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# Article Review of Semantic Change

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## Abstract

The article review focuses on explaining the concept of semantic change and how it affects the meaning of words. The abstract of the article provides a preview of the content covered in the review. It starts by identifying the key issues surrounding semantic change and how it occurs. The review then highlights the various factors that contribute to this phenomenon, including changes in social, cultural, and linguistic contexts. The abstract also presents the different methods used to study semantic change, such as corpus analysis and historical linguistics. Finally, the article review discusses the implications of semantic change for language users and provides insights into how individuals can navigate this ever-evolving aspect of language.

## Introduction

Over many centuries, semantics has evolved into its current state. There is a rich and extensive family tree of the English language. Between 450 and 1100 CE, the language was spoken as Old English (O.E.). "Middle English" (M.E.) refers to the period beginning about 1100 and ending around 1500 AD. After that, until 1800, the English language was known as Early Modern English (EMnE). The term "Present-Day English" (PDE) has been used to describe the language since the 19th century. Research into etymological shifts and definitional developments may have its roots in Old English. People have changed and modified words since language began based on their preferences and interpretations. Words have been evolving in their meanings for a long time. The word "lady," which had a mildly derogatory connotation in medieval and early modern English, is now used more pejoratively. The meanings of very few words have persisted over time. Regional and dialectal variances have brought about specific changes, while other changes have also occurred. The next generation's shifting worldview has led to terms taking on new meanings or, in some cases, taking on their literal translations. There are several causes for changes, and these elements have always been and will likely continue to do so going forward. It has been shown that language is fundamentally malleable. Both generalized college-level coursework and more narrowly focused research projects fall under semantics.

Achieving substantial results may be necessary and likely. Valid classification and thorough investigation are prerequisites for this subject. Many native English speakers often alter words and vocabulary. Semantic alterations affecting the whole English-speaking society, instead of just a particular region or dialect, are challenging to detect because people modify meanings to suit their linguistic needs. Because ebonics studies are becoming more popular, it is difficult to find studies investigating changes in a sense that are unconnected to this trend. It is challenging to categorize individual differences due to their intricacy. This thesis can only look at changes across numerous domains and people since the primary focus is on widespread semantic changes rather than localized differences. This theory has a good chance of producing noteworthy results. Providing information is the primary goal of this research. Therefore, this study's results will be meaningful, relevant, and significant since they will help readers better comprehend the changes in modern English's semantics. Furthermore, this research will elucidate the situation for those who steadfastly hold to the flawed ideas of the eighteenth-century grammarians and continue to try to "fix" and "rectify" a "deteriorated" language, seeing any alteration as an indication of moral deterioration. A study conducted by Barry in 2002

Since most people have acknowledged the Vietnam War, two notable cases of semantic shift exist. As the conflict dragged on, the terms "hawk" and "dove" started to be used interchangeably to designate pro- and anti-war factions. Because of this, the terms' original meanings were broadened beyond hawks' aggressiveness and doves' metaphorical calmness. The mouse is a standard tool for computer users while navigating the web and creating bookmarks. Words like "mouse" and "bookmark" gained further use outside their original contexts rather than supplanting them. As Edward (2012) stated, not everyone in a speaking community will immediately grasp a new meaning like any language change. When a new idea enters a language, it spreads across the speech community by socially established norms. The original intent of a shape and its creative meaning coexist until the former takes precedence.

**Semantics Aim in Reading**

"Semantic change refers to either adding a new meaning to the semantic system or removing an existing meaning from the semantic system, without altering the form itself."David P. Wilkins' article "Natural Tendencies of Semantic Change and the Search for Cognates" may be found in the book The Comparative Method Reviewed, edited by ( M. Durie 1996).

**Observing Change over Time**

The Tate Galleries is home to an extensive collection of modern and contemporary art from all over the globe and works by British artists from 1500 to the present. Sculpture, painting, printing, photography, video, installation, cinema, and performance are just a few of the creative media included in the collection. The Turner Bequest, which provides 300 oil paintings, watercolors, and sketches, makes up most of the nineteenth-century collection. The catalog information for the 69,202 artworks that Tate owns or shares with the National Galleries of Scotland is available in the JSON format of open data1. Fifty-three thousand six hundred ninety-eight entries have a timestamp out of the alternatives given above. Tate uses its three-tiered hierarchical topic index, which ranges from general to particular, to classify the objects. The timestamps in this dataset provide an exciting and unique look at how language and culture changed over two hundred years. Recognizing the data set's limitations, its concentration on artworks and specialized coverage does not diminish its value—it sheds light on society and culture via creative activity. Furthermore, it offers a chance to investigate pertinent approaches, most notably the open-source Somoclu program created at PERICLES (Wittek et al., 2015).

