Open University of Cyprus

Faculty of Pure and Applied Sciences

Postgraduate (Master's) Programme of Study
MSc Cognitive Systems

Postgraduate (Master's) Dissertation

Building the Cognition, Culture & Language (CCL) Ontology Based on the Analytical Framework of Cultural Linguistics

Poornima Sai Parasuraman Ravishankar

Supervisor
Ilianna S. Kollia

May 2021

Open University of Cyprus

Faculty of Pure and Applied Sciences

Postgraduate (Master's) Programme of Study

MSc Cognitive Systems

Postgraduate (Master's) Dissertation

Building the Cognition, Culture & Language (CCL) Ontology Based on the Analytical Framework of Cultural Linguistics

Poornima Sai Parasuraman Ravishankar

Supervisor
Ilianna S. Kollia

The present Postgraduate (Master's) Dissertation was submitted in partial fulfilment of the requirements for the postgraduate degree in MSc Cognitive Systems Faculty of Pure and Applied Sciences of the Open University of Cyprus.

May 2021

Summary

In this dissertation, we introduce the Cognition, Culture & Language (CCL) web ontology, based on the analytical framework of Cultural Linguistics. Cultural linguistics, which explores the relationship between cognition, culture and language, is a growing field of research. Within its paradigm, language is viewed as complex adaptive system, an emergent phenomenon arising and developing out of the varied nature of the interactions of its speakers over time. Thus, language is not simply a means of expression but a rich source of data to determine the cognitive experience of the world not only within a single human mind, but a whole community tied together by common beliefs, traditions, practices or even simply, the physical environment. If integrated with current technological advancements in Artificial Intelligence and Human-Computer Interaction, research from Cultural Linguistics could have potentially impactful applications within the domains of Education, Political discourse, AI Ethics and Social policy, just to name a few. Thus, this is a first attempt at converting this research into some suitable form of technological implementation. Ontologies for the semantic web, which are domain-specific subsets of hierarchical concepts and their relations, have widespread use in numerous AI applications due to the powerful reasoning and inference capabilities which they provide and therefore, are a natural fit for such an endeavour. CCL is a content ontology which models the core components of cultural conceptualizations. It has been assumed that the end-users of the ontology will primarily be NLP interfaces which process natural language content for use in applications within other domains. This work is inter-disciplinary, combining theories in cultural linguistics, cognition and ontology engineering for the semantic web.

Keywords: Cultural Linguistics, Cognition, Culture, Language, Web Ontology, OWL

Περίληψη

Στη διατριβή αυτή παρουσιάζουμε την οντολογία Cognition, Culture & Language (CCL), η οποία είναι βασισμένη στο αναλυτικό πλαίσιο της Πολιτιστικής Γλωσσολογίας. Η πολιτιστική γλωσσολογία, η οποία διερευνά τη σχέση μεταξύ της γνωσιακής λειτουργίας, του πολιτισμού και της γλώσσας, είναι ένα αναπτυσσόμενο πεδίο έρευνας. Στο πλαίσιο αυτό η γλώσσα θεωρείται ως ένα σύνθετο προσαρμοστικό σύστημα, ένα φαινόμενο που προκύπτει και αναπτύσσεται μέσω της ποικίλης φύσης των αλληλεπιδράσεων των ομιλητών της με την πάροδο του χρόνου. Έτσι, η γλώσσα δεν είναι απλώς ένα μέσο έκφρασης, αλλά μια πλούσια πηγή δεδομένων για τον προσδιορισμό της γνωστικής εμπειρίας του κόσμου, όχι μόνο ενός ανθρώπινου μυαλού, αλλά μιας ολόκληρης κοινότητας συνδεδεμένης με κοινές πεποιθήσεις, παραδόσεις, πρακτικές ή απλά, το φυσικό περιβάλλον. Εάν ενσωματωθεί με τις τρέχουσες τεχνολογικές εξελίξεις στην Τεχνητή Νοημοσύνη και στην Αλληλεπίδραση Ανθρώπου-Υπολογιστή, η έρευνα στην Πολιτιστική Γλωσσολογία θα μπορούσε ενδεχομένως να έχει επιπτώσεις σε τομείς όπως της Εκπαίδευσης, του Πολιτικού λόγου, της Ηθικής της Τεχνητής Νοημοσύνης και της Κοινωνικής πολιτικής. Η διπλωματική αυτή είναι μια πρώτη προσπάθεια μετατροπής αυτής της έρευνας σε κάποια κατάλληλης μορφής τεχνολογική εφαρμογή. Οι οντολογίες για τον σημασιολογικό ιστό, οι οποίες είναι υποσύνολα ιεραρχικών εννοιών για συγκεκριμένους τομείς και οι σχέσεις τους που δημοσιεύονται στον Ιστό, έχουν ευρεία χρήση σε πολλές εφαρμογές Τεχνητής Νοημοσύνης λόγω των δυνατοτήτων συλλογιστικής που παρέχουν και, ως εκ τούτου, είναι κατάλληλες για μια τέτοια προσπάθεια. Η CCL είναι μια οντολογία περιεχομένου που διαμορφώνει τα βασικά συστατικά των πολιτισμικών εννοιών. Έχει υποτεθεί ότι οι τελικοί χρήστες της οντολογίας θα είναι κυρίως NLP διεπαφές που επεξεργάζονται περιεχόμενο φυσικής γλώσσας για χρήση σε εφαρμογές εντός άλλων τομέων. Το παρουσιαζόμενο έργο είναι διεπιστημονικό, συνδυάζοντας θεωρίες από την πολιτιστική γλωσσολογία, τη γνωσιακή λειτουργία και τη μηχανική γνώσης οντολογία για το σημασιολογικό ιστό.

Λέξεις-κλειδιά: Πολιτιστική Γλωσσολογία, Γνωσιακή Λειτουργία, Πολιτισμός, Γλώσσα, Οντολογία Ιστού, OWL

Acknowledgements

I would like to thank my supervisor, Dr. Ilianna Kollia, for her invaluable knowledge, guidance and patience in answering my infinite million questions and for reading through this mile-long dissertation. This work would not have been possible without her constant support and encouragement, its quality ensured through her careful attention to detail.

I would also like to thank my parents who have provided me unflinching support throughout and without whom, I wouldn't have come this far.

Table of Contents

LIST OF FIGURES xi
LIST OF TABLES xiv
Chapter 1 1
Introduction 1
1.1 Cultural Cognition 2
1.2 The analytical framework of Cultural Linguistics 3
1.3 Language and cultural cognition 5
1.4 Web Ontologies and their relevance 5
1.5 The importance of the current research 6
1.6 NLP as the target application 7
Chapter 2 9
Literature Review 9
2.1 Cultural conceptualizations 9
2.1.1 Cultural schemas 10
2.1.2 Cultural categories 15
2.1.3 Cultural metaphor 16
2.1.4 Data from cultural research 20
2.2 Web ontologies and the semantic web 25
2.2.1 Why ontologies 25
2.2.2 What ontologies are made of 27
2.2.2.1 Classes and Relationships 27
2.2.2.2 Axioms and Reasoning 28
2.2.3 RDF and RDFS 30
2.2.4 OWL 31
2.2.5 Ontology Engineering methodologies and Ontology learning 33
2.2.6 General and Domain Ontologies 35

2.2.7 Cultural Ontologies and databases 36
2.3 Summary 37
Chapter 3 39
Methodology and Findings 39
3.1 What is considered data? 39
3.2 Methodology 40
3.2.1 Data collection 40
3.2.2 List of Publications considered Data 41
3.3 Findings 42
3.3.1 Modelling components of conceptualizations 42
3.3.1.1 Modelling Philosophy 43
3.3.1.2 Modelling Categories 45
3.3.1.3 Modelling Schemas 47
3.3.1.4 Modelling Metaphors 48
3.3.2 Identifying concepts surrounding conceptualizations 49
3.3.2.1 Context 50
3.3.2.2 Cultural Domains 53
3.3.2.3 Embodied experience and atoms 53
3.3.2.4 Cultural artefacts, symbols and exemplars 54
3.3.2.5 Salience and significance 55
3.3.2.6 Cultural values and beliefs and their change over time 56
3.3.2.7 Non-linguistic data 56
Chapter 4 63
Building the CCL Ontology 63
4.1 Requirements Specification 64
4.1.1 Purpose of the Ontology 64
4.1.2 Scope of the Ontology 64
4.1.3 Implementation Language 65
4.1.4 Intended Uses and Intended End-users 65
4.1.5 Ontology Requirements 65

4.2 Design 66
4.2.1 Design best practices 67
4.2.2 Design approach 68
4.2.2.1 Complexity and class decisions 69
4.2.2.2 Fuzziness and Cardinality 69
4.2.3 The CCL Ontology Design 70
4.2.3.1 Classes 70
4.2.3.2 Relationships and Class Equivalences 76
4.2.4 Reusability and considerations 81
4.2.4.1 Challenges 82
4.3 Implementation 82
4.3.1 Implementation best practices 83
4.3.2 The Protégé Ontology Editor 83
4.3.3 Implementation of the CCL Ontology 84
4.3.3.1 Classes 84
4.3.3.2 Properties 87
4.3.3.3 Ontology details 89
4.3.4 Reusability 90
4.4 Use Cases and Evaluation 92
4.4.1 General evaluation 94
4.4.2 Use case evaluation 96
4.4.2.1 Get background knowledge of a culture 96
4.4.2.2 Understand behaviour or reaction to a public comment 99
4.4.2.3 Understanding communication in a cross-cultural context 101
4.4.2.4 Make comparisons between cultures 103
4.5 Publication and Documentation 106
Chapter 5 109
Conclusion 109
5.1 Where do we go from here? 109
5.1.1 Assess requirements with real users 109

5.1.2 Add Linguistic and Cognitive Modelling 109
5.1.3 The NSM theory 110
5.1.4 Integrate with other knowledge bases 110
5.1.5 Build an interface and integrate with NLP applications 111
5.1.6 Modularize 111
5.2 Revisiting the basics 111
5.3 Concluding Remarks 112
Appendix A 114
Software 114
A.1 The CCL Ontology Software 114
References 115

LIST OF FIGURES

Figure 1. Cultural conceptualizations C1, C2, C3 and their components as may be observed collectively, across members and time 3
Figure 2. Cultural conceptualizations and their instantiations across members (Sharifian 2011: 6) 3
Figure 3. Cultural conceptualizations and their progression through time 4
Figure 4. A WordCloud representation of sample concepts associated with the schema 'Book' 13
Figure 5. Components of Metaphors 19
Figure 6. Interactions of the components of cultural conceptualizations 22
Figure 7. Factors affecting cultural conceptualizations 24
Figure 8. Components of an ontology 28
Figure 9. The parts of an RDF Statement 30
Figure 10. The RDF and RDFS layers 31
Figure 11. OWL, RDFS and RDF 33
Figure 12. Modelling philosophy – Components of conceptualizations 43
Figure 13. Modelling philosophy – Cultural component of conceptualizations 44
Figure 14. Components of a Cultural Category 46
Figure 15. Components of a Cultural Schema 47
Figure 16. Components of a Cultural Metaphor 49
Figure 17. Components of an ontology - Example 51
Figure 18. Modelling Context 52
Figure 19. Classes under Collective Mental Structure 71
Figure 20. Classes under Cultural Element 72
Figure 21. Classes under Entity 73
Figure 22. Classes in the CCL Ontology 75
Figure 23. Smaller classes with sub-classes in the CCL Ontology 76
Figure 24. Schema relationships 77
Figure 25. Category relationships 78
Figure 26. Metaphor relationships 79
Figure 27. Context relationships 80
Figure 28. Cultural Value, Belief and Norm relationships 81
Figure 29. Classes in the CCL Ontology in Protégé 85
Figure 30. Category and Metaphor Class Equivalence Definitions in Protégé 86
Figure 31. Schema and Context Class Equivalence Definitions in Protégé 87
Figure 32. Object Properties in Protégé 88
Figure 33. Data Properties in Protégé 89
Figure 34. Ontology Details in Protégé 89
Figure 35. Sample results from the OOPS tool 92

Figure 36. DL Query - Metaphor 94
Figure 37. DL Query 2 – Context 95
Figure 38. DL Query 3 – Rule 96
Figure 39. Use Case UC-01-KB Query 1 Results 98
Figure 40. Use Case UC-01-KB Query 2 Result subset 98
Figure 41. Use Case UC-02-UB Query 1 Result subset 101
Figure 42. Use Case UC-03-UC Query 1 Result subset 103
Figure 43. Use Case UC-04-MC Query 1 Result subset 105
Figure 44. Ontology Documentation - Summary Section 106
Figure 45. Ontology Documentation - Classes and Properties 107

LIST OF TABLES

Table 1. Concepts to be modelled within the ontology 58
Table 2. Sample attributes to be modelled within the ontology 61
Table 3. Organization of the 'Cultural Element' class 71
Table 4.Organization of the 'Type' class 74
Table 5. Reused Classes in the CCL Ontology 91
Table 6. Reused Properties in the CCL Ontology 91
Table 7. Use Case UC-01-KB Description 97
Table 8. Use Case UC-02-UB Description 99
Table 9. Use Case UC-03-UC Description 102
Table 10. Use Case UC-04-MC Description 104

Chapter 1
Introduction

Cultural linguistics is the nexus of language, culture, and conceptualization. The central goal of Cultural Linguistics is to analyze and discover the conceptualizations developed by the members of a linguo-cultural community as reflected in their language. The idea of thought influencing language is not a new one and has been around since the time of Franz Boas and his students Edward Sapir and Benjamin Whorf, who studied the relationship between language and its speakers' experience of the world (Sharifian 2017c: 86). The term was perhaps first used by Ronald Langacker in his paper "Culture, Cognition and Grammar" (Langacker 1994: 31, Peeters 2016: 5). Gary Palmer (Palmer 1996: 35) has also used the term as a merger between cognitive linguistics with anthropological linguistics and speaks about concepts in terms of 'imagery' which is defined as a complex cognitive process taking its input from various sensory stimuli and from the environment (Palmer 1996: 46). However, the framework of Cultural Linguistics by Farzad Sharifian (Sharifian 2011: 24) adopted in the current work provides an easier, more achievable form of analysis of the interplay of complex domains such as cognition and linguistics.

Cultural linguists theorize that language is influenced by culturally influenced conceptualizations produced through cultural cognition. Language is viewed as an emergent phenomenon arising out of the interactions of its speakers across space and time and the cultural component itself is constantly being modified and negotiated among them. (Sharifian 2017b: 3) Cultural linguistics is a rapidly developing field with an expanding research community and there is already a wealth of knowledge from various languages. However, this knowledge remains trapped within the research text and no attempts have been made to integrate it for use by technological applications.

1.1 Cultural Cognition

Cultural cognition is a collective term used for various conceptualizations and the processes involved in developing them by the members of a cultural community. Conceptualization in general, is the process of forming concepts of things based on an individual's experiences and observation. A cultural conceptualization is informed by specific cultural experiences such behaviour, language and cultural practices to which one has constant access, often in their immediate environment, and through living within a specific cultural community or with a subset of its members. The process of conceptualizing an experience through the cultural lens varies greatly based on the prior experiences of the individual as well as one's current environment and the concept one forms about the culture itself, also shows large variations with some parts showing strong agreement and others being weakly integrated or completely absent in some cases.

While cognitive linguists view these conceptualizations operating at the individual level, cultural linguists view them as operating at the group level with cultural cognition being shared and distributed across time and space. (Sharifian 2011: 4, Sharifian 2017b: 3) It is shared in the sense that some core components of such cognition are present within all its members and distributed in the sense, not all its components are present within all its members. Individual conceptualizations of a shared concept are approximate but contain sufficient analogues to produce an agreement at the group level. Cultural conceptualizations are also passed down through time and generations in the form of cultural artefacts such as social ones like rules, traditions and behaviour, physical artefacts such as tools and texts and mental artefacts like language. Over time, some parts of this cognition shared by a previous generation may be lost or modified and new components, added. Cultural cognition is also shared across space as observed in the global diaspora of a linguo-cultural community.

1.2 The analytical framework of Cultural Linguistics

Under the theoretical framework of Cultural Linguistics, cultural cognition is viewed as a complex adaptive system (CAS) arising out of the interactions between the members of its community. As with other CAS systems, cultural cognition is dynamic and exhibits emergent properties such as a macro level system developing through interactions at the individual level, the whole not being accounted for by the sum of its parts and importantly, nesting where the members of the system are themselves adaptive systems (Sharifian 2017b: 4) . Figure 1 below shows three cultural conceptualizations C1, C2 and C3 and the components which make them.

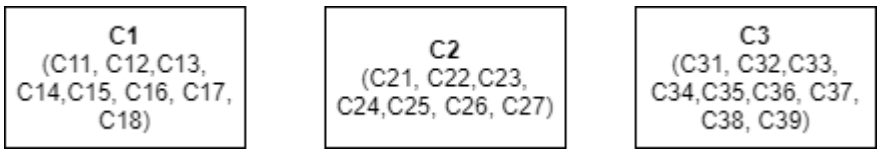

Figure 1. Cultural conceptualizations C1, C2, C3 and their components as may be observed collectively, across members and time

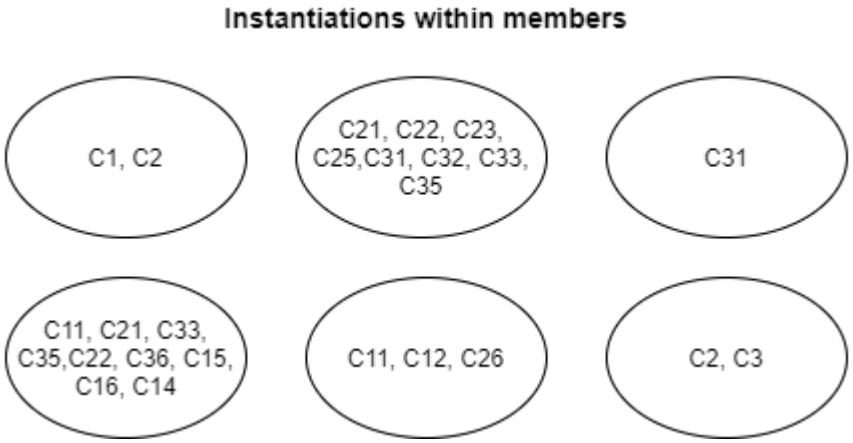

Figure 2. Cultural conceptualizations and their instantiations across members (Sharifian 2011: 6)

Figure 2 above shows how instances of whole conceptualizations or some of their various components can be distributed across agents and sometimes, with only a single

component of a cultural conceptualization existing within some of them. Figure 3 below shows how these conceptualizations come into or drop out of existence or amalgamate with others over time.

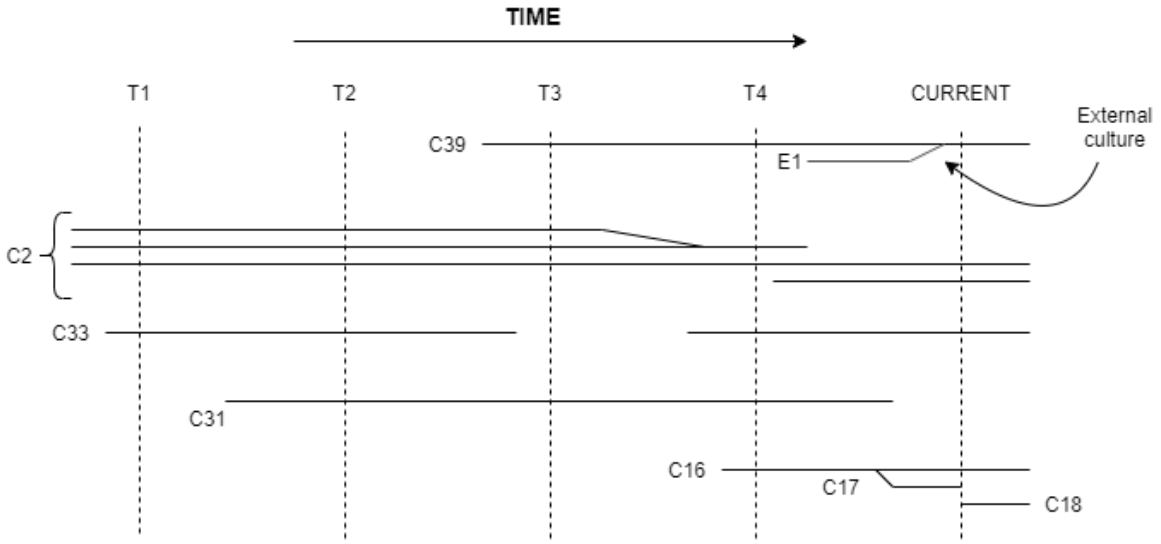

Figure 3. Cultural conceptualizations and their progression through time

In the analytical framework, the constituents of cultural conceptualizations are defined namely, schemas, categories and metaphors, as manifested in language. Conceptualizations consist of schemas and categories which may contain further sub-schemas and categories. Components of schemas and categories are distributed across the members of the community and may even be disjoint in some respects. Schemas are organizing structures which encode knowledge about situations, events, roles, rules, expectations, goals etc. Categories are how one groups together various entities. Categories may be traditional based on physical and empirically observed common attributes or they may be ad hoc based on how the categorizer perceives entities within situations. Categories activate schemas and the rules stored within schemas, especially the role schemas are built around cultural categories. Cultural metaphors map an abstract domain onto a concrete one and activate schemas and categories in the process. Production of such metaphors effects new understanding of both the source and target domains and this acts as a feedback to the schemas and categories these metaphors invoke.

1.3 Language and cultural cognition

Language is the main tool of analysis within the analytical framework of Cultural Linguistics. Cultural conceptualizations manifest outside the individual and are propagated in the form of cultural artefacts such as social behaviour and gestures, events and traditions, temporal artefacts such as plays, and are concretized in more permanent forms like recorded performances, art, and literature and especially, in language where these conceptualizations can be more readily observed. Like cultural cognition, language is viewed as an emergent phenomenon, a complex adaptive system itself, arising from a multitude of interactions among its speakers. It is largely through language that cultural cognition manifests itself outside the individual and propagates through the system. (Sharifian 2011: 29) Language is also extremely dynamic and it shifts and changes with the changing cognition of its speakers. Language also easily morphs into a variety of forms as observed in the meeting of cultures. (Sharifian 2011: 34)

1.4 Web Ontologies and their relevance

Tim Berners-Lee envisioned the semantic web as an extension of the worldwide web, which would add meaning to the information on the web. Information would be expressed as structures to enable some meaning to be derived. However, documents thus created would only make sense to some semantic subroutine meant to read these structures. These in themselves, do not explain concepts as humans make sense of them. While these semantic 'machines' reading semantic data are able to infer relationships between concepts as defined within the semantic web, the standard meaning of concepts and the relationships between objects and events as understood in the real world would bear no consequence to them (Berners-Lee, Hendler & Lassila 2001: 38-40). To express concepts, roles and relationships, we would need a method of knowledge expression, what have today come to be known as web ontologies.

Ontologies parse content within a specific domain, as independent units possessing characteristics and function, and establish the relationship between these units. (Chandrasekaran et al. 1999: 21) They also enable the creation of a shared vocabulary which can be used by domain experts and automated agents alike. Keeping them domain specific promotes easy search and retrieval, and efficiency. Web ontologies have thus, evolved to represent knowledge as categorizations and relations, where the most basic assumptions about a domain are explicitly stated and validated and the models produced, reused to form a standardized knowledge base for accessing applications. Naturally, ontologies are well-suited for expressing meaning as well as to elicit hidden assumptions and reify concepts which can then make their way into real-world applications.

1.5 The importance of the current research

As opposed to NLP where language is treated as the primary source of data independent of cognition, the aim of discovering cultural conceptualizations within language is to discover factors underlying the origin of language highly specific to the physical, mental, and social environment within which the language has arisen and developed. This is especially important for language processing within cognitive science applications as well as for applications in anthropological and historical linguistics, language change, international political discourse etc. and in language education where differences in cultural thinking often create disconnect and alienation amongst students (Sharifian, Rochecouste & Malcolm 2004: 203, Sujatha, 2002; McKeough et al., 2008)

While more and more new research in cultural linguistics is being added, most concepts exist as theories within published texts and research papers. Adoption of concepts from cultural linguistics, if at all, is not yet as widespread in technology as is with other methods. Therefore, technological applications are unable to make use of findings from valuable research. The semantic web by virtue of its founding principles is the embodiment of meaningful knowledge representation and as a first step towards bridging the gap, this dissertation aims to develop a conceptual model of cultural conceptualizations in terms of a semantic web ontology.

1.6 NLP as the target application

The primarily goal of the current work is to identify the cognitive parts underlying the cultural conceptualizations prevalent within a linguo-cultural community as reflected in the development and use of their language, and to produce a corresponding general ontology model of cultural conceptualizations for the semantic web, with potential future applications in automated processing. The result is a possible, partial web ontology model of cultural conceptualizations based on the general analytical framework of Cultural Linguistics. It will be called the Cognition, Culture and Language (CCL) ontology.

In considering an end application, I observed that there is not enough research on cultural linguistics within any specific commercial domain such as healthcare, education etc. to extract a meaningful generalization. Hence, it was decided that a neutral subject matter domain such as NLP will be used as the accessing application. NLP modules are the liaison between web ontologies and various applications. Moreover, web ontologies already being extensively used for NLP. Therefore, it makes logical sense to first develop an ontology understandable by the intermediary and more importantly, since there is also ample research to support the endeavour. Thus, this ontology is intended to organize as much as information as possible from the analytical framework, within its concepts and relationships and which can consequently be processed using current NLP methods and techniques for application within various domains as needed.

Chapter 2
Literature Review

This chapter presents a review of the literature on the Cultural Linguistics framework. It contains a brief commentary on research within the scope of this framework and on relevant existing web ontologies. The methodology of data collection for this dissertation is document analysis and almost all published research in Cultural Linguistics has been included within its scope. The core theory of Cultural Linguistics and the rationale of this framework, however, forms the background of this dissertation and is not a part of the data. This is also true of the review of foundational principles, standards, current recommended practices of web ontologies as well as existing ontologies related to the subject area of this dissertation. These have been included here, as a part of the Literature Review.

2.1 Cultural conceptualizations

Concepts are representations of categories and experiences within the environment which aid in the understanding of newly encountered instances of these categories (Barsalou 2016: 11). Concepts are themselves dynamic and distributed within cognition and are essential to the thought process especially in offline processing i.e., when an entity is not readily available for reference within one's environment. Conceptualization is the process of forming concepts by which, meaning and representation is assigned to an abstract idea held within cognition. Cultural conceptualizations are the main focus in the framework of Cultural Linguistics. These conceptualizations allow for cognition to be shared, and for shared cognition to be moulded and shaped, by the interactions of a cultural community's members. (Sharifian 2003: 189) The theory of cultural conceptualizations encompasses within it the concepts of cultural schemas, cultural categories and cultural metaphors (Sharifian

2017b: 7) which are essentially composed of their corresponding cognitive counterparts. Therefore, researchers subscribing to the cultural linguistics framework theory aim to align their analysis within the purview of this framework.

Cultural schemas, by definition, are rich structures which bring together various associated contexts belonging to potentially distant conceptual domains. Speaking from a cognitive point of view, cultural schemas must encode a large amount of information. Cultural categories are usually deeply entrenched in historical cognition built over time whereas cultural metaphors with historical origins may lose part of their historical association while retaining their semantic core. All three structures interact with one another and involve cognition at various levels from the foundational to the complex.

2.1.1 Cultural schemas

The schema theory in cognitive psychology theorizes that cognitive schemas are mental structures which are used to organize ideas and information about the environment, experiences, and one's learning from them which includes beliefs, norms, behaviours, knowledge of situations and learning from prior experience. Schemas are essentially a framework to draw knowledge from and within which new knowledge is placed (Sharifian, 2017: 12, Nishida 2005: 402). They are further divided into sub-schemas organized hierarchically (Nishida 2005: 410). Schemas occur at various levels of abstraction, that is, models are formed from a variety of combinations of generalization of events and specific information from those experiences (Casson 1983: 430, Palmer 1996: 63). Early critics of the schema theory pointed out that it does not sufficiently explain responses such as inhibition/inaction, how schemas are applied to novel problems incompatible with prior learning, but they also recognize that it is best suited to explain cultural interpretations of experience (Holland 1992: 75-76) i.e., how schemas are constructed from culturally reiterated experiences.

More recently, according to the Cultural Schema Theory (Nishida 1999: 753-769) developed within the context of cross-cultural communication, there are eight

foundational 'primary social interaction' (PSI) schemas (Nishida 1999: 757-759) based on the information they encode, as follows –

- Fact and concept schemas which contain general information and facts about entities/events
- Person schemas which contain knowledge of different types of people and their attributes
- Self schemas which contain knowledge that an individual has built about oneself and which are important to identity
- Role schemas to store knowledge about social roles and expected behaviours.
- Context schemas which contain information about a situation and the appropriate behaviours to be employed within it
- Procedure schemas which are the 'know-how' to store knowledge of sequences of events, the instructions for appropriate behaviours within these events
- Strategy schemas which store knowledge about problem-solving strategies and are usually acquired from extensive experience
- Emotion schemas which are schemas for storing affect and evaluation, where affect is an invoked emotion or feeling in response to some causal event/entity and evaluation is the thoughts, beliefs and judgements associated with it (Breckler & Wiggins 1989: 253)

These PSI schemas are developed and strengthened by activation through repetitive, coherent experiences. They are organized from the general to the specific, where the general schemas contain specific schemas which in turn contain subschemas divided to enable achieving goals of increasing specificity. The schemas are interconnected with changes within one effecting changes in the others and they are dynamic and self-regulating i.e. they undergo modifications to fit in new information and resolve any discords. (Nishida 1999: 764-765)

A cultural schema is a type of cognitive schema (Sharifian, 2017: 11) which is essentially built from a combination of other foundational cultural-cognitive schemas and categories. Cultural schemas when invoked, also invoke associated cultural categories and this also functions vice versa. In the description of his theoretical framework of Cultural Linguistics, Sharifian lists out the following schemas falling within the scope of

Cultural Schemas, some of which like the image schema may be more difficult to analyzed than others, in terms of their components –

- Event schemas which contain models of subjective experience including situations, behaviours, rules, associated occurrences of other events etc. (Mandler 2014: 75-76)
- Role schemas similar to Nishida's Role schema (Nishida 1999: 758)
- Image schemas which are schemas of intermediate abstraction, not significantly concrete or abstract but readily available to one's imagination when invoked (Palmer 1996: 66).
- Proposition schemas which contain relationships between concepts (Quinn & Holland 1987: 25, Sharifian 2011: 24)
- Emotion schemas similar to Nishida's Emotion schema (Nishida 1999: 759)

These schemas are a function of general human cognition and they encode human perception of the components of physical reality and constructed social reality. There may be differences in the philosophical and practical values assigned to them by different cultures, but they are bound to be found within each one of them. Roles, situations, events and entities exist within any community and form the foundation for more complex, culturally significant structures. Therefore, I infer that cultural schemas become cultural by virtue of the values they assume i.e., a culture is differentiated from other ones by the cultural schemas in existence as well as the distinctive values or combinations of them, including language, stored within these schemas. Figure 4 below shows, in the form of a WordCloud representation, the different mental concepts which can be associated and possibly be activated by the concept **Book**.

Figure 4. A WordCloud representation of sample concepts associated with the schema 'Book'

An example of a cultural schema in some cultures in South India is A BOOK AS A THING OF WORSHIP or more generally, A TOOL OF ONE'S TRADE AS A THING OF WORSHIP. This schema encodes within it the cultural value of respecting a person's means of knowledge and livelihood. The cultural value comes through evidently in the festival day called 'Ayudha Pooja' specifically marked for worship of books and various physical tools used in one's profession. The festival is associated with some Hindu deities and legends of them defeating 'evil'. Items such as books, musical instruments, weapons, vehicles are cleaned, decorated, anointed and worshipped. More recently, computers and typewriters have been included in this list. This list particularly signifies a dynamic, ad hoc category formulated and understood by the cultural community. Though not all

individuals may agree that all items in this category are worthy of worship, it shows a collective understanding of the general concept underlying the category. Since it is forbidden to use the tools placed for worship, the day of the festival is a public holiday in some regions of Southern India. This shows the emergence of some social practices based on others and their associations with the same schema. The A BOOK AS A THING OF WORSHIP cultural schema is also closely associated with another schema FEET COMING IN CONTACT WITH BOOKS AS A MARK OF DISRESPECT which has the associated notion that one's feet touching an entity that is sacred or worth of respect, is considered disrespectful.

A more complex example of a different type of schema is the CULTURAL EXEMPLAR role schema defined in Lu's study (Lu 2017: 89-110) of Chinese immigrant thought. Chinese immigrants in Australia view themselves as being at the forefront of cultural representation in a foreign land. They separate themselves from their fellow citizens in Mainland China but also separate themselves by national identity from the citizens of the country they are in. Therefore, a spatial separation schema and an identity schema based on geography come into play. These can also be viewed as associated with distinct categories in the mind of the cultural agent. Based on the context, there is a switch in self-inclusion within one or the other. The participants in the study also were cognizant of some instances of negative perception of the Chinese people in the eyes of the international community and suggested its mitigation through perfecting their own behaviour (Lu 2017: 102). This ties into a group identity schema whose facets change based on whether the context is international or national as well as association to one's cultural values, in this case, Confucianism and the degree of adherence to them. The principle that to set an example of morality one must strictly adhere to the cultural values of Confucianism shows a deeply ingrained cultural belief and one that is associated with ideals such as perfection and high morality. Another associated concept Guomin or 'National people', which took root during the twentieth century and played an important part in influencing the philosophical and moral attitude of the individual, also informed the behaviour of an immigrant person among other immigrants as well as their own view of the morality of their behaviour. Finally, all this contributes to immigrant persons viewing themselves in the self-assumed role of exemplars of their

culture, which they consider highly significant in the context of a multi-cultural environment.

