrative development and the process by which competing narratives are selected. The proposed architecture design consists of methodologies and technologies inspired by and designed to model human cognitive processes. This architecture consists of loosely-coupled layers, each implementing a unique function. The intended outcome is a framework that will overcome the problem of brittle AI systems and allow for a more robust and flexible architecture similar to the human ability to process with incomplete or perturbated information.

2 Overcoming Limitations of Current AI Approaches

Current AI approaches work in *data space*, aggregating large volumes of data to infer the general from the particular, i.e. inductive reasoning. Inductive systems are prone to be overly complicated, require a vast amount of data processing and cannot infer answers not previously programmed. Alternatively, humans reason in *event space*, by creating a cohesive narrative, a hypothetical explanation of observations. Narrative creation is an abductive process, an inference to a stable, consistent and useful explanation which accounts for goals and motivations. We posit that abductive reasoning, either alone or in conjunction with current AI approaches, will prove to be superior to current AI methods.

3 Computer Representation of Qualia Properties

Qualia are subjective, context-dependent internal representations of evoked experiences based on received or predicted sensor data [3]. Qualia provide the representation (mental-ease) through which all life forms generate a useful and consistent world model [8] and provide a cognitive structure to cohesive narratives. Our memories are not based on raw sensory input, but rather stored representations of qualia that were evoked by the sensory data, and we construct narratives based on the stored qualia [7]. This requires a method of manipulating qualia properties in memory and making sense out of the internal representation to represent the external world. Words in a human language are essentially labels used to communicate concepts which leads us to the potential of using Computing With Words (CWW) as a way to implement a qualia-property-based computational environment. CWW, which is based on fuzzy set theory and fuzzy logic, was developed to convert *concepts* from a cognitive format into a representation that could be processed computationally [16]. When humans lack full information they use narratives represented by words and propositional phrases to fill in the knowledge gap [9].

[1] Qualia are proposed as the fundamental *cognitive* component, not to be confused with proposed fundamental components of a narrative as proposed by Baikadi and Cardona-Rivers [1].

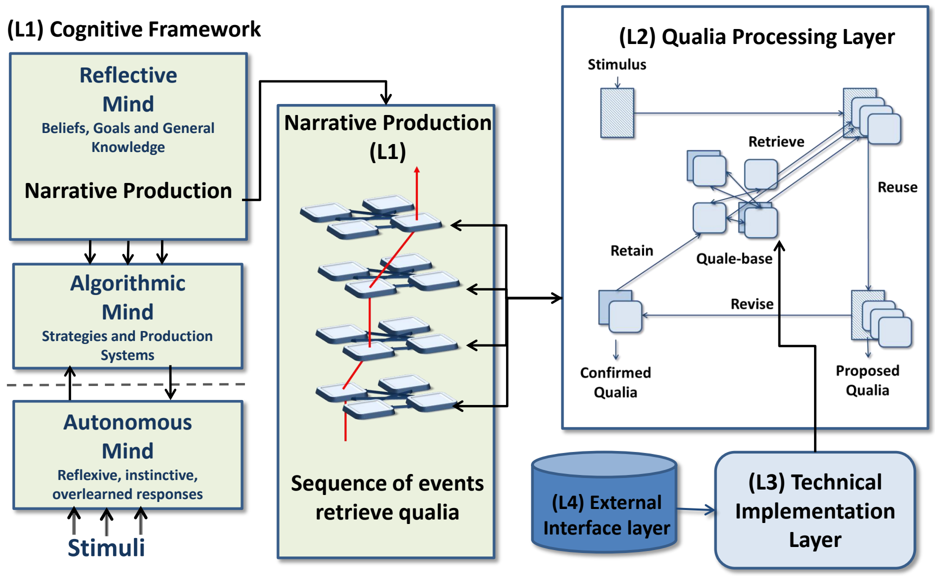

Figure 1 Cognitive Architecture [13, 14].

