

Diachronic semantics: changes of meaning of words over time and the consequences for keeping classification systems up to date

Drahomira Cupar, PhD

E-mail: dgavrano@unizd.hr

University of Zadar, Department of Information Sciences
Croatia

Abstract

Meanings of words in a natural language are changing over time under the influences of different factors. Words adapt to new meanings, lose old meanings, rearrange current meanings and change some parts of previous meanings, etc. The language as a living organism needs to be able to accept and adapt to those changes. Like natural languages, artificial languages such as classification systems or subject indexing systems have to adjust to those changes too. Linguist F. de Saussure defines language as a 'system of signs'. If we transfer this definition into the artificial language such as a classification system (e.g., Universal Decimal Classification (UDC)) and define it also as a 'system of signs' which has a vocabulary, a grammar and a syntax, we could draw parallels between phenomena which occur in natural and in artificial languages. The young linguistic discipline which deals with changes in meanings over time is called diachronic semantics and this paper explores how its mechanisms can be used to analyze the changes that occur in classification systems over time. Diachronic semantics uses various mechanisms to describe adapting and changing meanings of words. These mechanisms include: metaphor, metonymy, specialization, generalization, analogy and splitting.

This paper also aims to explain the borrowing and adjusting of the theory from the field of linguistics into the field of information sciences.

Keywords: semantic changes, classification system, Universal Decimal Classification (UDC), diachronic semantics, meanings of words

1 Introduction

Changes in natural or artificial languages, such as classification systems (e.g., UDC) can be driven by different agents or events. Raffaelli (2009) argues that these changes in natural language can occur due to the socio-cultural, environmental or technical developments. All of that can be as well applied to the changes in an artificial language. To add, changes can happen in the human thinking or in the publishing sector, e.g., publishing of books on the new discipline. Some changes are driven by users and their demands. A classification or an indexing system is maintained and revised during regular revision process which helps it to stay up to date with constant changes. During the updating process, changes are recorded in the system itself. For example, Universal Decimal Classification (UDC) system, records changes in relations between

“new” and “old” UDC number, when the change is made in caption and/or in notation. Maintaining order among changes is important because of the consistency issues of the classification system. When one number or its meaning is replaced by another, users can be confused by the change if it is not transparent and self-explained in the system.

The purpose of this paper is to analyse and interpret possibilities of using the methodology of diachronic semantics for explaining ways of changing meanings in class numbers over time. It also aims to explain borrowing and adjusting linguistics methodology which was applied in the field of information sciences. By defining UDC classification as artificial language (Svenonius 2000) the conditions for borrowing and adjusting methodologies of diachronic semantics on general classification system such as UDC are fulfilled.

This research explores two main questions: (1) how we can identify changes in meanings between two UDC captions by using mechanisms of semantic change from diachronic semantics; and, (2) by using model of diachronic indexing, how we can identify changes in UDC notations and UDC captions. These questions are part of bigger research conducted on the UDC main class *2 Theology. Religion*.¹

The argument for borrowing other field's methodology is that it provides different angle for looking at the research topic, in this instance, changes in the classification system (Jaeger 2010, Floyd 2009). The diachronic semantic methodology will help to identify which categories are needed in the system for enabling tracking of the changes of meanings over time. As semantic change is hard to measure because it has potential to reflect the subjectivity of the interpreter, it needs to be measurable by quantitative and qualitative methods combined. Certainly, tracking of the semantic changes over time will eventually give the editorial board control over the system while users will have the opportunity to navigate through the history of the subject, i.e. the classification number – by its notation or/and caption.

By exploring other existing theories and approaches for the measuring of the semantic changes in a classification system, this paper aims to be comparative rather than competitive to these other approaches.

¹ More on the topic in Gavranović, Drahomira 2013. Modelling of diachronic aspect of semantics of classification numbers in Universal decimal classification system (UDC). Unpublished dissertation. University of Zadar, Croatia. [in Croatian]

2 Borrowing theories – research methodology in information sciences

Applying methodologies from another discipline such as diachronic semantics asks for certain explanations. During the literature review and conceptual analyses of given theories (classification theory, conceptual modelling, diachronic indexing, ontogeny of classification system, instantiation, scheme versioning) it was necessary to employ different disciplines into the field of information sciences. After testing of the given theories some questions stayed unanswered. For example, theories found in the field of the information sciences could not address changes in the meanings which occurred during the replacements of the old UDC numbers. So, diachronic semantics, i. e. its mechanisms: metaphor, metonymy, specialization, generalization, analogy and splitting were used to help analyze changed meanings in the UDC captions and notations. This methodology was not only borrowed and used, but it was also enriched with new mechanism called merging. This newly formed mechanism can also be used in the analysis of semantic changes in natural language. Theories and methodologies found within discipline of information sciences were also explored and used to give better ground of borrowed theories and methodologies. Borrowed theories served only as a supplement rather than a substitution, in order to address the limitations of the main theory. Another borrowed theory in this area is called ontogeny of classification system (Akdağ Salah 2012, Tennis 2002). Ontogeny is a phenomenon borrowed from evolution theory which is applied to the evolution and growth of classification systems. The research methodology given in this paper is aiming to the interdisciplinary approach in the field of information sciences.

