

# Seismic Semantic Federation: The View from Machu Picchu

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## Abstract

Interoperability between ontologies is currently enabled by abstractions that standardize or bridge their compositional elements. This paper describes how geometric form will be used as a more flexible ontological abstraction, one that is capable of not only tolerating heterogeneity, but leveraging it. We exploit this capability to include a narratological mechanism – nested context – in our ontological design, drawing on structures explained in Bakhtin’s ‘dialogics’ of modern prose. It is expected that this mechanism will enable better representation and management of causal processes in our predictive intelligence system.

## Context

My mother grew up on a farm in remote Australia. Unlike her friends, she didn’t dream of raising cattle, owning a house, or even finding a husband. By the age of eight, she only wanted to see the Inca structures of Machu Picchu. We don’t know why this was her dream. I imagine her standing barefoot on cracked dirt, miles of dry paddock around her, the sole person in rural Queensland with Peruvian jungle on her mind.

By the time my mother reached the age of 50, the words “Machu Picchu” had come to refer to a place too wonderful and far away to reach. When she turned 53, I encouraged her to journey there with me. In Peru, on the first of a series of mountains that led to the sacred site, she developed such severe altitude sickness that a team of doctors spent a full day with us. I researched altitude sickness over a slow internet connection and learned that it was sometimes fatal.

It seemed as though we might have to abandon the trip. In serious cases, the only cure for altitude sickness was to return to sea level. But I also knew that if I didn’t take my mother to Machu Picchu, neither of us could bear what the words would come to mean.

## Nested Contexts

I was on the American continent – and therefore in a position to go to Peru – due to my attendance at the Intelligent Narrative Technologies symposium in 2007. At this forum, I introduced the foundational concepts for a system design, and this paper reports on the progress of that work. Earl Research is building a general parser for sensor streams called a Universal Watcher, and I am collaborating to construct a mind to sit behind it. The Watcher will be unique in that can interpret a range of media simultaneously: video feeds, raw synthetic aperture radar data, voice streams, documents, and web pages. It will be the eyes and ears of an intelligence system that leverages the ontological variety beneath that media.

In this paper, I will explain the narratological foundations for this work. Modern stories have an attribute particularly suited to modeling aspects of human phenomena that intelligence systems currently struggle to catch – nested contexts (Herman, 2006, p. 358). I will use Bakhtin’s notion of dialogical discourse to reveal the embedded logic(s) employed by stories, and then indicate how we will accommodate that diversity in a machine.

In this paper, the term ‘heterogeneous’ refers to concepts that conflict in terms of speaking position, context, and/or modes of representation. This definition is congruent with Bakhtin’s notion of heterogeneity (Bakhtin, 1981, p. 262-3) and that of ontological design (Visser, 1997, p. 165). When referring to a creative text, I use the term ‘story’ rather than ‘narrative.’ ‘Story’ refers to the abstract, conceptual space delineated by a tale, rather than events recounted, which is the usual association for the term ‘narrative’ (Herman, 2008, p. 347). I assume that stories can be comprised of conceptual, representational, stylistic as well as plot-driven elements. These combine to create “a cognitive construct that concerns certain types of entities and relations between these entities” (Herman, 2008, p. 347).

Stories are one of the ways that humans arrange heterogeneous information in order to extract causal logic (Cardier, 2007). In order to imitate aspects of this assembly in a digital context, I have modeled some of the constructive mechanisms that result in the artifact we think of as ‘story.’ Causal prediction depends on the way conceptual relations are built, so I turn to cognitive theories of narratology to flesh out my description. Turner argues that tales reflect the structure of human cognitive processes (Turner, 1996, p. 168). With this in mind, I draw on Boden’s model of creative cognitive process to inform my definition of story. She observes that:

...creativity occurs within a conceptual space, where much of what passes for creativity emerges from an exploration of this space, but where most dramatic forms of creativity necessitate a transformation of this space (Veale, Gervás and Pease, 2006, p 206).

In this paper, ‘story’ is modeled as a transformation, an assembly process that draws entities into specific relations in order to create – and represent – changing conceptual forms.