2.1.2 Cultural categories

Cognitive categories are categorizations of mental representations of real-world entities grouped using some criteria. This process of categorization leads to the formation of concepts (Murphy 2020). Categorization also enables quick comprehension of new instances and entities and promotes processing efficiency. Recent research on cognitive categories suggests that they have the following fundamental characteristics –

(1) There need be absolutely no resemblance between members which form a category nor is it necessary that they have any inherently similar attributes at all, for instance, things humans may categorize as 'nonsense'. (Lakoff 1987: 12)

(2) Categories are not well-defined, are dynamic and membership often exhibits variance within and across members. Thus, categories are fuzzy. (Lakoff 1987: 12, Murphy 2020)

(3) Categories contain exemplars and prototypes which are 'typical' members, most readily recalled when thinking of a category. A prototype is a member which possesses the most features representative of a category. All members of a category may not be equally representative of the categories' properties and members which are more dissimilar to the prototype become less typical of the category. (Lakoff 1987: 12, Murphy 2020) Typicality is determined by features which are common in one category but are not common in other categories. This is from the Family Resemblance theory (Rosch & Mervis 1975: 598-599, Murphy 2020). Categories also contain exemplars, previously encountered instances of a category which function as benchmarks to compare against, for future instances (Storms, De Boeck & Ruts 2000: 51). They enable forming the conceptual representation of what a category must be.

(4) Categories are organized hierarchically in order of specificity as superordinate (general), basic and subordinate (specific). Of these, the category labels in the 'basic' level are the ones most often used to identify an entity in the real world. However, the level of specificity itself may differ between individuals, with basic categories

being defined at a higher level of specificity, as observed for example, in the preferences of domain experts (Murphy 2020)

(5) Categorizations of new, unseen entities depend upon the knowledge we have of the world. Thus, it is easy to learn and categorize features of an entity, especially non-human and occurring with inherent, natural traits, which seem to be coherent and well-connected by virtue of the knowledge one already possesses. (Murphy 2020)

Cultural categories are essentially cognitive categories, formed through exposure to language and the cultural environment. They include a combination of foundational cognitive categories and schemas. Indeed, culture itself is a category albeit a large one, containing a multitude of diverse sub-categories. Culturally influenced categorizations may be a result of differing world views and the expressions vary across languages with respect to what implicit categorization decisions are made. Cultural categories are used in conjunction with cultural schemas. (Sharifian 2017b: 17) A study by Roberson et al. (Roberson, Davidoff, Davies & Shapiro 2005: 378-411) provides support to the assertion that linguistic tendencies may cause cognitive differences. It reports that the defined color categories in various languages range from two to twelve (Roberson et al. 2005: 379) and the absence of certain color categories within some dialects of a language may find attribution in environmental factors and societal needs (Roberson et al. 2005: 384) and may be constrained to some extent by language even though perceptually there may not differ significantly. The results of a study by Puglisi et al. (Puglisi et al. 2008) using a simulation game of a linguistically evolving population, show that while perceptual categories occur at an individual level, linguistic categories occur through interaction between the members and only a small, finite number of categories are required for communication and the full spectrum of perceptual categories though perceived, may never be used.

2.1.3 Cultural metaphor

A metaphor is a comparative cognitive process which also happens to be a component of language called a figure of speech. Metaphors map one conceptual system called the target onto another called the source. The target concept is usually an abstract one while

the source concept is one which is grounded in physical reality (Kövecses 2005: 5-6). Associated sets of concepts which can be metaphorically expressed in relation to one another in terms of spatial orientation are called Orientational metaphors (Lakoff & Johnson 1980: 14, Palmer 1996: 104) such as SUCCESS IS HIGH, FAILURE IS LOW, TIME VIEWED IN TERMS OF SPACE as seen in the expression 'occurrences spaced out across time'. Those which employ physical objects/experiences such as sensations or the human body are called Ontological metaphors (Lakoff & Johnson 1980: 25, Palmer 1996: 104) Etymology shows us that metaphors are not only employed in expressions ("a heart filled with love") but also in the origin of words, for instance comprehend (from Latin "to grasp") as well as in names indicating parts of a home or automobile as observed in some cultures. (Danesi 2004: 148-151)

Kövecses (Kövecses 2003: 311-312) in his take on the conceptual metaphor theory (CMT) first introduced by Lakoff and Johnson (Lakoff & Johnson 1980), lists out the following as the interacting components of a *conceptual metaphor* – experiential basis, the source domain, the target domain, the relationship between them, linguistic expressions associated with the metaphor, the mappings involved in building the metaphor, entailments i.e. additional mappings arising out of the mappings already made, blends i.e. new understanding of both the source and target domains due to the comparison being made, non-linguistic realization where the metaphor manifests in social reality and cultural models produced by the metaphor. Kövecses, in a later version of his theory (Kövecses 2005: 5-6), also includes in the components, the neural structures and connections which are activated between areas in the brain corresponding to the source and target concepts.

Metonymy, the practice of using a concept which is a part of or closely associated with another, to reference it, is an important process within cognition (Lakoff 1987: 77, Palmer 1996: 232) and consequently, within the process of metaphorization. Some examples of metonymy and particularly synecdoche, are the usage of 'The Crown' to refer to the British monarchy in the UK or as observed in the now famous expression 'Houston, we've had a problem' where Houston refers to the personnel at the Houston

NASA mission control center. Metonymy is an interesting phenomenon, the part of a concept selected to represent the other may change with respect to the context and the situation. For instance, the British Monarchy may be represented by 'The Crown' or 'Buckingham Palace' or 'Windsor' depending on the context and the message intended to be conveyed. Metonymical thinking is not restricted to well-known entities or persistent parts, it can be ad hoc and temporal such as referring to people at a party using the features of their garments or accessories like 'Mr. Floral trousers' or 'Glass slippers'.

A cultural metaphor is a target concept fit within the conceptual system of a source driven by cultural beliefs and perceptions. The constituent parts of the target concept are analogized with appropriate parts within the source concept and this appropriateness is determined by the cultural perception of the concept as well as the general cultural worldview (Sharifian 2017b: 18). Sharifian (Sharifian 2011 :21) observes the difference in perception in what qualifies as a metaphor from within the culture or emic perspective and external to the culture or etic perspective. This is to say, what may look like a metaphorical conceptualization to an observer outside the culture may in fact just be a worldview and not at all figurative for a member of the culture. Many times, cultural metaphors can be observed in proverbs, sayings and expressions which been passed down through time. But these may also be produced on the spot. Many cultural metaphors are also widely seen in media in response to trends or recent happenings. Figure 5 below shows how multiple metaphors are built by mapping elements within a target domain to source domain based on some similarity of structure or function and how new understandings of the source domain arise from such comparisons.

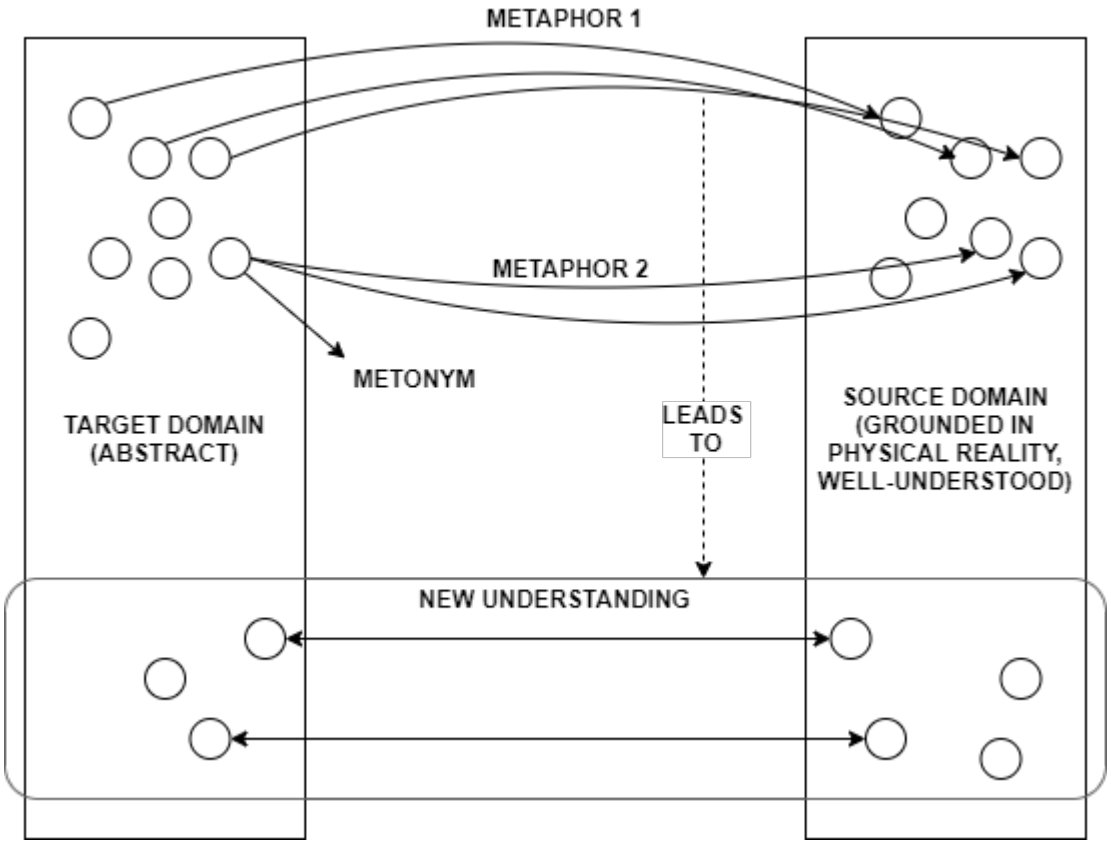

Figure 5. Components of Metaphors

Metaphors can be classified as primary or complex with the primary ones involving concrete source domains based on subjective experience (Grady 1997: 47-48). Primary metaphors are formed of components existing within cognition at a fundamental level. They give rise to propositional bases over which more complex meanings can be placed. Metaphors differ between cultures in the components selected for mapping, the domains chosen which may happen to be culture-specific and on different levels of embodiment which creates varying levels of universality and specificity, both within and across cultures (Kövecses 2010: 203).

Metaphors rely on cultural schemas for the selection of the domains and the components involved in the mapping process and use them to construct the underlying meaning of the conceptual metaphor. The cultural schemas associated with the source and target domains and the relationship between them are in turn, modified to

accommodate any new relevancies provided by the constructed conceptual metaphor. Glucksberg argues that metaphors are rarely understood through comparison and are primarily categorizing functions, what he calls 'class-inclusion assertions' (Glucksberg 2008: 68 - 69), which place both the source and target domains within some ad hoc category.

2.1.4 Data from cultural research

In summary, all three components of cultural conceptualizations reviewed above interact with and affect one another constantly. Sharifian (Sharifian 2011: 15) holds the view that categories are inherently cultural structures while schemas are mental structures which are invoked in many different aspects of language as well as behaviour and provide the basis for pragmatic acts (Sharifian 2011: 14) . Cultural metaphors certainly fall more on the creative side and are an effective way of understanding abstract concepts through the understanding of more tangible concepts rooted in physical experience such as time, space, temperature, the human body etc.

Singh (Singh 2002: 239-240) argues that not only language but other cultural artefacts such as texts, objects, traditions, rituals must also be considered to infer the cultural schemas underlying cultural cognition. Palmer also observes that language would be the only deciding factor of worldview in a culture which has no other means of communication (Palmer 1996: 291, Sinha & De López 2000: 29). Sinha et al. also argue that cognitive interpretation based on language being learnt is partly dependent on non-linguistic practices in different cultures (Sinha & De López 2000: 35-36).

Yanying Lu shows how conceptualizations of self and membership can change within members of the culture when they find themselves in a cross-cultural context, separated by geography and exposed to an external culture (Lu 2017: 90). Mckellin's study of the Managalase language of Papua New Guinea describes categories of kinship based not only on lineage but also on social practices such as working together, food sharing ,exchange of goods etc. These categorizations feed into cultural schemas which encode appropriate social practices based on kinship and affect/give rise to other schemas,

which then collectively form the basis of behavioural decisions within the individual in a social setting (McKellin 2017, 155-158).

In studying kinship categories in the Australian Aboriginal language Kuuk Thaayorre, Alice Gaby observes that vocative terms used for relations such as 'Father' are usually applied to a much larger set of people than is seen in other cultures. It is also common for strangers from the culture meeting for the first time to first identify and establish a kinship relation (Gaby 2017: 178). However, it can be observed from traditions and practices that a clear distinction is made between one's biological father and others who also fall within the 'father' category i.e., there are covert categories which come through in behaviour (Gaby 2017: 185).

Alexandra Bagasheva's comparative study of the use of body parts, specifically parts of the mouth, in conceptualizations within two different cultures shows how these body parts are categorized differently based on the context and their use in metaphors. It shows how studying metonymies and metaphors can yield valuable information on associated cultural categories (Bagasheva 2017: 218). Not only do these conceptualizations vary between the cultures studied, but they also, through the mode and context of usage, reflect the differences in cultural signification of certain kinds of social behaviours (Bagasheva 2017: 206). This study highlights the interactions between all three primary components of the cultural linguistics framework.

Figure 6 shows the interaction of culturally constructed conceptualizations with the external environment and the internal environment, i.e., the cultural community and the mental environment of an individual agent.

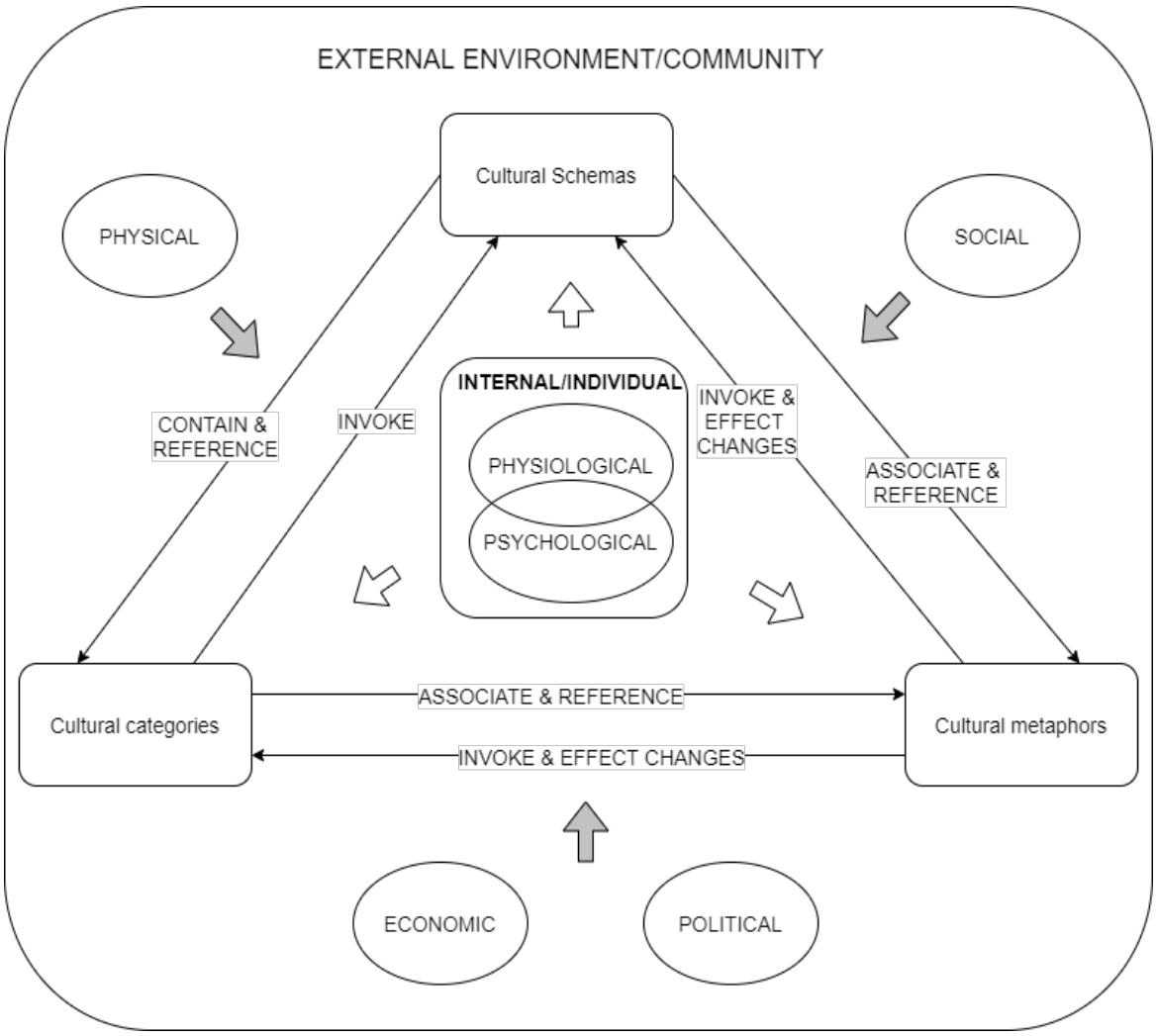

Figure 6. Interactions of the components of cultural conceptualizations

Wei-lun Lu (Lu 2017: 55-56) describes the Taiwanese cultural schemas of a person being perceived as a 'lotus' and 'heaven being full of lotuses', where the lotus stands as a symbol of purity/holiness. This association is itself a metaphor since the lotus is perceived as 'the flower which is rooted in slime and yet rises to the surface'. This in turn, is another complex metaphor where dirt/slime is seen as an undesirable environment whereas rising to the surface is seen as dissociating with and thus overcoming the undesirability and rising to a state of purity.

According to Ning Yu (Yu 2017: 69), the popularity and significance of the Beijing opera in the Chinese society has given rise to the Chinese cultural schema where life is perceived to be akin to an opera. Cited instances of expressions compare people with actors and aspects of life with roles in the opera, the various acts which constitute the performance, physical artefacts such as the stage and even the venue. Metaphors involving this cultural schema is shown to be used in a variety of contexts as well as assuming various meanings depending on what aspects of the target domain is selected for mapping.

Figure 7 below shows the different external factors affecting origination and change of cultural conceptualizations. This information is not encoded within the framework of Cultural Linguistics but is required to be inferred from cultural research. In some instances, traditions and behaviours, which go along with language use, provide additional support for and are even, the foundation of cultural conceptualizations. Thus, we see that it is in specific cultural data and language use that one can observe cultural schemas, categories and metaphors and the interactions between them, directly in action. In observing the association of specific instances of these components with some contexts and restricting them in others, we can determine what are the associated connotations and what may or may not be appropriate contexts for their use.

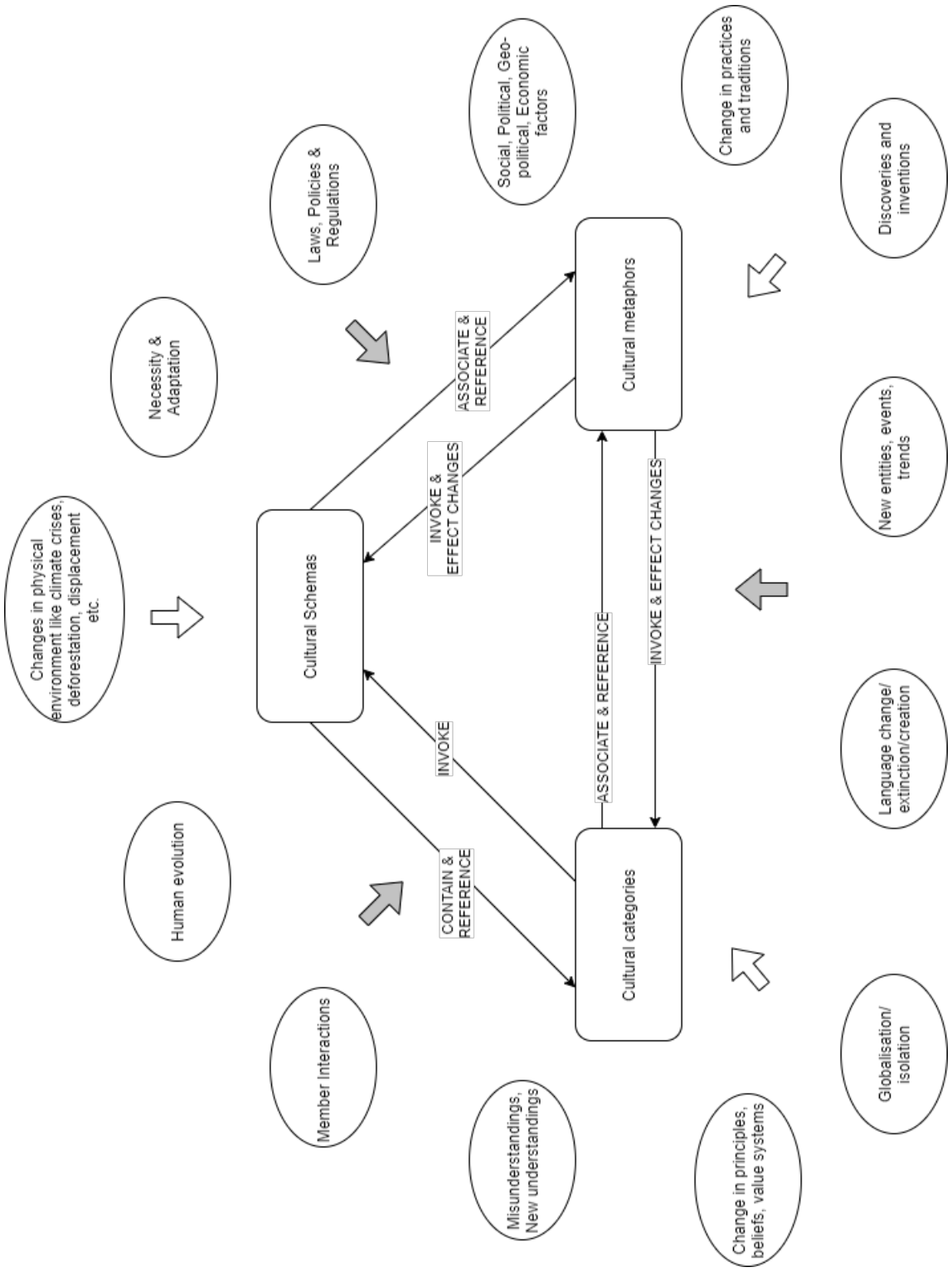

Figure 7. Factors affecting cultural conceptualizations

2.2 Web ontologies and the semantic web

Ontologies are formal models of knowledge made explicit through expressing it as hierarchical categorizations and relationships. Ontologies form a part of the content within the semantic web, an extension of the world wide web and they form a network of meaningfully represented data (Taye 2010: 183). They help in making hidden assumptions explicit as well as in analyzing knowledge, and enable the sharing and reuse of knowledge. (Noy & McGuinness 2001:1)

2.2.1 Why ontologies

Ontologies express, in the form of classes and relationships, the shared understanding and knowledge of a domain. They are the formal representation of concepts within the domain which have gained consensus from domain experts. Ontologies are developed with the primary objective of sharing knowledge and enabling reuse of this knowledge by both human and software agents (Musen 1992: 440, Noy & McGuinness 2001:1). Reuse in turn, reduces effort, ensures consistency across development initiatives and promotes efficiency in automation (Musen 1992: 451)

To understand the significance of ontologies, let us make a comparison with another method of linking information. There are numerous ways to link related information of which relational databases are a popular choice. As an example, in databases , data is organized under a fixed metadata framework in a structured manner within tables. The data within the tables can be considered instances of some class stored along with the value of their attributes and these instances may be connected to instances of other classes through some of these attributes. However, the information is in fact, a set of assertions and a key identifier for an instance is mandatory for its identification as being part of the class. The data itself can say nothing more than what the literal values stored in the tables contain. That is to say, there can be no automatic knowledge gain from the information thus stored, unless made sense by an external agent or process (Musen 1992: 438).

Ontologies, on the other hand, can express the relationships between the fixed metadata which databases contain as well as the data instances. Databases like the web serve to only store information whereas ontologies serve to describe the knowledge contained in the information. Since ontologies describe the knowledge about some complete subset of a domain, they can potentially be re-used easily (Obrst 2003: 366). Ontologies also contain rules and property restrictions on both cardinality and possible values.

Another important distinction between databases and ontologies is the closed-world and open-world assumption. The closed-world assumption states that anything that is not known to be true is false. Databases are closed-world systems. In the context of databases, we may consider all data as assertions or facts. Thus, from the database's point of view, only these assertions are true and anything outside these facts is false. The open-world assumptions states that a statement may be true whether or not it is known to be true. Ontologies are open-world systems. Systems with open-world assumptions can be certain that some assertion is false only if it is known or can be inferred to be false. For example, if a database contains the fact that a tomato is a vegetable, and if asked the question 'Is a tomato a fruit?', would return an answer equivalent to 'No'. But if the same fact is coded in an ontology, the answer would be equivalent to 'Unknown'.

Some of the most important functions of an ontology are reasoning and inference. Reasoning allows for the class membership to be inferred from its defined properties and attributes. With respect to automation, ontologies have the potential to make automatic agent functioning closer to the functioning of entities in the real world by providing them access to knowledge of entities and relationships as they exist in reality. Ontologies can also model completely fictional domains, but the central idea is that entities and relationships so modeled still follow real-world class hierarchical models and inference models which are essential to what one may philosophically consider as knowledge acquisition.

Thus, one of the primary goals of developing ontologies is to add meaning to data and convert it to knowledge. This is especially relevant in machine learning and artificial

intelligence where there is a large amount of data available to be ingested but the only useful information which can be extracted from it without reasoning capabilities is patterns. Inferences gained from depending on such patterns, are essentially a brute-force approach to knowledge. However, adding ontological knowledge to such enormous amounts of data solves the all-important problem of context modelling and when data has context, it is able to be applied in intelligent ways.

2.2.2 What ontologies are made of

An ontology is primarily a collection of concepts called classes, their properties and the relationships between them. These components along with instances i.e., specific values of these components, form the knowledge base (Noy & McGuinness 2001: 3). Ontologies also contain assertions or facts about classes and relationships, these assertions are called axioms.

2.2.2.1 Classes and Relationships

Classes are abstract concepts which categorize things in the real world using some common denominator and can have sub-classes which represent concepts at increasingly granular levels. A sub-class has attributes of the main class but also some distinct properties which separate it from other sub-classes. Thus, an instance of the sub-class is also necessarily a type of object belonging to the main class but not vice-versa. There is no property inheritance from the main class to sub-class as one may come across within some object-oriented languages. Rather, the main class is a generalization of all of its sub-classes. For instance, a bird is not categorized as an entity that flies because the general definition of a bird includes this attribute. Rather, an entity which is animate and has wings may be a bird and since there are instances of such entities which do not fly, the class 'bird' includes entities which may or may not fly.

Relationships between classes, referred to as properties, relate individuals of a class to individuals of another whereas attributes relate individuals to data values. Relationships between individuals are called object properties while those between individuals and data values are called data properties. Different classes may have the

same or similar attributes, such as 'Type' which may be shared by different classes and while these classes may have the same conceptual definition of the 'Type' attribute, the type values of one class may be completely different from the type values of another.

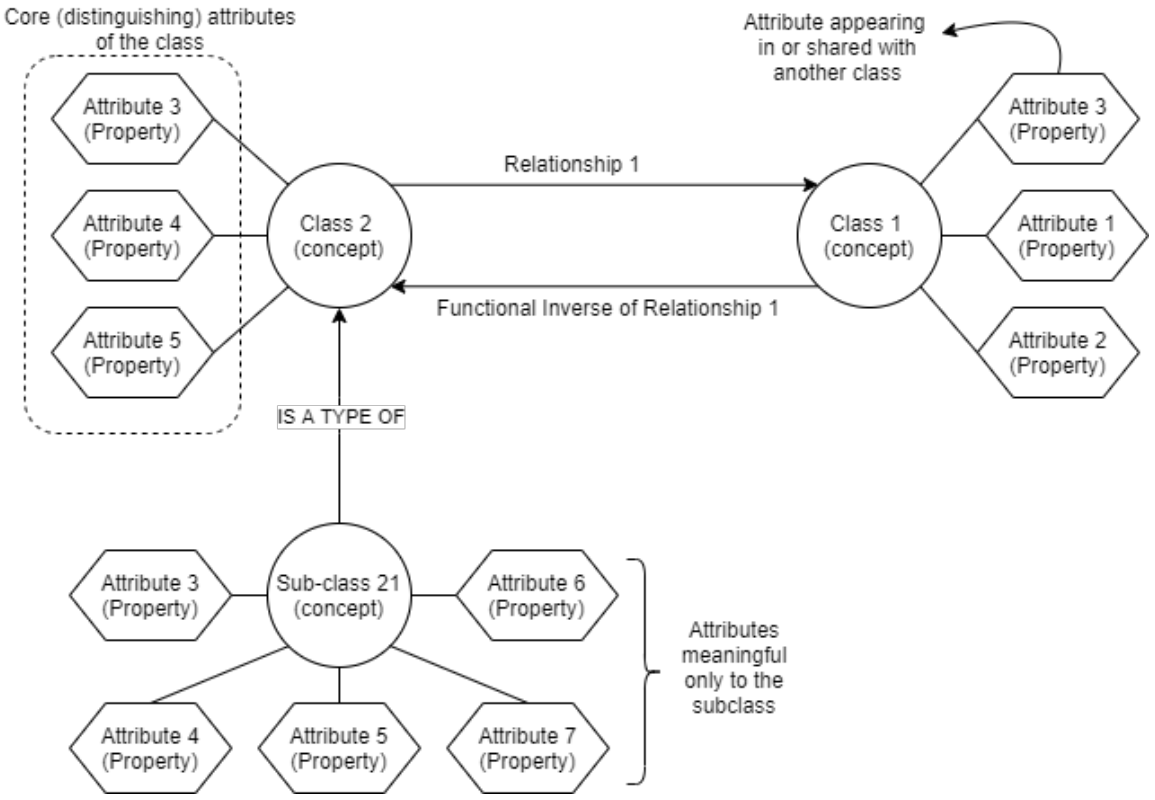

Figure 8. Components of an ontology

In Figure 8 above, we see that sub-classes have the same attributes as their superclass, but they may also possess attributes which only be meaningful when applied to them or when applied in the context of considering multiple sub-classes. Classes and their sub-classes are joined with other classes using relationships. Relationships work both ways and the relationship in one direction is the functional inverse of the relationship in the other direction.

2.2.2.2 Axioms and Reasoning

Axioms are assertions about the domain coded within the ontology. Any class and sub-class relationships, properties and attributes established within the ontology are

essentially assertions. All assertions are true by definition and given all assertions for the domain, reasoning is the process by which all possible deducible statements can be arrived at, through inference. A popular example used to demonstrate assertions and inference is–

Assertions : 1. Humans are mortal. 2. Socrates is human.

Inference: Socrates is mortal.

In ontologies, axioms are also the means of expressing necessary and sufficient conditions for an instance of a class. These axioms are called **class equivalence** axioms. For instance, the class constituting Earth-like planets can be conceptually represented as the things which are classified as Planet and have life. Therefore, we can write a class equivalence axiom that defines Earth-like planets as the things which are classified as planets and have life.

Similarly, assertions about **disjoint** classes are also axioms. Two classes are said to be disjoint when they cannot have any common instances. For instance, the class of all persons who are dead is disjoint with the class of all persons who are alive. A **covering** axiom ensures that an instance of a class belongs to one of its possible sub-classes, all of which are disjoint from one another. It places a value restriction on the class definition which ensures that all of its instances are categorized under one of its possible values. For example, an entity can be categorized under the class of *All Things Moving South* only if it is moving either straight South or South-East or South-West but not otherwise. A **closure** axiom defines all the possible subsets of a class and places both a value and an existential (cardinality) restriction on the class definition. For example, a rainbow can contain an arc of only one of the VIBGYOR colours and must contain at least one arc of each of those colours, failing which it cannot be classified as a rainbow. All the types of axioms described above are important for proper reasoning, maintaining consistency within the ontology as well as to ensure reasoning performance, especially in larger ontologies.

2.2.3 RDF and RDFS

The Resource Description Framework (RDF) as defined by the W3 specifications[1,2] is a way to make some statement or assertion about a resource on the web. A resource on the web is usually represented in the form of a Universal Resource Indicator (URI) which functions as a unique identification of a resource on the internet. The RDF *conceptual* statement is a fixed three-part format consisting of a subject or the resource on the web, a predicate which indicates a property of the resource and an object which indicates the value that the predicate can take, as shown in Figure 9 below. RDF is implemented in the Extended Markup Language (XML) and follows the XML syntax within the framework of the web.

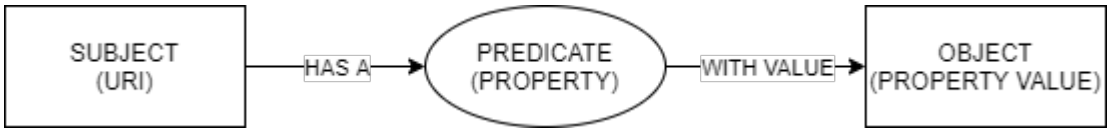

Figure 9. The parts of an RDF Statement

RDF Schema (RDFS)[3] is a meta-layer which adds semantic vocabulary to the RDF thus enabling the expression of URIs as concepts, properties and relationships between concepts. It also recursively defines itself. This is the technical implementation of the equivalent notions defined within the context of a web ontology. Using RDFS, instances (resources) can be grouped and categorized under one or more classes and properties can have their domains and ranges defined.