3 Diachronic semantics

In order to establish common ground for the research, this paper firstly defines the relation between the linguistic discipline diachronic semantics and knowledge organization system. The methodological apparatus of diachronic semantics could be applied on any artificial language such as classification system, subject headings system or thesaurus. According to de Saussure (1916, 2005) language is defined as “a system of signs that express ideas, and is therefore comparable to system of writing, the alphabet of deaf-mutes, military signals, etc.” (de Saussure 1916, 2005) and it is used to express thoughts, ideas, etc. All of the systems mentioned

previously have elements, symbols which change their meanings through time. In this research, a knowledge organization system – a classification system – is treated as one of the systems de Saussure defined. UDC classification is defined as a bibliographic language (Svenonius 1992, 2000). According to Svenonius, a bibliographic language is “a special-purpose language that is designed and applied in accordance with special set of rules. Its function is to communicate users’ information about information. In this role, it serves as a bridge connecting the language of documents with that of the users who seek them. It is an artificial language that, purged of the anomalies of natural language, is capable of providing systematic, as opposed to chancy, access to information in recorded form” (Svenonius 2000). Svenonius (2000) also divides bibliographic languages by attribute which can be work and document languages. Work language has sublanguages: author, title, edition and subject language. An example of a subject language is a classification system and indexing language. Svenonius gives clear connections between “living” and “artificial” language. Bibliographic language “consists of a vocabulary, semantics, syntax, and pragmatics. The vocabulary of a bibliographic language consists of the simple and complex expressions used to name the value of the three variables: entities, attributes, and relationships” (Svenonius 2000).

Due to various linguistic occurrences, words absorb different, new meanings or lose old ones (Blank 1999, 2003). As any living, natural language, each knowledge organization system is going through changes of meanings within a system, on the general, structural level and within elements. For example, during regular revisions of the UDC classification system, both captions and notations are going through changes (Ścibor and Shcherbina-Samojlova 1990, Slavic, Cordeiro and Riesthuis 2008). This paper is focused only on changes in UDC classification system which occurred during its revision process applying methods of diachronic semantics. The analysis was made on a corpus of the cancelled UDC numbers. It is important to emphasise that every classification system is controlled, and has rules which are governed by editorial board (Gilchrist 1990, Strachan, Oomes and Frits 1995). Every change has to be approved by the members of the board and cannot be arbitrary. This kind of control and maintenance policy enables system to maintain its stability, consistency and usability for its users.

All definitions of the mechanisms are redefined to best suit needs of the analysis within this particular research. These two disciplines, diachronic semantics and classification, or knowledge organization in general are connected on an abstract level. This paper does not aim to force rules

of one discipline on another but rather to use an approach which best suits for this particular research.

Another connection between these two disciplines takes place at the level of a system which was analysed – i.e. language, be it natural language or artificial, bibliographic language. Due to its similarities in structure and building rules, same sets of rules and ways can be applied for analysis.

Each KOS is controlled language with its elements – “words”, sets of rules on how to build a sentence – “grammar”, and rules on how to build relations among elements – “syntax”. Sentences can be built as statements which give meanings according to set of rules from artificial languages. In classification system citation order needs to be applied and maintain relations among elements, i.e. classification numbers. It has to be possible to reconstruct the history of changes in the system. Sometimes, due to carelessness, or if changes are applied too quickly, classification numbers can lose the original meanings and relations between changed numbers. Loss of the connections and relations between changed UDC numbers, whether it has happened in the notation or in the caption, can occur due to different reasons. Sometimes, by using and following relations which are kept between changed UDC numbers one can reconstruct the history of one UDC number. Sometimes those relations are permanently lost and cannot be restored. The main reasons for not keeping tracks of those relations can differ but this is beyond the topic of this paper.

The main topic of this paper is to recognize and to analyse changes in the system with the help of diachronic semantics mechanisms. The diachronic semantics can help in maintaining the consistency of the classification system and particularly it can help in preserving the history of one number and all phases and changes it went through during its ‘life’. For the illustration, here is the one example of the auxiliary table for former Yugoslav Republic which had one UDC number. After the split of Yugoslavia, each country got its own auxiliary number but, in the history of UDC number for Yugoslavia it has to be noted that it was a country ‘made of’ six other countries. For example, previously Croatia was “under” Yugoslavia just like all other today’s countries (i.e., Slovenia, Serbia, Bosnia and Herzegovina, Montenegro and FYR of Macedonia) and their classification numbers share the same history. If we do not keep these numbers connected in the system, we can lose important information. All resources in one library

catalogue can be insufficient if it is not marked that class number for Yugoslavia succeeded number for Croatia, Slovenia, etc.

The diachronic semantics has its roots in etymology and cognitive linguistics. Nowadays, researchers are using methodologies of these disciplines as well as diachronic semantics for reconstructing history of the meanings of the word. It depends on a corpus in which the reconstruction is done. In this paper, UDC is used as the corpus for the research and there is no need to consider influences on the changes in the words/ classification numbers outside the boundaries of the UDC.