Using lower-level components, namely single words, within a continually developing semantic context represented by multivariate statistics, these experiments measured Somoclu's capacity to replicate Tate's complicated index terms. Thoroughly comparing the quality of automated topic index building to its human predecessor in a scalable context was paramount. By examining emergent self-organizing maps (ESOMs; Ultsch, 2005), index term drift was identified, measured, and evaluated, leading to the generation of drift logs for all indexing levels. Furthermore, normalized histograms were produced to show how the collection's thematic content changed at each time step. We also used pie charts to demonstrate the clusters' thematic makeup further.

Furthermore, hierarchical cluster analysis (HCA) dendrograms were created for word relationship matrices to evaluate the clusters' durability. Next, we compared these dendrograms to ones created using matrices that showed the connections between the words and the texts. These allowed us to grasp the evolution of meaning over the periods under consideration. Another option would be to use a gravitational force field and its generating potential to depict the dynamics that have been observed. Darányi et al. (2016) provide more detailed descriptions of these methods. Using this physical metaphor, we may learn more about what causes semantic drifts and other changes in characteristics over time. The primary results and analysis methods of this research are detailed in the following section.

When discussing semantic drifts, "content mapping" means keeping track of which clusters phrases belong to at each time step. Recognizing the dynamic distance structure of indexing terminology entails computing the locations and displacements of words about a reference point. What this means is that drift has to be identified and measured precisely. By including a drift log, you may receive a complete rundown of all the index words, broken down by degree of indexing and % of total.

It is possible to partition drifts and then merge them. A split occurs when, in one epoch, two labels for ideas are applied to the same grid node; in the subsequent epoch, the labels are spread to two distinct nodes. On the other hand, the opposite happens when two companies combine. Splits reduce recall, and merges reduce accuracy, limiting access quality from an information retrieval (IR) perspective. It separates and combines signal indexing terminology at danger of loss or compromise from the standpoint of long-term digital preservation. Somoclu meticulously recorded the number of splits and mergers that occurred during each epoch for both periods. The addition of new catalog entries between 1796 and 1800 caused the words 'art' and 'works' to be separated at the level 2 topic index, according to an example of a semantic drift log file.

Likewise, "scientific" and "measuring" became separate concepts. Contrarily, the words "monuments," "places," and "workspaces" were amalgamated and assigned precise locations. Someone using this tool in 1800 would have required assistance to access the same items as someone using it in 1796, based on the identical topic index words.

The ideas and semantic tags in a vector field are dynamic because they are subject to change due to social factors like the introduction of new subjects, the impact on donations and trends in clothing, and so on. There needs to be more information on these forces, which shape and quasi-embed the Tate collection, making it impossible to explicitly determine the links between social issues and the collection's semantic makeup. Nonetheless, both sets of maps reveal distinct patterns. These patterns demonstrate a continuous semantic framework, where transitory changes in content did not considerably disrupt the links between concepts. For example, 'towns, cities, villages' are more likely to stay put than 'inland' or 'nature.' Somoclu served as a local representative, and the linguistic fields were therefore maintained at a consistent level. To evaluate the fields' stability, we computed the drift rates, which we found by counting the number of splits and merges in the BMUs. We were more concerned with whether they formed, joined, or broke away from a cluster (called a BMU) in the time between epochs than with the distance they traveled.

Level 1 ideas in this collection were seldom divided, whereas indexing levels 2-3 saw regular divisions and combinations—the drift rate increased significantly with time. In particular, level 2 index phrases varied between 19 and 22 percent from 1796 to 1845 but only 15 to 27. 5 percent from 1960 to 2009. Drift rates for level 3 periods were 29-57% between 1796 and 1845 and 54-61% between 1960 and 2009. These percentages show that the topic index's vocabulary, especially for contemporary art, becomes more unstable as it gets more comprehensive. Several parameter combinations of Somoclu did quite well in recreating the original Tate index terms, such as 'towns, cities, villages', according to the analysis of all three indexing levels I described before.

The impact of social conflicts on the Tate collection's makeup may also be seen in this study. A comparison of the level 2 indexing vocabulary over different periods demonstrates this. The development of new concepts and the eventual extinction of specific essential terms are hallmarks of language evolution, which is best seen in this context. For example, the focus might shift from "nation" to "nationality," or from "magic" to "tales," or from "royalty" and "rank" to something else entirely. There may also be a resurgence of interest in the esoteric that goes beyond traditional notions of religion and the supernatural.

