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## ► To cite this version:

Jani Marjanen, Jussi Kurunmäki, Lidia Pivovarova, Elaine Zosa. The expansion of isms, 1820-1917: Data-driven analysis of political language in digitized newspaper collections. 2020. hal-02491304v1

**HAL Id: hal-02491304**

**<https://inria.hal.science/hal-02491304v1>**

Preprint submitted on 25 Feb 2020 (v1), last revised 14 Dec 2020 (v5)

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# The expansion of isms, 1820–1917: Data-driven analysis of political language in digitized newspaper collections

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## Abstract

Words with the suffix -ism are reductionist terms that help us navigate complex social issues by using a simple one-word label for them. On the one hand they are often associated with political ideologies, but on the other they are present in many other domains of language, especially culture, science, and religion. This has not always been the case. This paper studies isms in a historical record of digitized newspapers from 1820 to 1917 published in Finland to find out how the language of isms developed historically. We use diachronic word embeddings and affinity propagation clustering to trace how new isms entered the lexicon and how they relate to one another over time. We are able to show how they became more common and entered more and more domains. Still, the uses of isms as traditions for political action and thinking stand out in our analysis.

## Keywords

isms; ideology; political language; diachronic word embeddings; affinity propagation clustering

## I INTRODUCTION

Words with the suffix -ism are indispensable terms for understanding politics and society, yet they are complex words that give rise to plenty of confusions. It is hard to tell how different isms ranging from communism to Protestantism and further to impressionism and positivism really relate to one another. For sure, people using everyday language seem to uphold the link between isms, and from an analytical perspective it is clear that most words with the suffix serve some sort of reductionist function. They are words that describe something complex in just one heading [Spira, 2015].

Most studies on isms have tried to make sense of them by trying to create reasonable typologies for understanding their areas of application or characteristics [Cuttica, 2013, Höpfl, 1983]. This paper departs from a more historical take, by trying to understand the historical process in which they developed. Isms have been used to categorize things ever since antiquity. In English a separate word, *isms*, emerged in the seventeenth century to denote them collectively. Ever since the sixteenth and seventeenth centuries isms have spread to many new domains in life, covering everything from religion, politics, science, arts and more. Isms have also gained a global reach so that they are used as cognate loans or direct translations in many languages [Höpfl, 1983, Kurunmäki and Marjanen, 2018b, Spira, 2015].

By focusing on the nineteenth century and using digitized historical newspapers from Finland, this paper takes the historical view even further. It uses word embeddings to analyze the spread of isms in the Finnish context. This method drawn from natural language processing (NLP)

differs a lot from traditional approaches in history and political science, but the possibility of clustering isms in a relatively large historical data set has several benefits also for scholarship in the humanities and social sciences. It can partly confirm the narrative of isms becoming especially political and even ideological in the course of the nineteenth century, but also that isms relating to psychology and the sciences entered the lexicon at this time. The clustering clearly shows how these isms belonged to different language domains. Further, the method can point out interesting new findings about the scope and nature of particular isms and their use in the Finnish context. For instance, the role of the discourse on socialism is here charted in the context of semantically similar terms, as is the rhetoric of separatism in different domains of language.

The results regarding separatism also point toward potential new method development in using word embeddings to cluster semantically similar terms as the term had a clear semantic continuity but was readily used in different discourses in consecutive periods. This type of complex historical case present in diverse data such as newspapers may be a welcome challenge for testing and developing methods with contextualized word embeddings.

## II RESEARCH QUESTIONS AND DATA

### 2.1 Research questions

This paper studies isms as particularly laden keywords in societal discourse in Finland in the long nineteenth century. We address the following research questions:

- How did the vocabulary of isms expand in the period?
- Which isms appear as similar based on their embeddings?
- How does the theme of politics distinguish itself in the clusters of isms over time?
- Are there interesting continuities in the enriched clustering that takes into account nearest neighbors of the isms?

Finally, we shortly discuss the differences in Finnish-language and Swedish-language discourse in Finland when looked upon through isms. It is worth pointing out that the bilingual nature of public discourse in nineteenth-century Finland creates a fruitful comparative starting point for investigating isms elsewhere in the world since the two languages were in constant interaction, but also developed at different speeds [Marjanen et al., 2019, Engman, 2016]. Similarly the transnational developments in the language of isms are heavily intertwined and follow the same trends, but local circumstances always set the context in which these words were used as political, social, and cultural keywords.