3.1 Diachronic semantics in the role of the classification theory

3.1.1 Diachronic semantics: definitions

Diachronic semantics in general is researching ways of reconstructing meanings of words over time. Raffaelli explains that "Diachronic semantics establishes factors which lead to semantic changes [...] and shows that mechanisms which brings to them are not historical coincidence but regularity" (Raffaelli 2009, 146). Raffaelli draws out explanations and main differences between the complementary disciplines of cognitive linguistics, etymology and diachronic semantics. One important phenomenon Raffaelli addressed is the synchrony – diachrony dichotomy.

In this paper, during the reconstruction of the semantic changes of UDC numbers and identification and categorization of relations established between the first UDC number and next, changed number, the same methodology will be used as it was used in diachronic semantics. To the list of the mechanisms, Raffaelli (2009), like Bréal (1924, according to Raffaelli 2009) and Ullmann (1962, according to Raffaelli 2009) adds another mechanism called splitting. The mechanism of splitting is recognized among one or more synonyms. Mechanisms mentioned above are identified and redefined within the diachronic semantics and in this research it will be applied to changes which are recognized in the UDC classification system.

According to Bréal, Ullmann and later Meillet (according to Raffaelli 2009), diachronic analyses of language structures cannot neglect (1) influences and role of culture and society and (2) ways how speakers of a certain language understand and conceive their culture and society (Raffaelli 2009). In the same manner during the design and organization of the classification system it is necessary to be aware of the factors which can affect the meaning of the UDC numbers and (1) culturological and sociological characteristics which can affect on shaping individual numbers

and (2) ways we understand each UDC number and its meanings which depend on sociological context and changes that can happen in society itself (e.g., disintegration of the state) or in science (e.g., emerging and/or disappearing of disciplines). Bréal and later Meillet gave special attention to the classification of semantic change which affects lexical structures through time. They defend the idea of the differentiation between causes and sources of semantic change. The causes are motivated by the integration of a language into culture and society while sources are motivated by the fact that language is a part of the human cognitive capacities (Raffaelli 2009). The same designation was applied to analysis of semantic changes in the classification system. In this research only changes which occurred during regular revisions of the UDC classification were taken into account. The reasons of changes which came from “outside of the classification system” were not discussed. Motivation of the causes and sources of the semantic changes in the classification system can differ from natural and artificial language. If classification is perceived as a language, parallels can be drawn and conclusions can be given while observing the changes as they happened in the language itself. As de Saussure (1916, 2005) explained, any system of signs can be seen as language so is UDC classification.

Earlier it has been stated that diachronic semantics establishes factors which bring to semantic changes. Its goal is to reconstruct relations and connections between lexical senses through time. “There are two aspects of reconstruction: (1) the reconstruction of semasiological structures and (2) the reconstruction of onomasiological structures. The first aspect of reconstruction aims to establish a method which could explain the relation between senses within a single polysemic structure through time, in accordance with the classification of causes of semantic change. The second aspect of reconstruction aims to outline the regularities and the particularities of conceptual relations within certain language family (Raffaelli 2009)”.

Authors as Raffaelli (2009), Sweetser (1990), Winters (1992) and Györi (2002) define the synchrony – diachrony dichotomy. According to Sweetser (1990) and Winters (1992) “diachrony in synchrony“ is highly motivated by connections between meanings of polysemic lexical senses. “Every polysemic structure in synchronic moment reflects diachronic changes which were caught in it because all meanings were evolving through time and each one is more recent than other“ (Raffaelli 2009, 7). Györi (2002) adds that connection between synchrony and diachrony needs to reflect language usage because every new usage of a term or a word can articulate new mental content. It is clear that Sweetser, Winters, Györi and Raffaelli as linguists deal with

semantic changes through usage of the words. That approach will be transferred on the UDC class number which represents language sign used in the artificial language. We can use it in synchrony (aims at describing language rules at a specific point of time, without taking into account its history) and in diachrony (considers the development and evolution of a language through history). Sometimes it is necessary to classify topics which only existed in the past and there is a need for an indexing system which provides indexing from that, historical point of view.

Metaphor, metonymy, specialization and generalization make internal changes and influence changes in the structures of different concepts. Raffaelli (2009) and Geeraerts (1997), among other linguists, add another mechanism called analogy. Analogy is the mechanism which influences changes from the outside which helps users to recognize certain patterns of linguistic changes.

Table 1. Classification of mechanisms of semantic changes in diachronic semantics²

Ext ern al me cha nis ms	An alo gy	Internal mechanisms		Sp litt ing	Ex ter nal me ch ani sm s
		metaphor	Primary		
		metonymy			
		generalization	Secondary		
		specialization			

Table one shows classification of mechanisms of semantic changes in diachronic semantics. Internal mechanisms are primary (metaphor and metonymy), and secondary (specialization and generalization). Primary mechanisms imply direct relation between concepts based on similarities or closeness. Secondary mechanisms imply metaphorical or metonymical shift, and newborn concept or meaning has broader or narrower structure or possibilities of usage in the different contexts (Raffaelli 2009). The mechanism splitting was added for describing phenomenon which occurs between words and influences relations between them. It can be found in diachronic relation between two or more synonyms and it basically means that two synonyms with close semantic structure during time begin to semantically differ from each other (Raffaelli 2009). Splitting and analogy are both external mechanisms. Analogy activates similar

² Table translated from Raffaelli, Ida 2009. Značenje kroz vrijeme. p 169.

mechanisms in two conceptual-linguistic units and splitting influences different or differently pointed mechanisms.