**Semantic Change and User Communities**

Moreover, as indicated earlier, a related worry is that different user communities may have access to the same resources or that user communities may change over time, along with changes in the meaning and comprehension of words and ideas. Indeed, this may increase the likelihood that resources may be unavailable owing to diverse community preferences. When searching for information or things, these communities could use different terminology and have other goals. Some people are more concerned with finding the original creators of stuff than finding ideas, inspiration, and entertainment.

Using online social networks to scientifically study and understand the user communities linked with a cultural heritage institution, in this case, the Tate Galleries is a practical way to examine the effect of communities. Gaining insight into correctly categorizing and assisting different user groups drives us today and in the future. The 'user community' is both varied and ever-changing. Therefore, these approaches are significant for future use in providing a controllable monitoring manner and understanding complex events.

Keeping track of and assessing the cultural and social elements that pose a threat in this society requires awareness of how it is changing. Institutions and more extensive cultural and government organizations must strictly regulate and oversee how their audiences use their facilities and services (Schlieder, 2010). We use social media to keep tabs on the social climate to lessen the impact of any dangers brought about by changes in that setting. The majority of Tate's recognized user population is someone who actively seeks out the platform via social media. Moreover, we expect it to be dynamic and ever-evolving, with changes coming slowly but surely.

We have found an example of change within the Tate community on Tumblr that corresponds to a rise in activity around 2012 through the integration of social network analysis of the Tumblr network and topic modeling (Blei, 2012) applied to the content of posts from this community: Both techniques were able to identify changes in the Tate-related material created by the Tumblr community by analyzing the data at different degrees of detail using 5 and 15 topic model solutions, respectively (Figures 2 and 3). They specifically showed how the content and structure of this social network have changed to meet its changing needs. The five-topic model picked up a rise in focus on the Tate Modern and the transmission of exhibition materials, together with a temporary change from catalog data to image data. The community's focus on Tate Modern and the sharing and promotion of exhibits genuinely marks a substantial shift in the Tumblr community's engagement with the platform, even if the early alterations in the subject may reflect a study of new media.

**Learning Semantic Drift from Past Versions of Linked Data Vocabularies:**

Berners-Lee et al. (2001) argued that Semantic Online improves online content organization by integrating RDF, language, and reasoning. Integrating various data sources into collaborative online databases makes it much more manageable. Schemas like ontologies and vocabularies are crucial in enhancing Linked Data with semantics on the web. They allow users to describe their data in a way that makes sense and create links between different data sets. Various publishers meticulously choose these vocabularies and regularly release revised editions with new vocabulary. For instance, between 2012 and 2015, schema.org released at least twenty-three separate versions of its lexicon. Publishers often update their word lists to reflect changes in the real world, user demands, and design constraints [Stojanovic et al., 2002]. Evaluating the updates' quality is complex and should only be done by humans.

The veracity of data found on the Internet sometimes needs to be improved. Hence, several methods have been devised to assess its quality. The appropriateness of data for consumption is a standard definition of data quality [Wang 1996]. The quality of Semantic Web data is being measured in several ways at the moment [Zaveri 2016]. However, these measures primarily focus on overall dataset characteristics, ignoring the diachronic nature of online vocabularies, which entails their change and development with time. There needs to be more standards for determining whether changes to a Web vocabulary in subsequent editions are appropriate. This means we do nothave yet to determine how well these vocabularies will develop. For Linked Data, how reliable are the mechanisms of vocabulary evolution? Does the revision's changes make sense? Is there a steady and predictable progression in the current Linked Data vocabularies? Is there a way to track its development?

This research suggests a metric for gauging how well diachronic Linked Data vocabularies have evolved. This measure is introduced based on the assumption that machine learning has matured to the point where it can generate high-quality prediction models for regular dataset sequences. As Pesquisa (2012) showed, the predictors for ontology evolution, first presented by Stojanovic (2004), are now well understood and valuable for building reliable models of ontology change prediction.

So, we set up a quantitative metric to evaluate the quality of a Linked Data vocabulary over time. We could determine which change models were the most successful by looking at their predecessors in a vocabulary chain. This study uses state-of-the-art ML algorithms [Pesquita, 2012] and trustworthy ontology evolution predictions [Stojanovic, 2004]. In order to ensure that vocabulary evolves to high standards, we use the performance of these change models. This metric sets up a formal framework for evaluating the stability of a diachronic Linked Data vocabulary, and that is something you must grasp.