[1] https://www.w3.org/TR/rdf11-concepts/
[2] https://www.w3.org/TR/rdf11-primer/
[3] https://www.w3.org/TR/rdf-schema/

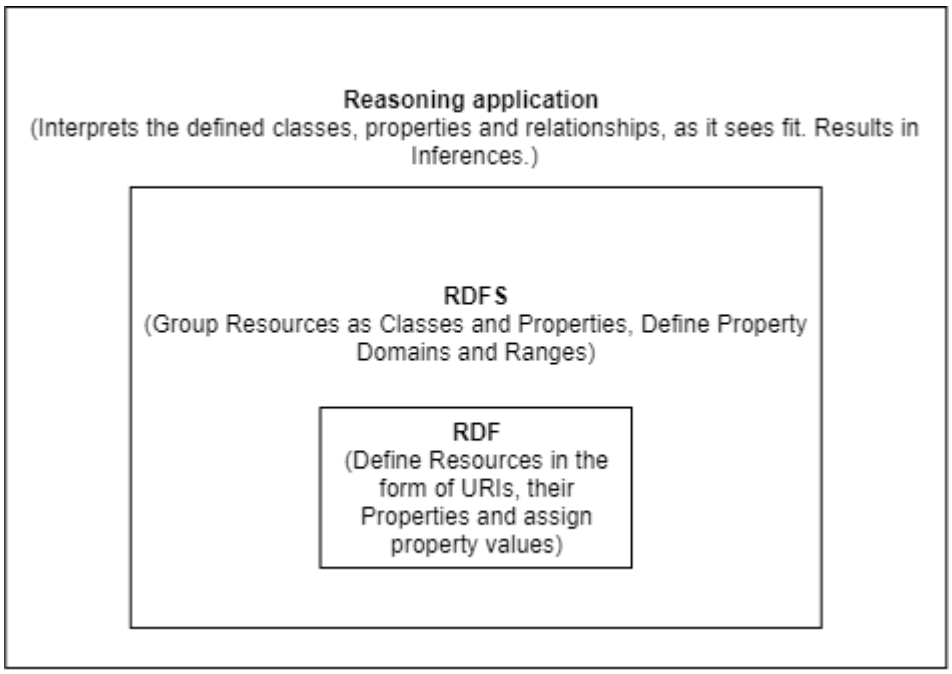

Figure 10. The RDF and RDFS layers

However, neither RDF nor RDFS provides a mechanism to interpret these organizing structures i.e., no reasoning and inference is possible within RDF and RDFS. An external reasoning application may be able to define how to interpret them and then perform reasoning and inference. The relationship between RDF and RDFS is shown in Figure 10 above.

2.2.4 OWL

The Web Ontology language or OWL, specifically version 2, is a logic-based, computational language used for expressing ontologies (Hitzler, Krötzsch, Parsia, Patel-Schneider & Rudolph 2009: 6) and is based on a subset of first-order logic called Description Logics. Description Logics(DL) are a family of languages, which are used to describe knowledge of a domain in a way that is structured and well-understood (Baader, Horrocks & Sattle 2008:135). The two important components of DLs are the TBox containing terminological knowledge such as concepts, classes and relationships and the axioms describing them and the ABox containing assertions about instances (Baader, Horrocks & Sattle 2008:136, Kollia 2014: 2).

Consequently, OWL primarily consists of axioms which are assertions (ABox), entities which are classes, properties and individuals, and expressions which are relationships between the entities (TBox). For example, the concept of an Earth-like planet can be expressed as OWL axioms using the functional-style syntax[4] (Kollia, Glimm & Horrocks 2011: 383), one of many syntaxes for OWL, in a number of ways as follows –

SubClassOf(EarthLikePlanet ObjectIntersectionOf(Planet ObjectHasValue(has Life)))

SubClassOf(ObjectIntersectionOf(Planet ObjecthasValue(hasLife)) EarthLikePlanet)

The above axioms state that an *Earth-like Planet* is a subclass of both *Planet* and of the set of objects which have the value *Life* for the property *has* and that the set of objects which belong to the class *Planet* as well as have the value *Life* for the property *Has* must be an object of class EarthLikePlanet, which defines them as equivalent classes. Here, *Life* is both the value of the property and an individual of another class, possibly *ThingsOnPlanets*. The above axioms can be equivalently written as follows,

EquivalentClasses(EarthLikePlanet ObjectIntersectionOf(Planet ObjectHasValue(has Life)))

OWL provides a rich subset of meta-vocabulary to express knowledge about a certain domain, various datatypes and data ranges, cardinality and value restrictions and properties such as transitivity, disjointness, reflexivity and asymmetricity. However, OWL is a declarative language used to describe the state of things in some world and cannot compute inferences. But OWL tools such as reasoners can be used to compute inferences from what is asserted in OWL. While OWL can describe knowledge, a formal syntax is required for OWL statements to be coded and exchanged between tools and applications. This process of breaking down conceptual knowledge into statements following some interchange syntax is called serialization. The recommended exchange syntax[5] is the RDF/XML format which is mandatory for all OWL tools to support. In using the RDF/XML syntax, OWL reuses RDFS and RDF vocabulary terms as well as extends them with OWL specific vocabulary.

[4] https://www.w3.org/TR/owl2-syntax/
[5] https://www.w3.org/TR/owl2-overview/

Figure 11 below shows the relationship between OWL, RDFS and RDF.

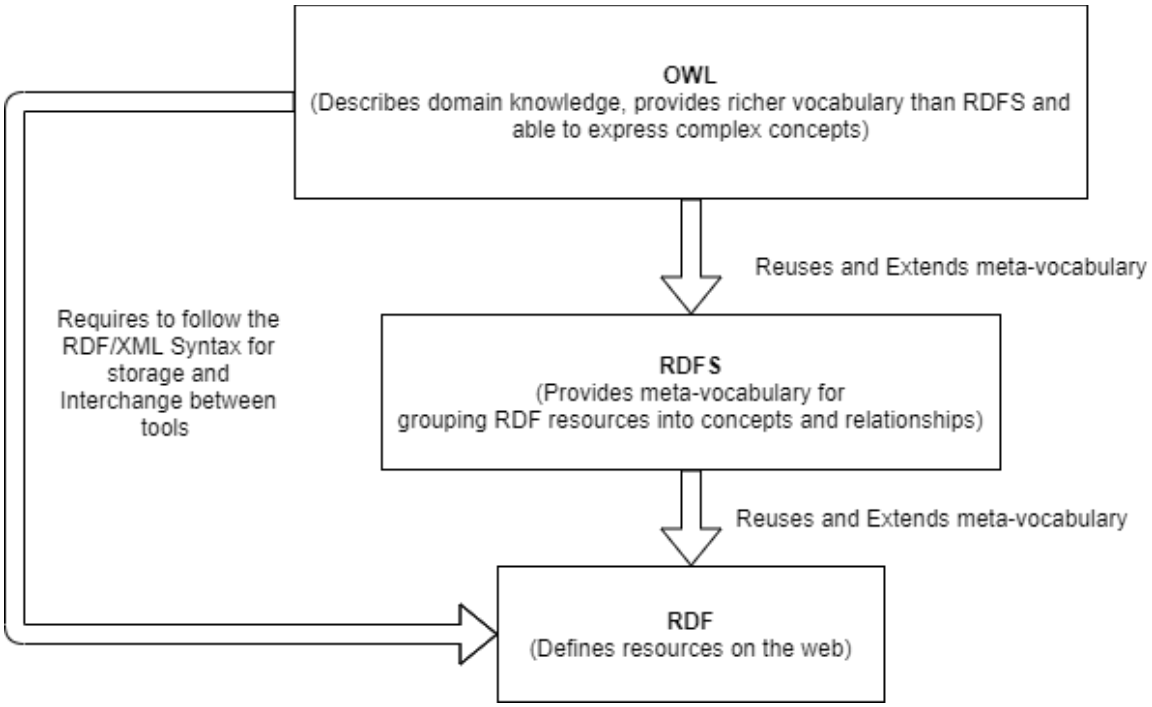

Figure 11. OWL, RDFS and RDF

While RDFS was developed as a way to give meaning to the resources described on the web in RDF, OWL was primarily developed to describe a subset of knowledge. It leverages and extends the existing RDF-RDFS Syntactic Framework for storage and interchange. Apart from the RDF/XML syntaxes, there are other syntaxes such as Turtle, the Manchester Syntax as well as the functional syntax used above, which can be used for OWL serialization. The Manchester syntax in particular is easy to read and used in a variety of Ontology development tools such as Protégé.

2.2.5 Ontology Engineering methodologies and Ontology learning

Ontology engineering methodologies prescribe a framework with the necessary processes and best practices to be followed within each phase of development, enhancement and maintenance of ontologies. Ontology 101 and Methontology are some examples. While many methodologies have been proposed and differ in their

recommendations, most agree on the following two steps. The first step is to collect core subject matter in the domain and gather requirements and determine the scope and granularity of the ontology. Next, the domain knowledge must then be formalized by expressing in terms of concepts and relations, starting from the most-specific to the general or the bottom-up approach, or from the most general to specific called the top-down approach or the middle-out approach where the core concepts are first modeled and more general and specific ones, later in the process (Gandon 2002: 85). Uschold and Gruninger present an argument for the preference of the middle-out approach (Uschold & Gruninger 1996: 21, López, Gómez-Pérez, Sierra & Sierra 1999: 36) since it starts with modelling the core concepts first and then generalizing or specifying as required, which saves effort and time in maintenance as well as rework. Data acquisition for ontologies can be done manually by human subject matter experts or automatically using programmatical methods. Data can also be derived from structured content such as databases which already have some relationships defined and implemented. Finally, implementation and evaluation of the ontology must be designed to guarantee maximum efficiency and consistency with minimum necessary information.

Ontology learning is the automatic construction of ontologies from domain-specific text corpora using machine learning methods. It is a relatively new approach to building ontologies and is widely and actively researched. It is recognized as a difficult task owing to the unavailability of a domain thesaurus and needing human expert intervention in any case (Lee, Kao, Kuo & Wang 2007: 547, Zouaq & Nkambou 2008: 51). Ontology learning consists primarily of the following sequential steps – term extraction, disambiguation and identifying synonyms, identifying concepts and relations, establishing hierarchies, and finding rules (Toledo-Alvarado, Guzman-Arenas & Martínez-Luna 2012: 399). In order for term extraction to yield accurate results, the text provided as data must be carefully selected, cleaned and prepared. There is also no clear agreement on what is considered a concept (Toledo-Alvarado, Guzman-Arenas & Martínez-Luna 2012: 399). Lee et al. (Lee, Kao, Kuo & Wang 2007: 563) suggest using manual ontology construction as a faster means of achieving a usable ontology. Zouaq et al. (Zouaq & Nkambou 2008) demonstrate the successful construction of an ontology from text in the education domain. However, it must be noted that the term extraction

step uses documents containing pure foundational concepts, and relationships are extracted from linguistic structure (Zouaq & Nkambou 2008: 53). Their approach also uses exhaustive data preparation methods and ontology evaluation exercises.

Like ontology learning, ontology engineering is another widely researched area with new guidelines and recommendations constantly being presented. The domain of the ontology should be well defined, and one must not try and model all concepts and information within the domain but only produce an essential subset of concepts and hierarchies which can yield meaningful knowledge for the end application (Noy & McGuinness 2001: 19). In developing new ontologies, reuse of existing ontologies is recommended (Noy & McGuinness 2001: 5-6, Simperl 2009: 906) to leverage the knowledge already available, but the methods of integration are not always efficient (Bontas et al. 2005: 345, Simperl 2009: 923).

While Gyrard et al. (Gyrard, Serrano & Atemezing 2015: 415-416) list ontology reuse as a best practice, they also recommend that only well-maintained ontologies be reused. Evaluation is the next step and can be done at various stages of development from design to syntactic checking as well as the final implementation. Many approaches have been proposed such as comparison with other benchmark ontologies, end-user validation, verification by fitting a test data set in the model produced and verification by human domain experts (Brank, Grobelnik & Mladenic 2005 : 1). Gyrard et al. (Gyrard, Serrano & Atemezing 2015: 415) also recommend sharing and publishing the ontology which may encourage reuse. Finally, production of detailed documentation is emphasized by many in the research and development community.

2.2.6 General and Domain Ontologies

Web ontologies are mostly domain-specific i.e., they are made to express concepts within a particular domain such as bio-medical imaging, e-commerce, manufacturing etc. Ontologies define and use their own custom vocabulary and can restrict usage for accessing applications to this set of vocabulary, thereby standardizing the use of the knowledge represented for the domain (Jacob 2003: 22) However, there are also

ontologies which are foundational i.e., ontologies which express knowledge about the most basic nature of entities and events within physical reality. Some examples are BFO, DOLCE, GFO, SUMO and OpenCyc (Keet 2011: 321) .

2.2.7 Cultural Ontologies and databases

DOLCE is a cognitive and linguistic ontology and has been reused with CIDOC Conceptual Reference Model which is a cultural heritage ontology developed for museums (Doerr 2009: 468, 474). Phefo et al. (Phefo, Kefitiley & Hlomani 2015: 529) have suggested a cultural knowledge ontology which includes language, art, geographical region, heritage, belief systems and religion, among others. Ontolex-lemon model is a lexical ontology for language data and contains the description of a concept, specifically a word in the lexicon, as well as its usage (McCrae et al. 2017: 19). The model also allows for storage of the same concepts in various languages. Kirby et al. (Kirby, Gray, Greenhill, Jordan, Gomes-Ng, Bibiko, Blasi, Botero, Bowern, Ember, Leehr, Low, McCarter, Divale & Gavin 2016) describe a cultural database called D-PLACE which records geographical, environment, language, and cultural information of more than 1400 societies. This database records various cultural concepts along with supporting data as well as metadata about the source of the information.

Perhaps one of the most significant ontologies proposed for cultural knowledge specifically, is the Upper Ontology of Culture (UOC) by Blanchard et al. (Blanchard, Mizoguchi & Lajoie 2011: 179-212) which attempts to be the foundational ontology for culture-related concerns. It models the processes which causes the production and modification of cultural elements. The UOC describes the concept 'culture' by first describing in detail, the parts which produce it, namely the agent, its internal and external environment. The ontology places emphasis on representing the parts of a 'cultural agent' and its central focus is the cognition at the individual and group level and how it is integrated with culture at both levels.

2.3 Summary

The above sections presented an account of the literature on cultural conceptualizations and on web ontologies which were reviewed. It can be seen that there is no mention of an ontology which deals with conceptualizations since there is either none in existence or none that is publicly available or widely used. The analytical framework of cultural linguistics as seen from the description of its concepts is structured enough and well-suited to be organized in the form of a web ontology. Considering the potential for its application in various domains, the case for developing such an ontology becomes strong.

Chapter 3
Methodology and Findings

The methodology employed for this dissertation is document analysis and conceptual modeling. This includes analysis of published research and literature as well as narrative and prescriptive text on the various subject areas. Consequently, identifying documents and performing data collection was partially merged with the literature review.

3.1 What is considered data?

The goal of this work is to identify and model the components of cultural conceptualizations underlying natural language, with the objective of building a content ontology to be accessed by NLP applications. Therefore, some components of the cultural conceptualizations framework likely to be expressed in language and relevant to current NLP applications are considered data. Some relevant research on language and culture outside the Cultural Linguistics framework has also been included. More importantly, components underlying various cultures and their corresponding cultural practices, behaviour, categorizations, expressions, utterances, metaphors and literature, all demonstrated primarily in language, are considered data. In some cases, metadata for instances of such conceptualizations exhibited in traditions and social behaviour have also been included for additional support, when perceived as necessary or beneficial. Specific instances of language use, while featuring in data analysis, are too specific to be metadata and hence, excluded. The data thus collected is the aggregated set of cultural metadata which forms the framework within which culture-specific information can be placed.

3.2 Methodology

The first step was to review published literature on the analytical framework of Cultural Linguistics as well culture-specific research aligning with and employing this framework. Following this, various research papers on cultural conceptualizations were reviewed. The data obtained from document analysis was analyzed to identify the key components of the cultural conceptualization theory. This information was further supplemented with related research in Cognitive Semantics and Ethnosemantics. The components thus identified have been used to develop an ontological model to be fit within the framework of the semantic web.

3.2.1 Data collection

Data analysis was conducted manually and was iterative. A selection of research papers was first reviewed to collect the metadata i.e., culture-independent data from the cultural components forming the subject of the research. Then, further papers on other cultural components were reviewed to capture any metadata which did not feature in the first iteration. Successive iterations of analysis helped add and verify data which was already collected.

Corpus-based automatic methods were considered, but such methods usually require a lot of extensive pre-processing and preparation of data before it can be used and involve quite an amount of manual effort. As detailed in section 2.2.2, automatic analysis methods to generate ontologies are still being widely researched and there is no 'best method' to reliably generate ontology terms. Most methods use a combination of linguistic structure analysis and frequency determination to identify concepts. In culture-specific research corpus, this method tends to identify culture-specific concepts themselves instead of the metadata underlying them.

Another issue is that the information is encoded in linguistic data and the corpus is itself linguistic data using conceptualizations in the language of publication. Thus, in trying to

identify concepts within the core demonstrative part of the research paper i.e., the cultural topic it is about, we also would unintentionally identify concepts in the descriptive part of the text i.e., the concepts used to describe the target concepts. It must also be noted that the structure of the metadata we would like to identify is itself dynamic and shifts between cultures. Categorization of these concepts is not fixed and therefore, any categorizations generated automatically will require a rigorous review process. Further, considering this is perhaps one of the first exercises of building a web ontology for cultural conceptualizations, thorough manual analysis by a human who completely understands the objective of the exercise seemed the most fitting approach.

3.2.2 List of Publications considered Data

The following is the list of publications which form the input for the core research of this dissertation -

- 'Cultural conceptualisations of mouth, lips, tongue and teeth in Bulgarian and English' by Alexandra Bagasheva (Bagasheva 2017)
- 'Kinship semantics: culture in the lexicon.' by Alice Gaby (Gaby2017)
- 'Language, culture, and context' by Istvan Kecskes (Kecskes 2015)
- 'Cultural Conceptualisations of RIVER in Hungarian Folksongs' by Judit Baranyiné Kóczy (Kóczy 2017).
- 'Cultural conceptualisations of DEATH in Taiwanese Buddhist and Christian eulogistic idioms' by Wei-lun Lu (Lu 2017)
- 'Cultural Conceptualisations of Collective Self-representation Among Chinese Immigrants ' by Yanying Lu (Lu 2017)
- 'Grounding and Relational Schemas in Managalase, Papua New Guinea' by William H. McKellin (McKellin 2017)
- 'Family resemblance: Studies in the internal structure of categories' by Eleanor Rosch and Carolyn B Mervis (Rosch & Mervis 1975)

- ‘Cultural conceptualisations and language: Theoretical framework and applications’ by Farzad Sharifian (Sharifian 2011)
- ‘Cultural Linguistics: Cultural conceptualisations and language’ by Farzad Sharifian (Sharifian 2017b).
- ‘Prototype and exemplar-based information in natural language categories’ by Gert Storms, Paul De Boeck, and Wim Ruts (Storms, De Boeck, & Ruts 2000)
- ‘Life as opera: A cultural metaphor in Chinese’ by Ning Yu (Yu 2017)

3.3 Findings

Culture, one of the primary research subjects in fields such as anthropology and social psychology, has now permeated into other areas of research such as cognition and linguistics and there is now, an abundance of published literature on culture and its effects and the factors affecting it. However, within all these fields and especially cognition and cognitive linguistics, it is only relatively recently that researchers have acknowledged the interplay of culture, cognition and language (Sinha & De López 2000:26).

3.3.1 Modelling components of conceptualizations

It must be borne in mind that the modelling of cultural conceptualizations must happen at a group level since

- its components as defined within the cultural linguistics framework are, indeed, aggregates at the cultural level
- a fairly well-rounded and exhaustive core model can only be achieved if modelled at the group level, since individual conceptualizations are non-uniform and incomplete, with some only encoding the bare minimum
- only core and distinctive elements represented in a majority of the cultural individuals should be modeled so that the individual processes of

conceptualization are not rendered obscure or signified by any means, as irrelevant.

Therefore, the part of the ontology representing cultural schemas, categories and metaphors is meant to code information which is known and has gained agreement at the group level.

3.3.1.1 Modelling Philosophy

An important philosophy employed in modelling this ontology and which demands to be explicitly stated is that a distinction is made between cognitive components and cultural components of conceptualizations.

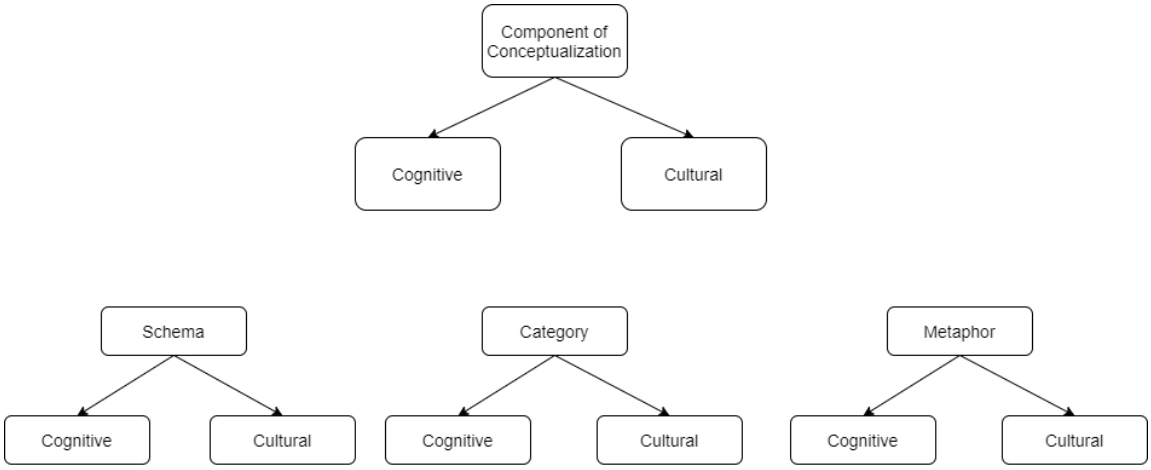

Figure 12. Modelling philosophy – Components of conceptualizations

The cognitive counterparts, such as the understanding of space, time, shapes, emotions etc., are assumed to be the most basic constituents underlying cognition and therefore, that they are formed before culture is induced within cognition. The cultural counterparts are assumed to encode the cognitive components within them. The cultural component may encounter multiple cognitive components as well as other cultural components and any new information pertaining to a context.

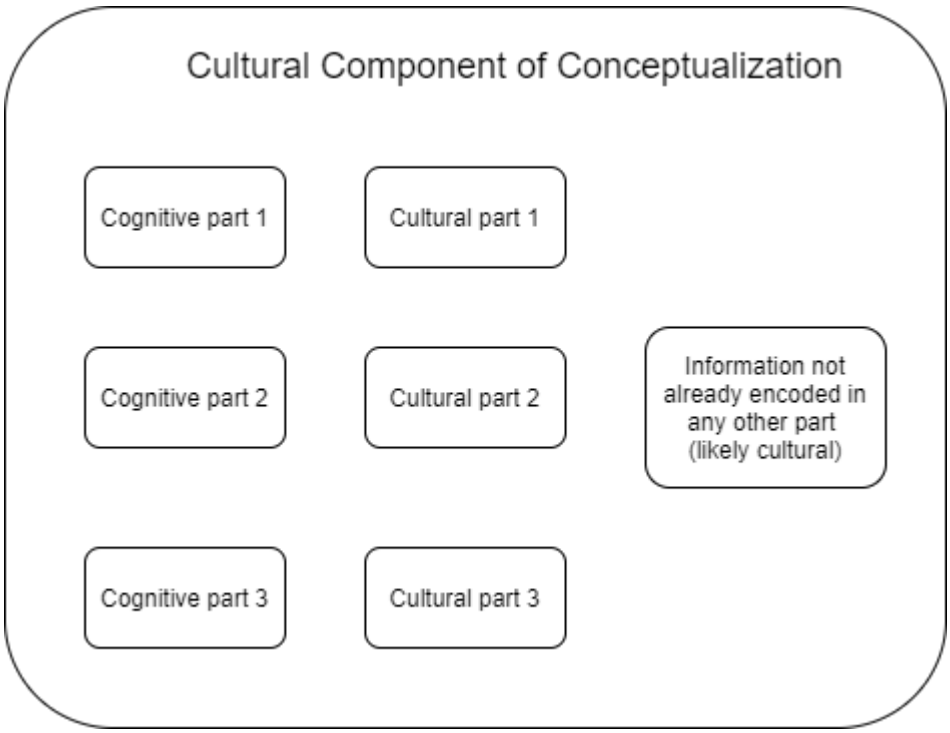

Figure 13. Modelling philosophy – Cultural component of conceptualizations

Figure 12 and 13 show how this view plays out. Schemas, categories and metaphors are differentiated as cognitive and cultural, and the cultural components may encode one or more of any of the cognitive components as well as other cultural components.

However, for decades, there has been an active debate on the effect of culture on cognition. Studies in neuroscience have shown that neural structures are strengthened and activated based on repeated exposure to activities and the argument is that if this is the case, then constant exposure to the same cultural environment must certainly be a factor in the development of these structures. Behavioural research shows that tasks associated with attention, memory, reasoning and categorization have significant differences between individuals of East Asian and Western cultures (Park & Huang 2010 : 392). This has also been shown to hold for comparisons made between other cultures as well as within cultures (Varnum, Grossmann, Kitayama & Nisbett 2010: 11). But Park et al. (Park & Huang 2010 : 399) also observe that the possibility of these differences being driven by environmental factors instead of cultural experiences must not be ruled out.

Nisbett et al. (Nisbett & Norenzayan 2002: 562) term some parts of cognition universal i.e., human infants are born with certain natural cognitive tendencies and mechanisms and more importantly, they propose that cognition and culture are *constituents of one another*. They talk of culture and cognition shaping each other where cognitive influences are observed in the similarities in perceptual understanding of reality in humans around the world and culture, in the differences in interpretation of situations in various societies (Nisbett & Norenzayan 2002: 562, 565). Even if these may deeply influence one another, they are still perceived as separate processes.

This consequently leads to asking if modelling schemas distinctively as cognitive and cultural components makes sense. Strandell (Strandell 2017) proposes viewing cultural schemas as the social counterparts of cognitive schemas. He suggests that the cultural schema be perceived as an analytical tool itself instead of as an entity which has an inherent, independent existence which one needs to decode. This I believe, sums up my approach towards the modelling process. The objective is not to try and model the cognitive functioning and workings of the mind, and whether or not cultural influences are intertwined with basic cognitive processes. Rather, it is to model in as much detail as possible, the parts of the analytical tool with which results of the naturally occurring social conceptualization process can be analyzed to yield a meaningful summary.

3.3.1.2 Modelling Categories

It is worth repeating that categorization is one of the most fundamental functions of cognition and thus, cognition is inherently categorizing. Contexts create new categories and attributes, and they expand or reduce the scope of classes.

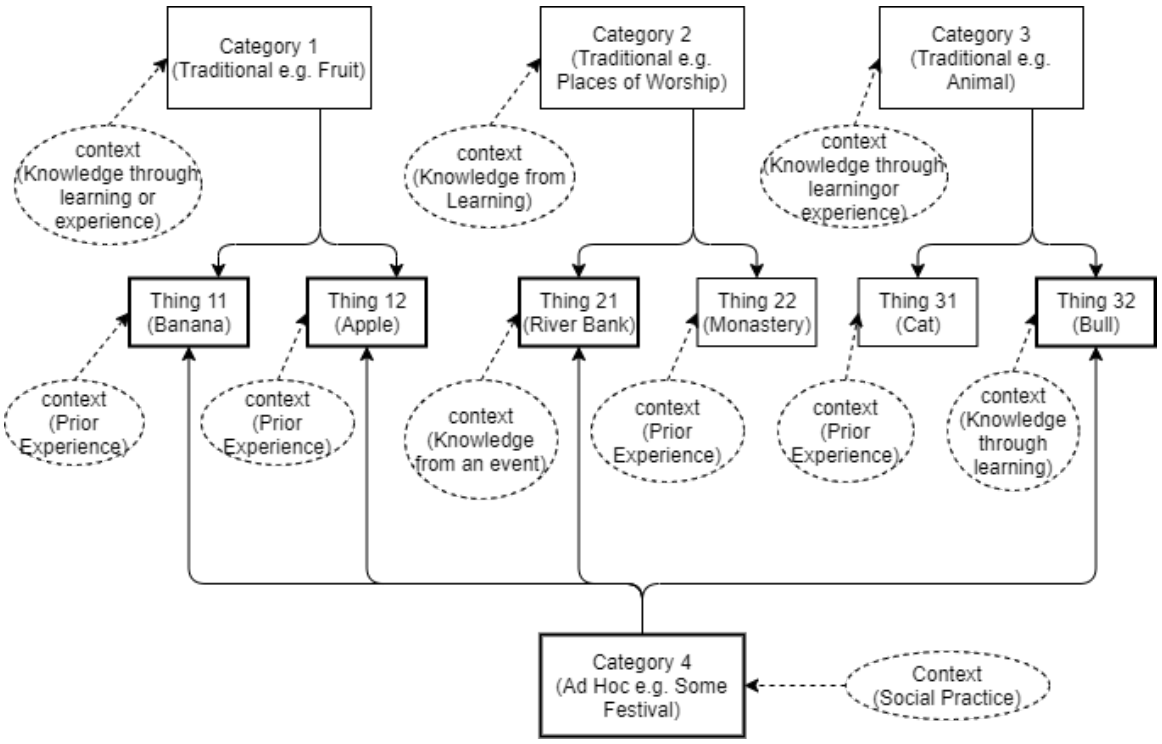

Figure 14. Components of a Cultural Category

The concept of an E-book did not exist before the invention of the internet. Thus, categories, classes and their attributes are dynamic and of which, some parts undergo constant change. Categories can be traditional i.e., that we which formally categorize in the world, or they can ad hoc or custom categories which cultural agents put together based on some context.

Figure 14 shows how different categories may be organized. All categories may have one or more contexts attached to them based on if the category is already learned or known. Thus, a category can be placed within the current context while being attached to a prior context. The figure also shows an ad hoc cultural category formed out of traditional contexts. However, both traditional and ad hoc categories can be cultural. For instance, consider a language like French which uses the traditional gender categories male and female, but assigns one of these genders arbitrarily to non-human objects. A category also may be part of a hierarchy of categories or sometimes, be a stand-alone category with its root being itself.

3.3.1.3 Modelling Schemas

Cultural schemas can accumulate data from rules, behaviour, practices, beliefs, values, events and entities. In a sense, the cultural schema brings together many disparate concepts and thus can be viewed as an ad hoc category, itself. As in the case of categories, each of these components can have prior contexts associated with them. Schemas may encode whole concepts or only parts of them learnt previously.

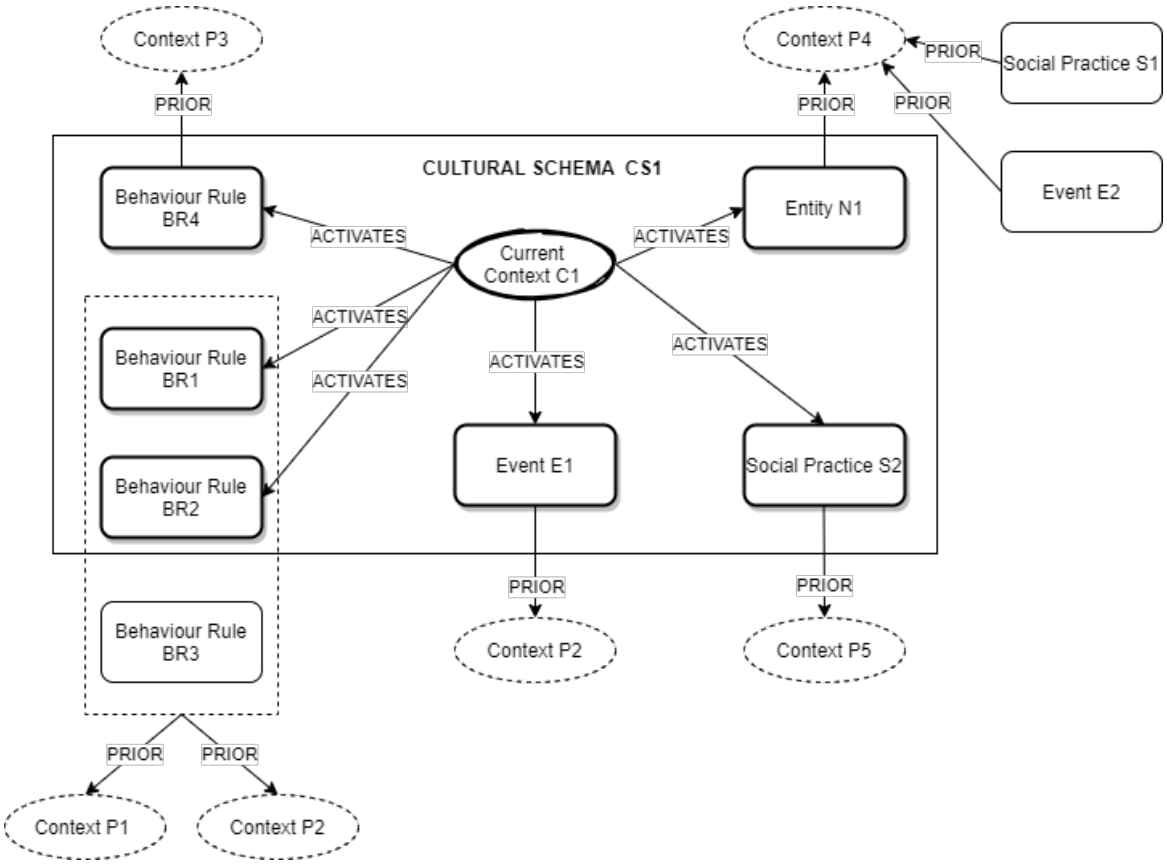

Figure 15. Components of a Cultural Schema

As seen in Figure 15, cultural schema CS1 encodes behaviour rules BR1 and BR2 but not BR3 which was learned in the same contexts as the previous two rules. This may happen because the current situation renders the rule BR3 irrelevant and activates only BR1 and BR2. In addition to selective grouping and encoding, schema instantiations can differ in the schema components they activate during activation in various situations.