The technical context of this work is discussed in detail by a companion paper, ‘The Geometry of Social Anticipation’ (Goranson, 2009). I will only touch on existing methods of ontological semantic interoperability here, in order to indicate how narratological mechanisms distinguish our approach.

The effectiveness of a computerized ontology depends on its abstractions, because these are the avenues of functionality. Gruber defines ‘ontology’ as a conceptual infrastructure:

A conceptualization is an abstract, simplified view of the world that we wish to represent for some purpose...An ontology is an explicit specification of a conceptualization (Gruber, 1993, p. 199).

Visser notes that conflicting conceptual frameworks (at a number of levels) are responsible for poor interoperability between systems: the more closely a conceptualization fits a specific domain – the more conceptually ‘heterogeneous’ it is in relation to other systems – the less compatible it will be with them (Visser, 1997, p. 164). One method of preventing incompatibility has been to institute common standards, such as those of the Semantic Web (Orgun, 2008, p. 182). Another solution has been to develop bridging mechanisms, such as an intermediary lexicon that agents can use to communicate (Park, 2004, p. 598). Alternatively, overarching ontologies have been built, in an attempt to create one large enough to subsume the others, and this is also known as ‘federation’ (Park, 2004, p. 598). Li argues that, when faced with the problem of a growing and changing field, the best way to integrate ontologies is an agent-based approach (Li, 2008, p. 198).

At a finer level, current mappings among ontologies depend on a particular view of semantics. Ontological terms are often defined as linked semantic entities (Visser,

1997, p. 166; Kalfoglou, 2005, p. 6). It is usually assumed that different terms have been chosen to represent objects which, at a root level, exist in a reality that has an objective, knowable order (Firat, 2007, p. 48; Hu, 2008, p. 363). In these cases, transference between contexts is a matter of referring to a template that sufficiently captures the common reality.

This is the first of many ways that the term ‘context’ changes when shifted from a computing to a story domain. In computing, when two different contexts share a common underlying reality, integration is simply a matter of affirming similarity between equivalent semantics, or adding a node to account for new territory (Hakimpour, 2001, p. 298; Chen, 2009, p. 2769).

In the arts, each story brings a new underlying reality. If I substitute the words “physically different state” for “monstrous insect” in Kafka’s sentence, “*As Gregor Samsa awoke one morning from uneasy dreams he found himself transformed in his bed into a monstrous insect*” (Kafka, 1992, p. 76), I have not switched an equivalent semantic coin, instead I have plunged into a world of supernatural causal possibilities (Sokel, 2002, p. 157). Reconciling semantics from two different stories therefore depends on a more complex understanding the roles the terms play in their respective contexts. The information “cost of airfare” should have a different causal agency in a system that finds airfares compared with one that catalogues plane crashes. Even though an airfare price can exist in both conceptual worlds, there are not many scenarios in which an airfare determines the cause of a plane crash, whereas it is often responsible for which airfare is chosen.

Current systems still struggle even when dealing with basic semantic relationships. In the “standards” solution, information is shoehorned into a single field of representation, which can render a system inefficient due to the nuances lost (Visser, 1997, p. 164). Creating a fixed bridge is restrictive in a different way; if a term has meaning due to a pre-determined classification, re-contextualization is limited to static links (Li, 2008, p. 199). We use an intermediate language of form to serve in a manner that is part intermediary lexicon, part overarching ontology, but at the same time, is something different again. Iconic form has unique features that can make the capture of more complex structures possible. We use these features to import some of the causal mechanisms of story into our system.

## Irrelevant Detail

The doctors left the hotel, after describing the dangerous symptoms I should watch for while my mother slept. Over the next three days, I waited for her to wake long enough to ask whether she thought she should return to sea level. On the second evening I passed the time by watching a video with the hotel staff. The tape was for guests, a recording of *The Simpsons* in English. The locals laughed along with

the video even though they only partly understood the language, because the images were funny. In this episode, Homer Simpson faced death after a visit to a Japanese restaurant, because the apprentice chef hadn't learned how to cut a blowfish in a way that avoided the poison.