3.1.2 Adaptation of diachronic semantics mechanisms for researching changes in UDC

Mechanisms of diachronic semantics are applied in analysis of semantic changes found in class captions and notation. Diachronic semantics recognizes six different mechanisms which can be applied to analysis of semantic changes in language through time. On the conceptual level those mechanisms were taken and redefined to suit the needs of analysis of changes which occur in a classification system over time. The classification system went through changes during revisions and cancellation process. Each UDC number consists of a UDC notation and a UDC caption. This methodology was applied to changes which were recognized in UDC captions. Its aim is to reconstruct meanings embodied in UDC captions.

It is important to emphasise that definitions of mechanisms applied in this paper are not the same as used in linguistics for analysing changes in natural language. But they are close on conceptual, abstract level. Definitions applied in this paper are taken originally from Raffaelli (2009). These are:

specialization – a mechanism which indicates narrowing or specialization of the meaning; a new classification number has narrower meaning in comparison to the starting classification number;

generalization – a mechanism which indicates broadening or generalization of the meaning; a new classification number has broader, more general meaning in comparison to the starting classification number;

metaphor – a mechanism which indicates transfer of meaning from one classification number to another, based on conceptual similarities;

metonymy – a mechanism which indicates transfer of meaning from one classification number to another, based on conceptual closeness;

analogy – a mechanism which indicates transfer of meaning from one classification number or several numbers by mimicking process which caught its close or similar structure; and,

splitting – a mechanism which indicates splitting of the meaning in two or more different meanings. During splitting, the original meaning is only partially transferred to new UDC number(s).

There is another type of the semantic change which wasn't described above. It can occur in the UDC system when two or more UDC numbers merge their meanings into new meaning. So, new mechanism called merging was introduced. The mechanism of merging is used to describe semantic changes when the meaning of two or more UDC numbers merge and absorb another meaning. Merging is also applied to UDC numbers which sometimes extract a part of original meaning and merge it with another meaning. The merge is sometimes complete, and sometimes partial.

In conclusion, borrowing and adjusting methodologies of diachronic semantics and practical application to analysis of semantic changes in classification systems allows approaching the research problems from different aspects and angles. These phenomena can be observed from the point of view of diachronic semantics and classification theory, i.e. knowledge organization. Changes can occur under cultural or sociological influences or due to occurrences of the new concepts and disciplines. The concepts in a language – natural or artificial are living “organisms” and can be observed as such, no matter if the concept existed in the past or is newly constructed.

4 Theories from the field of information sciences used for analysis of semantic changes

In addition to the diachronic semantics, other existing theories in the field of the information sciences used by Tennis (2002), Akdag Salah et al. (2012) and others for exploring diachronic aspects of classification system are diachronic indexing, scheme versioning and ontogeny. Diachronic indexing has two main aspects. Firstly, there has to be a system which enables document indexing from the aspect of the time in which document was created and secondly, it predicts the existence of a system which enables the user to navigate through that system, simultaneously connecting diachronical aspect of the subject, or the history of subject (document) and synchronic aspect of the same subject (document) at the time of the search. Theoretically, Tennis (2002, 2007a, 2007b, 2012b) has both aspects covered. Tennis proposed a

framework for diachronic indexing with possibilities of marking types of changes with three categories: structural, word-use and textual. Tennis' proposed system of marking the changes is rather time consuming and implies fulfilling huge sets of administrative data for each class number and for every change. Another approach proposed by Tennis is to follow versions of classification schemes called scheme versioning. But this approach does not allow us to recognize changes on the smallest level or unit of the system – classification number. It is important and useful for the whole system in general to track versions of the scheme but it is not sufficient for tracking changes at an elementary level. Connected to the scheme versioning is instantiation theory brought by Smiraglia (2005).

The third related theory useful in this context is dealing with possibilities of tracking changes in the system through systems' ontogeny. Ontogeny is a theory borrowed from biology, it is a theory of evolution dealing with evolution, growth, and development of every part of the organism (i.e. classification system). The results of the research by Akdag Salah et al. (2012) show that UDC system has radically grown over 100 years and it is possible to reconstruct changes in the system back to the beginning of the UDC. The authors found ways to count changed numbers in auxiliary tables as well as in the main tables. But, the main problem in this type of research is that it does not have qualification of numbers. It can only be acknowledged that UDC classification has grown over 100 years of existence but those results needs to be researched further to see what types of changes have happened there. Those numbers can be underlying information for future research. The contextualization of the given data can help in understanding changes UDC classification went through over time. Also, it is important to be aware of the fact that things have dramatically changed over the last hundred years in society, culture, science and some phenomena cannot be addressed from the modern point of view. It would be interesting to see reconstruction of one classification system in order to reflect historical times when that system existed and was used. All research approaches mentioned above, when taken together into account, can help in successful reconstruction of meanings or for the measuring of the semantic change in classification system. The answer lies in every one of them.