Thus, the schema may only be partially activated in some situations while being wholly active in others.

There may be additional components specific to the situation which may be added to the activated schema. However, it is the core idea of the schema we are trying to model, and this core should then contain the most important, persistent components which are observed in a majority of the situations.

3.3.1.4 Modelling Metaphors

Metaphors must encode two domains, a source and a target and must make some analogy between them. A domain can be a subset of a larger domain and both source and target may belong to this larger domain, or they may be from two unrelated domains. Cultural metaphors may also take their inspiration from a cultural domain like the ancient Chinese philosophy of the Dao or a more recent trend such as new-age spirituality in Western countries. The domains of a metaphor may also refer to behaviours, practices, qualities, events and a range of other concepts.

Metaphors also usually have some associated expression in language. While schemas and categories may also underlie linguistic expressions, the expressions associated with metaphors are more direct and tend to approximately match the mental metaphor. Metaphors may also have underlying cultural schemas and categories, beliefs and values associated with them. However, this can only be determined through linguistic expressions of the metaphor. Metaphors in language do not have the same meaning that they literally communicate. Thus, the intended meaning has to be considered. Expressions may also have associated time of origin and time periods when they were more or less relevant than in the current day. This may also be true for intended meaning. Finally, metaphors may also contain sub-metaphors within them.

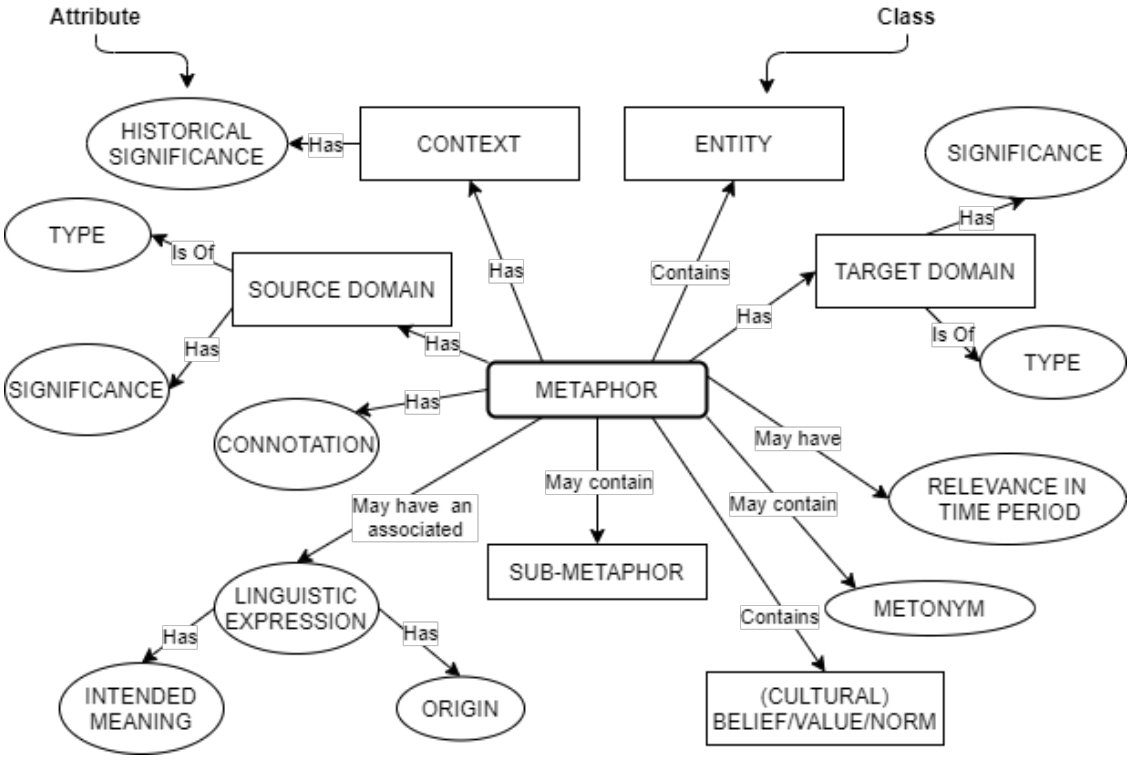

Figure 16. Components of a Cultural Metaphor

Figure 16 shows some of the core components of a cognitive and cultural metaphor which need to be modeled. Cognitive metaphors may not contain most of the culturally arising components such as relevance and origin and may not have direct expressions in language. These metaphors come through in other unrelated expressions of speech. So, for a cognitive metaphor, it may be sufficient to model only the source and target domain components and the analogical relation between them.

3.3.2 Identifying concepts surrounding conceptualizations

The following concepts are not formally identified within the Cultural Linguistics framework, but they feature in one form or another within the instantiation of a cultural conceptualization.

3.3.2.1 Context

The general structure of an ontology was elaborated in Section 2.2.1 (Figure 8). Below is an example of the concepts book, e-book and author (Figure 17). Figure 17 below shows a conceptual representation of sample classes Book, E-book and Author, their attributes and how they relate to one another. As seen in it, the attributes 'File format' and 'Available for download on' make sense when put in the context of the class 'E-book'. These are not always meaningful for the class 'Book'. The difference between the two classes is *context*. For instance, when referring to a book on a certain shelf of the bookcase in the living room, one knows it has to be a physical book.

Context is all-permeating. It is arguably the most important component of any conceptualization. It is a body of knowledge, a frame of reference to which one constantly recedes, to make sense of the current situation. It provides relevance to the application of a particular meaning in a situation when there are multiple possible ones. Concepts within the mind are not situated in a vacuum, dissociated from other concepts and able to be understood solely by the ideas which make them up. Rather, even the most abstract notion is attached to one or more contexts within which it was encountered (Barsalou 2016: 13). This means that concepts falling within the category of prior knowledge have associations to the contexts which are recalled as a whole when the mental concept is activated.

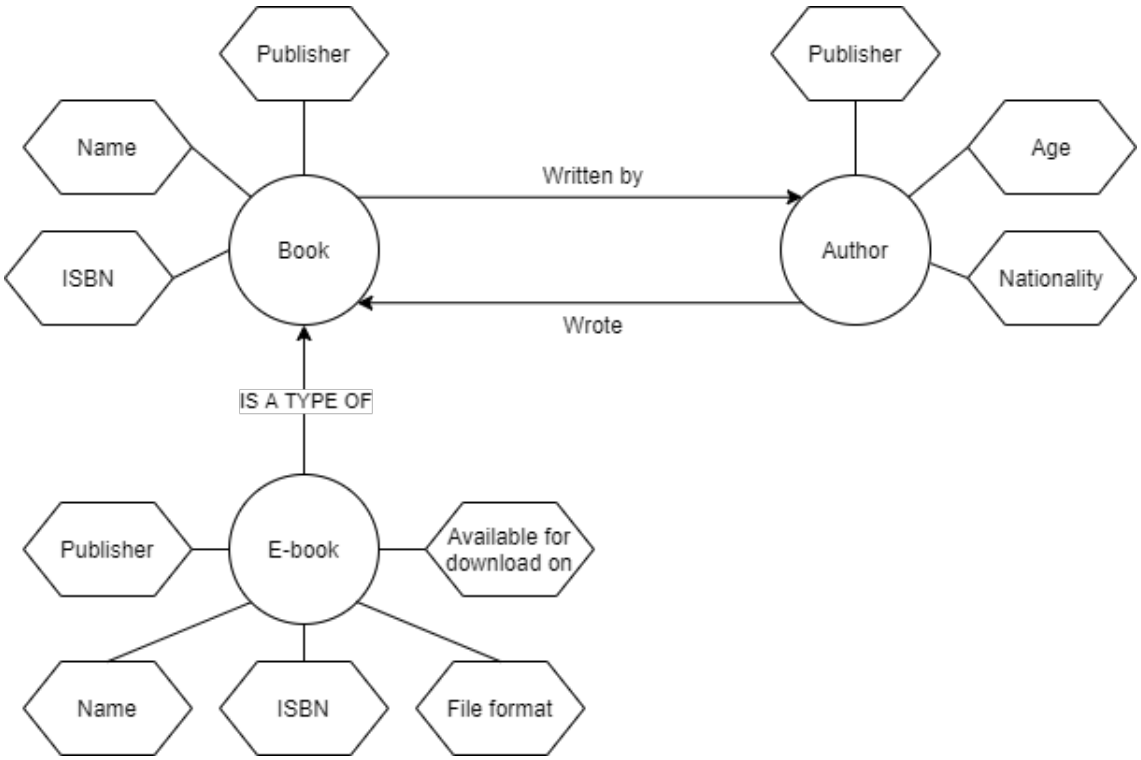

Figure 17. Components of an ontology - Example

Thus, not only is there a current context to consider, but there are also prior contexts of which the speaker has knowledge from prior learning and experience (Kecskes 2015: 117). For instance, there can be various contexts associated with a speech act. The command 'Stop!' can have different implications when considered within the context of instruction than when considered within the context of conflict. This particular speech act requires an agent to know not only the meaning of the linguistic expression but also the probable reasons behind issuing such a command and the possible consequences of non-compliance. One may also associate different emotions and feelings which may generally feature within the different situations. Again, when associating prior contexts with schema components, we must take care to include only those contexts which are very highly likely to be encountered and learnt by a majority of the cultural population. Individually experienced prior contexts are irrelevant in this ontology.

Context can be associated with the situation, the physical environment, mental states of the agents, the knowledge they possess, the subset of language chosen for expression, culturally accepted behaviour, expectations, role definitions etc. Cultural schemas and categories, though essentially cognitive, are not merely sub-types of cognitive schemas and categories. They are collections of various contexts associated with multiple cognitive and cultural schemas and categories. Context is also one of the hardest concepts to model. From a modelling perspective, context is the surrounding information which can provide relevance to the current situation and the agents within it. Since it also restricts the various possibilities of meaning, a certain entity or situation can assume and narrows down the circumstance to an intelligible and practically useful chunk of cognitive unit to be processed, anything that can provide this information is considered context.

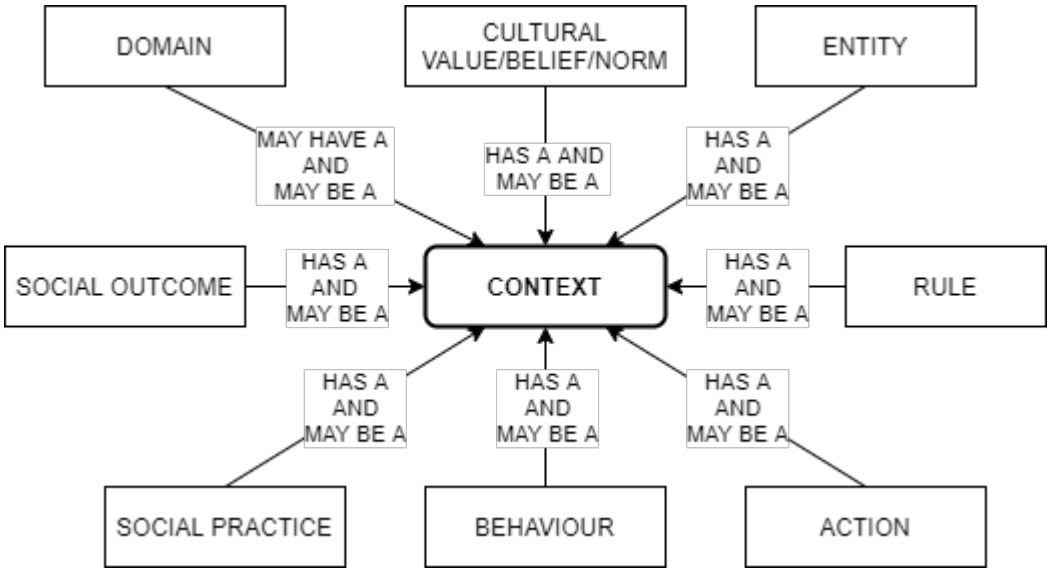

Figure 18. Modelling Context

Figure 18 above shows the various classes which can form the context for another class. There can be one or more contexts associated with a class, to account for prior contexts or similar contexts. Context can be derived from the current situation or from another situation leading to the current one or from contexts first encountered during situated learning i.e., learning that contains information about the environment in which a real-life instance of the concept was encountered.

3.3.2.2 Cultural Domains

A domain is a body of knowledge confined by some set of criteria and may consist of smaller bounded subdomains of information. The higher the granularity of the subdomain, the more well-defined it is. Like a context, it can derive its values from a number of other concepts. But unlike a context, a domain is a static body of information which describes a set of entities and relationships with a core that persists through time.

Cultural domains, in the context of cultural linguistics, are systems of concepts specific to the culture and formed and developed uniquely within it. These domains are usually systems built on religious/spiritual beliefs and world views, and in rituals, practice and traditions, which have developed and persisted over a period of time. These domains are usually associated with a large number of cultural schemas and metaphors and may form the basis of many of them. Some examples of such domains are the Chinese belief system Confucianism, events like the world wars which have affected most cultures or even a person such as Christ and the collective events in his life. As seen from the examples above, a cultural domain may exist within different cultures but may have different significations within them thus making the domain unique to the culture. Even when almost exactly alike, the differences may arise from locally perceived affectation or in customs and traditions or even, just language.

A domain is a very general, high-level concept which many foundational ontologies have exhaustively modeled. However, foundational ontologies are heavy and detailed in terms of reasoning and integrating them with the current ontology might prove too big a task to handle. Therefore, a pared down version of the concept will be modeled and used.

3.3.2.3 Embodied experience and atoms

For concepts such as emotions which are rooted in bodily experience, extracting the cognitive underpinnings underlying language use becomes even more difficult since bodily experience is a concept which is difficult to elaborate in the first place. However, it can be seen from the above instance and in various metaphors used across languages

that abstract concepts such as feelings/emotions are usually analogized with other physical spatially situated entities which are perceived to go through comparable changes in terms of their various states of being. For instance, the shape that a wave takes is likened with the variation in intensity of feelings. Feelings are also often associated with temperature, such as when affection is associated with warmth and indifference with coldness. Such fundamental and automatic analogies cannot be inferred through logic and reason and therefore have to be considered as axiomatic facts.

3.3.2.4 Cultural artefacts, symbols and exemplars

Cultural artefacts are entities produced and mediated by cultural agents i.e., they are products of the culture itself. Cultural artefacts can be both material and symbolic and the signification assigned to them is communicated primarily through language (Cole & Engeström 1993: 9). They encode within them abstract cultural values and beliefs which can manifest directly within physical entities such as cultural literature, art and architecture or symbolically in traditions, performance arts and social laws.

A cultural symbol is any sort of entity including the set of images, scenes and events, that has some symbolism within the culture and conveys an idea distinct to it. For instance, the schema EMOTION IS RIVER WATER mentioned by Kóczy (Kóczy 2017: 228) focuses on how numerous folk songs use this conceptualization as a metaphor to convey varied meanings by selecting the variations in the state of the river Tisza (such as flow, stagnation, flooding) for comparison with various emotional situations. In this case, the river Tisza can be viewed as a cultural symbol.

An exemplar is an entity which when encountered by an individual, aids in the formation of an abstract conceptual representation of a category. For instance, when thinking of a bird, one may imagine a sparrow more readily than a vulture. A sparrow may thus represent an exemplar of a bird for that individual. In a cultural sense, exemplars are usually persons who are known to represent a certain abstract, non-quantifiable quality or idea such as honesty, wisdom or love. For instance, the Buddha

is a popular exemplar of wisdom and Albert Einstein is a commonly cited exemplar for human genius. Cultural exemplars are not just well-known persons but may also be the average cultural agent who is representative of some subset of the culture within some situation. As seen in Lu's study of immigrants, Chinese immigrants in Australia view themselves as exemplars of their culture within a cross-cultural context and place great value on being such exemplars (Yu 2017: 102-103).

3.3.2.5 Salience and significance

A notable thing in the cases of Yu (Yu 2017: 65-87) and Kóczy (Kóczy 2017: 223-245) is the volume of metaphors which use the same entity (e.g., an Opera) or similar entities (e.g., a particular river or rivers) for an analogy. Volume is a major factor in an entity being identified a basis for cultural conceptualizations. By virtue of the value that it holds for a community and by the number of references which are made to it, this entity becomes a sort of cultural symbol and the references made to it increase when it is consciously recognized as a cultural artefact. The entity in question happens to be significant in some way to the community and its significance extends over time and perhaps, even generations.

Kóczy's (Kóczy 2017: 226) paper elaborates on the cultural background and context associated with the cultural schema RESERVEDNESS which is mostly a direct consequence of the way of peasant life in the Hungarian countryside. Thus, understanding the historical significance of a cultural entity or idea would be beneficial in identifying the cognitive lens with which it has been and is perceived. The higher the historical significance of the entity, the deeper it is encoded within cultural values which have been passed down through the generations. However, the prevalent cognitive understanding of this entity's significance modulates its current cultural value and this along with factors introduced through globalization, affects its role within the culture for future generations.

3.3.2.6 Cultural values and beliefs and their change over time

Cultural beliefs are convictions held within a cultural community and passed down through time. When these beliefs have been passed down for centuries, it is highly probable that they have been based on folk religion, spirituality, science or biology. Cultural values are manifestations of some significance placed on an idea or belief and its prioritization by the community. These values tend to form the basis of other ideas, traditions, practices, and behaviour of individual agents within the community. Cultural values and beliefs are also modulated by events in the real world such as war, laws and regulations, new immigrations etc. and their impact on the community as a whole.

When dynamic concepts such as these come into expression within language, the historical basis and connotation reference is often lost through time and what remains is simply the implied meaning. Although the words and expressions may remain in use in the language, the understanding associated with such expressions gets reduced to the figurative meaning becoming the primary meaning. Thus, cognition also changes over time to absorb only that which is indicated in the figurative meaning. This then begs the question – how much of such a structure can be termed cultural and how relevant is it to encode historically associated components lost through time? The answer may well depend on the application using the information.

3.3.2.7 Non-linguistic data

Some of the richer research with respect to cognitive focus comes from the analysis of anthropological data and cultural behavior and practices corresponding to linguistic use. This is exhibited in the clear and succinct analysis of the KINSHIP schema presented in the study by William McKellin (McKellin 2017: 159 - 162) where relationships can be established either through biological lineage, food-sharing, or exchange and feasting practices. The research on KINSHIP schema by Alice Gaby (Gaby 2017: 184) observes that though some categories such as MALE PARENT i.e., persons addressed as 'Father' appear to be highly inclusive, cultural behaviours and expectations of roles within certain situations show that there is a clear cognitive difference in categorization between the biological parent and others who may be addressed using the same term.

Although these covert categories have not been captured in the research, this is a good example of why non-linguistic practices must be observed to get a holistic view of the cultural concept.

Table 1 below shows the list of concepts which will be modeled with the ontology and Table 2 below shows a sample of the attributes to be modeled for some of the classes mentioned in Table 1.

Concept	Description
Context	Frame of reference for understanding situations/behaviour/actions
Domain	A body of knowledge about entities, events, relationships, situations pertaining to a certain subject area
Rule	A combination of initial conditions which when satisfied render some target state valid
Entity	An entity physical or abstract or an event which exists within reality either by form or by the recognition of its existence
Cultural Beliefs	A belief in relation to religion/philosophy/social rules and behaviour, for instance, held by the cultural community
Cultural Values	The value (religious/philosophical etc.) held the community with regard to a tradition/practice/entity/belief/behaviour
Social practice	A practice which even if not unique, is distinct to the culture. It has some attached cultural value to it.
Action	Movement(Specifically travel over a distance)/Speech/Silence/Non-action/Facial or other Gesture/Emotion expression
Cultural Norm	A social standard or agreement which forms the basis of rules, expectations and the blueprint for behaviour
Cultural Schema	Collection of various cognitive schemas, cognitive and cultural categories and associated metaphors

Cultural Category	A set of classification criteria to classify entities/situations and other structures encoded as a mental structure
Category Membership rule	The attributes entities must possess to belong to a cultural category
Cultural Metaphor	A metaphor within the culture with distinctly cultural components such as the domain used within the expression or the expression itself
Cultural artefact	A cultural artefact is one which is produced and mediated by cultural agents i.e., it is a product of culture.
Cultural symbol	A cultural symbol could be any sort of entity that has some symbolism within the culture.
Cultural exemplar	An exemplar is of great significance and is somehow distinctly representative of the culture both within and outside it. It is usually the abstract idea of a person displaying certain characteristics or may be well-known persons.
Intended Outcome	The target state/goal to be achieved by conforming to a certain rule or manipulating variables such as behaviour

Table 1. Concepts to be modelled within the ontology

(Class) Attribute	Description
(Context) Current social relevance	If a cultural context such as a social practice, then how relevant is it today within the culture? For instance, women being denied voting rights.
(Behaviour) Alignment With - Name	Name of Class with which it wants to attain alignment objective - Rule/Norm/Value/Belief
(Behaviour) Alignment Objective	Align/Not align/Neutral
(Rule) Condition	An initial state which needs to be satisfied for a target state to potentially be true. The 'If'.
(Rule) Assertion	The target state assertion which is true when all its necessary conditions are satisfied. The 'Then'.
(Domain) Significance within culture	How significant is this domain within the culture? This attribute only makes

	sense within some context such as a metaphor, an event etc.
(Cultural Value) Priority	Priority given to this value over others in general, which is indicative of its significance
(Social practice) Contains Events	One or more events associated with a practice and as a part of it
(Intended Outcome) Alignment With - Name	Name of Class with which it wants to attain alignment objective - Rule/Norm/Value/Belief
(Intended Outcome) Alignment Objective	Align/Not align/Neutral
(Cultural Schema) Main schematic theme	Summary of the conceptualization
(Cultural Schema) Ideas involved in the central theme of the schema	An explanation of the idea involved in the schema theme
(Cultural Schema) Historical origin	To track the origin, if known, for schemas which may have come into origin due to some well-known events like significant national events (as opposed to ones which are gradually and systematically formed)
(Cultural Schema) Ideas involved in the schema	These may not show up in the theme but may form a part of the detailed schema. These may also be encoded within sub-schemas.
(Cultural Category) Membership rule	What conditions must be satisfied for entities to belong to this category?
(Cultural Category) Prototype	Category prototype(s) or exemplar(s) which is/are the most representative example of a category
(Cultural Metaphor) Analogical element	The analogical relationship tying the source and target domains of the metaphor
(Cultural Metaphor) Base cognitive belief/perceptions on which base relation is based	What is the underlying belief or conceptualization which led to this particular target being mapped to this particular source? For instance, "Time and tide stop for no one". Time is cognitively perceived as a moving entity.
(Cultural Metaphor) Base cultural belief/value/norm on which base relation is based	What is the underlying belief/value or other cultural structure which led to this particular target being mapped to this particular source?

(Cultural Metaphor) Pre-conceptualizations	Pre-conceptualizations are mental structures of knowledge about contexts a person already possesses as a background/frame of reference employed to deconstruct and understand the situation at hand. These may be related to underlying the entities/relations and ideas contained within the metaphor, may point to other schemas or categories.
(Cultural Metaphor) Intended meaning	A metaphor usually is used within contexts to convey a meaning sometimes completely different from what it semantically says.
(Cultural Metaphor) Metonym	A concept which references another concept of which it is a part of or closely associated with.
(Cultural Metaphor) Immediate Cultural context	A frame of reference which is more general and relevant than the general context - Like War, Political event such as Brexit, a social media trend etc.
(Cultural Metaphor) Socio-political-cultural causes of origination	Any social/political/geo-political causes of origination of this metaphor. Partly covered in the Immediate Cultural context, perhaps?
(Cultural Metaphor) Expression Used	General expression associated with this metaphor
(Cultural Metaphor) Time period in relevance	Any associated time periods when this metaphor was most relevant
(Cultural Metaphor) Weightage/Cultural relevance	How relevant is the metaphor at a cultural level? How frequent is its use?
(Cultural Artefact) Current Cultural significance	Is this culturally significant(relevant) today?
(Cultural Artefact) Historical Significance	Has this been culturally significant(relevant)?
(Cultural Artefact) Artefact category	Linguistic, behavioural, object (textual/archaeological/art) etc.
(Cultural Artefact) Associated time periods for historical significance	Any associated time periods when this artefact came into being or was most relevant/significant
(Cultural Symbol) Symbolism	What does this entity symbolize?
(Cultural Symbol) Current Cultural significance	Is this culturally significant(relevant) today?
(Cultural Symbol) Historical Significance	Has this been culturally significant(relevant)?
(Cultural Symbol) Type of Symbol	Physical(Person/thing)/Geographical(place)/social(event)/Aphilosophy(idea or concept)

(Cultural Symbol) Associated time periods for historical significance	Any associated time periods when this symbol came into being or was most relevant/significant
(Cultural Exemplar) Exemplar name	Assign a name for identification. For well-known persons, this may even be a sobriquet. If not well-known, a descriptive name representative of the idea of the exemplar can be assigned. For instance, The Perfect Host.
(Cultural Exemplar) Current Cultural significance	Is this culturally significant(relevant) today?
(Cultural Exemplar) Historical Significance	Has this been culturally significant(relevant)?
(Cultural Exemplar) Associated time periods for historical significance	Any associated time periods when this exemplar came into being or was most relevant/significant

Table 2. Sample attributes to be modelled within the ontology

Chapter 4
Building the CCL Ontology

This chapter details the approach towards design and development, the implementation and evaluation of the Cognition, Culture and Language (CCL) Ontology and the best practices followed in each phase of Ontology engineering. The requirements for the Ontology come from the result of the modelling exercise in the previous chapter.

Web ontologies can be developed for any domain by any individual and they are now so widespread that the World Wide Web Consortium (W3C) has published a set of recommended best practices for the development and evaluation of these ontologies so as to enable better reusability and interoperability. Other practices have been recommended in research articles stemming from the experience of developing ontologies. These recommended practices have evolved through the years and continue to do so. Each of the sections below start with a relevant subset of best practices where established or commonly followed practices and go on to describe to what extent these were met during the progression of each phase of development.

The design and development of the CCL ontology were done in an iterative fashion with the core classes being built first. Reusable vocabulary terms were added in the following iterations and concepts were further grouped in subsequent iterations. The sections below describe the product from the final iteration of development. Evaluation was done on this final product.

4.1 Requirements Specification

Requirements specification is the starting point of any software engineering process, and since web ontologies are considered software, this applies to Ontology engineering too. The following requirements specification is based on the guidelines outlined for creating the Ontology Requirements Specification Document (OSRD) published by Suárez et al. (Suárez-Figueroa, Gómez-Pérez & Villazón-Terrazas 2009: 968 - 977). Though it was not feasible to follow all the guidelines mentioned, due to the limited time, scope and personnel involved in the work performed for this dissertation, it nevertheless provided a good frame of reference to build the requirements specification.

4.1.1 Purpose of the Ontology

The purpose of the CCL ontology is to model the domain of Cultural conceptualizations in general and the analytical framework of Cultural Linguistics, in particular. The ontology is intended to be a content ontology which provides users a conceptual schema where their research findings can be documented. The ontology will also enable establishing linkage between documented information and lead to the discovery of new relationships, made possible by ontology reasoning.

4.1.2 Scope of the Ontology

The scope of the ontology includes modelling in detail, the components of cultural conceptualizations as defined by the analytical model of cultural linguistics proposed by Farzad Sharifian (Sharifian 2011: 24). It emphasizes on the collective cognitive structure described by this framework and the components encoded within this structure. While the one of the cornerstones of the referenced framework is Culture, this ontology is not aimed at modelling the various components of culture itself. While multiple cultural components have been identified to be included in the ontology, they are only relevant as long as they significantly contribute to the description of the core concepts of cultural conceptualizations. Thus, modelling of socio-cultural concepts is out of scope. Also, out of scope is the modelling of foundational concepts which make

up physical reality. These concepts will be reused as necessary or modeled in shallow detail, just enough to contribute meaningfully in relation to the core concepts.

4.1.3 Implementation Language

The implementation language used will be the Web Ontology Language (OWL) and particularly, OWL DL, which is a decidable subset of the language. The Ontology editor used is a free, open-source editor called Protégé. Protégé is one of the more popular ontology editors and has current and reliable support and comes with various reasoners for performing reasoning within the tool.

4.1.4 Intended Uses and Intended End-users

The ontology is intended to be used to document research findings from Cultural Linguistics under suitable concepts and their properties. Thus, the primary users would be Cognitive and Cultural Linguists and other cognitive–cultural researchers in ethnoscience, cognitive anthropology etc. Once documented, the coded text information within the ontology can be accessed and processed by NLP applications and further applied in a variety of domains such as Education, AI Ethics, Political discourse etc. based on context and need.

4.1.5 Ontology Requirements

Requirements for any software development usually are determined by domain experts and end-users who will be using it and are captured in the form of competency questions (CQ). However, the scope of this dissertation does not include engaging with experts or end-users and the main concepts to be modelled were arrived at through text analysis. Therefore, it has been assumed that the principal requirement for the ontology is to translate in as much detail as possible the research documented in the domain of Cultural Linguistics to an ontology where reasoning can be applied to this information in addition to being documented.

The requirements have been divided into functional and non-functional requirements. Functional requirements are those which capture the core function which the system would actively perform, and non-functional requirements describe the processes and/or systems which support the optimal functioning of the core system. The main functional requirements are –

1. Model the components of cultural conceptualizations, namely the cultural schema, category and metaphor, in as much detail as possible based on the theory of the Cultural Linguistics framework
2. Model the relationships between these components based on both theoretical research and their real-world instances published in the research data
3. Model any external factors socio-geographical-political factors affecting these core components based on real-world instances published in the research data

The following non-functional requirements were identified –

4. To produce an easily understandable ontology which is representative of the domain, for the end-user
5. Use natural language descriptions for naming components which are not are part of the core technical jargon and make provisions for a large amount of descriptive text to be coded within the ontology
6. Follow best practices and methodologies for design, implementation and evaluation of the ontology to prevent common pitfalls and ensure efficiency and performance

4.2 Design

This section details the various technical components and their interactions which will need to be created and considered before they can be implemented. We start with a brief description of a subset of best practices which ontology design must follow. This list of best practices has been gathered from the publications of different organizations

such as the W3 Consortium[6] and the specifications for Ontology presentation in the International Semantic Web Conference (ISWC)[7] conducted annually by the Semantic Web Science Association (SWSA) as well as from the best practice recommendations published by (Garijo & Poveda-Villalón 2020) for FAIR[8] vocabularies. Some useful practices were borrowed from the OBO Foundry principles[9] developed for medical domains.

4.2.1 Design best practices

In ontology development, the emphasis is on semantic interoperability and reusability which involves following some set standards. These are both important factors given the sheer volume of ontologies being developed today. Interoperability is the ability to exchange and ingest information between two or more systems without a complete re-engineering of any of the systems involved and with each of the systems providing a well-defined and established interface to its information. Gyrard et al. (Gyrard, Serrano & Atemezing 2015: 412) mention technical, syntactic, semantic and organizational interoperability, of which, syntactic and semantic operability are of particular importance to this work. When adhered to, syntactic interoperability guarantees that ontologies created using a different software and/or language by a different team can be easily integrated within the current environment with little or no effort spent in re-engineering. This can be only ensured by making developed ontologies available in standard file formats which can be ingested by any ontology tool.

"A rose by any other name would smell as sweet" and it should, since it is indeed a sort of symbol to represent the concept of a flower which we know as a 'rose'. While classes may take on different names within different ontologies, they should be able to be matched between these ontologies by their conceptual abstraction (McGuinness 2002: 181-182). This is the idea of Semantic interoperability. Obrst (Obrst 2003: 368) describes some successful commercial and governmental initiatives in semantic

[6] https://www.w3.org/2001/sw/BestPractices/
[7] https://iswc2021.semanticweb.org/resources-track
[8] Findable, Accessible, Inter-operable and Reusable(FAIR)
[9] http://ontoworld.org/wiki/OBO_ foundry

interoperability. It can be seen, however that semantic interoperability is the result of collaborative effort. Mapping concepts between ontologies is to be performed with much deliberation (Kollia, Tzouvaras, Drosopoulos & Stamou 2012: 2) and may require an intermediary application or even an intermediate ontology to achieve this.

Ontology reuse is the process of using existing ontological knowledge i.e., whole or parts of existing ontologies (Pâslaru-Bontaş 2007: 41) developed by domain experts and currently in widespread use. It is one of the ways semantic interoperability can be promoted. Using vocabulary terms, concepts and properties which have already been well-researched can prevent errors originating from incorrect modelling and can save effort and time, when integrated properly. Reusing ontology terms also serves as a standardization process for vocabulary within a certain field. However, such an undertaking presents a number of challenges such as selecting appropriate concepts and/or multiple definitions of them from a variety of available ontologies, the compatibility of granularity between the current ontology and the ontologies considered for reuse, the differences in ontology structure in terms of grouping and modularization as well as in their philosophy of what is considered a concept or a property. Fortunately, there are a number of methodologies which present guidelines for reuse procedures and the NeOn methodology is particularly well-suited, due to its emphasis on reuse and its flexibility in recommending reuse methods. It suggests a number of methods of reuse of both ontological and non-ontological resources, including reusing, re-engineering, merging, restructuring or a combination of these (Suárez-Figueroa 2010: 84 - 85). With more ontologies following reuse methodologies in conjunction with the other best practices, reuse in some form is now becoming easier to achieve.

4.2.2 Design approach

Keeping the above-mentioned best practices in consideration, the approach used is middle-out considering there are both upper level and more specific concepts of the core concepts, which can be modeled. The core ontology was first designed using the classes and attributes modelled for cultural conceptualizations. Other concepts were

added incrementally as was necessary. Over iterations, some classes such as Entity Type were converted from attributes to sub-classes, in order to perform better reasoning. On the other hand, a concept such as Linguistic Expression, was modeled as a data property.