### 2.2 Data

To answer these questions, we use a digitalized collection of nineteenth-century Finnish newspapers freely available from the National Library of Finland [Pääkkönen et al., 2016]. Though the archive contains newspapers starting from 1770s, the earlier time periods do not have enough data for the analysis we apply in this paper. Thus, we keep to the data from 1820 to 1917. From 1809 to 1917 Finland was a Grand Duchy in the Russian empire and in this period it gained many state institutions of its own [Jussila, 2004]. The process of new political vocabulary entering the lexicon was heavily intertwined with the development of Finland as a state and a nation [Hyvärinen et al., 2003].

The collection contains newspapers in the Russian, German, Swedish and Finnish languages, with the latter two as the main languages. In our analysis, these dominant languages are treated as two separate corpora even though contemporaries often relied on newspapers in both languages. The period has been described as an interaction between three languages in Finland,

Table 1: Corpus size by double decade.

Time slice	Millions of words	
	FINNISH	SWEDISH
1820–1839	1.3	25.5
1840–1859	10.3	77.9
1860–1879	90.6	326.7
1880–1899	805.3	966.9
1900–1917	2439.0	953.0
<b>Total</b>	3346.6	2355.2

Swedish being the main language for administration and learned life, Finnish being the primary language of the majority of the inhabitants in Finland and increasingly seen as the language of the future, and Russian as the language that most people in Finland did not read, but still loomed in the background as the main language of the Russian empire [Engman, 2016].

In this paper we use the Finnish and Swedish corpora, leaving the far more smaller data sets of Russian and German for the further research. The total amount of words in both corpora is presented in Table 1. Both corpora are lowercased and lemmatized using LAS, an open-source language-analysis tool [Mäkelä, 2016].<sup>1</sup> It is a meta-analysis tool that provides a wrapper for other existing tools developed for specific tasks and languages. Though LAS supports multiple languages, most efforts were done to process Finnish data, including historical Finnish. The output for our Swedish data is more noisy. In particular, the Swedish LAS lemmatizer is unable to predict the lemma for out-of-vocabulary words, e.g. *boulangismen* (definite form of ‘boulangism’). Thus we applied additional normalization by converting all words ending with *-ismen* or *-ismens* into *-ism* forms. For all other words we use the LAS output; implementation of proper Swedish lemmatization is beyond the scope of this paper, as most of our findings are based on clustering the isms only, thus perfect lemmatization of other words is less crucial.

### III METHOD

#### 3.1 Diachronic embeddings

To trace semantic shifts in word meanings we split a lemmatized corpus into double decades (1820–1839, 1840–1859, and so on until 1900–1917) and train continuous embeddings [Mikolov et al., 2013] on each time slice. We use the Gensim Word2Vec implementation [Řehůřek and Sojka, 2010] using the Skip-gram model, with a vector dimensionality of 100, window size 5 and a frequency threshold of 100—only lemmas that appear more than 100 times within a double decade are used for training. In this way we try to ensure that each word in a model has a reliable amount of context and the embeddings are trustworthy. However, we lose some isms because they appear less than 100 times in a double-decade. For example, the Finnish word *feminismi* was mentioned 91 times between 1900 and 1917 and was excluded from our analysis, while its Swedish counterpart was mentioned 242 times and is visible in our results. Our models allow us to detect when a word became frequent, in what context it was used and what is the difference between the Swedish and Finnish contexts. They do not allow us, however, to check when the word appeared for the first time and comparison of word distributions between languages is not fully reliable for less frequent words.

Since training word embeddings is a stochastic process, the particular values of vectors do

<sup>1</sup><https://github.com/jiemakel/las>

not stay close across runs, though distances between words are quite stable. To ensure that embeddings are stable across time slices, we follow the vector initialization approach proposed in [Kim et al., 2014]: embeddings for  $t + 1$  time slice are initialized with vectors built on  $t$ ; then training continues using new data. The learning rate value is set to the end learning rate of the previous model, to prevent models from diverging rapidly. This approach has been previously used in [Hengchen et al., 2019] with slightly different data.