4 Architecture

The proposed architecture consists of four layers designed to emulate cognitive processes as shown in Figure 1. The highest layer of abstraction, L1, is a *framework* that implements the dual-process theory of higher cognition [13]. Narratives are generated within the *Reflective Mind*, one of three *minds* comprising the *framework*. Within the *reflective mind* we implement the *process layer*, L2, which stores, retrieves and updates the fundamental components internal to the framework used to create narratives. The *technical implementation* layer, L3, implements a technical solution for computer representation and calculations. An *external interface layer* (L4) connects to external entities and allows for the introduction of new concepts via a semantic network, such as ConceptNet, WordNet, and Lexipedia.

4.1 Cognitive Framework (L1)

The cognitive framework layer is based on the tripartite model of mind, which explains human cognition by the interaction of the three minds or cognitive levels [12, 13]:

- The *autonomous/reactive mind* is characterized by reactivity to external stimuli. Stimuli can be attended to reflexively, and can be passed to the reflective mind for conscious processing, at which point qualia are evoked.
- The *algorithmic mind* is responsible for cognitive control (sequencing behaviors and thoughts). Fluid intelligence is the general computational power of the algorithmic mind and is exemplified by the ability to sustain simulation and hypothetical thinking.
- The *reflective mind*, responsible for deliberative processing and rational behavior is characterized by sequentiality. It accesses general knowledge structures, personal opinions and beliefs and reflectively acquired goal structures; this is where spatially, temporally and modally cohesive narratives are generated. Qualia processing (L2) is one of many components of narrative development, and the component our research is addressing.

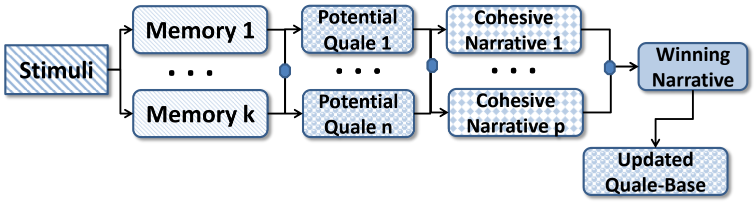

Figure 2 The Stimuli-Qualia Gap.

It is within the reflective mind that competing narratives are evaluated and the most plausible is selected. The methodologies required for this process are the primary areas of our research. Previous research [4, 5] describes an implementation of the tripartite model using agent based modeling techniques to simulate the processing of information within and across the three minds. We propose to extend this approach for our cognitive framework (L1).

4.2 Processing Layer (L2)

The *process layer* seeks to resolve the relationship between external stimuli and properties representing internally generated (evoked) qualia, known as the stimuli-qualia gap. We believe reasoning using quale-based representations will better emulate the human ability to perform gist processing. As shown in Figure 2, external stimuli generate memories that evoke qualia, which in turn generate one or more cohesive narratives (hypotheses). Humans select the most credible narrative and update their quale-base with new quale as appropriate. Case-based Reasoning (CBR) originated with research into how humans apply previously learned knowledge to new problems using previously solved situations [10, 15, 14]. CBR incorporates four activities in a continuous cycle of learning, or improvement [14]: retrieval of similar cases, reusing a solution suggested by a similar case, revising a solution to better fit a new problem, and retaining the new solution once it has been confirmed or validated.

4.3 Technical Implementation Layer (L3)

The technical implementation layer implements (in software) the generation, retrieval and processing of qualia properties to support cognitive simulation. It is within this layer that quale properties are processed using CWW as discussed earlier.

4.4 External Interface Layer (L4)

When the proposed architecture is initialized, it will have a starting knowledge base. Over time it will expand to new domains, and include new knowledge. To expand the knowledge base we propose the integration of external semantic networks, allowing the integration of new concepts and new stimuli-quale relationships. The initial semantic network being considered is ConceptNet, a crowdsourced database describing general, commonsense knowledge expressed in words. A concept is the fundamental unit represented, and concepts are related to one another [11, 6].

5 Conclusion and Future Work

This paper presented an approach for developing a cognitive architecture based on the novel concept of quale representation and modeling human cohesive narrative development. We posit the resulting implementation will lead to a methodology for improved decisions and greater Situational Awareness (SA).

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