4.2.2.1 Complexity and class decisions

The Cultural Linguistics domain is highly inter-disciplinary. It is information heavy i.e., the outcome of a majority of the research is the discovery, description and documentation of the knowledge contained in the making and functioning of multiple naturally occurring cognitive and social phenomena. Modelling the concepts in all the different domains at the most granular level would have required an incredible amount of research resulting in hundreds of classes and relationships. It would have digressed from the core domain we are trying to model and would have resulted in a large and practically, unmaintainable ontology. This would in turn, impede efficiency and performance during reasoning and would present challenges in understanding and use for end-users and data stewards. It would also potentially result in consensus issues about definitions of certain common concepts between the disciplines. Thus, owing to the complexity of the domain, it was decided that some properties be coded as data properties which could contain descriptions in textual format, which can then be processed by NLP applications to decode the meaning. Symbolism is an example of one such concept which has been retained as a data property.

4.2.2.2 Fuzziness and Cardinality

The core components of Cultural Linguistics are of a cognitive nature and therefore, are fuzzy. This means that there are no clearly defined boundaries where a cognitive component ends and what it does or does not include. For instance, a cultural metaphor may or may not have a historical significance, it may be associated with one or more contexts and it may or may not have associated cultural categories. A cultural schema may contain information about only social roles within situations, while another one may contain information about the sequence of events in a social practice and rules to be followed by members, along with various, dynamically changing roles within the

larger event, various contexts associated with each rule , role and event and some associated entity like a historical or religious personage. To allow for all of these variations within concepts, only the most common and necessary parts of the component were identified as mandatory, and the rest were made optional. Thus, the user can choose not to code these optional attributes for an instance since they may not apply in some cases. The open-world assumption in the implementation language OWL allows for such situations and still obtain the desired inferences.

4.2.3 The CCL Ontology Design

The following section describes in detail the class, property and relationship terms identified and the organization of concepts.

4.2.3.1 Classes

The classes identified for this ontology have been grouped where possible based on a common theme. Since the ontology combines research from different areas, the major themes are cognitive-cultural and socio-cultural. The core group of concepts corresponding to cultural conceptualizations are organized under the 'Collective Mental Structure' parent class. The group of concepts relating to socio-cultural elements are grouped under the 'Cultural Element' parent class. The 'Collective Mental Structure' class contains the core classes – Schema, Category and Metaphor which in turn are divided into Cognitive and Cultural sub-classes.

Figure 19 below show the organization of the Collective Mental Structure class.

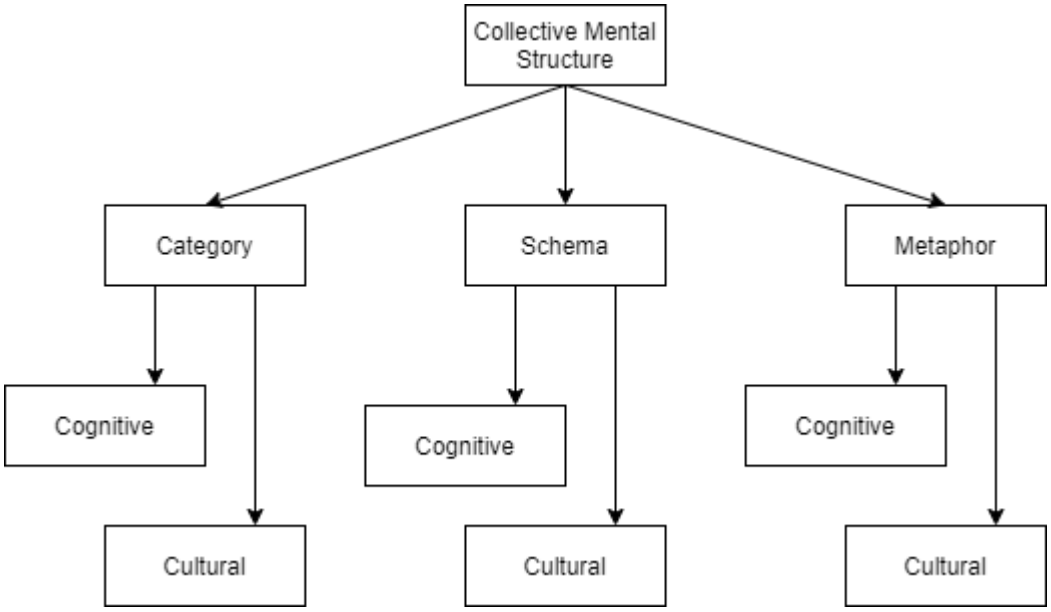

Figure 19. Classes under Collective Mental Structure

Table 3 and Figure 20 below show the organization of the Cultural Element class.

Parent class	Sub-class (Level 1)	Sub-class (Level 2)
Cultural Element	Linguistic System	
	Cultural Agreement Structure	Cultural Belief
		Cultural Norm
		Cultural Value
	Cultural Entity	Cultural Artefact
		Cultural Exemplar
		Cultural Symbol
	Culture Descriptor	
	Language	Dialect
	Social Practice	

Table 3. Organization of the 'Cultural Element' class

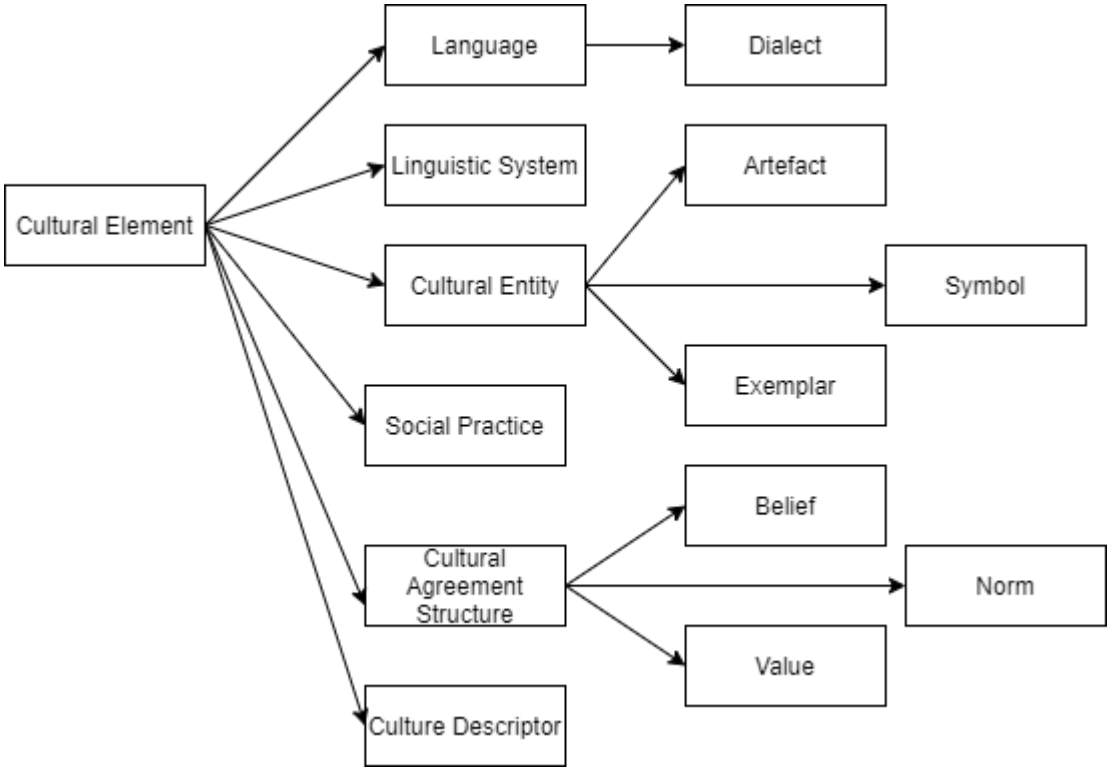

Figure 20. Classes under Cultural Element

The foundational concept 'Entity' is the other major class. Figure 21 below shows the organization of the 'Entity' class. As seen below, the 'Cultural Entity' class is a sub-class of both 'Cultural Element' and 'Entity'. The Abstract, Physical and Temporal entities are based on existence within physical reality while the Cultural Entity falls under a social classification scheme of the class 'Entity'.

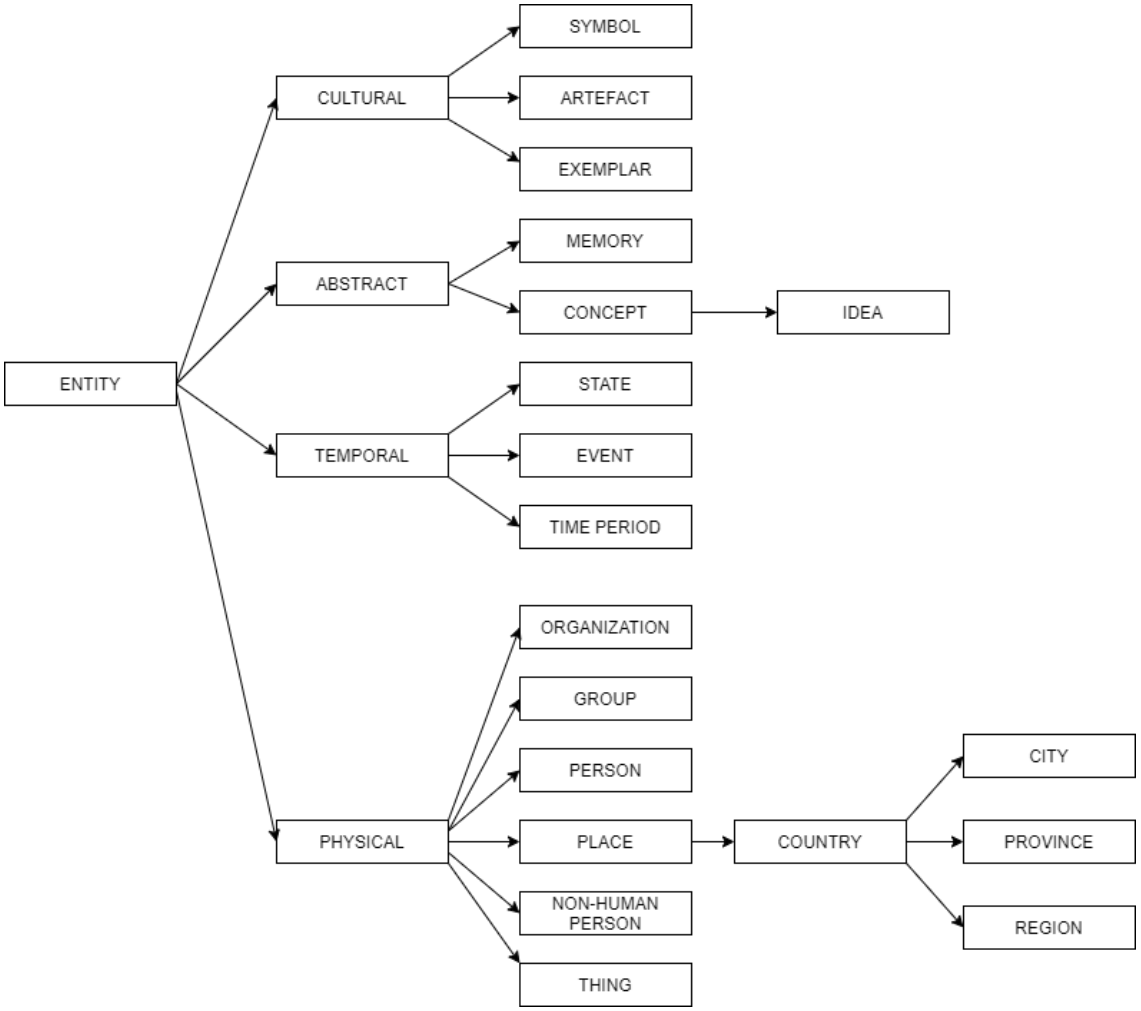

Figure 21. Classes under Entity

'Type' was decided to be modeled as a class since the set of types can differ based on context. Type values created as instances of classes can aid in better reasoning by associating certain instances of type with certain contexts. The 'Type' class contains many sub-classes. Table 4 below shows the organization of the 'Type' class.

Parent class	Sub-class (Level 1)	Sub-class (Level 2)	Sub-class (Level 3)
Type	Action Type		

	Assertion Type		
	Category Type	Cultural Category Type	
	Context Type		
	Domain Type	Cultural Domain Type	
	Entity Type	Cultural Entity Type	Artefact Type Exemplar Type Symbol Type
	Hierarchy Type		
	Metaphor Type	Cultural Metaphor Type	
	Norm Type		
	Outcome Type		
	Rule Type		
	Schema Type	Cultural Schema Type	
	Value Type		

Table 4.Organization of the 'Type' class

The following concepts do not have or form sub-classes, they can be associated with other classes – Action, Behaviour, Context, and Intended Outcome. 'Category Organization' describes a single level in a category hierarchy which can be constructed through inference. This class allows for organizing cognitive and cultural categories if they are part of some hierarchy. The 'Intended Outcome' class describes a goal or a target state to be achieved in certain contexts such as following a rule or adhering to a certain behaviour. The 'Rule' class is a multi-purpose class which can contains general or specific rules from different domains and contexts, for instance, social rules, behaviour rules, mental rules etc. 'Action' is essentially an event in space-time in its physical manifestation but conceptually may be part of multiple concepts such as a practice, behaviour, rule or event and 'Behaviour' is a cognitive-psychological concept and the result of various underlying factors.

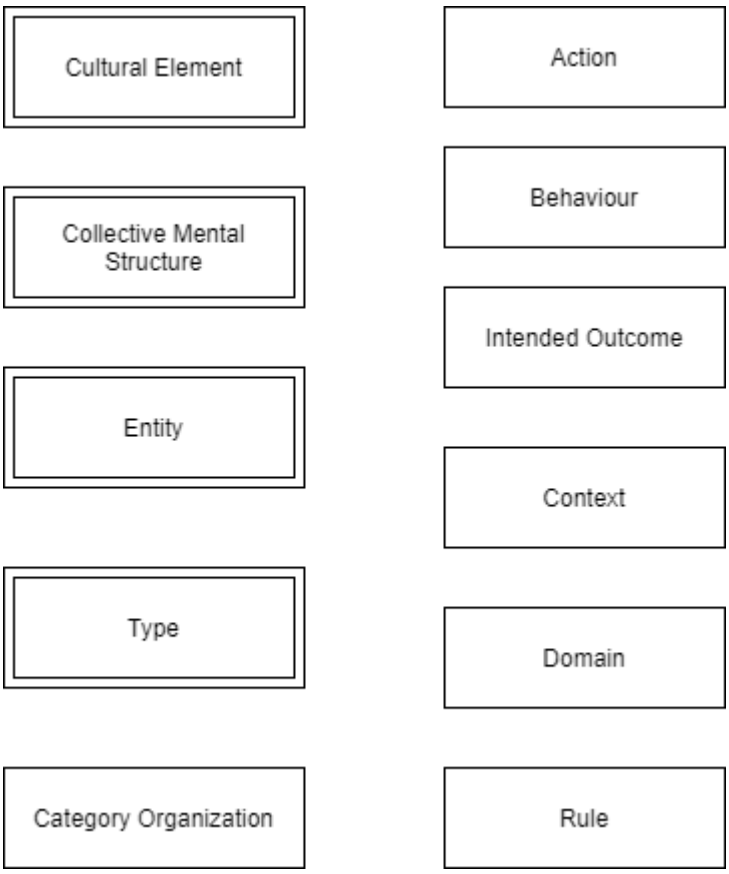

Figure 22. Classes in the CCL Ontology

'Domain' and 'Context' are both concepts which serve as a body of information. The 'Domain' class would contain well-defined subsets of established knowledge about a certain subject. The knowledge contained in the 'Domain' class is meant to be fairly static. The 'Context' class is intended to contain background information relevant to a particular situation, so this knowledge is expected to change with circumstance and situation. The knowledge contained in the 'Context' class is dynamic and can modify itself with time. The context itself may change with time, moving in and out of relevance based on other factors.

Figure 22 above list all the classes in the ontology, double-lined boxes contain the classes with the most sub-classes. Other than these four, Domain, Rule and Category Organization also have sub-classes. Figure 23 shows these smaller classes.

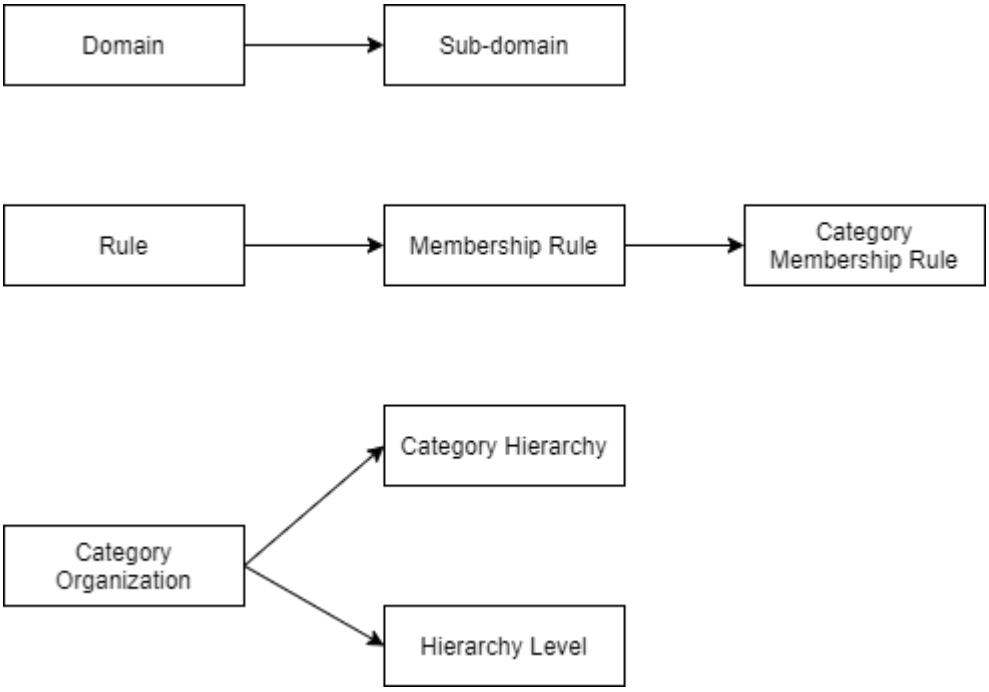

Figure 23. Smaller classes with sub-classes in the CCL Ontology

4.2.3.2 Relationships and Class Equivalences

This section details the relationship between classes and the definitions of each class.

Schemas, both cognitive and cultural, have at least one schema type and an associated cultural descriptor indicating which socio-cultural community they are being coded for. Schemas should also encode at least one of – a rule or behaviour or category or metaphor or context or a cultural value, norm or belief (cultural schema) or social practice (cultural schema). Figure 24 below shows a simple UML class diagram of the Schema class and its most important relationships.

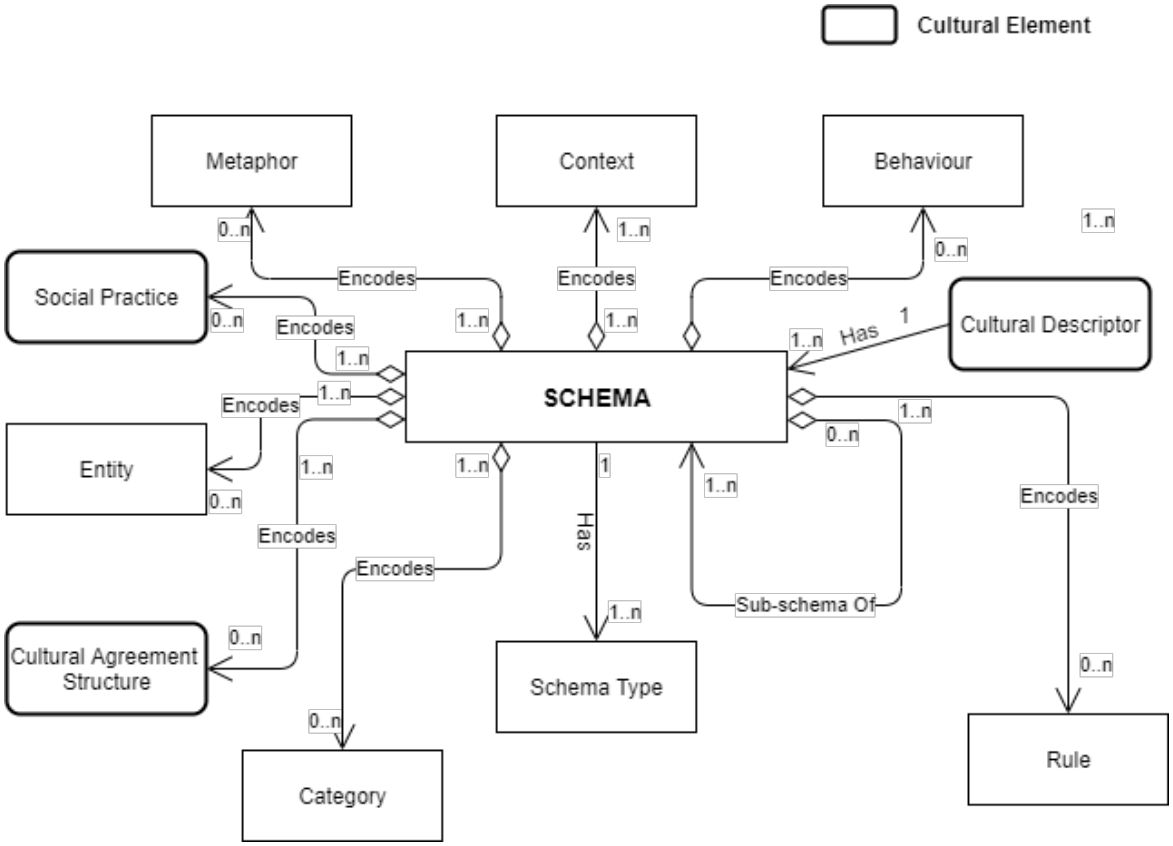

Figure 24. Schema relationships

Categories have at least a prototype or an exemplar. A category doesn't exist by itself; it invokes some schema and has some context. A category also must have some membership rule which even if fuzzy, describes a core aspect of the category. There may be one or more membership rules, each having some weight which is a measure, analog or discrete or a numerical or non-numerical range based on the application, to indicate fuzziness. A membership rule with lower weight indicates its longer distance from the core aspects which a category represents. Finally, the category must be associated with a culture descriptor describing the culture of which it is a part. A cultural category must have some cultural type associated with it. Categories can be associated zero or more category hierarchies of which they may form a part. Figure 25 below shows a simple UML class diagram of the Category class and its most important relationships.

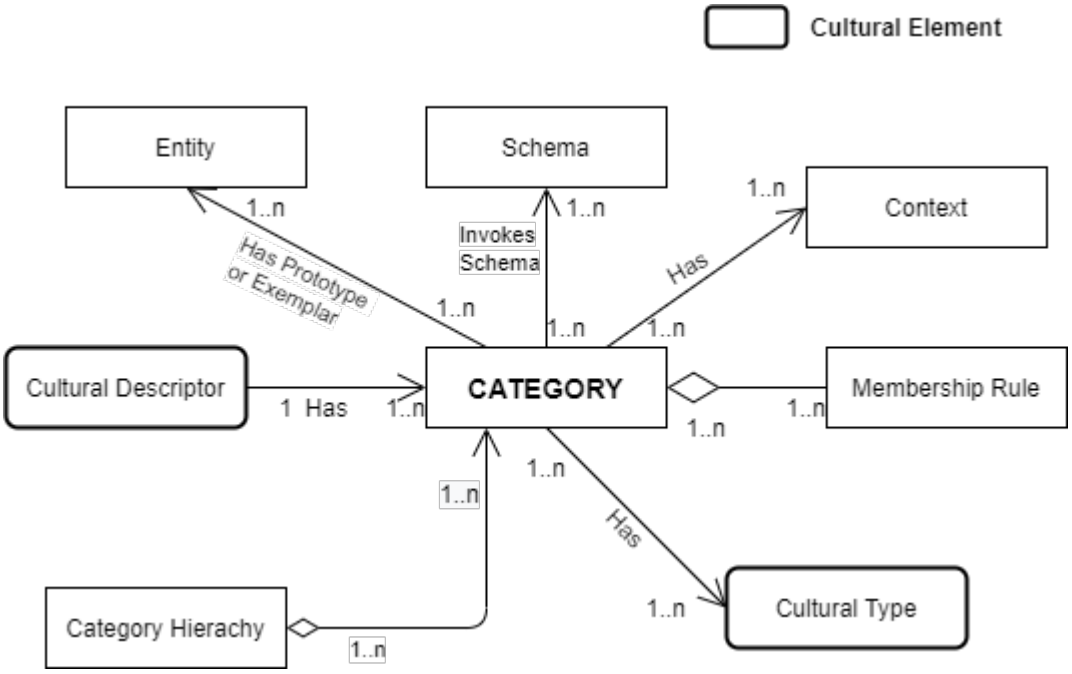

Figure 25. Category relationships

Metaphors have at least a source and target domain and some analogical element contained within it. A metaphor must have some underlying schema for its constituent components and therefore, invokes at least one schema and has some context. A metaphor must contain at least one entity and must have some intended meaning which is usually different from the semantic sense the sentence conveys. It may also contain zero or more sub-metaphors. A cultural metaphor must have some cultural type associated with it. Finally, like the other components the metaphor must be associated with some culture descriptor. Figure 26 below shows a simple UML class diagram of the Metaphor class and its most important relationships.

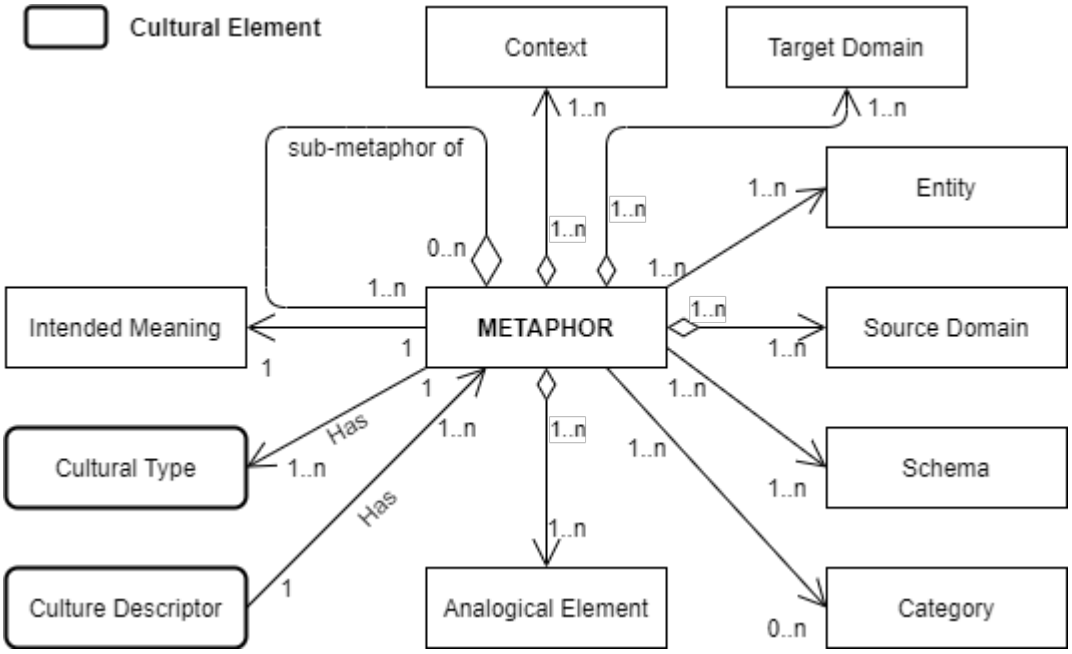

Figure 26. Metaphor relationships

Context is defined as a class which contains information about either a rule, behaviour, cultural element, action, domain, entity, intended outcome or type. Figure 27 below shows a simple UML class diagram of the Context class. The **Rule** class must have some condition, assertion, assertion type and rule type. The **Action** class must have a Context and Action Type and will contain general action descriptions. The **Behaviour** class must have a Context, description, some action as well as a cultural descriptor since this class will describe behaviour within a cultural context. The **Domain** class must have a name, type, description and context and can have zero or more associated entities. The **Entity** class enforces the name, description and type attributes and these will be the only required attributes in order to maintain simplicity of the ontology. The **Intended Outcome** class contains a context, an alignment objective and needs to align with either a cultural norm, value or belief.

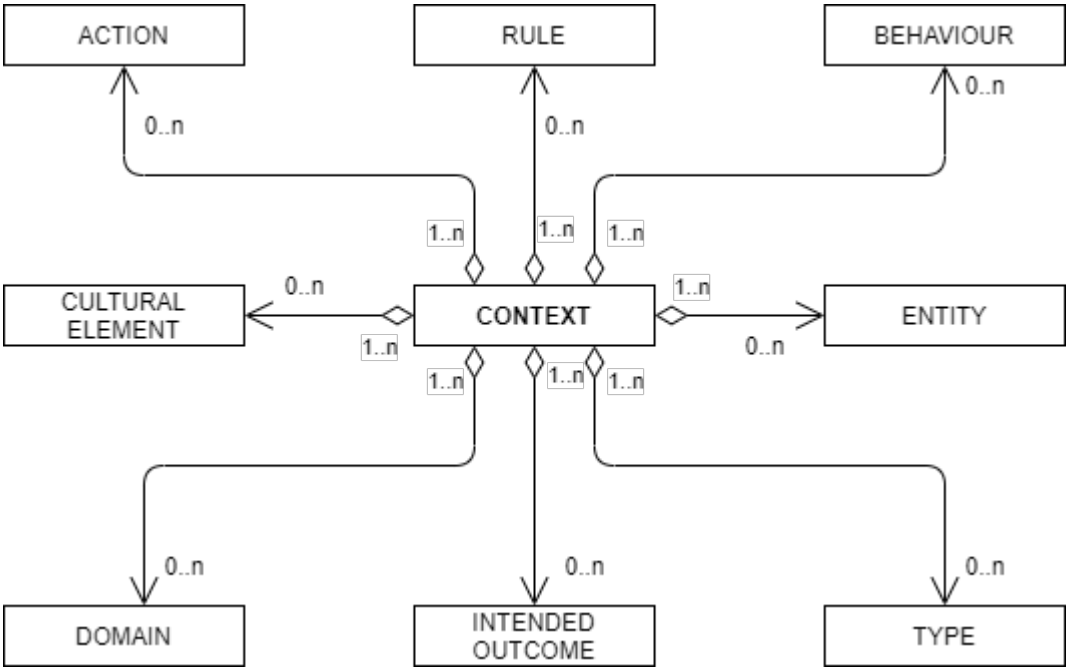

Figure 27. Context relationships

The **Category Organization** class contains two sub-classes – the Category Hierarchy and Hierarchy Level. The **Category Hierarchy** contains a general description of the hierarchy in the form of the attributes Root category and Number of levels. The **Hierarchy Level** class must contain one or more associated categories in a level and ideally all categories in the level within a branch, the superordinate category which ties them together and the level number of the hierarchy. It must be associated to some Category hierarchy and together, these two classes can form an actual category hierarchy through inference.

The **Cultural Element** class grouping contains all socio-cultural components under it, including language and linguistic system. The **Language** class must have a name and an associated linguistic system. The **Linguistic System** class has a name and description. This has been modeled as such to prevent adding complexity. **Social Practice** must contain an event, some associated cultural value, norm or belief and a context. It must also be associated with a cultural descriptor.

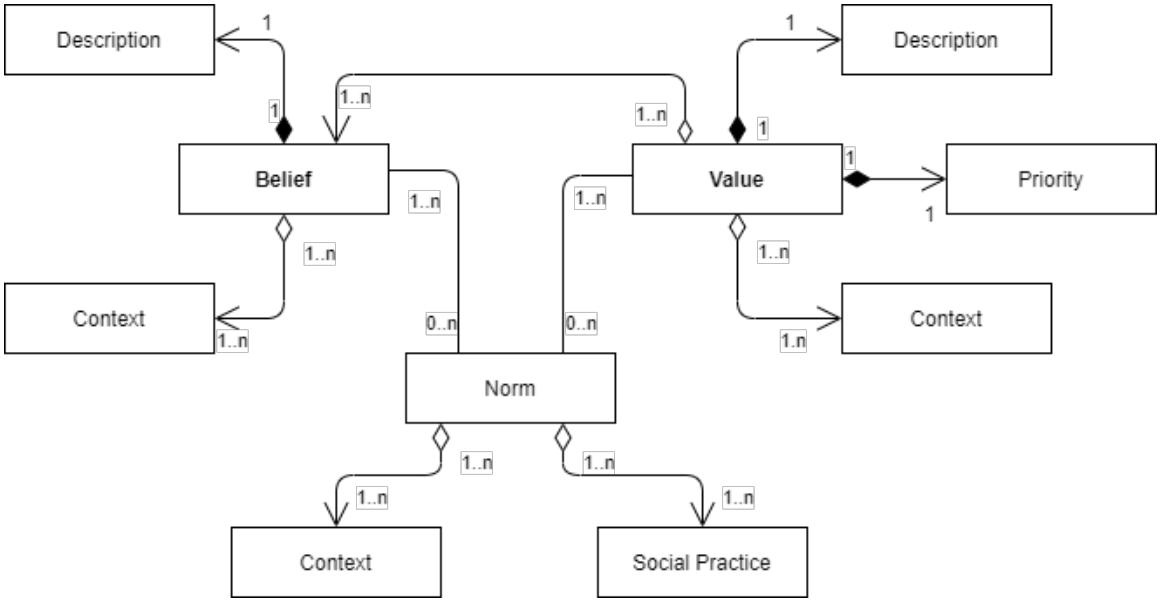

Figure 28. Cultural Value, Belief and Norm relationships

The **Culture Descriptor** records the details of the society for which the Cultural Linguistics analysis is being done. It has some associated language and norm, belief or value and can have a name and description. The **Cultural Agreement Structure** contains the Cultural Value, Norm and Belief classes and has the relationships depicted in Figure 28 above.