Temporally aligned embeddings have been used before to trace semantic drift by computing distances between vectors representing a word in two time periods or by measuring differences in nearest neighbours for these vectors [Hamilton et al., 2016]. However, most studies that tackle semantic shift detection in computational linguistics deals with clear cases of word meaning change such as the complete change of meaning of the word ‘gay’ or acquiring of a new completely different sense such as words ‘virus’ or ‘cell’. These rapid transformations could also be found in our data: e.g. Swedish word *flygare*, which initially meant an insect but changed its meaning to “aviator” in the beginning of the twentieth century. The embedding models that we trained is able to detect this change, since the nearest neighbors of *flygare* completely changed. At the same time, distance-based methods seem to be less useful for isms, since their meanings do not change to that extreme. For example, ‘patriotism’, whether it had positive or negative connotations, always has a meaning semantically close to “love of one’s country”. At the same time, the political and social context in which the word was used changed over time. Further the term could be used for quite different rhetorical purposes and it carried new social and affective meanings that are not as readily visible in the embeddings.<sup>2</sup> Thus, in this paper we do not lean on distances between word vectors across time and instead use clustering to find which isms were closer to each other—i. e., had similar contexts—in various periods of time.

### 3.2 Clustering

To investigate the expansion of the vocabulary of isms we cluster words into close groups based on their embeddings. Since our task is mostly exploratory and the number of clusters cannot be known in advance we apply the Affinity Propagation clustering technique [Frey and Dueck, 2007]. The method splits all datapoints into *exemplars*, i.e., cluster representative tokens, and *instances*, i.e., other members of clusters. At the initial step all datapoints present a cluster of their own. Then for each instance-representative pair a likelihood for an instance to be represented by an exemplar is computed by taking into account all other instances of the exemplar and all other available exemplars for the instance. This computation is repeated until convergence is reached; if an exemplar has no instances it is dismissed. We use the standard implementation of this algorithm from the Scikit-learn package [Pedregosa et al., 2011] with default parameters.

Affinity Propagation has been previously used for various language analysis tasks, including collocation clustering into semantically related classes [Kutuzov et al., 2017] and unsupervised word sense induction [Alagić et al., 2018]. The main advantages of the method are that it detects the number of clusters automatically and is able to produce clusters of various size. As a side effect it returns exemplars, i.e. cluster representatives, which are not necessarily equal to the geometric centre of the cluster.

The main drawback of the Affinity Propagation is pairwise computations. The method is quadratic in time and memory and cannot be applied to large datasets, such as a whole corpus vocabulary. Thus, data selection is an unavoidable step. In this paper we use Affinity Propagation in two experiments.

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<sup>2</sup>For social, affective and other types of meaning, see Leech [1974]

In the first experiment, we extract from the corpus all ism words. i.e. words that end with *-ism* in Swedish and *-ismi* in Finnish and cluster only this set of words. We exclude from the list words that are shorter than 5 characters for Swedish and 6 characters for Finnish. This is to filter out obvious errors that appeared in the optical character recognition of the newspapers such as ‘ism’, ‘tism’, or ‘rism’. Though the words ‘ism’ and ‘ismi’ exist in the Swedish and Finnish languages, they are very uncommon in nineteenth-century press. The extraction allows us to identify how close these words are to each other given other isms in the corpus.

In the second experiment, we try to put isms into a richer context and trace other words associated with them in the respective double-decades. We extract from the corpus all words which have a cosine similarity to any isms that is less than 0.5. Then we perform clustering on this enriched dataset. Finally, the clusters are filtered so that only clusters that contain at least one isms word are presented for qualitative analysis. An output of this procedure is different compared to the first experiment, i.e. words that were clustered together in the isms-only clustering, can break up into different enriched clusters, since in the latter setting they have more exemplar options.

Henceforth we refer to the results of the first and the second experiments as *ism clusters* and *enriched clusters* respectively. We discuss the outcomes of the two experiments interchangeably since they give different perspectives on the development of ism vocabulary.

Clustering is performed separately for each time slice. To link clusters across time we perform visualization with Sankey charts. In the Sankey diagram, clusters from time slice  $t$  are linked to clusters in time slice  $t + 1$  if they have words in common. The magnitude of the link is the sum of the word frequencies of the common words between the linked clusters from adjacent time slices. We use the frequencies from the source cluster, that is the cluster from time slice  $t$ .