### Relevant Detail

The accepted structure for an essay like this one is based on formal logic, in which a good argument emerges when its conclusions follow directly from its premises:

A conclusion follows logically from a set of premises in [propositional logic] if there is proof of that conclusion from just those premises...(Tomassi, 1999, p. 45).

In a sound argument, the conclusion is derived from *just* the provided premises. Irrelevant information is not welcome in either logical or essay frameworks.

Aside from the information a logical system voluntarily eschews, there are limits to the knowledge that can be captured by it. Gödel's Incompleteness Theorem proved that formal axiomatic frameworks could not be both correct and complete (Chaitin, 2002, p. 166). Part of the problem is that, when phenomena are formally modeled, their representations develop their own phenomena, which can openly contradict the dynamics to which they refer (Hofstadter, 1979, p. 696). Law demonstrates that these inadequacies of logical method become critical when applied to the "tide, flux and unpredictability" of social systems (Law, 2004, p. 7). He points out that the fragment of information deemed 'irrelevant' might be crucial to the process under watch, its absence causing the formalism to be "distorted into clarity" (Law, 2004, p. 2). The concern for current military intelligence systems is that important aspects of the human world are passing through the sieve.

Stories offer a more flexible net. Bakhtin illustrates how novels draw together an array of speaking styles and positions into a coherent yet open-ended whole (Bakhtin, 1981, p. 7). In addition to the linear sequence embodied in plot, stories use a range of additional mechanisms to build structure. Devices such as analogy, repetition, naming, ambiguity, dialogue, style and headings combine with concepts to fashion multidimensional relationships. Analogy is a particularly agile device, a type of contextual frame that is capable of retroactively changing information, as well as making it open to unspecified links later on (Holyoak, 1995, p. 116). The property of being available for unrestricted future connections, yet retaining enough structure to convey meaning, is this paper's primary interest in relation to 'context.'

To implement the property of hidden and multiple connection in a machine, we employ special constructive logics, known as "linear" logics (Lehman, 2007). Linear logic is then extended using Situation Theory, which notates informational elements in a way that can feed both logical and analogical structures. In this work, a 'situation'

acts as a context that includes the structures needed for causal assembly. I pause to further define 'situation' here.

Devlin describes a 'situation' as a scope from which information is assembled through the attunements of an agent (Devlin, 1991, p. 15). Our definition is similar except in two respects. The first is that Devlin differentiates between situations and the agents that encounter them (Devlin, 1991, p. 30). In our system, an agent is always a situation, and vice versa. Each situation has a structural history that informs its scope, giving it the attunement and constraints of Devlin's agents.

Secondly, our situations are nested. Not only are our contexts more complex, but that machinery is given extra sophistication because it is embedded in other structures. Just like the range of voices in a story, contrary fragments do not invalidate the information presented. Instead they are its fabric, their contradictions defining a scope whilst becoming a signifier for it (Bakhtin, 1981, p. 262).

In daily life, it is easy to see how one fragment of information can change a situation, producing actions that are contrary to expectation. Identifying a process, such as a serious illness, instantly defines a new context. It can cause an important endeavor to be abandoned, turning it into a situation of retreat instead. But if that situation is nested within an additional frame, a different sort of agency might emerge, and a new trajectory be generated from it.

### Heterogeneous Assembly

The image of my mother as a child, standing on dry earth and thinking of jungles, informed the choices I made next. When she woke, her face grey from fluid loss, she told me that she was happy. She was grateful to finally be here, in a country she had imagined all her life. She wanted to continue her journey to Machu Picchu regardless of the consequences.

We stepped onto an unknown path. I discharged our guide and the tour group left us behind. I was given a list of the trains, towns and buses that were markers across the Andean plateau. We had no plan except for these names and a hand-drawn map to the nearest station. I arranged for my mother to be carried to the train on a motorbike because she couldn't walk unaided. Everything was negotiated using hand gestures. I bought local blankets to wrap around her, their weave covered in the symbols of mountain gods. We headed deeper into Peru.



## Heterogeneous Perspectives

Patterns on blankets, maps, physical gestures, dialogue, a photograph. When humans are forced to make a new situation, they reach for any useful fragments and assemble them. When they narrate a process, they do the same. Herman draws an equivalence between nested narrative and distributed intelligence, noting that the heterogeneity of multiple elements:

...increases the distributional reach of a framed tale, enhancing the overall power of the knowledge generating system to which it lends structure. (Herman, 2006, p. 357).