4.2.4 Reusability and considerations

The principles of reusability dictate that concepts from existing ontologies be used before modelling new ones. I found that the core concepts for cultural conceptualizations have not been modeled before and there were no ontologies from which a majority of the concepts could be reused. There are a good number of 'cultural knowledge' ontologies but none of these models the cognitive aspect. CRM is a good candidate since it was well researched and has been developed by a team of experts; however, the concepts have been modeled for a specific domain namely cataloging cultural heritage information and museum artefacts, specifically, physical artefacts. While they have cultural value and labels attached to them, they do not explain the cognitive part of culture. Of these however, some were selected to model cultural

artefacts. CRM also provides an upper ontology, and some concepts and a subset of properties were identified for reuse.

4.2.4.1 Challenges

While looking for suitable concepts to reuse, I found that although terms were available in many ontologies and some of which looked like good candidates, they had not undergone any maintenance recently. In the case of a foundational ontology like DOLCE, even with the simplified versions, the concepts were too complex to identify and reuse in a modular fashion. Selecting only some classes and attributes is possible but it introduces the risk of improper reasoning and this was therefore, avoided. One Linguistic ontology GOLD which I had wanted to partially reuse was last updated in 2010. Other ontologies which had once been published had been either taken down, made private, or were moved.

4.3 Implementation

This section describes the details of the actual implementation including file format, the ontology development tool and reasoner used, naming procedures for concepts and attributes as well as ontology publishing and documentation. This list of best practices has been gathered from the publications of different organizations such as the W3 Consortium[10,11] and the specifications for Ontology presentation in the International Semantic Web Conference (ISWC)[12] conducted annually by the Semantic Web Science Association (SWSA), from the best practice recommendations published by (Garijo & Poveda-Villalón 2020) for FAIR[13] vocabularies as well as other reliable guidelines[14] published on the internet.

[10] https://www.w3.org/2001/sw/BestPractices/
[11] https://www.w3.org/TR/ld-bp/
[12] https://iswc2021.semanticweb.org/resources-track
[13] Findable, Accessible, Inter-operable and Reusable(FAIR)
[14] https://www.mkbergman.com/911/a-reference-guide-to-ontology-best-practices/

4.3.1 Implementation best practices

The best practices for Ontology implementation deal with file formats for interoperability, standard term and concept naming practices, recommendations for class and property definitions and publishing practices for accessing and reuse of the ontology. The following practices are recommended –

1. Creating an appropriate namespace prefix for the ontology and using suggested prefixes for existing ontologies
2. Using standard naming rules for terms and properties in the Ontology, camelCase for concepts and properties
3. Creating inverse properties where applicable
4. Adding labels along with the language of the labels to all terms in the ontology
5. Ontology serialization in an interoperable format such as OWL, RDFS or RDF/XML
6. Creating ontology metadata such as a license, creator and contributor details and versioning details
7. Publishing ontologies using a permanent URL using websites like PURL.org or W3ID.org
8. Create dereferenceable URIs for resources i.e., a URI which return some information about the URI itself when it is accessed via its HTTP link.

4.3.2 The Protégé Ontology Editor

The CCL Ontology was built using Protégé. Protégé[15] is a popular open-source ontology editor with a user-interface to build ontologies. Inference Rules such as an object which is an instance of a sub-class, is also an instance of the main class, is pre-programmed in Protégé, thus making it easy for the user to focus on the core ontology. Protégé offers programming interfaces to plug in a variety of reasoners and visualization tools and comes with a query interface. Ontologies developed in Protégé can also be downloaded in a variety of formats such as RDF, RDF/XML and OWL. Axioms are written in the

[15] https://protege.stanford.edu/

Manchester Syntax[16] in Protégé. The editor is also kept in accordance W3C standards and recommendations making an ontology developed using it, automatically compliant in this respect.

4.3.3 Implementation of the CCL Ontology

The following sections show the implementation of the ontology in the Protégé environment. The ontology has the URI **http://purl.org/net/CCL#** and uses the # naming convention (Garijo & Poveda-Villalón 2020: 3). The suggested namespace prefix of the ontology is **CCL**.

4.3.3.1 Classes

Following recommended best practices, IRIs for classes in the ontology are named using the camelCase notation and always starting with capital letters, for example CognitiveSchema, TimePeriod etc. Each class is created under the General OWL top-level class *Thing* but this class is not part of the ontology itself. The various different levels indicate the class hierarchy within each class. Every class has a display name (label) and a description. The URIs are descriptive and are the same as the display name but without spaces. Figure 29 below shows all the classes in the CCL Ontology.

[16] https://www.w3.org/TR/2012/NOTE-owl2-manchester-syntax-20121211/

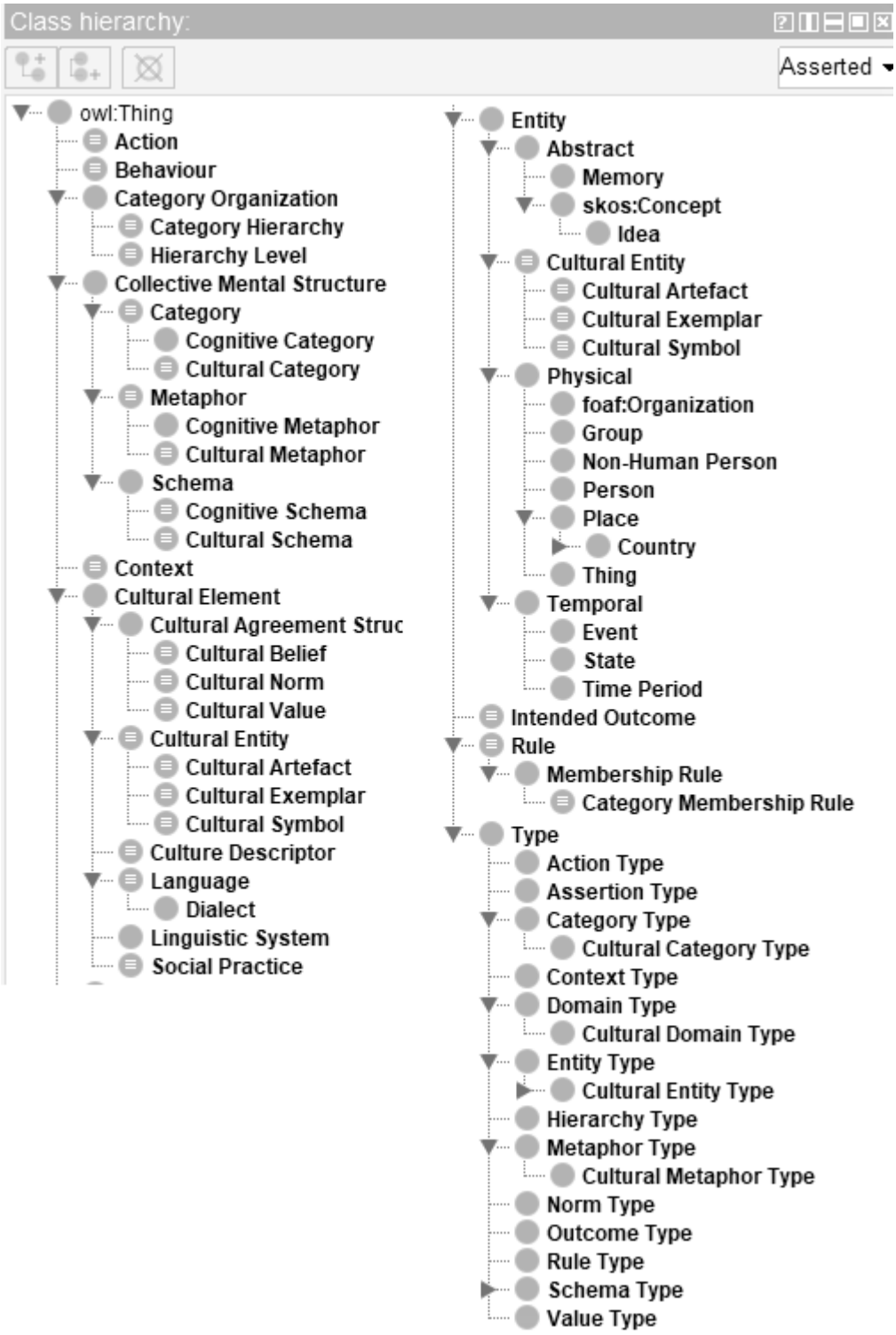

Figure 29. Classes in the CCL Ontology in Protégé

Figures 30 shows the class equivalences for the Category, Cultural Category, Metaphor and Cultural Metaphor classes. The Cognitive Category and Metaphor do not have any

equivalence definitions and therefore are the same as the Category and Metaphor classes, respectively. The syntax used for defining equivalent classes is the Manchester Syntax (Horridge, Drummond, Goodwin, Rector, Stevens, & Wang 2006).

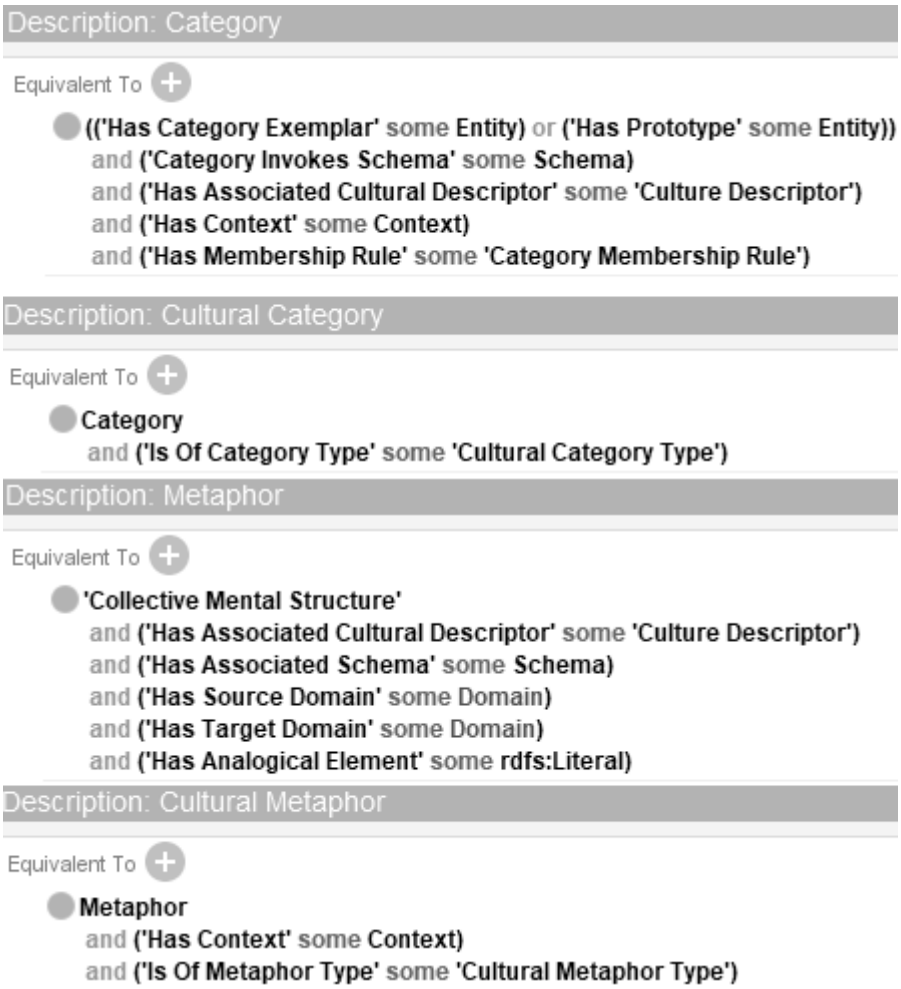

Figure 30. Category and Metaphor Class Equivalence Definitions in Protégé

Figures 31 below shows the class equivalences for the Cognitive Schema, Cultural Schema and Context classes.

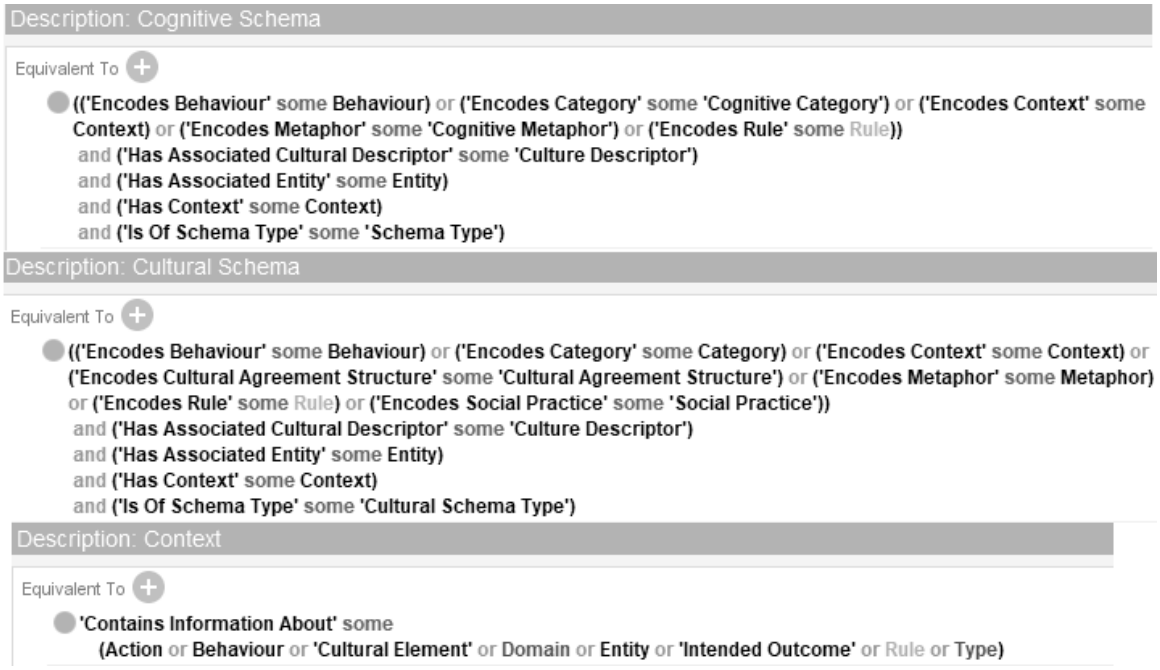

Figure 31. Schema and Context Class Equivalence Definitions in Protégé

4.3.3.2 Properties

Following recommended best practices, IRIs for properties in the ontology are named using the camelCase notation and always starting with a lower-case letter, for example *hasImmediateCulturalContext*. Inverse properties have been defined for object properties where applicable. It is recommended that the domain and range be defined for every property. However, due to the complexity of the concepts being modeled, either a domain or a range has been added to the properties, when absolutely certain of them. In other cases where the property is specific to one class and has a definite range, such as the 'encodes' properties such as *encodesRule*, both domain and range are defined. For instance, the range of the property *hasContext* has to be a context and therefore, the range is defined for this class. However, the domain for this property can be a number of classes including any classes which may be added in the future. Also, as an example of an inverse property, *hasContext* has the inverse *isAContextOf*. Properties names are descriptive and a majority of them contain the class name of their domain or range. Some properties have sub-properties and are organized as such to facilitate grouping and understanding. In these cases, the inverse functions have a similar hierarchical structure. Properties associating an instance with another within the same

class, and which cannot be applied to the original instance are irreflexive. Some examples are *hasContext* and *hasSubDomain*. Figure 32 below shows object properties, hierarchies, property description, domain and range as well as the transitive nature of the property as defined in the Protégé editor.

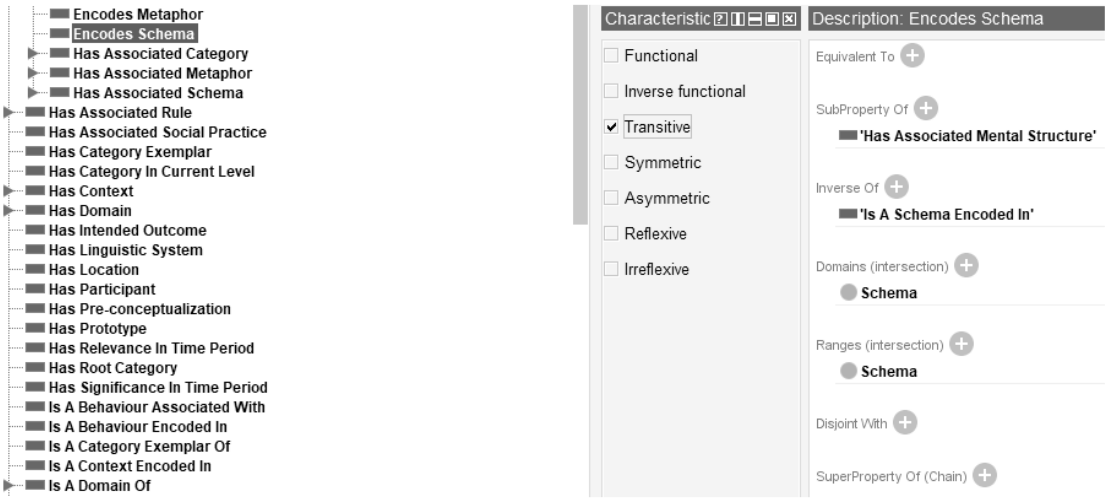

Figure 32. Object Properties in Protégé

There are also data properties, properties whose range are the class of data values. The data properties have the same naming convention as that of the object properties. Most of the data properties have both their domains and ranges defined as they often apply to only one class. Most data properties have textual or string data values, denoted by the class *rdfs:literal*, and others take numeric data values, denoted by the classes *xsd:integer* or *xsd:float*. Some data properties also have sub-properties. Figure 33 shows a subset of the data properties.

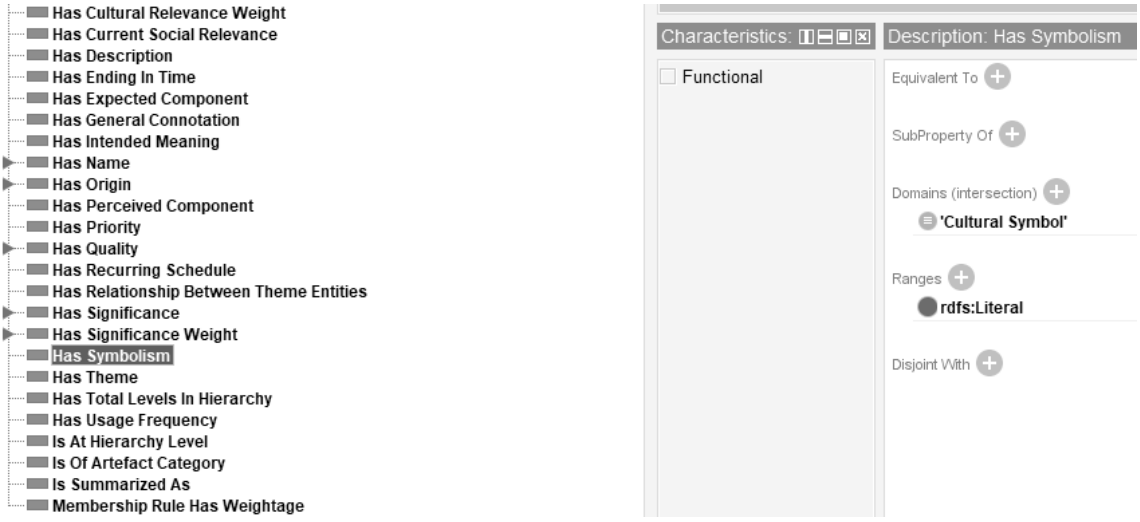

Figure 33. Data Properties in Protégé

4.3.3.3 Ontology details

Figure 34 shows the metadata attributes of the Ontology – the version is 1.0.0 following the **a.b.c** format, where **a** stands for a major version and **b** and **c**, for minor versions.

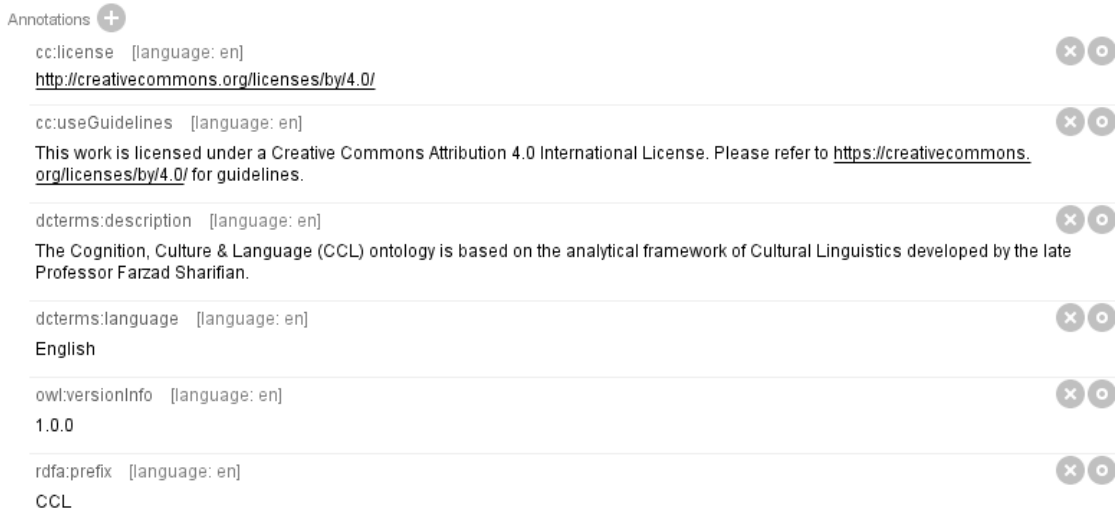

Figure 34. Ontology Details in Protégé

The cc:license property from the Creative Commons ontology has been added to indicate that the license for this ontology is the CC 4.0 BY license and there is a usage property added for it with a link to the guidelines. There is a short description of the

ontology as well as the suggested prefix for the ontology which is 'CCL'. All the metadata properties have been reused from other ontologies. Figure 34 shows the Ontology metadata.

4.3.4 Reusability

Though there were challenges in identifying ontologies and concepts for reuse (Refer to section 4.2.3.1), reusability has been partially achieved. A subset of the modelled high-level concepts was identified within other well-established ontologies such as SKOS, FOAF and CRM and have been reused. Some concepts such as 'organization' and 'group' were found in multiple ontologies. However, the reused terms were from ontologies whose conceptual definitions were closer to that of the CCL ontology. So, while both 'organization' and 'group' were available in FOAF, 'Group' was modelled from the CRM ontology as it was conceptually closer to the 'group' concept in CCL. 'Group' was originally not identified as a concept to model, but the definition of 'Organization' in FOAF did not satisfy the modelling requirement and further, FOAF made a distinction between 'Organization' and 'Group'. In the quest for a similar term in another ontology, I came across 'Group' in CRM which was closer to the definition of 'Organization' I had wanted to model. However, since 'Group' from CRM and 'Organization' from FOAF covered different subsets of the same parent class and more importantly, since a well-established ontology like FOAF made a distinction between the terms, I decided to retain both terms and, in this case, it is fair to say that the ontology was extended with reusable terms.

The following classes have been reused from other ontologies –

Class Name	URI	Ontology
Linguistic System	http://purl.org/dc/terms/LinguisticSystem	Dublin Core
Concept	http://www.w3.org/2004/02/skos/core#Concept	SKOS
Organization	http://xmlns.com/foaf/0.1/Organization	FOAF
Group	http://www.cidoc-crm.org/cidoc-crm/E74_Group	CIDOC CRM

Person	http://www.cidoc-crm.org/cidoc-crm/E21_Person	CIDOC CRM
Place	http://www.cidoc-crm.org/cidoc-crm/E53_Place	CIDOC CRM
Event	http://www.cidoc-crm.org/cidoc-crm/E5_Event	CIDOC CRM
State	http://www.cidoc-crm.org/cidoc-crm/E3_Condition_State	CIDOC CRM
Time Period	http://www.cidoc-crm.org/cidoc-crm/E4_Period	CIDOC CRM

Table 5. Reused Classes in the CCL Ontology

The following properties have been reused from other ontologies –

Property Name	**URI**	**Ontology**
gender	http://xmlns.com/foaf/0.1/gender	FOAF
Overlaps With Place	http://www.cidoc-crm.org/cidoc-crm/P121_overlaps_with	CIDOC CRM
Borders With Place	http://www.cidoc-crm.org/cidoc-crm/P122_borders_with	CIDOC CRM
Falls Within Place	http://www.cidoc-crm.org/cidoc-crm/P89_falls_within	CIDOC CRM
Contains Place	http://www.cidoc-crm.org/cidoc-crm/P89i_contains	CIDOC CRM
involvesAgent	http://www.ontologydesignpatterns.org/ont/dul/DUL.owl#involvesAgent	DOLCE UL

Table 6. Reused Properties in the CCL Ontology

4.4 Use Cases and Evaluation

A preliminary step in Ontology evaluation is scanning the ontology for pitfalls. This was done using the Ontology Pitfall Scanner or OOPS[17] tool (Poveda-Villalón, Gómez-Pérez, & Suárez-Figueroa 2014). The tool lists common pitfalls and their importance, based on research and experience. It is advisable to fix the critical pitfalls at a minimum.

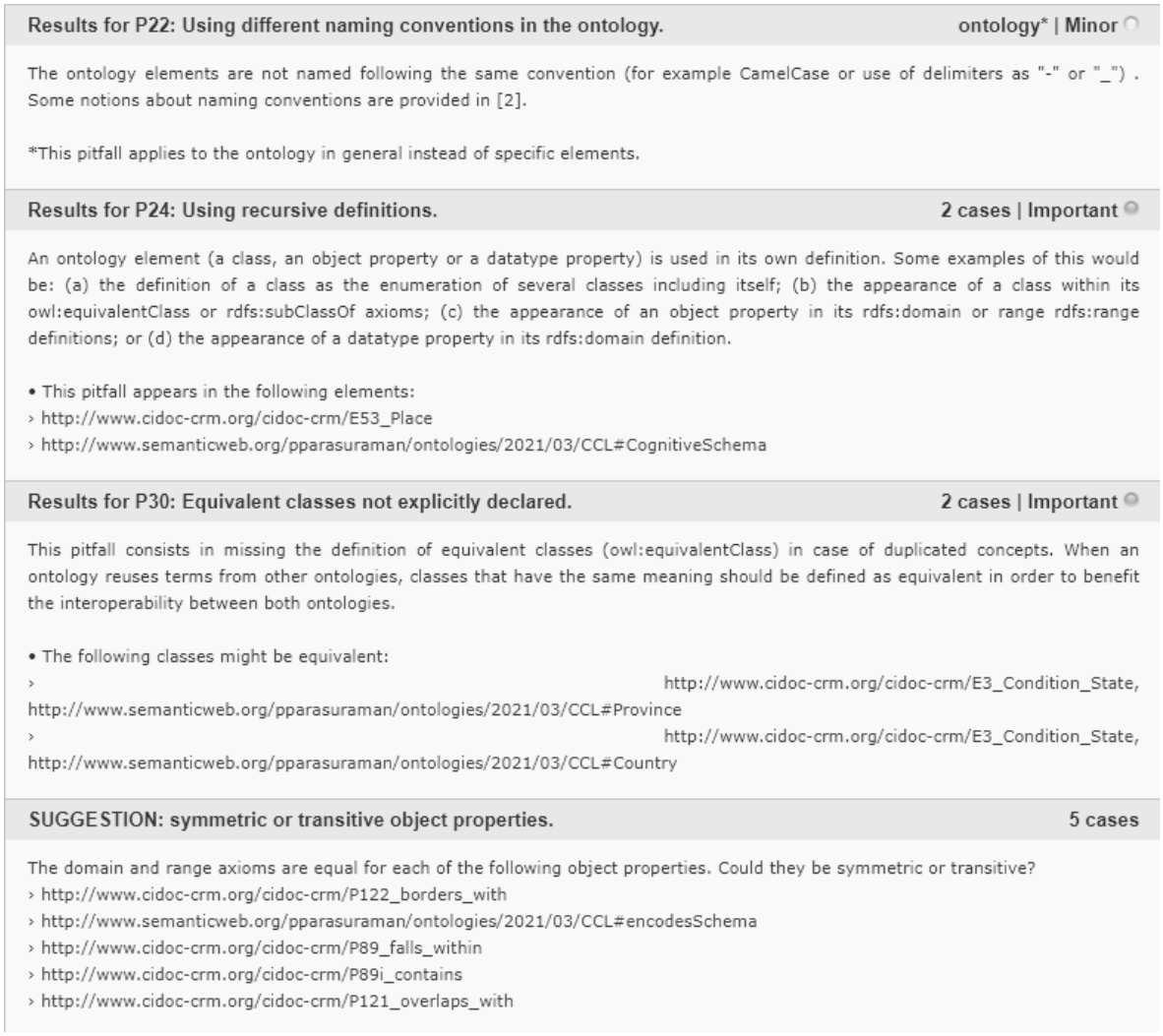

Figure 35. Sample results from the OOPS tool

Figure 35 above shows a sample output from OOPS. Some pitfalls returned by the tool such as recursive properties associating instances of the same class, adding annotations,

[17] http://oops.linkeddata.es/

adding transitivity to properties were considered and fixed where possible. Some recursive properties were made irreflexive, annotations such as labels and descriptions were added, and transitivity was added to properties where applicable. However, some other pitfalls such as a lack of a domain or range were unable to fixed without risking incorrect inferences due to issues mentioned in section 4.3.3.2. Similarly, there is a pitfall listed for different naming conventions in the ontology. This pitfall is the result of reusing terms from various ontologies, some of which contain '-' or '_' characters while the CCL ontology does not use these for IRI names.

There are many ways of evaluating ontologies based on their type, such as comparing against a benchmark or gold-standard, application-based, data-driven and assessment by humans (Brank, Grobelnik, & Mladenic 2005: 2). Of these the gold-standard approach cannot be followed since there is no ontology which models the chosen domain yet. The data-driven approach, which consists of identifying terms within a domain and comparing it with the ontology terms, cannot be chosen since this approach was used to build the ontology. The approach that fits this particular situation is the application-based approach. This can theoretically be combined with the assessment-by-humans approach, but the involvement of domain experts is not within the scope of this dissertation work. Since there are no users for this ontology yet, the scope of evaluations is limited to evaluation through querying to ensure that the concepts have been modeled as per the specifications. A list of possible use cases will be used to perform this evaluation. The Protégé tool comes with SPARQL query language plugins, of which two were used – the DL Query plugin and the Snap SPARQL Query plugin. The DL Query is useful in searching for class and subclass relationships as well as their instances. More complex queries including querying over inferences can be executed using the Snap SPARQL query plugin and these queries work well specifically with instances. Other frameworks such as the OWL-BGP (Kollia & Glimm 2012: 233), which supports SPARQL query answering over OWL Ontologies using the OWL Direct Semantics Entailment Regime can also be used.

4.4.1 General evaluation

This section shows the general relationships between classes and well inferred types of instances. The DL Query interface in Protégé accepts queries about classes and relationships written in Manchester syntax and can return results for super classes, sub-classes and instances.

In figure 36 below, we see that the result shows us all the classes which are a sub-class of the anonymous class formed by the condition **'Encodes Metaphor' some 'Cognitive Metaphor'**. The instances listed in the figure are asserted instances of the class **Cultural Schema**. Instances which need to be classified using inference are not listed, since the inference requires other conditions to be satisfied for successful classification.

Figure 36. DL Query - Metaphor

Figure 37 shows all classes and their sub-classes and super-classes which must have at least one context and can have an associated category. Even though not all classes in the results are explicitly defined with the property **Has Associated Category**, these are returned due to the open world assumption in OWL.

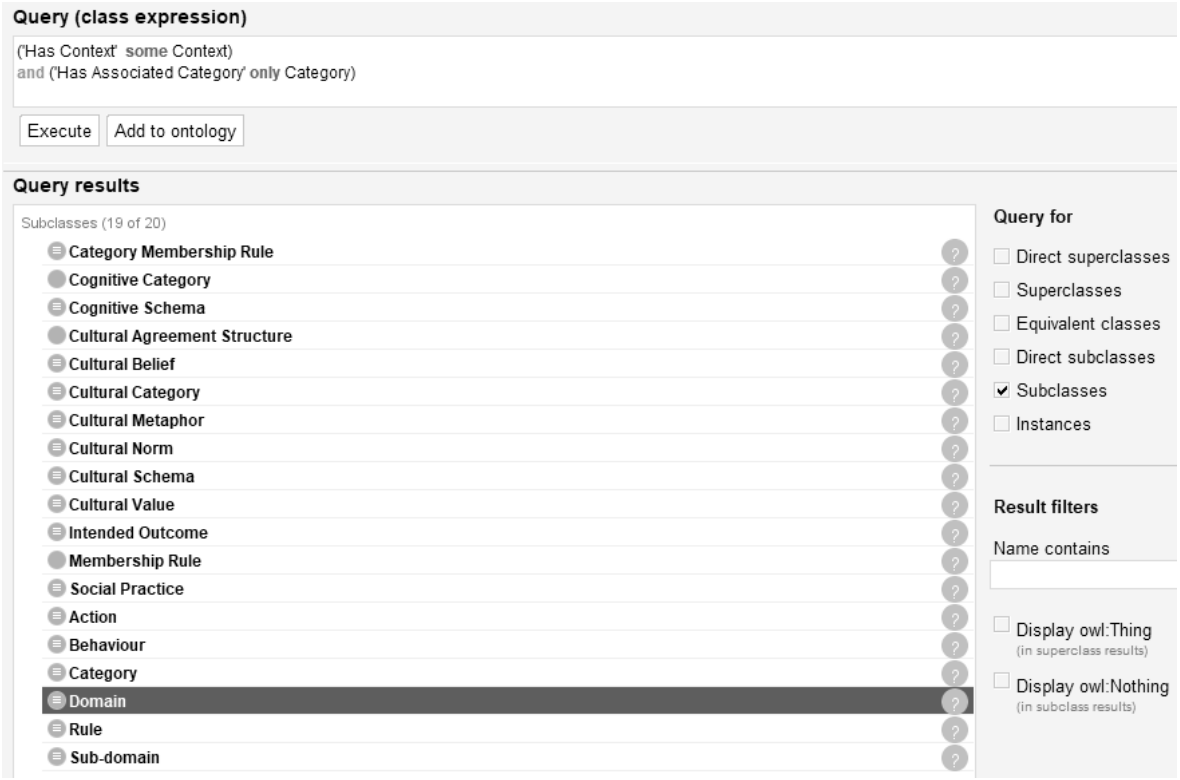

Figure 37. DL Query 2 – Context

Figure 38 below shows the results of all sub-classes for the anonymous class of objects which satisfy the condition **'Has Associated Rule' some Rule**. All the classes in the results are defined as sub-classes of the anonymous class **'Has Membership Rule' some 'Category Membership Rule'**. The **Has Membership Rule** is a sub-property of **Has Associated Rule** and **Category Membership Rule** is a sub-class of **Rule**. Thus, it was inferred that any classes which have a Category Membership Rule also in general have an associated Rule.