5 Methodology

For researching diachronic aspect of changes in UDC classification 1500 UDC numbers were used. Those numbers were extracted from the Cancellation files (UDC Consortium, 1995-2009). All of the UDC numbers were taken from the main class 2 *Religion. Theology*. The Cancellation files are published online, on the website of the UDC Consortium and in yearly publication *Extensions & corrections to the UDC*. Those files contain information on changes which occurred across the whole of the UDC classification. In the year of 2000 main class 2 *Religion. Theology* was transformed into the fully faceted class and several interesting things were noticed there. Extracted from Cancellation files, all changes were subjected to analysis. The chosen time span was 15 years; from 1995 till 2009 (Major changes to the UDC 1993-2013).

6 Results and discussion

6.1 Diachronic semantics: results and analysis

This paper focuses on two particular phases of the research and two major questions. Phase 1 addressed research question *How can we identify changes in meanings between two changed UDC captions using mechanisms of semantic change from diachronic semantics?* The research was conducted by using combined qualitative and quantitative methods on 1542 UDC captions which went to different types of changes. In about 34% (526 UDC captions) there were no semantic changes. For example, one UDC number was changed in its notation, but the meaning in the caption stayed the same. In the rest of the captions we recognized the mechanism of generalization in 26% of the sample (397 UDC captions), and the mechanism of splitting which was recognized in almost 8% (104 captions). As an example of the mechanism generalization there is one change from the year 2007 where UDC notation 26"652"-538 *Sacrifice* became UDC notation 216 *Religion of the Biblical period. Ancient Judaism. Old Testament religion*. The caption *Sacrifice* became an example of combinations within specialized tables in the main class 2 *Theology. Religion* made in 2000 and it is now 261-538 *Sacrifice*. During this transformation, in the first and last UDC caption nothing has changed, but notation is rather different. The notation itself went through the process of splitting, and after that was placed in hierarchically lower UDC subclass [from 26 into 261]. At last, its caption was transferred into a new UDC caption 261-538. The auxiliary for time period ["652"] was also removed from the first UDC

complex number. Considering the process of faceting UDC main class 2 *Theology. Religion* it can be concluded that the meaning of the UDC number was generalized.

The mechanism called splitting has happened without semantic changes in cancelled and changed captions. For example, UDC number 261.5 The church and intellectual development, education split its meaning into combination of two simple UDC numbers 261:37 [*Church : Education*]. The mechanism of specialization was spotted in 82 examples (5%). One example of specialization in UDC captions was when the caption *Teaching. Speeches* became new caption *Words and sayings of Jesus. Deeds of Jesus* as more specialized and more exact meaning. Metaphor was rare – only in 16 captions (around 1%). Some examples for the metaphor are not clearly described. For example, UDC caption was *Errors. Fideists. Rationalists. Semirationalists* and after revision in 2000 it became *Non-Christians. Non-believers*. This type of change in the meaning is explained from the Christian point of view. It can be described as metaphor in linguistic meaning but it can also be specialization. Metaphors are open for further discussion because it is pure cognitive aspect of the transferring of the meaning and it is hard to be recognized in the controlled system. The mechanism analogy could be seen in less than 1% (13 captions). This mechanism is also hard to explain in the controlled system. When a word is entering the language, it “takes over” the rules of the existing system - suffix, prefix, declination, etc. In the UDC classification, caption *External means to perfection* was changed into *Contemplative and reflective religion*. It was categorized as analogy but it is not clear if it is right categorization of the semantic mechanism.

The biggest difference between natural language and artificial language is in the degree of control over meaning, which is rather high in artificial language; the process of changing of the meanings is also very high. Under the influence of combined mechanisms, results are as following: the mechanism of splitting of meaning and specialization was recognized in 24% (375 examples); the mechanism of splitting and generalization were recognized in 20 examples (more than 1%). An interesting combination was the mechanism of splitting and metaphor. This only has taken place in less than 1% (9 examples) but it was recognized in UDC captions. Here is the example of this combination of the mechanisms. Religion and the state was split in 7 different captions. First one [1] *Religion and the state* have the same meaning as original UDC caption. Other six captions: [2] *Freedom of conscience. Freedom of worship, of religious ceremony*; [3] *Tolerance. Irenics*; [4] *Conflict. Antagonism. Hostility*; [5] *Tolerance. Intolerance*; [6]

Persecution; [7] *Political persecution*. The question is why the changes imply all negative connotations between state religion and the state. It could be seen as metaphoric but is yet to be decided whether it is really metaphorical change in the semantics.

Interesting fact is that most of the changes were made during major revision of the class 2 in the year of 2000. There were 1155 UDC numbers that were altered during the process in the same way. Only a mechanism of metonymy and merging was not recognized in this sample. The most important reason for this is that metonymy is a very specific mechanism of change in the natural language. The mechanism of merging was applied to UDC notations where we cannot measure semantics. The results have shown that mechanisms of diachronic semantics can be seen as useful tool for analysis of semantic changes in the system.