Heterogeneous perspectives increase the scope of the modeled situation. Some of the artifacts represented in the story about my mother retain traces of their original purpose, and they contribute some of those structures to the imagined situation. The dialogue, photo and blanket patterns carry residual meanings from other contexts. Although spatially and temporally scattered, they become clues as to what sort of assembly – and what sort of agency – we have encountered. The reader interprets these dispersed, heterogeneous informational artifacts as related because they share the same frame.

Bakhtin notes that storytelling has not always been process-orientated. Classical texts, such as Greek and Roman literature, spoke in a unified voice about events that were sealed in the past (Bakhtin, 1981, p. 4). By contrast, the younger genre of the novel reflected the range of speaking positions and stylistic textures that emerged from the “multitude of different languages, cultures and times” that collided in modern Europe (Bakhtin, 1981, p. 11). Unlike previous genres, novels were concerned with situations in transformation, and represented them through an array of perspectives and formats (Bakhtin, 1981, p. 112). With the advent of modern prose, authorial voice was no longer only the style in which a story was recounted. Instead it became the sum of the voices it could reproduce and the scope they inferred (Bakhtin, 1981, p. 314).

Nearly 40 years later, the heterogeneity of text has evolved. The genres that can participate in a “reading” now include video, email, text messages and games. Killoran, a theorist on the heteroglossia of the world wide web, believes Bakhtin would have approved of his ‘dialogics’ being applied to the digital domain, as well as “visual and multimodal discourses” (Killoran, 2005, p. 134). With such a wide variety of information types, the question of coherence is raised anew. What is the nature of the voice that can be made by the sum of these multiple tongues? What new information might it articulate, and how can we represent that on digital terms?

## Representing Heterogeneity

In its original context, an informational fragment “possesses its own belief system” (Bakhtin, 1981, p. 315). Once within an author’s frame, however, its perspective refracts through the new situation - the story:

The languages thus introduced into a novel may be either directly intentional or treated completely as objects, that is, deprived of any authorial intentions – not as a word that has been spoken, but as a word to be displayed, like a thing. But more often than not, these languages do refract, to one degree or another, authorial intentions (Bakhtin, 1981, p. 321).

In an intelligence system, both the representational medium and system must be as non-refracting as possible, whilst still being coherent enough to allow diverse elements to stand in relation to each other.

It should be noted that when I mention the authorial ‘frame,’ I am not referring to Minsky’s notion – Minsky’s frames are templates that depend on a prescription of what the encountered situation entails (Jahn, 1997, p. 442). This is different from our situations, which use story mechanisms to develop their relational structure. Nor do I use the term ‘frame’ in reference to a narrator. It would be possible to speak about a narrator in these terms, but I am interested in how a frame provides refraction, regardless of whether it manifests as a personified voice. When a perimeter is delineated, the elements within it relate on the same plane, in spite of their exotic sources. As a consequence, nested context is a remarkable device; when a situation is bounded, the distinction created between one context and another automatically unifies the elements that appear within each (Frow, 2005, p. 44). A frame is a unifying parameter.

An example of a writerly frame that causes minimal interference can be found in Mordue’s novel, *Dastgah: diary of a headtrip*. One chapter consists solely of quotations overheard in New York. Most of the 60 fragments are no more than 1-2 lines in length, and there is no plot or narrator that curates them:

“A square is less funky. A triangle is prettier.”

“I would assume part of the pressure you’re feeling is that you are two big guys and one dog in one very small apartment.”

“You are such a jerk. You are such a fucking jerk. We had a cab and we were going to have such a good time. You are a jerk. You are such a fucking jerk.”

(Mordue, 2001, p. 273-4)

Mordue’s depiction of New York consists of multiple keyholes into specific situations, each a verbatim record of voices that emerged from those contexts. When gathered into a single frame, they become components of definition for the space they were drawn from. The value of these representations is in their fidelity to the phenomena they stand for. When considered as a united entity, they reveal an aspect of New York’s specific heterogeneity more fully than a single voice could.