Figure 38. DL Query 3 – Rule

4.4.2 Use case evaluation

The following four use cases were identified, and evaluation was done using SPARQL queries. The data was obtained from research publications and excerpts of which were used as descriptions.

4.4.2.1 Get background knowledge of a culture

USE CASE 01	
Identifier	UC-01-KB
Title	Get background knowledge of a culture or its subset
Intended User	Political researcher
Description	This use cases describes how the CCL ontology can be used to learn background knowledge about a culture or a subset of it within some general or specific context.
Example	A user wants to understand the political happenings in Ghana and asks the questions 'What is the current political trend in Ghana?'
Data source	"Cultural conceptualisations of DEMOCRACY and political discourse practices in Ghana" by Ansah GN (Ansah 2017: 369-387)

Pre-requisites	The question is first transformed to a suitable query to present to the ontology. The query is to be formulated using the vocabulary of the ontology.

Table 7. Use Case UC-01-KB Description

Query Description:

First, we identify all instances of the class *Context* for a culture using the *hasAssociatedCulturalDescriptor* property associated with the individual *The_Ghanaian_Culture* of the class *CulturalDescriptor*. Next, we obtain a subset of the contexts using the property *isOfContextType* which associates instances of *Context* with the *ContextType* individual *CON_Political* to indicate context type 'political'. All objects associated with these identified political contexts are retrieved using the *hasContext* property which associates an instance of *Context* with instances of *Schema*, *Category*, *Metaphor*, *CulturalValue*, *CulturalNorm*, *CulturalBelief*, *SocialPractice*, *Domain* and some subclasses of *Entity*. The final result set is a list of all current political contexts as well as associated schemas, categories, beliefs, values, norms etc. which gives the user details of both ongoing trends and how the community feels about or reacts to them.

SPARQL Queries Used:

Query 1:

```
SELECT DISTINCT ?context ?class ?associatedobject ?associatedentity ?description
WHERE { ?context ccl:hasAssociatedCulturalDescriptor ccl:The_Ghanaian_Culture.
{?associatedobject ccl:hasImmediateCulturalContext ?context}.
?associatedobject ccl:hasAssociatedEntity ?associatedentity.
?associatedobject rdf:type ?class.
FILTER (?class != owl:Thing).
OPTIONAL {?associatedobject ccl:hasDescription ?description}. }
ORDER BY ?context
```

Query 2 :

```
SELECT DISTINCT ?context ?associatedobject ?class ?description
WHERE { ?context ccl:hasAssociatedCulturalDescriptor ccl:The_Ghanaian_Culture.
        ?context  ccl:isOfContextType ccl:CON_Political.
```

```
        {?associatedobject ccl:hasImmediateCulturalContext ?context} UNION
{?associatedobject ccl:hasContext ?context} UNION {?associatedobject
ccl:hasPriorContext ?context}.
        ?associatedobject rdf:type ?class.
        FILTER (?class != owl:Thing).
        OPTIONAL {?associatedobject ccl:hasDescription ?description}. }
        ORDER BY ?context
```

Results:

?context	?class	?associatedobject	?associatedentity	?description
ccl:Democracy_And_Freedom_Of_Speech	ccl:CollectiveMentalStructure	ccl:Criticism_Or_Critique_As_A_Mark_Of_Disrespect	ccl:The_Ghanaian_Leader	Criticism or critique is a mark of disrespect@en
ccl:Democracy_And_Freedom_Of_Speech	ccl:Schema	ccl:Criticism_Or_Critique_As_A_Mark_Of_Disrespect	ccl:The_Ghanaian_Leader	Criticism or critique is a mark of disrespect@en
ccl:Democracy_And_Freedom_Of_Speech	ccl:CulturalSchema	ccl:Criticism_Or_Critique_As_A_Mark_Of_Disrespect	ccl:The_Ghanaian_Leader	Criticism or critique is a mark of disrespect@en
ccl:Democracy_And_Freedom_Of_Speech	ccl:CollectiveMentalStructure	ccl:Criticism_Or_Critique_As_A_Mark_Of_Disrespect	ccl:The_Ghanaian_Social_Citizen	Criticism or critique is a mark of disrespect@en
ccl:Democracy_And_Freedom_Of_Speech	ccl:Schema	ccl:Criticism_Or_Critique_As_A_Mark_Of_Disrespect	ccl:The_Ghanaian_Social_Citizen	Criticism or critique is a mark of disrespect@en
ccl:Democracy_And_Freedom_Of_Speech	ccl:CulturalSchema	ccl:Criticism_Or_Critique_As_A_Mark_Of_Disrespect	ccl:The_Ghanaian_Social_Citizen	Criticism or critique is a mark of disrespect@en
ccl:Democracy_And_Freedom_Of_Speech	ccl:CollectiveMentalStructure	ccl:Society_Above_Individual	ccl:The_Ghanaian_Social_Citizen	The concept of freedom of speech is inherently contradictory to the fo...
ccl:Democracy_And_Freedom_Of_Speech	ccl:Schema	ccl:Society_Above_Individual	ccl:The_Ghanaian_Social_Citizen	The concept of freedom of speech is inherently contradictory to the fo...
ccl:Democracy_And_Freedom_Of_Speech	ccl:CulturalSchema	ccl:Society_Above_Individual	ccl:The_Ghanaian_Social_Citizen	The concept of freedom of speech is inherently contradictory to the fo...
ccl:Recent_Instances_Of_Bribery_And_Corrupti...	ccl:CollectiveMentalStructure	ccl:Bribery_And_Corruption_Is_Concealment_And_R...	ccl:The_Ghanaian_Social_Citizen	Bribery and corruption is concealment and rottenness@en
ccl:Recent_Instances_Of_Bribery_And_Corrupti...	ccl:Schema	ccl:Bribery_And_Corruption_Is_Concealment_And_R...	ccl:The_Ghanaian_Social_Citizen	Bribery and corruption is concealment and rottenness@en
ccl:Recent_Instances_Of_Bribery_And_Corrupti...	ccl:CulturalSchema	ccl:Bribery_And_Corruption_Is_Concealment_And_R...	ccl:The_Ghanaian_Social_Citizen	Bribery and corruption is concealment and rottenness@en
ccl:Recent_Instances_Of_Bribery_And_Corrupti...	ccl:CollectiveMentalStructure	ccl:Corruption_As_An_Undesirable_Thing	ccl:The_Ghanaian_Political_Institution	Corruption is an undesirable thing@en
ccl:Recent_Instances_Of_Bribery_And_Corrupti...	ccl:Schema	ccl:Corruption_As_An_Undesirable_Thing	ccl:The_Ghanaian_Political_Institution	Corruption is an undesirable thing@en
ccl:Recent_Instances_Of_Bribery_And_Corrupti...	ccl:CulturalSchema	ccl:Corruption_As_An_Undesirable_Thing	ccl:The_Ghanaian_Political_Institution	Corruption is an undesirable thing@en
ccl:Recent_Instances_Of_Bribery_And_Corrupti...	ccl:CollectiveMentalStructure	ccl:Undesirable_Things_Are_Done_In_Concealment	ccl:The_Ghanaian_Political_Institution	"The expressions that denote engaging in corrupt practices in Ewe lit...
ccl:Recent_Instances_Of_Bribery_And_Corrupti...	ccl:Schema	ccl:Undesirable_Things_Are_Done_In_Concealment	ccl:The_Ghanaian_Political_Institution	"The expressions that denote engaging in corrupt practices in Ewe lit...
ccl:Recent_Instances_Of_Bribery_And_Corrupti...	ccl:CulturalSchema	ccl:Undesirable_Things_Are_Done_In_Concealment	ccl:The_Ghanaian_Political_Institution	"The expressions that denote engaging in corrupt practices in Ewe lit...
ccl:Recent_Insult_Politics_In_Ghana	ccl:CollectiveMentalStructure	ccl:Society_Above_Individual	ccl:The_Ghanaian_Social_Citizen	The concept of freedom of speech is inherently contradictory to the fo...
ccl:Recent_Insult_Politics_In_Ghana	ccl:Schema	ccl:Society_Above_Individual	ccl:The_Ghanaian_Social_Citizen	The concept of freedom of speech is inherently contradictory to the fo...
ccl:Recent_Insult_Politics_In_Ghana	ccl:CulturalSchema	ccl:Society_Above_Individual	ccl:The_Ghanaian_Social_Citizen	The concept of freedom of speech is inherently contradictory to the fo...

Figure 39. Use Case UC-01-KB Query 1 Results

?context	?associatedobject	?class	?description
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:A_Bribe_is_Putting_Something_Under_A_Mat	ccl:CulturalMetaphor	"Addo metaphorically connects the Akan lexical conceptsad...
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:A_Bribe_is_Putting_Something_Under_A_Mat	ccl:CollectiveMentalStructure	"Addo metaphorically connects the Akan lexical conceptsad...
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:A_Bribe_is_Putting_Something_Under_A_Mat	ccl:Metaphor	"Addo metaphorically connects the Akan lexical conceptsad...
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Bribery_And_Corruption_Is_Concealment_And_Rottenn...	ccl:CollectiveMentalStructure	Bribery and corruption is concealment and rottenness@en
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Bribery_And_Corruption_Is_Concealment_And_Rottenn...	ccl:Schema	Bribery and corruption is concealment and rottenness@en
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Bribery_And_Corruption_Is_Concealment_And_Rottenn...	ccl:CulturalSchema	Bribery and corruption is concealment and rottenness@en
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Corruption_As_An_Undesirable_Thing	ccl:CollectiveMentalStructure	Corruption is an undesirable thing@en
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Corruption_As_An_Undesirable_Thing	ccl:Schema	Corruption is an undesirable thing@en
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Corruption_As_An_Undesirable_Thing	ccl:CulturalSchema	Corruption is an undesirable thing@en
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Ghanaian_Belief_2	ccl:CulturalElement	"In the Akan culture, anything that needs to be concealed, i.e...
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Ghanaian_Belief_2	ccl:CulturalAgreementStructure	"In the Akan culture, anything that needs to be concealed, i.e...
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Ghanaian_Belief_2	ccl:CulturalBelief	"In the Akan culture, anything that needs to be concealed, i.e...
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Ghanaian_Value_2	ccl:CulturalElement	Anything desirable and of value is not concealed but display...
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Ghanaian_Value_2	ccl:CulturalValue	Anything desirable and of value is not concealed but display...
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Ghanaian_Value_2	ccl:CulturalAgreementStructure	Anything desirable and of value is not concealed but display...
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Public_Display_In_Ceremonies	ccl:CulturalElement	In Akan culture, anything desirable, for example, a new born ...
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Public_Display_In_Ceremonies	ccl:SocialPractice	In Akan culture, anything desirable, for example, a new born ...
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Undesirable_Things_Are_Done_In_Concealment	ccl:CollectiveMentalStructure	"The expressions that denote engaging in corrupt practices ...
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Undesirable_Things_Are_Done_In_Concealment	ccl:Schema	"The expressions that denote engaging in corrupt practices ...
ccl:Recent_Instances_Of_Bribery_And_Corruption_In_Ghana	ccl:Undesirable_Things_Are_Done_In_Concealment	ccl:CulturalSchema	"The expressions that denote engaging in corrupt practices ...
ccl:Recent_Insult_Politics_In_Ghana	ccl:Ghanaian_Value_1	ccl:CulturalElement	Many people in Ghana regard their society as hierarchical—...
ccl:Recent_Insult_Politics_In_Ghana	ccl:Ghanaian_Value_1	ccl:CulturalValue	Many people in Ghana regard their society as hierarchical—...
ccl:Recent_Insult_Politics_In_Ghana	ccl:Ghanaian_Value_1	ccl:CulturalAgreementStructure	Many people in Ghana regard their society as hierarchical—...
ccl:Recent_Insult_Politics_In_Ghana	ccl:Politeness_In_Public_Speaking	ccl:CulturalElement	Even though there are fine differences in some of the socio-...
ccl:Recent_Insult_Politics_In_Ghana	ccl:Politeness_In_Public_Speaking	ccl:SocialPractice	Even though there are fine differences in some of the socio-...
ccl:Recent_Insult_Politics_In_Ghana	ccl:Public_Discourse_Norm	ccl:CulturalElement	The cultural norm of public discourse in Ghana@en

Figure 40. Use Case UC-01-KB Query 2 Result subset

The results in Figures 39 and 40 show that the current political contexts identified are *Recent_Insult_Politics_In_Ghana, Recent_Instances_Of_Bribery_And_Corruption_In_Ghana,*

Democracy_And_Freedom_Of_Speech. The Cultural Schemas identified pertaining to the contexts above have been developed in the environment of the political contexts. The results also list Cultural Metaphors which have been used in these contexts as well as the cultural beliefs and values existing within the community.

4.4.2.2 Understand behaviour or reaction to a public comment

USE CASE 02	
Identifier	UC-02-UB
Title	Understand behaviour or reaction to a public comment
Intended User	Public Relations Office
Description	This use cases describes how the CCL ontology can be used to understand the reaction to a certain situation by a cultural community.
Example	A user wants to understand why certain remarks made by a top political official in recent interview to a Ghanaian television channel was not received well by the Ghanaian community. In fact, there have been protests and expressions of disapproval. The user asks, 'Why such remarks when common in other parts of the world, have led to this dire situation in some parts of Ghana?'
Data source	"Cultural conceptualisations of DEMOCRACY and political discourse practices in Ghana" by Ansah GN (Ansah 2017: 369-387)
Pre-requisites	The question is first transformed to a suitable query to present to the ontology. The query is to be formulated using the vocabulary of the ontology.

Table 8. Use Case UC-02-UB Description

Query Description:

First, we identify all contexts associated with the *CulturalDescriptor* individual *The_Ghanaian_Culture* using the *hasAssociatedCulturalDescriptor* property. Next, we subset these contexts based on the terms 'speech', 'talk', 'speak' or 'discourse' within the descriptions of these instances made available through the *hasDescription* property. Next, we obtain a list of objects associated with these contexts using the *hasContext* property which associates an instance of *Context* with instances of *Schema*, *Category*, *Metaphor*, *CulturalValue*, *CulturalNorm*, *CulturalBelief*, *SocialPractice*, *Domain* and some subclasses of *Entity*. Finally, we retrieve the description information for this subset of objects. The final result set is a list of all current contexts as well as associated schemas, categories, beliefs, values, norms etc. which gives the user details of what cultural conceptualizations are prevalent within the community regarding public discourse and its classification into appropriate and inappropriate practices .

SPARQL Queries Used:

Query 1 :

```
SELECT DISTINCT ?context ?associatedobject ?class ?value
WHERE { ?context ccl:hasAssociatedCulturalDescriptor ccl:The_Ghanaian_Culture.
?context ccl:hasDescription ?description.
FILTER regex(str(?description),"discourse|speech|speak|talk","i").
?associatedobject ccl:hasContext ?context.
?associatedobject ccl:hasDescription ?value.
?associatedobject rdf:type ?class.
FILTER (?class != owl:Thing).}
ORDER BY ?context ?associatedobject
```

Results:

?context	?associatedobject	?class	?value
ccl:Appropriateness_In_Social_Discourse_Practices	ccl:Criticism_Or_Critique_As_A_Mark_Of_Disrespect	ccl:CulturalSchema	Criticism or critique is a mark of disrespect@en
ccl:Appropriateness_In_Social_Discourse_Practices	ccl:Criticism_Or_Critique_As_An_Insult	ccl:CollectiveMentalStructure	Criticism or critique is an insult@en
ccl:Appropriateness_In_Social_Discourse_Practices	ccl:Criticism_Or_Critique_As_An_Insult	ccl:Schema	Criticism or critique is an insult@en
ccl:Appropriateness_In_Social_Discourse_Practices	ccl:Criticism_Or_Critique_As_An_Insult	ccl:CulturalSchema	Criticism or critique is an insult@en
ccl:Appropriateness_In_Social_Discourse_Practices	ccl:Ghanaian_Belief_1	ccl:CulturalElement	"Traditionally, it is an offence to show disrespect to a King/C...
ccl:Appropriateness_In_Social_Discourse_Practices	ccl:Ghanaian_Belief_1	ccl:CulturalAgreementStructure	"Traditionally, it is an offence to show disrespect to a King/C...
ccl:Appropriateness_In_Social_Discourse_Practices	ccl:Ghanaian_Belief_1	ccl:CulturalBelief	"Traditionally, it is an offence to show disrespect to a King/C...
ccl:Appropriateness_In_Social_Discourse_Practices	ccl:Public_Discourse_Norm	ccl:CulturalElement	The cultural norm of public discourse in Ghana@en
ccl:Appropriateness_In_Social_Discourse_Practices	ccl:Public_Discourse_Norm	ccl:CulturalNorm	The cultural norm of public discourse in Ghana@en
ccl:Appropriateness_In_Social_Discourse_Practices	ccl:Public_Discourse_Norm	ccl:CulturalAgreementStructure	The cultural norm of public discourse in Ghana@en
ccl:Democracy_And_Freedom_Of_Speech	ccl:Criticism_Or_Critique_As_A_Mark_Of_Disrespect	ccl:CollectiveMentalStructure	Criticism or critique is a mark of disrespect@en
ccl:Democracy_And_Freedom_Of_Speech	ccl:Criticism_Or_Critique_As_A_Mark_Of_Disrespect	ccl:Schema	Criticism or critique is a mark of disrespect@en
ccl:Democracy_And_Freedom_Of_Speech	ccl:Criticism_Or_Critique_As_A_Mark_Of_Disrespect	ccl:CulturalSchema	Criticism or critique is a mark of disrespect@en
ccl:Democracy_And_Freedom_Of_Speech	ccl:Society_Above_Individual	ccl:CollectiveMentalStructure	The concept of freedom of speech is inherently contradictory...
ccl:Democracy_And_Freedom_Of_Speech	ccl:Society_Above_Individual	ccl:Schema	The concept of freedom of speech is inherently contradictory...
ccl:Democracy_And_Freedom_Of_Speech	ccl:Society_Above_Individual	ccl:CulturalSchema	The concept of freedom of speech is inherently contradictory...
ccl:Recent_Insult_Politics_In_Ghana	ccl:Ghanaian_Value_1	ccl:CulturalElement	Many people in Ghana regard their society as hierarchical—...
ccl:Recent_Insult_Politics_In_Ghana	ccl:Ghanaian_Value_1	ccl:CulturalValue	Many people in Ghana regard their society as hierarchical—...
ccl:Recent_Insult_Politics_In_Ghana	ccl:Ghanaian_Value_1	ccl:CulturalAgreementStructure	Many people in Ghana regard their society as hierarchical—...
ccl:Recent_Insult_Politics_In_Ghana	ccl:Politeness_In_Public_Speaking	ccl:CulturalElement	Even though there are fine differences in some of the socio-...
ccl:Recent_Insult_Politics_In_Ghana	ccl:Politeness_In_Public_Speaking	ccl:SocialPractice	Even though there are fine differences in some of the socio-...
ccl:Recent_Insult_Politics_In_Ghana	ccl:Public_Discourse_Norm	ccl:CulturalElement	The cultural norm of public discourse in Ghana@en
ccl:Recent_Insult_Politics_In_Ghana	ccl:Public_Discourse_Norm	ccl:CulturalNorm	The cultural norm of public discourse in Ghana@en
ccl:Recent_Insult_Politics_In_Ghana	ccl:Public_Discourse_Norm	ccl:CulturalAgreementStructure	The cultural norm of public discourse in Ghana@en
ccl:Recent_Insult_Politics_In_Ghana	ccl:Society_Above_Individual	ccl:CollectiveMentalStructure	The concept of freedom of speech is inherently contradictory...
ccl:Recent_Insult_Politics_In_Ghana	ccl:Society_Above_Individual	ccl:Schema	The concept of freedom of speech is inherently contradictory...

Figure 41. Use Case UC-02-UB Query 1 Result subset

The results in Figure 41 show that all the contexts related with speech or discourse have been identified. The Cultural elements such as schemas, beliefs, values etc. pertaining to these contexts have also been identified.

4.4.2.3 Understanding communication in a cross-cultural context

USE CASE 03	
Identifier	UC-03-UC
Title	Understanding communication in a cross-cultural context
Intended User	Educators
Description	This use cases describes how the CCL ontology can be used to understand a fragment of speech properly and within context, especially in cross-cultural situations.
Example	A user wants to understand the meaning of something a student said which doesn't make sense. This is the first time they have heard such a strange story. The user asks, 'What is the significance of a spirits or spiritual phenomena within this particular culture'?
Data source	" 'It was all a bit confusing…' comprehending Aboriginal English texts. Language, Culture and Curriculum" by Sharifian F,

	Rochecouste J & Malcolm IG (Sharifian, Rochecouste & Malcolm 2004: 203–228)
Pre-requisites	The question is first transformed to a suitable query to present to the ontology. The query is to be formulated using the vocabulary of the ontology.

Table 9. Use Case UC-03-UC Description

Query Description:

First, we identify all instances of the class *Context* for a culture using the *hasAssociatedCulturalDescriptor* property associated with the individual *The_West_Australian_Aboriginal_Culture* of class *CulturalDescriptor*. Next, we identify all objects associated with these identified contexts using the *hasContext* property which associates an instance of *Context* with instances of *Schema*, *Category*, *Metaphor*, *CulturalValue*, *CulturalNorm*, *CulturalBelief*, *SocialPractice*, *Domain* and some subclasses of Entity. Next, we subset these objects based on property values with the terms 'spirit', 'ghost' or 'being'. The final result set is a list of all current contexts as well as associated schemas, categories, beliefs, values, norms etc. which gives the user the user an idea of the cultural perception of supernatural phenomena in the community. This could be a fairly broad search and can be used to obtain exhaustive knowledge depending on what data is available.

SPARQL Queries Used:

Query 1 :

```
SELECT DISTINCT ?context ?class ?associatedobject ?property  ?value
WHERE { ?context ccl:hasAssociatedCulturalDescriptor
ccl:The_West_Australian_Aboriginal_Culture.
        ?associatedobject ccl:hasContext ?context.
        {?property a owl:ObjectProperty. ?associatedobject ?property ?value} UNION
{?property a owl:DatatypeProperty. ?associatedobject ?property ?value}.
        FILTER regex(str(?value),"spirit|ghost|being","i").
        {?associatedobject rdf:type ?class}.
```

```
FILTER  (?class != owl:Thing).}
ORDER BY ?context ?class ?associatedobject ?property
```

Results:

?context	?class	?associatedobject	?property	?value
ccl:Narration_Of_A_Routine_Incident_By_An_Aboriginal_Person	ccl:CollectiveMentalStructure	ccl:The_Scary_Things_Schema	ccl:hasAssociatedLinguisticExpression	Excerpt from actual discourse: "She was stayin at her uncle's an 'e wok...
ccl:Narration_Of_A_Routine_Incident_By_An_Aboriginal_Person	ccl:CulturalAgreementStructure	ccl:WAA_Belief_1	ccl:hasDescription	The belief in the existence of supernatural beings such as "Beings kno...
ccl:Narration_Of_A_Routine_Incident_By_An_Aboriginal_Person	ccl:CulturalAgreementStructure	ccl:WAA_Belief_2	ccl:hasDescription	"People may encounter the spirits of people who previously lived and di...
ccl:Narration_Of_A_Routine_Incident_By_An_Aboriginal_Person	ccl:CulturalAgreementStructure	ccl:WAA_Value_1	ccl:hasDescription	Spiritual beings have a significant impact on normal life and therefore ...
ccl:Narration_Of_A_Routine_Incident_By_An_Aboriginal_Person	ccl:CulturalBelief	ccl:WAA_Belief_1	ccl:hasDescription	The belief in the existence of supernatural beings such as "Beings kno...
ccl:Narration_Of_A_Routine_Incident_By_An_Aboriginal_Person	ccl:CulturalBelief	ccl:WAA_Belief_2	ccl:hasDescription	"People may encounter the spirits of people who previously lived and di...
ccl:Narration_Of_A_Routine_Incident_By_An_Aboriginal_Person	ccl:CulturalElement	ccl:WAA_Belief_1	ccl:hasDescription	The belief in the existence of supernatural beings such as "Beings kno...
ccl:Narration_Of_A_Routine_Incident_By_An_Aboriginal_Person	ccl:CulturalElement	ccl:WAA_Belief_2	ccl:hasDescription	"People may encounter the spirits of people who previously lived and di...
ccl:Narration_Of_A_Routine_Incident_By_An_Aboriginal_Person	ccl:CulturalElement	ccl:WAA_Value_1	ccl:hasDescription	Spiritual beings have a significant impact on normal life and therefore ...
ccl:Narration_Of_A_Routine_Incident_By_An_Aboriginal_Person	ccl:CulturalSchema	ccl:The_Scary_Things_Schema	ccl:hasAssociatedLinguisticExpression	Excerpt from actual discourse: "She was stayin at her uncle's an 'e wok...
ccl:Narration_Of_A_Routine_Incident_By_An_Aboriginal_Person	ccl:CulturalValue	ccl:WAA_Value_1	ccl:hasDescription	Spiritual beings have a significant impact on normal life and therefore ...
ccl:Narration_Of_A_Routine_Incident_By_An_Aboriginal_Person	ccl:Schema	ccl:The_Scary_Things_Schema	ccl:hasAssociatedLinguisticExpression	Excerpt from actual discourse: "She was stayin at her uncle's an 'e wok...
ccl:The_Australian_Aboriginal_Worldview	ccl:CollectiveMentalStructure	ccl:The_Scary_Things_Schema	ccl:hasAssociatedLinguisticExpression	Excerpt from actual discourse: "She was stayin at her uncle's an 'e wok...
ccl:The_Australian_Aboriginal_Worldview	ccl:CulturalAgreementStructure	ccl:WAA_Belief_1	ccl:hasDescription	The belief in the existence of supernatural beings such as "Beings kno...
ccl:The_Australian_Aboriginal_Worldview	ccl:CulturalAgreementStructure	ccl:WAA_Belief_3	ccl:hasDescription	"With regard to creation, Aboriginal worldview maintains that Creative An...
ccl:The_Australian_Aboriginal_Worldview	ccl:CulturalBelief	ccl:WAA_Belief_1	ccl:hasDescription	The belief in the existence of supernatural beings such as "Beings kno...
ccl:The_Australian_Aboriginal_Worldview	ccl:CulturalBelief	ccl:WAA_Belief_3	ccl:hasDescription	"With regard to creation, Aboriginal worldview maintains that Creative An...
ccl:The_Australian_Aboriginal_Worldview	ccl:CulturalElement	ccl:WAA_Belief_1	ccl:hasDescription	The belief in the existence of supernatural beings such as "Beings kno...
ccl:The_Australian_Aboriginal_Worldview	ccl:CulturalElement	ccl:WAA_Belief_3	ccl:hasDescription	"With regard to creation, Aboriginal worldview maintains that Creative An...
ccl:The_Australian_Aboriginal_Worldview	ccl:CulturalSchema	ccl:The_Scary_Things_Schema	ccl:hasAssociatedLinguisticExpression	Excerpt from actual discourse: "She was stayin at her uncle's an 'e wok...
ccl:The_Australian_Aboriginal_Worldview	ccl:Schema	ccl:The_Scary_Things_Schema	ccl:hasAssociatedLinguisticExpression	Excerpt from actual discourse: "She was stayin at her uncle's an 'e wok...

Figure 42. Use Case UC-03-UC Query 1 Result subset

The results in Figure 42 show that all the contexts, schemas, beliefs, values, norms etc. pertaining to all contexts flagged as associated with 'ghost', 'spirit' or 'being', within the Western Australian Aboriginal culture have been identified.

4.4.2.4 Make comparisons between cultures

USE CASE 04	
Identifier	UC-04-MC
Title	Make comparisons between cultures
Intended User	Cultural Studies Student
Description	This use cases describes how the CCL ontology can be used to compare conceptualizations across cultures.
Example	A user wants to make comparisons between different cultures and determine how a subject is conceptualized within different cultures. The user asks, ' How is corruption conceptualized within the Ghanaian culture vs the Chinese culture?'

Data source	1. “Winds and tigers: metaphor choice in China’s anti-corruption discourse” by Jing-Schmidt Z & Peng X (Jing-Schmidt & Peng 2017: 1-26). 2. "Cultural conceptualisations of DEMOCRACY and political discourse practices in Ghana" by Ansah GN (Ansah 2017: 369-387)
Pre-requisites	The question is first transformed to a suitable query to present to the ontology. The query is to be formulated using the vocabulary of the ontology.

Table 10. Use Case UC-04-MC Description

Query Description:

In this case, all cultures belonging to a certain country must be identified. The domain of the property *isAssociatedWithPlace* is the class *hasAssociatedCulturalDescriptor* and its range is the class *Place*. We filter the place to be either *Ghana* or *China*, as these are the countries of interest to the user. Next, we identify all objects of the class *Context* using the *hasAssociatedCulturalDescriptor* property for the cultures identified in the previous step and filter them by the term ‘corrupt’ occurring within the descriptions of the context. Since we are interested in the conceptualization of corruption within these two societies, all instances of the class *CollectiveMentalStructure* and objects associated with these instances are retrieved using the *hasContext property* which associates an instance of *Context* with instances of *Schema*, *Category*, *Metaphor*, *CulturalValue*, *CulturalNorm*, *CulturalBelief*, *SocialPractice*, *Domain* and some subclasses of *Entity*. The final result set is a list of all contexts relating possibly to a subset of the domain ‘Corruption’ as well as associated schemas, categories, beliefs, values, norms etc. within each culture associated with either countries.

SPARQL Queries Used:

Query 1:

```
SELECT DISTINCT ?culturaldescriptor ?context ?class ?associatedobject ?value
WHERE {      {?culturaldescriptor ccl:isAssociatedWithPlace ccl:China} UNION
{?culturaldescriptor ccl:isAssociatedWithPlace ccl:Ghana}.
        ?context ccl:hasAssociatedCulturalDescriptor ?culturaldescriptor.
        ?context ccl:hasDescription ?description.
        FILTER regex(str(?description),"corrupt","i").
        ?associatedobject ccl:hasContext ?context.
        {?property rdf:type owl:ObjectProperty. ?associatedobject ?property ?value}
UNION {?property rdf:type owl:DatatypeProperty. ?associatedobject ?property
?value}.
        {?associatedobject rdf:type ?class}.
        FILTER  (?class = ccl:CollectiveMentalStructure && ?property !=
owl:topObjectProperty).
        }
        ORDER BY ?culturaldescriptor ?context
```

Results:

Figure 43 shows a subset of the results of the SPARQL Query. We see a context for each of the cultures and associated cultural schemas, metaphors and categories with the objects they associate with or encode, respectively.