## IV RESULTS

Some of our results are directly related to the political history of Finland and the development of newspapers as a medium, whereas others go well together with previous notions of the development of the language of isms in general. They strengthen earlier interpretations by giving more robust proof for interpretations that have mostly relied on the qualitative reading of sources. Other findings come across as surprising also for historians of political ideologies, and may at least to some extent force us to rethink how we look upon the history of political discourse. In what follows, we will present the findings in this order.

### 4.1 Swedish and Finnish clusters in comparison

As expected, Finnish-language and Swedish-language isms cluster differently in terms of timing and themes that are present (see Figure 1 and Figure 2). There are three main reasons for this:

- Swedish-language press in Finland developed earlier and included more abstract content earlier in the century, whereas newspapers in Finnish—and the Finnish written language—started maturing only in the latter half of the century. Consequently, we have been able to produce meaningful clusters of isms for 1820s onward for Swedish and only from the 1860s onward for Finnish. As described earlier, the languages were in constant interaction, but the scope of Finnish-language newspapers was much smaller in the first half of the century and the content was to a lesser degree theoretical and political. Furthermore, Swedish-language newspapers were quicker in adopting new terms from publications in Sweden because of the language connection and thus had a sort of mediating function with regard to new political vocabulary.
- The *-ismi* was not a productive suffix in the Finnish language but used through cognate

FINNISH				
Time slice	<i>ism</i>	<i>close</i>	<i>cluster</i>	<i>select</i>
1820 - 1839	0	-	-	-
1840 - 1859	0	-	-	-
1860 - 1879	1	157	1	12
1880 - 1899	35	5977	20	442
1900 - 1917	119	8940	70	1543

SWEDISH				
Time slice	<i>ism</i>	<i>close</i>	<i>cluster</i>	<i>select</i>
1820 - 1839	3	724	3	49
1840 - 1859	17	1845	12	211
1860 - 1879	61	5229	31	669
1880 - 1899	120	12233	54	1320
1900 - 1917	137	11858	56	1387

Table 2: Number of distinct words used on various steps of the to obtain enriched clusters: **isms** is a number of distinct words with suffix *-ism*, **close** is a number of words, which cosine similarity to at least one *ism* is higher than 0.5, **cluster** is a number of clusters that contain at least one *ism*, **select** is a number of words in these clusters.

loans and through analogous derivation of foreign words.<sup>3</sup> Consequently, isms are in general less common in Finnish than in Swedish. Nonetheless they were used in both languages especially as Finnish political language developed through an interplay with Swedish. In the particular case of adopting isms as key terminology in Finnish, the latter half of the century was a crucial turning point.

- The political outlook of the two languages was slightly different. From the 1880s onward the Finnish and Swedish newspapers were printed in nearly equal amounts. At this time the language spheres also started specializing. Swedish speakers lived mostly in larger towns and around the coast, whereas Finnish speakers inhabited most of the country [Marjanen et al., 2019]. In Lapland, Sami languages also had a strong presence, but they were not at this time published in print. At this point, Finnish-language papers were more likely to have a rural or working-class background and Swedish-language papers were more likely to be more urban, liberal and bourgeois, which also shows in the use of isms. This is typically visible in the proportionately big role the cluster around socialism manifests in Finnish compared to Swedish. The clusters clearly show that Finnish-language *ism* vocabulary was more politically oriented in the early twentieth century. Cultural, philosophical and scientific isms were less present.

The distinction between Swedish and Finnish is also visible from the analysis of the enriched clusters. The number of words used on various steps of analysis is presented in Table 2, which shows that the number isms in the Finnish data is much smaller than for the Swedish data. The table also shows that though 0.5 is an arbitrary threshold, up to 90% of words selected using this threshold are filtered out after the clustering. This is an indirect justification that the threshold is sufficient and most of the relevant words are present in the output. The number of selected clusters is generally smaller than the number of words with the suffix *ism* since they tend to cluster together.

<sup>3</sup> As such the *ism* is not strictly speaking a suffix in Finnish, but a rather a sublexical suffix-like unit as often the whole words a cognate loans in which the root itself is not a word in Finnish. We thank Antti Kanner for pointing this out.