Consequently, we have made a great deal of contributions to this research. We provide a metric to evaluate the progress made in the Linked Data vocabulary. The inferred optimum change models' performance forms the basis of this statistic. We build a domain-agnostic approach that can be used with any Linked Data vocabulary by expanding an existing change learning technique for biological ontologies. We next look at how diachronic Linked Data vocabulary features impact our method's evolution quality evaluation. Finally, all Linked Data vocabularies are evaluated for their stability and quality.

From various online sources, 139 version chains, including 669 versions of Linked Data vocabularies, have been organized. Based on our findings, 36.10 percent of the evaluated version chains get scores between 0.5 and 0.9, and 39.80 percent get scores over 0.9. Furthermore, 25.10 percent display patterns of predictability that are either random or unexpected. These gifts are intended to accomplish three separate goals: Our research shows that, at first glance, many online vocabularies must follow the expected, slow development

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patterns. Consequently, there may be a large discrepancy between the intended and actual interpretations of the data due to the use of obsolete terminology.

The quality indicators we have developed also help us pinpoint which versions in the chains have undergone significant changes so we can see where we went wrong while building our lexicon. This is an excellent tool for engineers to improve the accuracy of annotated data and terminology. As a result, the models may help vocabulary engineers make modeling decisions consistent with the previous engineering process, even if they are imperfect.

**The Sema Drift Suite of Tools to Measure Semantic Drift in Ontologies**

Using semantic drift, one may track and measure how ontologies have evolved across time and between revisions. Nevertheless, just a few methods may be directly used with Semantic Web structures. Additionally, there is a much greater need for apps and solutions that are more relevant. The PERICLES partners have developed a new set of tools called SemaDrift. Several methods were developed to measure how much meaning has changed inside ontologies over time or across versions. The application of structure similarity and text similarity approaches provides substantial insights. Any ontology developed from any application area may be quickly implemented using these methodologies (Stavropoulos et al., 2016b). A vital application programming interface (API) that provides the tools for creating open-source software is the SemaDrift Library. Two graphical user interfaces are part of the suite: the SemaDrift Fx desktop and the SemaDrift Protégé Plugin (Stavropoulos et al., 2016a). Developers and domain specialists may use these APIs to monitor drift in any domain. All software modules are covered under the Apache Licence. The SemaDrift Library—a Java API—serves as the foundational library to process and parse ontology versions to extract drift metrics. The system uses the OWL-API library for parsing and can handle several versions of ontologies. It provides several useful features to clients as well. For example, they may avoid re-processing models by collecting ontology hierarchies in tree-like structures.

The Sema Drift Protégé Plugin allows for smooth communication with Protégé, a popular program for creating ontologies. It improves the product by providing a GUI for determining drift. Drift metrics between two successive versions of an ontology—one opened in Protégé and another ontology chosen by the user—are calculated using the Java Sema Drift Library. For the Protégé app to work, you will need at least the latest version. You may assess the drift between two successive versions of an ontology of your choice with the help of the standalone desktop tool Sema Drift Fx. The Sema Drift Library API may be more easily used with the help of the JavaFX framework's improved graphical user interface (GUI). Future visual capabilities, such as ontologies, dynamic graphs, and visual morphing chains, may be easily included thanks to this integration.

**Conclusion**

Research in semantic transformation is currently trending in this article. The first part of this article provides a concise summary of the literature on semantic change, explains its key points, and analyses the connections between the many different ideas. Our next step was to compare and contrast several theoretical studies that have recently investigated semantic shift, starting with those that have used semiotics to detect semantic drift. Subsequently, we surveyed research on Tate Galleries' content and community transformation. Finally, we took a closer look at how to detect semantic drift in ontologies.

Although this article includes specific applications in digital preservation, its ramifications are not limited to just that. For instance, it is well-known that technological progress destroyed data formerly usable by computers due to software and hardware obsolescence, commonly referred to as "bit rot." This led to the loss of cultural artifacts and data. Nonetheless, the effects of linguistic shifts are the primary subject of the present study. New terms are necessary to describe the ever-evolving thoughts and concepts that arise in modern civilization. The definitions of already-established terminology may also change, generally or for specific communities. Social influences and changes in the community are another factor to consider, as they impact language development. Schlieder (2010), Blank (1999), and Hestrom (1997) have all addressed these concepts.

The problem of cultural semantics has been there for at least two thousand years, not a recent invention, as we claim. The study of phrase and word meanings returned to Vedic India continued in ancient Greece and culminated in the twentieth century with many ideas shaped by scholasticism and other philosophical currents. This points to the fact that there are not so many comprehensive explanations of meaning.