In our case, the medium of the frame – the unifying abstraction – is unusually important, in that it must capture as much detail as possible with minimal alteration of its components. To find this, we turned to cognitive science.

## Representational Form

Cognitively, humans cohere heterogeneous entities by translating their features into models. Studies performed by Johnson-Laird suggest that humans have a two-tiered process of heterogeneous comprehension, the first being ‘parsing,’ and the second being a synthesized model of the described situation:

First, utterances are translated into a mental code that provides a direct linguistic representation of them. (Johnson-Laird, 1981, p. 353).

This is our Watcher, which brings multiple media into the system. It categorizes the features of this raw input in real-time, preparing material for assembly by the ‘mind’:

Secondly, the linguistic code may be used as part of the basis for the inferential construction of a mental model of the state of affairs that the utterances describe (Johnson-Laird, 1981, p. 353).

This is the intelligent system associated with Watcher, which decomposes incoming elements into the state that is best able to retain the most information. For this we selected an abstraction that refracted least, regardless of the structures encountered. This mode has also been proven to be natural to cognition.

When a human is asked to consider situations comprised of heterogeneous elements, Johnson-Laird’s studies suggest that diagrammatic representations can be understood more quickly, as well as producing more accurate responses to related questions (Johnson-Laird, 2006, p. 144). Intuitively, this finding can be seen in everyday life – when two people don’t understand each other, eventually one will seize a pen and draw a diagram.

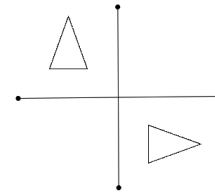
Johnson-Laird was steered towards diagrams by the work of Pierce, who also believed they were a desirable medium for modeling. Besides reduced refraction, there is an extra advantage to using form. Pierce noted that when images were iconic – when they had a structure that somehow imitated the thing they represented – a close inspection could reveal truths other than those used in their construction (Johnson-Laird, 2006, p. 22). Not only are iconic diagrams a good translation media, as they capture much original information, but sometimes they are even able to represent more than what was initially stated.

The intermediary that provides cohesion in our system will be a specific, iconic grammar designed to capture narrative information as situations. In some respects this performs a similar role to an ‘intermediary lexicon’ but as this is not its only function, we do not classify it this way. The specifics of our form mechanisms are not covered by this paper, but the work is being jointly developed with Ryuji Takaki, from the Japanese Society for the Study of Form. In practical terms, it is a geometric characterization of the structure of semantic knowledge units. When two forms come together, they define the corners of new situation, their combined shape becoming the revised context and creating local relational structures in the same

way that analogy does (Kurtz, 2001, p. 421). Form will allow us to store what is known about a situation in rich detail. Using geometry, we can then assemble the pieces.

## The Logic of Form(ation)

The assembly of our informational forms relies on principles developed in collaboration with Michael Leyton. Leyton distinguishes between fixed and process-oriented geometric notions, with an emphasis on how causal structure is best supported by the later (Leyton, 1992, p. 7). He points out that geometry has been traditionally founded on the principle of “memoryless shape” because it ignores crucial elements of its own process of definition:



[This diagram] shows two triangles. [In traditional geometry], to test if they are congruent, one translates and rotates the upper triangle to try to make it coincident with the lower one. If exact coincidence is possible, one says they are congruent. This allows one to regard the triangles as essentially the same. In contrast, in the theory of geometry I have developed, the two triangles are different because they have different histories. For example, to convert the upper one to the lower one, it is necessary to add a history of translation and rotation (Leyton, 2006, p. 8-9).

Leyton observes that transitions between shapes inform the way humans reason about the causal history of situations. He gives the example of entering a subway station and seeing “crumpled newspapers, splashes, broken walls and bottles” (Leyton, 1992, p. 3). Even though this is a static scene, the commuter is able to infer, from the lack of regularity of the shapes, some of the processes the items have encountered (Leyton, 1992, p. 3). The “asymmetry” of objects stores information that is currently missing from geometric reasoning (Leyton, 1992, p. 7).