In general, it can be concluded that most of the changes in revised UDC class 2 have happened under the mechanism of splitting. Reasons for that can be seen in decision of changing UDC class 2 *Religion. Theology* into a fully faceted class (McIlwaine and Mitchell 2006, Broughton 2000). That is the reason why most compound and complex numbers were split into simple numbers with simple meanings. Also, most mechanisms were recognized in combination and that makes semantic changes more complex than one might think at first. In order to introduce this kind of analysis of semantic changes, it is needed to decide whether all explanations of the changes are clear enough and whether it was managed to bypass subjectivity in analyses.

6.2 Diachronic indexing: results and analysis

To be able to make comparison of two approaches of semantic changes analysis further results will provide explanations of the second phase of the research conducted on the same sample. Second research question was *How can we identify changes in UDC notations and UDC captions by applying another model of diachronic indexing?* The diachronic indexing and categorization of the semantic changes proposed by Tennis (2002) was used for analysis. The categorization of changes made by Tennis is: structural, word-use and textual (Tennis 2007b). Textual changes were excluded because they were not applicable to the researched corpus. The categorization of the structural changes was applied to changes in UDC notations, and categorization of the word-use (i.e. terminological) changes was applied on UDC captions. Table 2 shows the categorization of the semantic changes made by Tennis in order to name types of

changes. These changes can be recognized during diachronic indexing in the classification scheme. Tennis also emphasises that all of the changes can occur in combination (Tennis 2007b). According to Tennis (2007b), structural changes affect user's navigation through the scheme. Structural changes also affect the semantics of a scheme because they change the relationships that obtain between values in that scheme. Structural change falls into five basic changes as shown in Table 2 (left side). On the other hand, word-use changes do not affect navigation through the structure. Those changes preserve the structure of a scheme, while adding or replacing words (Table 2 (right side)).

Table 2. Categorization of semantic changes by Tennis (2007b)

Structural change	Word-use change
• Addition of a new value	• New word used as lead-in
• Change in synonym structure (use eugenics to lead to both genetics and psychology)	• New synonyms added (replaced one for one, for example, <i>genetics</i> for <i>eugenics</i>)
• Change in equivalence structures (e.g., USE and/or USED FOR)	• New preferred value added
• Assignment of value to another group in the hierarchy	• Change in definition of value
• Addition or elimination of associative relationship (e.g., RT).	<i>NOTICE: Textual changes are not categorized.</i>

In Phase 2, 1345 examples suitable for analyses of UDC captions were extracted. In 49 examples (less than 4%) unnoticeable semantic changes were found and those examples were labelled with label “no change”. When types of changes were analysed it was obvious that *change in synonym structure* and *change in equivalence structure* are recognized between UDC notation and UDC caption in the same class number. Therefore they are not visible in this research. The first category was modified with *deleting of old value*. Sometimes, value, as Tennis calls it, was only deleted without adding new value, i.e. class number.

In the sample of 1296 UDC numbers the following combinations of structural semantic changes were recognized as follows:

- addition of a new value (19); UDC 261.4 *The church and morality* became combination of 261 *The Church* and 17 *The morality*;
- addition of a new value + assignment of value to another group in the hierarchy (9); UDC 267.12 *Salvation Army* became 267-055.1/.2SA *Salvation army*;

- addition of a new value + deletion of a value (88); 294 *Religion of the Hindus* became 233 *Hindu religion in the broad sense. Hinduism narrowly*;
- deletion of a value (48); 2-486 *Sick* became 2-48 *Recipients of pastoral care. Social types and groups*. Examples of combination: *sick*;
- addition of a new value + deletion of a value + assignment of value to another group in the hierarchy (1089). This is predominant combination found in the sample. One example is seen in UDC 217 *Humanity's duties to God* which was changed into 2-184 *Man's relation to gods*. Within structural changes, one UDC number was deleted and moved to a different hierarchical level. On the terminological side, old caption/value was replaced with new caption;
- addition of a new value + deletion of a value + assignment of value to another group in the hierarchy + addition of associative relationship (45). This type of change includes addition or deletion of associative relations. One or more UDC numbers were divided in two different classes. For example, 254.4 *Education and training of the priest* became 27-725:37 *Clergy. Christian ministers : Education*.

Again, most of changes were recognized in the year 2000 during the process of revision in combination of addition of a new value + deletion of a value + assignment of value to another group in the hierarchy. It captured 84% of all researched UDC numbers. All of these structural changes have taken place in the UDC captions.

The second type of changes was word-use change. During the research, word-use change was often referred to as terminological change. Word-use change was recognized only in relation between first and its changed UDC caption. In the chosen sample, 791 examples (47%) were without any semantic changes. There was a structural change, but terminologically, it was not 'measurable'. To the rest of the UDC class numbers (555 examples) categorization of word-use changes was applied. In the sample were found following semantic changes and its combinations: new word used as lead-in + change in definition of value – broader (12); new word used as lead-in+ change in definition of value– narrower (53); new preferred value added (197); new preferred value added + change in definition of value – broader (13); change in definition of value– narrower (103); change in definition of value– broader (44); change in definition of value – narrower (85).

Due to the faceting process of the main class 2 one needs to be careful when interpret changes – sometimes dramatic structural changes (main class becoming special auxiliary class) cannot be measured as semantic change. The results from first and second phase match. And conclusion is that in order to have a better interpretation of changes it is necessary to use different methodologies simultaneously.