?culturaldescriptor	?context	?class	?associatedobject	?property	?value
ccl:The_Chinese_Culture	ccl:Recent_Economic_Growth_and_S...	ccl:CollectiveMentalStructure	ccl:Corruption_As_A_Serious_Social_Ha...	ccl:hasAssociatedMentalStructure	ccl:Disease_Causes_Harm
ccl:The_Chinese_Culture	ccl:Recent_Economic_Growth_and_S...	ccl:CollectiveMentalStructure	ccl:Corruption_As_A_Serious_Social_Ha...	ccl:hasAssociatedMentalStructure	ccl:Corruption_Is_Vermin
ccl:The_Chinese_Culture	ccl:Recent_Economic_Growth_and_S...	ccl:CollectiveMentalStructure	ccl:Corruption_As_A_Serious_Social_Ha...	ccl:hasAssociatedMentalStructure	ccl:A_Social_Problem_Is_A_Disease
ccl:The_Chinese_Culture	ccl:Recent_Economic_Growth_and_S...	ccl:CollectiveMentalStructure	ccl:Corruption_As_A_Serious_Social_Ha...	ccl:hasAssociatedMentalStructure	ccl:Corruption_Is_Disease
ccl:The_Chinese_Culture	ccl:Recent_Economic_Growth_and_S...	ccl:CollectiveMentalStructure	ccl:Corruption_As_A_Serious_Social_Ha...	ccl:hasAssociatedMentalStructure	ccl:Vermin_Causes_Harm
ccl:The_Chinese_Culture	ccl:Recent_Economic_Growth_and_S...	ccl:CollectiveMentalStructure	ccl:Corruption_As_A_Serious_Social_Ha...	ccl:hasAssociatedMentalStructure	ccl:Weed_Causes_Harm
ccl:The_Chinese_Culture	ccl:Recent_Economic_Growth_and_S...	ccl:CollectiveMentalStructure	ccl:Corruption_As_A_Serious_Social_Ha...	ccl:hasContext	ccl:AntiCorruption_Campaign_By_The_C...
ccl:The_Chinese_Culture	ccl:Recent_Economic_Growth_and_S...	ccl:CollectiveMentalStructure	ccl:Corruption_As_A_Serious_Social_Ha...	ccl:hasContext	ccl:Recent_Economic_Growth_and_Surgi...
ccl:The_Chinese_Culture	ccl:Recent_Economic_Growth_and_S...	ccl:CollectiveMentalStructure	ccl:Corruption_As_A_Serious_Social_Ha...	ccl:hasImmediateCulturalContext	ccl:AntiCorruption_Campaign_By_The_C...
ccl:The_Chinese_Culture	ccl:Recent_Economic_Growth_and_S...	ccl:CollectiveMentalStructure	ccl:Corruption_As_A_Serious_Social_Ha...	ccl:hasImmediateCulturalContext	ccl:Recent_Economic_Growth_and_Surgi...
ccl:The_Chinese_Culture	ccl:Recent_Economic_Growth_and_S...	ccl:CollectiveMentalStructure	ccl:Corruption_As_A_Serious_Social_Ha...	ccl:isOfSchemaType	ccl:SCH_Social
ccl:The_Chinese_Culture	ccl:Recent_Economic_Growth_and_S...	ccl:CollectiveMentalStructure	ccl:Corruption_As_A_Serious_Social_Ha...	ccl:isOfType	ccl:SCH_Social
ccl:The_Chinese_Culture	ccl:Recent_Economic_Growth_and_S...	ccl:CollectiveMentalStructure	ccl:Corruption_As_A_Serious_Social_Ha...	ccl:hasDescription	Corruption is a serious social harm requir...
ccl:The_Chinese_Culture	ccl:Recent_Economic_Growth_and_S...	ccl:CollectiveMentalStructure	ccl:Corruption_As_A_Serious_Social_Ha...	ccl:hasName	Corruption_As_A_Serious_Social_Harm_...
ccl:The_Ghanaian_Culture	ccl:Recent_Instances_Of_Bribery_And...	ccl:CollectiveMentalStructure	ccl:Corruption_As_An_Undesirable_Thing	ccl:encodesCulturalAgreementStructure	ccl:Ghanaian_Belief_2
ccl:The_Ghanaian_Culture	ccl:Recent_Instances_Of_Bribery_And...	ccl:CollectiveMentalStructure	ccl:Undesirable_Things_Are_Done_In_C...	ccl:encodesCulturalAgreementStructure	ccl:Ghanaian_Belief_2
ccl:The_Ghanaian_Culture	ccl:Recent_Instances_Of_Bribery_And...	ccl:CollectiveMentalStructure	ccl:Corruption_As_An_Undesirable_Thing	ccl:encodesCulturalBelief	ccl:Ghanaian_Belief_2
ccl:The_Ghanaian_Culture	ccl:Recent_Instances_Of_Bribery_And...	ccl:CollectiveMentalStructure	ccl:Undesirable_Things_Are_Done_In_C...	ccl:encodesCulturalBelief	ccl:Ghanaian_Belief_2
ccl:The_Ghanaian_Culture	ccl:Recent_Instances_Of_Bribery_And...	ccl:CollectiveMentalStructure	ccl:Bribery_And_Corruption_Is_Conceal...	ccl:encodesMetaphor	ccl:A_Bribe_is_Putting_Something_Under...
ccl:The_Ghanaian_Culture	ccl:Recent_Instances_Of_Bribery_And...	ccl:CollectiveMentalStructure	ccl:Bribery_And_Corruption_Is_Conceal...	ccl:encodesMetaphor	ccl:A_Bribe_Is_A_Room_Thing
ccl:The_Ghanaian_Culture	ccl:Recent_Instances_Of_Bribery_And...	ccl:CollectiveMentalStructure	ccl:Bribery_And_Corruption_Is_Conceal...	ccl:encodesMetaphor	ccl:A_Bribe_Is_A_Night_Thing
ccl:The_Ghanaian_Culture	ccl:Recent_Instances_Of_Bribery_And...	ccl:CollectiveMentalStructure	ccl:Corruption_As_An_Undesirable_Thing	ccl:encodesSchema	ccl:Undesirable_Things_Are_Done_In_C...
ccl:The_Ghanaian_Culture	ccl:Recent_Instances_Of_Bribery_And...	ccl:CollectiveMentalStructure	ccl:Corruption_As_An_Undesirable_Thing	ccl:hasAssociatedCulturalAgreementStruc...	ccl:Ghanaian_Belief_2
ccl:The_Ghanaian_Culture	ccl:Recent_Instances_Of_Bribery_And...	ccl:CollectiveMentalStructure	ccl:Undesirable_Things_Are_Done_In_C...	ccl:hasAssociatedCulturalAgreementStruc...	ccl:Ghanaian_Belief_2
ccl:The_Ghanaian_Culture	ccl:Recent_Instances_Of_Bribery_And...	ccl:CollectiveMentalStructure	ccl:A_Bribe_Is_A_Night_Thing	ccl:hasAssociatedCulturalDescriptor	ccl:The_Ghanaian_Culture
ccl:The_Ghanaian_Culture	ccl:Recent_Instances_Of_Bribery_And...	ccl:CollectiveMentalStructure	ccl:A_Bribe_Is_A_Room_Thing	ccl:hasAssociatedCulturalDescriptor	ccl:The_Ghanaian_Culture

Figure 43. Use Case UC-04-MC Query 1 Result subset

4.5 Publication and Documentation

The Ontology classes and properties can be accessed using the URL **http://purl.org/net/CCL** and the current version of the ontology is 1.0.0.

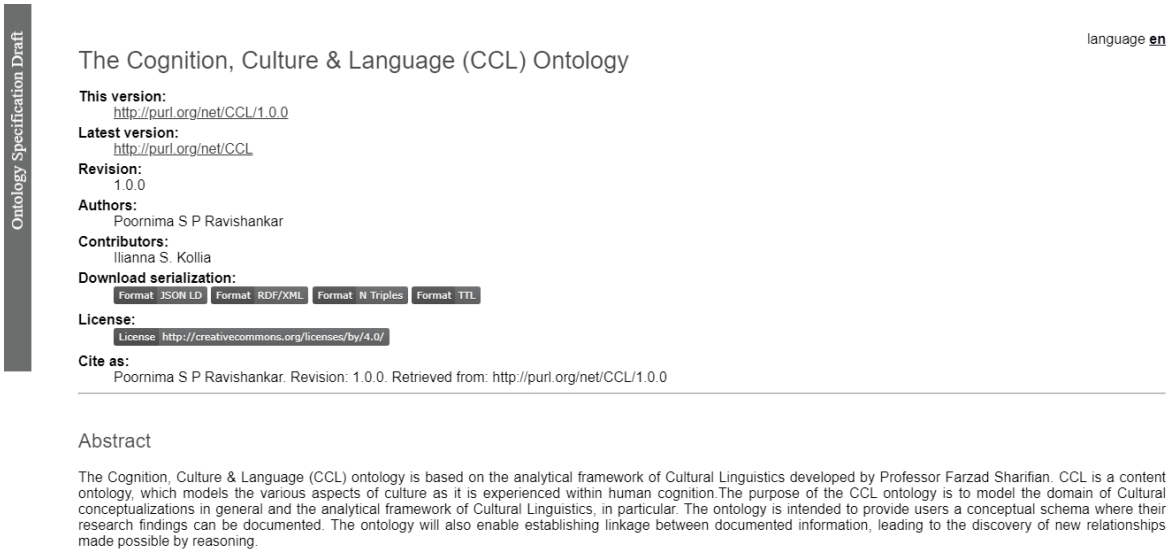

Figure 44. Ontology Documentation - Summary Section

Figures 44 and 45 show an excerpt of the documentation. The documentation for the ontology was generated using the WIDOCO tool[18] (Garijo 2017: 95, 101). WIDOCO builds on the Live OWL Documentation Environment (LODE) and produces documentation using the annotation properties within the ontology. It allows for some customization through its interface such as the option to generate and include links to multiple serialization formats such as N-triples (.nt) and Turtle (.ttl) within the HTML page as well as a visualization option using WebVOWL. All files are stored in GitHub.[19]

[18] https://github.com/dgarijo/Widoco/
[19] https://github.com/pr-paras/theCCLontology

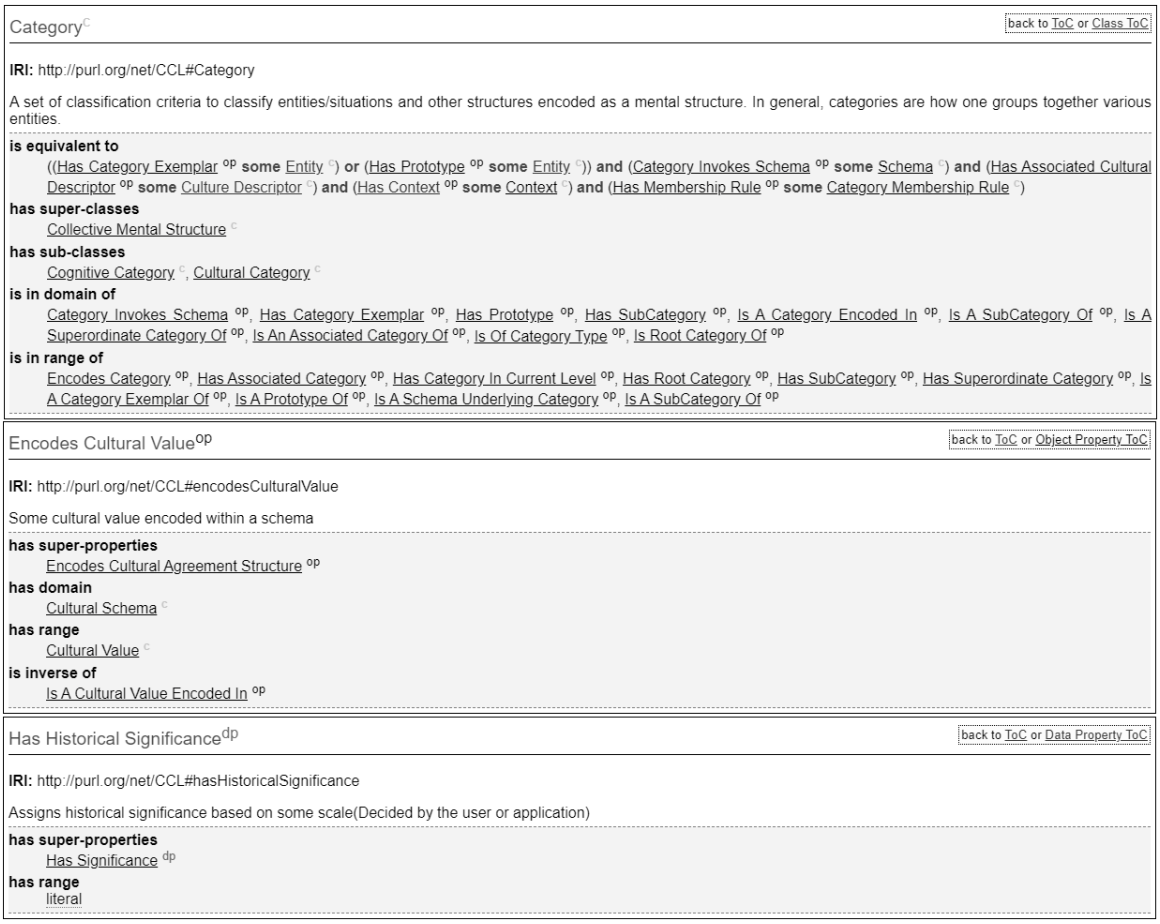

Figure 45. Ontology Documentation - Classes and Properties

Chapter 5
Conclusion

In the previous chapters, we have seen how the model for the CCL Ontology was arrived at, the rationale behind its design, the principles followed during implementation and some challenges we faced during the process. In this chapter, we present some ideas for improving upon the ontology, some things to reconsider and possible future directions.

5.1 Where do we go from here?

The following sections provide some suggestions for future work.

5.1.1 Assess requirements with real users

The first and most important course of action for the CCL Ontology would be to garner interest among cultural linguists, anthropologists and ethnoscience researchers performing cultural work. Since this work utilized content analysis from text to extract requirements, it is important to assess these current requirements with real users to determine their relevance and exhaustiveness.

5.1.2 Add Linguistic and Cognitive Modelling

Being an ontology of Cultural Linguistics, CCL sits at the intersection of various fields such as cognition, linguistics, anthropology and ethnoscience. The ontology was designed using the middle-out approach starting with the core domain concepts first

and then expanding as needed. The ontology in its current version stays true to this principle. However, the ontology could be enhanced on the linguistics side and the linguistic modelling expanded, considering the applications accessing the ontology are expected to be NLP applications.

Also, the ontology could be extended with a model of basic cognitive concepts. Cognition is a fairly broad domain and cognition itself can be studied within multiple paradigms such as functional, structural, physical, behavioural etc. Therefore, it is first important to select a suitable paradigm. The subset of cognition to be considered for modelling is language processing and reasoning, though future research may identify other relevant areas. An important Cognitive-Linguistic Ontology is DOLCE. It may be possible to model all the relevant cognitive concepts by reusing parts of the DOLCE ontology, but this would require careful consideration and effort as it is a complex ontology.

5.1.3 The NSM theory

The Natural Semantic Meta (NSM) language is a system of meaning representation (Goddard 2010: 459) which aims to represent all utterances as a combination of some basic blocks of meaning called semantic primes, which are independent of language. The NSM approach attempts to reduce the utterance of a lexical expression in terms of its list of universal atomic meaning representations (Goddard 2010: 461). Integrating this theory within the linguistic part of the ontology would be especially useful in understanding how different cultures visualize, in terms of language, the experience of meaning of a certain entity.

5.1.4 Integrate with other knowledge bases

The CIDOC CRM Ontology is a widely adopted ontology of cultural heritage and the knowledge bases of artefacts created using this ontology can be invaluable in adding to the cultural linguistics research. Elements from other sources of data such as

Europeana[20] and the D-Place Database mentioned in section 2.2.7 as well as anthropological sources can be used to further enrich the ontology.

5.1.5 Build an interface and integrate with NLP applications

When the CCL Ontology was first conceived, it was intended to record data which can be accessed by NLP applications for further processing. It was assumed that there will be some interface which will make this possible. It may be necessary that a standard method of interaction with the ontology be built for all accessing NLP applications and this should be done in the form of APIs.

5.1.6 Modularize

In building all the above components, the ontology can become massive in size. Therefore, a modular approach will be best, given the diversity of domains and concepts to be modeled. Each module can be designed to be a complete ontology and function independently, if required but can also be integrated with the other modules through interfaces.

5.2 Revisiting the basics

The notion of what constitutes culture is a highly contested one (Ingold 1994: 329). Though there is a general, abstract understanding of the term, its definition varies within different domains. Culture can be approached from the viewpoint of the progress of societies, their beliefs and thought or their traditions and practices, as symbols and meanings and even the artefacts they create (Sewell Jr 2005: 79–84). In any case, there have been massive changes in perception of what researchers now consider culture to be. According to Schudson (Schudson 1989: 153), "it is the precondition and the condition of human-ness". With recent focus on culture in the biological and cognitive domains, culture is now considered more intertwined with the

[20] https://www.europeana.eu/

nature of being human (Whiten, Hinde, Laland & Stringer 2011: 938). Thus, the definition of culture is constantly changing as multiple perspectives take shape.

As noted in the modelling philosophy in section 3.3.1.1, research is now shedding light on basic cognitive processes being culturally infused from the start and that cultural practices may pattern attention and behaviour (Veissière, Constant, Ramstead, Friston & Kirmayer, 2020: 1) . Thus, in the future, we may find that a clear distinction may not be made between cognition and cultural cognition. It may not make sense to distinguish between cognitive conceptualizations and cultural conceptualizations. The Cultural Linguistics framework itself may undergo further changes. The current modelling of these concepts in the CCL Ontology has to be periodically reviewed and revised to accommodate newer research.

5.3 Concluding Remarks

In this dissertation, I have presented an ontology of cultural conceptualizations which models the factors and framework of cultural thinking and understanding. Given the significance of web ontologies in Cognitive and Artificial Intelligence applications and the growing dependence of the world on them, it is important to consider how policies and decision making based on these applications may be affecting the average social citizen. Allowing for cultural considerations is a necessary step towards achieving balance and equality through representation of the numerous cultural groups which make up the global society today. With this view, the argument for inclusion of cultural factors in technology is one worthy of emphasis. Ontologies such as the CCL ontology could have a big impact when integrated in applications within a wide range of domains including, but not limited to that of education, political discourse, AI ethics and social policy.

Appendix A
Software

This section lists all the software created as a part of this dissertation.

A.1 The CCL Ontology Software

The CCL Ontology RDF file is attached below –


CCL.txt

The above ontology was extended with instances for performing reasoning and evaluation. The extended ontology is attached below.


CCL_extended_with
_instances.txt

Both the above files can be opened using Protégé or another Ontology editor or in a text editor such as Notepad.

References

Ansah, G. N. (2017). Cultural conceptualisations of DEMOCRACY and political discourse practices in Ghana. In *Advances in cultural linguistics* (pp. 369-387). Springer, Singapore.

Antoniou, G., & Van Harmelen, F. (2004). Web ontology language: Owl. In *Handbook on ontologies* (pp. 67-92). Springer, Berlin, Heidelberg.

Baader, F., Horrocks, I., & Sattler, U. (2008). Description logics. *Foundations of Artificial Intelligence*, *3*, 135-179.

Bagasheva, A. (2017). Cultural conceptualisations of mouth, lips, tongue and teeth in Bulgarian and English. In *Advances in Cultural Linguistics* (pp. 189-221). Springer, Singapore.

Barsalou LW. (2016). Situated conceptualization: theory and applications. In *Foundations of embodied cognition. Volume 1, perceptual and emotional embodiment* (eds Y Coello, MH Fischer) (pp. 11 – 37). East Sussex, UK: Psychology Press.

Berners-Lee, T., Hendler, J., & Lassila, O. (2001). The semantic web. *Scientific american*, *284*(5), 34-43.

Blanchard, E. G., Mizoguchi, R., & Lajoie, S. P. (2011). Structuring the cultural domain with an upper ontology of culture. In *Handbook of research on culturally-aware information technology: Perspectives and models* (pp. 179-212). IGI Global.

Bontas, E. P., Mochol, M., & Tolksdorf, R. (2005, June). Case studies on ontology reuse. In *Proceedings of the IKNOW05 International Conference on Knowledge Management* (Vol. 74, p. 345).

Brank, J., Grobelnik, M., & Mladenic, D. (2005, October). A survey of ontology evaluation techniques. In *Proceedings of the conference on data mining and data warehouses (SiKDD 2005)* (Vol. 17). Citeseer Ljubljana, Slovenia.

Breckler, S. J., & Wiggins, E. C. (1989). Affect versus evaluation in the structure of attitudes. *Journal of experimental social psychology*, *25*(3), 253-271.

Casson, R. W. (1983). Schemata in cognitive anthropology. *Annual review of anthropology*, 429-462.

Chandrasekaran, B., Josephson, J. R., & Benjamins, V. R. (1999). What are ontologies, and why do we need them? *IEEE Intelligent Systems and their applications*, *14*(1), 20-26.

Cole, M., & Engeström, Y. (1993). A cultural-historical approach to distributed cognition. *Distributed cognitions: Psychological and educational considerations*, 1-46.

Danesi, M. (2004). *A Basic Course In Anthropological Linguistics (Studies In Linguistic And Cultural Anthropology)*. Canadian Scholars Press.

Doerr, M. (2009). Ontologies for cultural heritage. In *Handbook on ontologies* (pp. 463-486). Springer, Berlin, Heidelberg.

Gaby, A. (2017). Kinship semantics: culture in the lexicon. In *Advances in cultural linguistics* (pp. 173-188). Springer, Singapore.

Gandon, F. (2002). *Distributed Artificial Intelligence and Knowledge Management: ontologies and multi-agent systems for a corporate semantic web* (Doctoral dissertation, Université Nice Sophia Antipolis).

Garijo, D. (2017, October). WIDOCO: a wizard for documenting ontologies. In *International Semantic Web Conference* (pp. 94-102). Springer, Cham.

Garijo, D., & Poveda-Villalón, M. (2020). Best Practices for Implementing FAIR Vocabularies and Ontologies on the Web. *arXiv preprint arXiv:2003.13084*.

Glucksberg, S. (2008). How metaphors create categories–quickly. *The Cambridge handbook of metaphor and thought*, *67*, 83.

Goddard, C. (2010). The natural semantic metalanguage approach. *The Oxford handbook of linguistic analysis*, 459-484.

Grady, Joseph. (1997). *Foundations of Meaning: Primary Metaphors and Primary Scenes*. Doctoral dissertation, University of California at Berkeley.

Gyrard, A., Serrano, M., & Atemezing, G. A. (2015, December). Semantic web methodologies, best practices and ontology engineering applied to Internet of Things. In *2015 IEEE 2nd World Forum on Internet of Things (WF-IoT)* (pp. 412-417). IEEE.

Hitzler, P., Krötzsch, M., Parsia, B., Patel-Schneider, P. F., & Rudolph, S. (2009). OWL 2 web ontology language primer. *W3C recommendation*, *27*(1), 123.

Holland, D. (1992). The woman who climbed up the house: some limitations of schema theory. *New directions in psychological anthropology*, 68-79.

Horridge, M., Drummond, N., Goodwin, J., Rector, A. L., Stevens, R., & Wang, H. (2006, November). The Manchester OWL syntax. In *OWLed* (Vol. 216).

Horrocks, I. (2013). What are ontologies good for?. In *Evolution of Semantic Systems* (pp. 175-188). Springer, Berlin, Heidelberg.

Ingold, T. (1994). Introduction to culture. *Companion encyclopedia of anthropology: Humanity, culture, and social life*, 329-349.

Jacob, E. K. (2003). Ontologies and the semantic web. *Bulletin of the American Society for Information Science and Technology*, *29*(4), 19-19.

Jing-Schmidt, Z., & Peng, X. (2017). Winds and tigers: metaphor choice in China's anti-corruption discourse. *Lingua Sinica*, *3*(1), 1-26.

Kecskes, I. (2015). Language, culture, and context. *The Routledge handbook of language and culture*, 113-129.

Keet, C. M. (2011, May). The use of foundational ontologies in ontology development: an empirical assessment. In *Extended Semantic Web Conference* (pp. 321-335). Springer, Berlin, Heidelberg.

Kirby, K. R., Gray, R. D., Greenhill, S. J., Jordan, F. M., Gomes-Ng, S., Bibiko, H. J., ... & Leehr, D. (2016). D-PLACE: A global database of cultural, linguistic and environmental diversity. *PloS one*, *11*(7), e0158391.

Kóczy, J. B. (2017). Cultural Conceptualisations of RIVER in Hungarian Folksongs. In *Advances in Cultural Linguistics* (pp. 223-245). Springer, Singapore.

Kollia, I., Glimm, B., & Horrocks, I. (2011, May). SPARQL query answering over OWL ontologies. In *Extended Semantic Web Conference* (pp. 382-396). Springer, Berlin, Heidelberg.

Kollia, I., Tzouvaras, V., Drosopoulos, N., & Stamou, G. (2012). A systemic approach for effective semantic access to cultural content. *Semantic Web*, *3*(1), 65-83.

Kollia, I., & Glimm, B. (2012, November). Cost based query ordering over OWL ontologies. In *International Semantic Web Conference* (pp. 231-246). Springer, Berlin, Heidelberg.

Kollia, I. S. (2014). Optimizing Query Answering over Expressive Ontological Knowledge (Doctoral dissertation).

Kövecses, Z. (2003). Language, figurative thought, and cross-cultural comparison. *Metaphor and symbol*, *18*(4), 311-320.

Kövecses, Z. (2005). *Metaphor in culture: Universality and variation*. Cambridge University Press.

Kövecses, Z. (2010). Metaphor and culture. *Acta Universitatis Sapientiae, Philologica*, *2*(2), 197-220.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. University of Chicago press.

Lakoff, G. (1987). *Women, fire, and dangerous things: What categories reveal about the mind*. University of Chicago press.

Langacker, R. W. (1994). Culture, cognition, and grammar. *Language contact and language conflict*, *25*, 53.

Lee, C. S., Kao, Y. F., Kuo, Y. H., & Wang, M. H. (2007). Automated ontology construction for unstructured text documents. *Data & Knowledge Engineering*, *60*(3), 547-566.

López, M. F., Gómez-Pérez, A., Sierra, J. P., & Sierra, A. P. (1999). Building a chemical ontology using methontology and the ontology design environment. *IEEE Intelligent Systems and their applications*, *14*(1), 37-46.

Lu, W. L. (2017). Cultural conceptualisations of DEATH in Taiwanese Buddhist and Christian eulogistic idioms. In *Advances in cultural linguistics* (pp. 49-64). Springer, Singapore.

Lu, Y. (2017). Cultural Conceptualisations of Collective Self-representation Among Chinese Immigrants. In *Advances in Cultural Linguistics* (pp. 89-110). Springer, Singapore.

Mandler, J. M. (2014). *Stories, scripts, and scenes: Aspects of schema theory*. Psychology Press.

McCrae, J. P., Bosque-Gil, J., Gracia, J., Buitelaar, P., & Cimiano, P. (2017, September). The Ontolex-Lemon model: development and applications. In *Proceedings of eLex 2017 conference* (pp. 19-21).

McGuinness, D. L. (2002). Ontologies come of age. *Spinning the semantic web: bringing the World Wide Web to its full potential*, 171-194.

McKellin, W. H. (2017). Grounding and Relational Schemas in Managalase, Papua New Guinea. In *Advances in Cultural Linguistics* (pp. 149-172). Springer, Singapore.

McKeough, A., Bird, S., Tourigny, E., Romaine, A., Graham, S., Ottmann, J., & Jeary, J. (2008). Storytelling as a foundation to literacy development for Aboriginal children: Culturally and developmentally appropriate practices. *Canadian Psychology/Psychologie Canadienne*, *49*(2), 148.

Murphy, G. L. (2010). What are categories and concepts. *The making of human concepts*, 11-28.

Murphy, G. (2020). Categories and concepts. In R. Biswas-Diener & E. Diener (Eds), *Noba textbook series: Psychology.* Champaign, IL: DEF publishers. Retrieved from http://noba.to/6vu4cpkt

Musen, M. A. (1992). Dimensions of knowledge sharing and reuse. *Computers and biomedical research*, *25*(5), 435-467.

Nisbett, R.E., & Norenzayan, A. (2002). Culture and cognition. In D. L. Medin (Ed.), *Stevens' handbook of experimental psychology: cognition* (3rd ed) (pp. 561-597). New York: John Wiley & Sons.

Nishida, H. (1999). A cognitive approach to intercultural communication based on schema theory. *International journal of intercultural relations*, *23*(5), 753-777.

Nishida, H. (2005). Cultural schema theory. *Theorizing about intercultural communication*, *401418*.

Nitish Singh (2002) ,"From Cultural Models to Cultural Categories: A Framework For Cultural Analysis", *in NA - Advances in Consumer Research Volume 29, eds. Susan M. Broniarczyk and Kent Nakamoto, Valdosta, GA : Association for Consumer Research*, Pages: 239-240.

Noy, N. F., & McGuinness, D. L. (2001). Ontology development 101: A guide to creating your first ontology. Stanford Knowledge Systems Laboratory Technical Report KSL-01-05 and Stanford Medical Informatics Technical Report SMI-2001-0880, March 2001. Retrieved from https://protege.stanford.edu/publications/ontology_development/ontology101-noy-mcguinness.html

Obrst, L. (2003, November). Ontologies for semantically interoperable systems. In *Proceedings of the twelfth international conference on Information and knowledge management* (pp. 366-369).

Palmer, G. B. (1996). *Toward a theory of cultural linguistics*. University of Texas Press.

Park, D. C., & Huang, C. M. (2010). Culture wires the brain: A cognitive neuroscience perspective. *Perspectives on Psychological Science*, *5*(4), 391-400.

Pâslaru-Bontaş, E. (2007). *A contextual approach to ontology reuse: methodology, methods and tools for the semantic web* (Doctoral dissertation).

Peeters, B. (2016). APPLIED ETHNOLINGUISTICS is cultural linguistics, but is it CULTURAL LINGUISTICS?. *International Journal of Language and Culture*, *3*(2), 137-160.

Phefo, O. S., Kefitiley, N., & Hlomani, H. (2015, August). Towards the Cultural Knowledge Ontology. In *2015 IEEE International Conference on Information Reuse and Integration* (pp. 526-533). IEEE.

Poveda-Villalón, M., Gómez-Pérez, A., & Suárez-Figueroa, M. C. (2014). Oops!(ontology pitfall scanner!): An on-line tool for ontology evaluation. *International Journal on Semantic Web and Information Systems (IJSWIS)*, *10*(2), 7-34.

Puglisi, A., Baronchelli, A., & Loreto, V. (2008). Cultural route to the emergence of linguistic categories. *Proceedings of the National Academy of Sciences*, *105*(23), 7936-7940.

Roberson, D., Davidoff, J., Davies, I. R., & Shapiro, L. R. (2005). Color categories: Evidence for the cultural relativity hypothesis. *Cognitive psychology*, *50*(4), 378-411.

Quinn, N., & Holland, D. (1987). *Culture and cognition.* In D. Holland & N. Quinn (Eds.), *Cultural models in language and thought* (p. 1–40). Cambridge University Press.

Rosch, E., & Mervis, C. B. (1975). Family resemblance: Studies in the internal structure of categories. *Cognitive Psychology*, 7, 573–605.

Schudson, M. (1989). How culture works. *Theory and Society*, *18*(2), 153-180.

Sewell Jr, W. H. (2005). The concept (s) of culture. *Practicing history: New directions in historical writing after the linguistic turn*, 76-95.

Sharifian, F. (2003). On cultural conceptualisations. *Journal of Cognition and Culture*, *3*(3), 187-207.

Sharifian, F., Rochecouste, J., & Malcolm, I. G. (2004). 'It was all a bit confusing…' comprehending Aboriginal English texts. Language, Culture and Curriculum, 17(3), 203–228.

Sharifian, F. (2008). Distributed, emergent cultural cognition, conceptualisation, and language. *Body, language, and mind*, *2*, 109-136.

Sharifian, F. (2011). *Cultural conceptualisations and language: Theoretical framework and applications* (Vol. 1). John Benjamins Publishing.

Sharifian, F. (2015). Cultural linguistics. *The Routledge handbook of language and culture*, *473*, 492.

Sharifian, F. (Ed.). (2017a). *Advances in cultural linguistics*. Singapore: Springer.

Sharifian, F. (2017b). *Cultural Linguistics: Cultural conceptualisations and language* (Vol. 8). John Benjamins Publishing Company.

Sharifian, F. (2017c). Cultural linguistics and linguistic relativity. Language Sciences, 59, 83-92.

Simperl, E. (2009). Reusing ontologies on the Semantic Web: A feasibility study. *Data & Knowledge Engineering*, *68*(10), 905-925.

Sinha, C., & De López, K. J. (2000). Language, culture, and the embodiment of spatial cognition. *Cognitive linguistics*, *11*(1/2), 17-42.

Spear, A. D. (2006). Ontology for the twenty first century: An introduction with recommendations. *Institute for Formal Ontology and Medical Information Science, Saarbrücken, Germany*.

Storms, G., De Boeck, P., & Ruts, W. (2000). Prototype and exemplar-based information in natural language categories. *Journal of Memory and Language*, *42*(1), 51-73.

Strandell, Jacob. (2017). “The Cultural Schema: Towards Conceptual Compatibility in Culture-Cognition Interaction” in *Culture-Cognition Interaction: Bridging Cognitive Science and Cultural Sociology*. Doctoral dissertation, University of Copenhagen.

Suárez-Figueroa, M. C., Gómez-Pérez, A., & Villazón-Terrazas, B. (2009, November). How to write and use the ontology requirements specification document. In *OTM Confederated International Conferences" On the Move to Meaningful Internet Systems"* (pp. 966-982). Springer, Berlin, Heidelberg.

Suárez-Figueroa, M. C. (2010). *NeOn Methodology for building ontology networks: specification, scheduling and reuse* (Doctoral dissertation, Informatica).

Sujatha, K. (2002). Education among scheduled tribes. *India Education Report: A Profile of Basic Education, New Delhi: OUP*.

Taye, M. M. (2010). Understanding semantic web and ontologies: Theory and applications. *arXiv preprint arXiv:1006.4567*.

Toledo-Alvarado, J. I., Guzman-Arenas, A., & Martínez-Luna, G. L. (2012). Automatic building of an ontology from a corpus of text documents using data mining tools. *Journal of applied research and technology*, *10*(3), 398-404.

Uschold, M., & Gruninger, M. (1996). Ontologies: Principles, methods and applications. *TECHNICAL REPORT-UNIVERSITY OF EDINBURGH ARTIFICIAL INTELLIGENCE APPLICATIONS INSTITUTE AIAI TR*.

Varnum, M. E., Grossmann, I., Kitayama, S., & Nisbett, R. E. (2010). The origin of cultural differences in cognition: The social orientation hypothesis. *Current directions in psychological science*, *19*(1), 9-13.

Veissière, S. P., Constant, A., Ramstead, M. J., Friston, K. J., & Kirmayer, L. J. (2020). Thinking through other minds: A variational approach to cognition and culture. *Behavioral and Brain Sciences*, *43*.

Whiten, A., Hinde, R. A., Laland, K. N., & Stringer, C. B. (2011). Culture evolves.

Yu, N. (2017). Life as opera: A cultural metaphor in Chinese. In *Advances in cultural linguistics* (pp. 65-87). Springer, Singapore.

Zouaq, A., & Nkambou, R. (2008). Building domain ontologies from text for educational purposes. *IEEE Transactions on learning technologies*, *1*(1), 49-62.