Leyton’s observations unearth the same flaw in method recognized by Gödel and Law. It is also similar to the distinction between ‘fixed form’ and ‘process-oriented form’ that Bakhtin establishes in his analysis of dialogics. In all cases, there is an acknowledgement of the role that representational structures play in the (trans)form(ation) of meaning. The multiple voices of the novel, like Leyton’s geometric shapes and Law’s method, establish their identities in relation to the contexts that identified them.

Once abstracted into form, assembly of these elements will be managed according to process-oriented geometry. Shifts such as linking, comparison and anticipated future situations will be shape-based translations. Semantics will no longer be pre-classified labels, but instead become

signposts that emerge from layered phenomena, based on relative shifts at the logical level. It is expected that this multilayered use of form will add an extra degree of iconic resonance to the phenomena it captures. Shape-based principles will operate in the user interface, the ontological foundations, and the manner in which agents learn to negotiate with each other. When heterogeneous entities meet on all levels, they will refer to form.

## Topography

The Andean locals tell me they have more red blood cells than I do, their bodies having adapted to the altitude over many generations. Their mountains are cut into strata, because as the elevation increases, different foods can be grown at each level, until the heights in which nothing survives except Llama. I find the Peruvian altitude punishing and although I'm not as badly affected as my mother, any short stroll still causes a fight for breath. I eventually realize that this country must be negotiated through the lens of topography. I buy a map that shows the height of every town relative to sea-level, and each night book a hotel in the lowest-lying village on our path, making it the target for the following day. When we starting sleeping at lower altitudes, my mother's health begins to improve. After three days, we arrive at the foot of the mountain that cradles Machu Picchu.

## The Character of Stories

The story about my mother's journey to Machu Picchu is driven by conflict between two conceptual situations: *protect my mother's emotional wellbeing and stay in the Andes* versus *protect my mother's physical wellbeing and leave the Andes*. When those two networks of ideas meet in the story frame, the reader watches their elements negotiate, a process that manifests through shifts of the characters' thoughts, actions and locations (Cardier, 2007). A story eventually restores enough coherence to achieve a sense of resolution, the nodes changing as the protagonists work to transform their context (Herman, 2008, p. 359). By the end of this tale, my mother will have given up on her dream, or given up on her health, or negotiated a new approach to Machu Picchu. If a new path is attempted, a new context will emerge, and fresh insights will be possible within that space.

When semantics ride on form, another correlation between our abstraction and the world emerges. The acting theory of Meisner reveals how, in performed stories, semantics are surface representations that draw their arrangement from emotional surges, which are themselves stimulated by conflict from physical and psychological forms (Meisner, 1987, p. 115). Meisner terms these surges "impulse."

By definition, heterogeneous forms of any type will conflict. In our system, the tension produced through these

misalignments is central to the design. When two conceptual structures meet, they will encounter correlations and also profound asymmetries. We use the resulting tension surges to drive the assembly process.

## The Character of Mountains

By the time we reached the stone temples of Machu Picchu, my mother was able to walk slowly unaided. We decided to spend two full days amongst the ruins, as though we lived there. Each day I hired a guide who was willing to walk at her pace, patiently filling in time by talking. One had studied ancient architectural design.

This guide sat with us in one of the temples while my mother rested, explaining the special properties of Inca stonemasonry. Inca buildings were designed to effectively distribute seismic shocks throughout the walls and foundations (Cuadra, 2008, page 344). This enabled the architecture to survive in spite of its location in the earthquake-prone Andes, mountains that are the result of an ongoing collision between tectonic plates. All Inca homes were designed to withstand foundational shifts, but the sacred buildings of Machu Picchu had an additional advantage. Our guide drew a picture of this special attribute in the sand. Between the smooth-faced bricks were dozens of jagged teeth.

Even though the bricks were sheared flat on the outside, their joining surfaces were staggered with deliberate angles. Those internal corners acted as points of distribution when seismic shocks struck. Instead of shattering, the bricks relayed the tension throughout the entire structure. Machu Picchu was preserved because the Incas had learned how to conduct the impulses that arose between conflicting forms.