The analysis showed complexity of changes which cannot be measured only from one side. During revision processes, we have to be able to recognize types of changes, measure and track those changes in notation and in caption in order to maintain stability of the system. This analysis was done only on one UDC class and it cannot be used for generalization. It can be considered as source for better understanding and naming types and ways one semantic change occurs in the system. It is yet to be found out whether this research can be applied in practice and if it is possible to track history of the subject within administrative fields of an individual classification record.

Table 3. Example of analysis of changes with diachronic semantics on UDC number *211 God. The Deity. The Supreme Being. Deism. Theism. Atheism.* [Changed in 2000]

UDC caption	UDC notation	Divided into..., ... and into...: splitting	Replaced by: notation	Replaced by: caption	Mechanism of diachronic semantics
God. The Deity. The Supreme Being. Deism. Theism. Atheism	211	1:4	2-14 God	God. Gods (Personalized god(s) as distinct from immanent spirits.	splitting: specialization
			2-145.2 Deism	Creator God. Demi-urge. Designer god. Deism.	splitting: specialization
			2-145.3 Theism	Preserver god. Theism. Providence. Safekeeping and governance of the world.	splitting: specialization
			299.2 Atheism	Atheism.	splitting: specialization

Example in Table 3 shows direction and number of changes which happened under the influence of mechanism called splitting. In the given example, splitting has ratio 1:4 but it is not clear

weather this ratio is the same for every change. It is not possible to measure precisely ‘semantic distance’ between, e.g., 211 and 2-14 or 211 and 299.2. For this type of analyses it is not crucial to measure that, but when thinking about meaning of each notation and caption, then ‘semantic distance’ will certainly make a difference. In order to categorize the semantic difference between each changed number, it could only be by using qualitative analyses and designation, e.g., distance between 211 and 2-14 is ‘smaller’ than between 211 and 299.2. Any other type of qualification would be more speculative than that.

The relation established between the first notation [211] and the second [2-14] or the third [299.2] is subject of another analysis and should be done with another type of methodological apparatus. Here, notations were used as representation of captions. The example in Table 3 shows that part of the original meaning of UDC number 211 ended up in four new UDC numbers. Previously 211 was main class number, and after splitting, three parts of the meaning ended up being special auxiliary numbers in main class 2 [2-14, 2-145.2, 2-145.3]. That means that the nature of the UDC numbers changed in accordance to starting UDC number.

Looking at each of new UDC captions, the conclusion is that each of them has gained part of meaning/caption from the first UDC number. This action is called the mechanism of specialization – complex caption was split into four simple captions. Each of them acquired new UDC notation. In this example two mechanisms were recognized at the same time, i.e., firstly meaning was split into four different meanings, and then each of new meaning was specialized under mechanism of specialization.

For better understanding of summarized results in Table 4 and Table 5 there are detailed examples of semantic changes. Example in Table 4 shows mechanism of merging four different UDC numbers (partially or completely) in one UDC number 2-14*God. God(s). (Personalised god(s) as distinct from immanent spirits).*

Table 4. Example of merging (partially and completely) of four different UDC numbers in one UDC number and analysis with mechanisms of diachronic semantics. [Changed in 2000]

UDC caption	UDC notation	Replaced by: notation	Replaced by: caption	Mechanism of diachronic semantics
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God. The Deity. The Supreme Being. Deism. Theism. Atheism	211	2-14 God	God. God(s). (Personalised god(s) as distinct from immanent spirits.	splitting: specialization
		2-145.2 Deism	Creator God. Demi-urge. Designer god. Deism.	splitting: specialization
		2-145.3 Theism	Preserver god. Theism. Providence. Safekeeping and governance of the world.	splitting: specialization
		299.2 Atheism	Atheism.	splitting: specialization
God: concept, definition, nature, essence. Aseity. First cause. Prime mover. The supernatural in religion and nature. Universality of belief in God	211.2	2-13 The Holy. The supernatural,	The holy. The sacred The supernatural. Objects of religion/worship	splitting: generalization
		2-14 God	God. God(s). (Personalised god(s) as distinct from immanent spirits.	splitting: specialization
Divinities. Objects of religion	291.21	2-14	God. God(s). (Personalised god(s) as distinct from immanent spirits.	specialization
Gods. Personified abstractions and divinities considered as pure spirit	291.214	2-14	God. God(s). (Personalised god(s) as distinct from immanent spirits.	0 (no semantic changes)

In this example there are four simple UDC numbers which have either the same semantic value or narrower/more specific than first UDC number. Each complex UDC number “lost” something which was transferred into new UDC number 2-14. Mechanism of merging was used here as a mechanism necessary for identification of the semantic changes which are common during revision of classification. Sometimes meanings of cancelled numbers similar or partially similar to each other merge their meanings and coexist at a hierarchically higher or more abstract level. The mechanism called merging was not defined in the literature of diachronic semantics. It was made only to accommodate types of changes which occur in an artificial language, such as classification system.