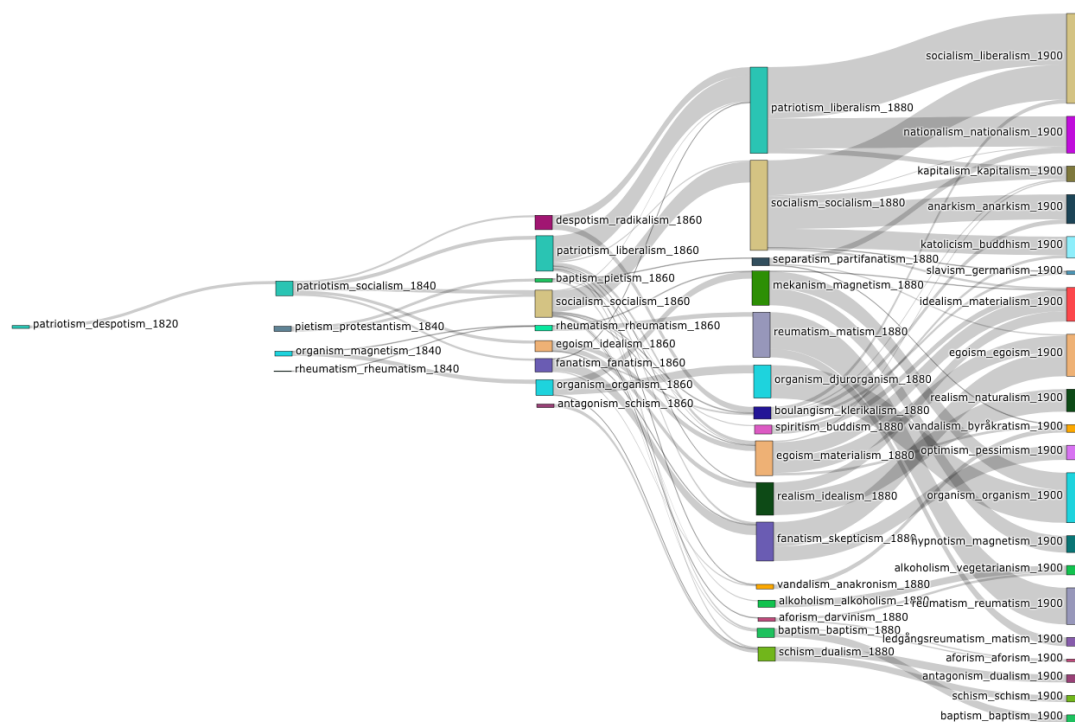


Figure 1: Sankey diagram of isms clusters from the Swedish dataset covering five double decades from 1820 to 1917. The cluster name is the most frequent ism word for that cluster followed by the cluster representative and the double decade.

## 4.2 Expansion of the language of isms

By looking at the raw counts of different isms we see an expansion of isms in the nineteenth century. This is partly the function of a growth in data size over time, but mostly because new isms were introduced and often also lexicalized to the extent that they became nodal points in newspaper discourse. One feature of the suffix is that it is rather easy to deploy in *ad hoc* inventions of new words, so many isms were introduced, but never resonated in public use. These are as such interesting instances of linguistic innovation, but are excluded in this study as we use a frequency threshold for training our embeddings. The threshold also effectively excludes many false variants caused by noisy optical character recognition.

Aligning the clusters in the Sankey plots provides a possibility of visually exploring how the vocabulary of isms developed over the course of the century. As can be seen in Figure 1, there is quite a steady expansion of isms from the 1820s onward for Swedish. As the models for producing the clusters rely on enough datapoints for training, particular clusters appear with a delay compared to first uses of particular words. For instance, patriotism appears the first time in the corpus in 1791 and liberalism 1820, but the clusters in which they are part of (but not necessarily cluster representatives or most frequent ones) appear in 1820–1839 and 1840–1859, as can be seen in Swedish clusters (Table 8). The word socialism appears the first time in 1840 and is also included in the cluster for 1840–1859, since it immediately became popular and the amount of newspapers in Swedish had already grown.

The visualization of Finnish-language clusters provides a much shorter story, but the expansion