## Convergent Information

As I walked away from Machu Picchu on the second day, I felt peaceful. A child was standing in a drought-stricken paddock in Queensland and she was happy. As my relaxed thoughts drifted, I overheard snippets of conversation between passers-by. Beside me, someone else's guide described the poisonous spiders in the jungle around us, and I remembered the episode of *The Simpsons*. I tried to remember a particularly funny line from the video, an explanation by the Japanese chef to his apprentice about how to cut the poisonous blowfish.

The memory was fuzzy. As I toyed with possible versions of the phrase, I saw that only some expressions were funny. I realized that when conceptual conflict is expressed semantically, some of its tension is distributed. Alternate forms of an idea spread the tensions differently – only some of which triggered the impulse to laugh in me.

The insight carried by the voice of a cartoon character linked to the Watcher. Our ontological language of form would include a metric for tension distribution. If concept

was shape, re-contextualization was an earthquake – a re-arrangement that created asymmetries as well as fitted surfaces. Our predictive intelligence would be based on geometric translations, but it would also be determined by distributive need. The system would compare what sort of subsequent situations could best distribute the tension between conflicting agents.

Seeing the Watcher from this angle also provided the means by which our agents would negotiate. In current work on interoperability, whether enforcing a standard or building a bridge, the objective is to subsume ontological structures so their semantics can relate via a common reference point. Our agents would use ‘form’ as this federating medium. Like two people who draw a diagram in order to align ideas, a ‘topographical’ map would serve as the shared referent. Its overview would enable them to locate their own representations against those created by other agents, and establish local reference points.

Unlike conventional ontologies, however, this map would not be fixed, because the Watcher’s input stream ensures a constantly changing landscape. While there are no computerized ontological models that can automatically adjust for adapting context (Rizvi, 2008, p. 292), a precedent exists in the communicative disciplines. In the domain of stories, interaction between global and local levels is known as ‘genre.’

Frow correlates genre and ontology, saying that both are:

...a set of conventional and highly organised restraints on the production and interpretation of meaning (Frow, 2006, p. 10).

Genre differs from a computerized ontology, however, in that its restraints are more malleable. One example is the superhero genre - in the 1930s superheroes were mysterious, in the 1940s they had sidekicks, by 2000 they were well-intentioned volunteers with military-grade accessories (Thrushall, 2004, p. 150-163). Genre is a context that helps a reader situate an utterance, informing how it is read. At the same time, that utterance can slightly modify the criteria for that genre (Frow, 2006, p. 48).

Our ontology will adapt via an exchange between global and local levels in the same manner. Other systems have recognized the need for this sort of exchange, but still depend on a fixed, underlying synthetic reality onto which their ontological terms are registered (Hakimpour, 2005, p. 298; Hu, 2008, p. 363). In our case, a fixed synthetic reality is not required. Instead the unified connected meanings will be automatically updatable, made possible by the following process.

When our agents gather within a frame, they produce an overall image, a topographical map. That overarching shape becomes a situating reference for the satellite utterances within, a view that enables them to locate and negotiate with each other. As they use this to assemble and resolve tension, their negotiations change the topography. Instead of being solely a touchstone for agents, our ontology is composed of them. The more information fed into the system, the richer the overall view will be.

Like the authorial voice in Bakhtin’s novel, our system’s ontology will not be predicated on a single voice and style, it will be the sum of the entities it has gathered. The cohesion is distributed, so the ontology emerges when all the heterogeneous apertures are seen simultaneously. Form is the only unifying frame, within which all elements can occupy the same scope. The agents orientate themselves in relation to it, just as we refer to the revolving sky. Federation is the view from above.

## Conclusion

Traditional approaches to ontological interoperability still encounter problems when dealing with divergent abstractions, particularly in relation to semantics. We convert all aspects of our system into geometric form, in order to bridge its operations at every level, and to leverage the scope offered by heterogeneity. This will allow us to employ the dialogic structure currently only seen in modern prose and capture real-world phenomena more faithfully. Diverse representational structures stand for different aspects of processes, and when brought together, can create richer models of the situations under watch. Their correlations are multiple yet inconsistent, and like this story, will constantly transform, as the contexts change, in the process of creating coherence.

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