The UDC number 2-14 was found in main class 2 *Religion. Theology* four times [in 211, 211.2, 291.21 and in 291.214]. Individual meanings of UDC numbers partially or completely merged into one UDC number 2-14. The main problem of this example may be in the parts of the

meaning from original UDC numbers which ended up in more than one new UDC number. For example, in Table 4 there are UDC notations which could not find its place in the new UDC number 2-14 *God. God(s)* and that is *Personalised god(s) as distinct from immanent spirits*. This part of the meaning was “left behind”. On the other hand, the mechanism of specialization extracted only one meaning from UDC number. For example, UDC number 211 *God. The Deity. The Supreme Being. Deism. Theism. Atheism* specialized itself and split its meaning in four new numbers: 2-14, 2-145.2, 2-145.3 and 299.2 where each part contains particular meaning. There are some differences between new meanings. First three UDC numbers are conceptually much closer to each other. Last one [299.2] is far from the first meaning and it has longest semantic distance from its original meaning 211. UDC number 211.2 *God: concept, definition, nature, essence. Aseity. First cause. Prime mover. The supernatural in religion and nature. Universality of belief in God* divided in two UDC numbers: 2-13 *The Holy. The supernatural* and 2-14 *God*. One of the numbers has changed due to the mechanism of splitting and generalization [2-13], and another due to the mechanisms of splitting and specialization [2-14]. Third example had a simple change. Caption from UDC number 291.21 *Divinities. Objects of religion* completely transferred into caption of UDC number 2-14 *God*, with changes in terminology (word-use, as Tennis called it). Last example had the similar changes. The meaning from UDC number 291.214 *Gods. Personified abstractions and divinities considered as pure spirit* completely transferred into the caption of the UDC number 2-14 *God*, and also it had terminological changes. Although the meanings from the UDC numbers 291.21 and 291.214 are lost and transferred into 2-14, a bigger issue is to determine in which ratio first UDC number 211 was split into four new UDC numbers. It is not clear how it can be measured what percentage of meaning passed from UDC number 211.2 into two numbers 2-13 and 2-14. While it is not possible to say exact ratios or percentages of accuracy which happened during transfer of meaning, it is possible to say under which circumstances those changes happened. This kind of analysis can help to maintain administrative issues. Maybe categorization from diachronic semantics can be used for better understanding of what has taken place during the revision process.

Only two examples were used to demonstrate possible usage of mechanisms of diachronic semantics in order to reconstruct paths of changes in meaning during revision process. If those paths can be saved in the system by naming the types of relations between changed numbers

(notations and captions) it can offer better understanding of what is going on in the system during the revision process. Individual events can be tracked in one UDC number or can analyse what has happened in many UDC numbers simultaneously. This type of analysis is rather time consuming but it can help in understanding how to qualitatively measure semantic change in one UDC number or between different numbers joint together.

7 Conclusions

The mechanisms of diachronic semantics (metaphor, metonymy, specialization, generalization, analogy and splitting) (Raffaelli 2009) are redefined in the field of classification, exclusively for this research. During the research, another mechanism called merging was added to the list of mechanisms and it can be used while analysing changes in natural language. This kind of methodological approach represents appropriate tool for analysis of changes which occur in the classification system over time.

Borrowing theory from diachronic semantics was successful because it was borrowed at a high, conceptual level. At conceptual level we draw line between changes which occur in natural and artificial language such as UDC. According to Tennis' model of diachronic indexing there are three categories of changes: structural, word-use and textual changes. Structural and word-use change were identified in our research but textual change was not applicable.

Research was conducted on 1500 UDK numbers retrieved from cancelation files of main UDC class *2 Religion. Theology*. All researched numbers were cancelled during period of 15 years, from 1995 till 2009. Main UDC class *2 Religion. Theology* was chosen for this research due to revision process where analytico-sinhetical class was transformed into fully faceted classification in 2000. During that revision process the '10 years rule' was abandoned which means that cancelled numbers were reused immediately which caused lots of problems for the users of classification. This cannot be the case and it only occurred in UDC during this period of changes, not before not after. This also showed difficulties for managing changes in the whole system.

This research contributes at two different levels. Firstly, it helps to establish categorization of changes; it statistically justifies occurrences of semantics changes over time and applies mechanisms of semantic changes in UDC captions. Secondly, it justifies the need for building a system which can mark notes about history of changes to facilitate navigation through history of concepts. This could facilitate navigation through diachronic indexing of documents which would allow users to track history of concept by using only classification system which keeps historical changes. Results can be used as a starting point for future research projects, e.g., on other classes of UDC classification (main or auxiliary) or it can apply its methodology to different classification systems.

Revision of knowledge organization system is extremely hard work and it needs to be addressed having in mind that one small change in one class number – in caption or notation will have repercussions for the whole system. The analysis described in this paper asks for carefulness because reasons and influences of the semantic changes in natural language are different from changes in artificial languages. Meanings which are contained in class numbers are connected inside the system as well as in its environment – society, literature, etc. In order to help users to find information they need, knowledge organization system has to be able to fulfil high expectation of today and future users to keep its trustworthiness and quality and to stay up to date by reflecting changes in its environment.

In conclusion, changes in meaning which occur during the revision processes in a classification system can be fully viewed through complex methodology applied in this research. Only a combined approach can give us a complete view on changes which occur in notation or captions in one classification system.

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