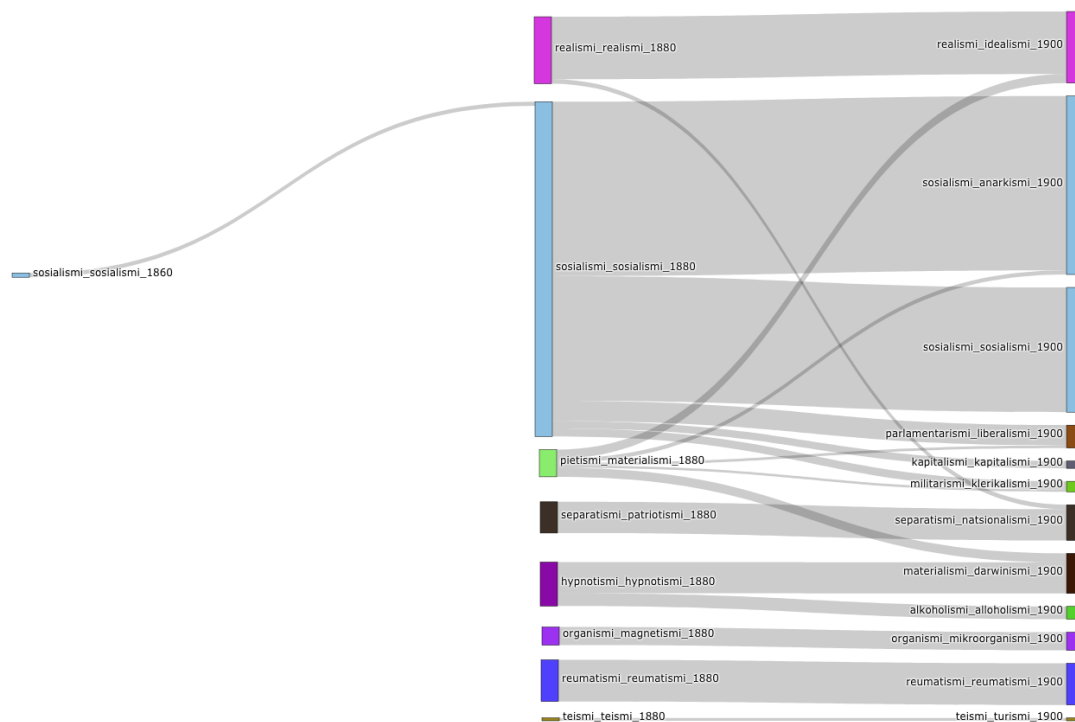


Figure 2: Sankey diagram of isms clusters from the Finnish dataset covering three double decades from 1860 to 1917. The cluster name is the most frequent ism word for that cluster followed by the cluster representative in the double decade.

of isms into new domains is also visible in this data. A peculiarity of the Finnish data is that although the number of isms grew also for Finnish, the clusters show much stronger continuities in the sense that the clusters fluctuate much less than for the Swedish data. In this case the emergence of clusters that can be described as political or ideological are the ones that change the landscape of isms most significantly, whereas medical, cultural and scholarly isms only play a minor role.

### 4.3 Politics and ideology as distinct clusters

Previous interpretations by Kurunmäki and Marjanen [2018a], have suggested that the early nineteenth century meant the breakthrough of isms that we today associate with major political ideologies, whereas the end of the century saw the rise of plenty of new isms in the sciences (including medicine) and the arts. Again, looking at first appearances of particular isms in the Swedish-language data set suggests this holds also for Finland. However, the clusters allow for a stronger claim that suggest that the political and ideological isms form a quite distinct category after they have been introduced.

Figure 1 and Table 8 show that there is a clear continuity in the politically laden isms which start from a cluster with *patriotism*, *fanatism* (Eng. fanaticism) and *despotism* in one cluster in 1820–1839 and continue with an expansion over the consecutive double decades. Most frequent isms in the political clusters are *patriotism*, *socialism* and *despotism* up to 1859, and then *boulangism*, *fanatism*, *anarkism*, *nationalism* and *kapitalism* (Eng. capitalism) up to 1917. There is some fluctuation between the political clusters, like *liberalism* and *patriotism* being quite tightly associated with one another until the last time slice of the investigated period, and

some unsurprising continuities, like *konservatism* (Eng. conservatism) and *liberalism* being in the same clusters throughout. Still, it seems that there is less fluctuation between the distinctly political clusters and the other clusters. Also religious isms (starting from *pietism*), and medical isms (e.g. *rheumatism*) come across as fairly stable. The philosophical, artistic and scientific isms are also distinguishable, albeit they do cluster more freely. The case of rheumatism is very specific as it has a high frequency and appears often in health-related advertisements, which means it does not co-occur very often with other isms, but is rather an isolated marketing term in marketing pills and ointments.