Because information theory allowed them to automate the communication process, many assumed they understood the problem. However, according to Claude Shannon, information theory was all about the formal parts of communication and wholly ignored semantics [Shannon, 1948]. Moreover, "information retrieval" has existed since the 1960s. It has only served to confuse people further and hide the reality that they want computers to provide them with meaningful answers. Furthermore, semantics' mysterious character is still a mystery.

Information retrieval experts were alerted to the problem of inter-indexer consistency early on because of its growing significance on the Internet [Chi, 2015]. When given a collection of papers for manual keyword assignment, human indexers could not agree on a document's topic. Consequently, they index it using only partly overlapping keywords. Luhn suggested automatic indexing in 1957 to deal with uncertainty; it relies on statistical assumptions. However, data mining and text categorization studies conducted within the last half-century have shown that more than scalability is needed to fix the original issue. In general, digital goods will be more difficult to retrieve in the future due to inconsistent indexing, and there is always the chance that words may have different meanings due to changes in use or the need to rethink concepts.

This data demonstrates how semantic change is essential in many fields of study and everyday life. Thus, we state that the problem of semantic change cannot be solved by a single method. The need for a holistic strategy incorporating recent developments in computational semantics, community analysis, ontologies, and the Semantic Web was already established. Below, we list important things that must be sorted out so that people in computer science and related disciplines can better grasp the links, difficulties, outcomes, and relevance of semantic changes. First, we outline three challenges.

The main problem is that there is a massive gap between the several academic disciplines that are trying to answer this question. Databases, ontology-based data access, data mining, knowledge organization systems, and linguistics are just a few areas where scholars and practitioners have different takes on the problem of semantic change despite their shared interest in and study of it. Their unique study area usually dictates these distinctions. The best way to tackle the widespread problem of semantic drift is to create familiar places and language, as mentioned at the beginning of this article.

The lack of (official) terminology that may be used to describe and analyze changes in meaning is another related topic that needs development. This is true for the standard paradigms in library science, such as representing the current state of a category's division. It is particularly relevant in more formal settings, like the Semantic Web, where our present knowledge only allows for the accurate description of events like conceptual shift or semantic drift using an existing ontology. Reasoning services that consider semantic drift will most likely be included in query engines. This is excellent news for anybody looking for content that changes drastically and fundamentally over time. Indeed, the study results presented in this paper might be used in this setting.

Another issue is the need for comprehensive, historically recorded test datasets to study semantic change in a controlled environment. Semantic Web researchers often experiment using data from the Internet Archive, CommonCrawl, or the Dynamic Linked Data Observatory. However, datasets with schema and instance details, plain text, assertions that machines can understand, and complete metadata (such as collection timestamps and provenance) are desperately needed. The lack of appropriate data for analysis is further caused by the fact that the optimal frequency of these crawls has yet to be understood entirely (e.g., hourly, daily, weekly, yearly).

When thinking about potential, the capacity to combine semantics with statistics is the primary and most important chance for advancement. Distributional semantics and knowledge representation are the two traditional ways of looking at this problem. These illustrate the dilemma when comparing symbolic reasoning and logic with inductive reasoning and machine learning in artificial intelligence. However, innovations like Semantic Statistics' RDF Data Cube standard (Cyganiak et al., 2013) show that combining the two methods is possible and usually beneficial. For example, the conventional split between an idea's intent and its extension—between its formal semantic definition and its composition in terms of instances—can be better grasped with methods that permit statistical and symbolic representations to communicate their meanings. The study of these concepts' semantic development is similarly affected by this.

Using version control systems to understand data modifications is the second untapped opportunity in this area that we are aware of. PROV-O—the W3C standard for data attribution and history documentation—is becoming more popular in Semantic Web applications. It is used to describe the operations done on data in great detail. Commonalities include the use of modern version control systems (such as git), application containers (such as docker), and popular source code repositories (such as GitHub) as data repositories. Recognizing the capabilities of these infrastructures to record software and dataset alterations more precisely and, meaningfully and on a bigger scale is vital. In order to comprehend semantic drift, they may be easily used as a helpful resource.

We have begun to address specific challenges connected to semantic transformation in our existing cooperation. Still, there are many opportunities for future studies and real-world applications. Statistical methods and a dearth of data are formidable obstacles to studying semantic change, but they also offer promising avenues for future research. As a result, researchers, both now and in the future, have a great chance of making significant strides in this area. With great anticipation, we look forward to learning more and participating in these innovative discoveries.

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