For Finnish-language, the data is too scarce to produce meaningful clusters for more than three time slices. Even though the Finnish corpus for the 1880–1899 double decade is comparable in size with the Swedish corpus, the number of *distinct isms* in Finnish is smaller than in Swedish: 44 for Finnish and 125 for Swedish.

With scarcer data the distinctness of the clusters is even clearer. Clusters with socialism as the most frequent ism are rather dominant both for Swedish and Finnish, but the role of socialism as a pivotal ism is even more pronounced for the latter as is also indicated by Marzec and Turunen [2018]. Further work is needed to explain this in more detail, but apart from above mentioned demographic and political background factors for Finnish-language press, it also seems that the discourse on socialism may have been less confined in Finnish than in Swedish.

#### 4.4 Socialism as a pivotal ism

While the two data sets are different, they both show that a many isms pivot around the discourse of socialism especially toward the end of the century. Socialism does not fluctuate between clusters, but really seems to be one of the terms that organized the debate. We get supplementary perspective on this phenomenon by looking at the relative frequency of a selection of most frequent isms in our data (Figure 3). Like the clusters, the relative frequencies indicate a growing proportion of isms over time and also demonstrate some difference between the data sets. For the Swedish data set we see a change on the overall landscape of the vocabulary with terms such as patriotism being dominant at first but then surpassed in frequency by socialism. In Swedish, we also find a broader selection of isms from political to religious and medical topics, present for the second half of the nineteenth century. In Finnish, the landscape is different as it appears that the whole vocabulary relating to isms was dominated by socialism from the 1860s onward. It appears as if the word socialism in a way invited other isms to be lexicalized in the Finnish language. Once socialism became inevitable in Finnish-language political discourse, other isms well-known from Swedish and other Germanic languages were easier to introduce also to Finnish. This does not mean that isms did not at all feature in Finnish, only that they were infrequent and not a normal part of the lexicon. We must also note that most authors who produced texts in Finnish, also operated in Swedish, so while they did not write about isms in Finnish, they still held notions of isms through the other main language of the country.

Albeit a comparison with China may come across as far fetched, the introduction of isms in central categories for political thinking in China provides a dramatic instance that can be contrasted to the Finnish case. As Ivo Spira has shown, the discussion on modernization in China in the early 1900s prompted comparisons with Western ideological discourse through a discussion of different isms. At this time, a sign corresponding to ism was introduced (*zhǔyì* 主義) and it quickly became a way of translating Western isms into Chinese, but also a way to conceptualize locally embedded isms [Spira, 2018]. As such, the isms may be seen as a way of synchronizing Chinese and Western political thought, so that they were used to translate and compare ideological positions [Jordheim, 2014, 2017].

Table 3: Enriched clusters for Finnish and Swedish that contain word *socialism(i)*. Cluster *representatives* are marked with italic, **isms** are highlighted with bold.

1880–1889			
FINNISH		SWEDISH	
<b>sosialismi</b> ‘ <b>socialism</b> ’	5115	<b>socialism</b> ‘ <b>socialism</b> ’	5560
<i>anarkismi</i> ‘anarchism’	1120	<i>reaktion</i> ‘reaction’	6991
<i>nihilismi</i> ‘nihilism’	602	<i>socialdemokrati</i> ‘social democracy’	2303
<i>militarismi</i> ‘militarism’	328	<b>anarkism</b> ‘ <b>anarchism</b> ’	1975
<i>kommunismi</i> ‘communism’	316	<i>frigörelse</i> ‘liberation’	1823
<b>radikalismi</b> ‘ <b>radicalism</b> ’	171	<i>proletariat</i> ‘proletariat’	1548
<i>sosiaalidemokratia</i> ‘social democracy’	386	<i>emancipation</i> ‘emancipation’	1225
<i>sosialidemokratia</i> ‘social democracy’	339	<b>nihilism</b> ‘ <b>nihilism</b> ’	1181
<i>villitys</i> ‘craze’	337	<i>socialdemokratien</i> ‘social democracy’	1023
<i>luokkataistelu</i> ‘class struggle’	177	<i>utopi</i> ‘utopia’	1016
<i>reaktio</i> ‘reaction’	136	<b>antisemitism</b> ‘ <b>antisemitism</b> ’	911
<i>pappis-malta</i> ‘clericalism’ <sub>ocr</sub>	130	<i>bourgeoisie</i> ‘bourgeoisie’	772
		<i>anti</i> ‘anti-’ <sub>ocr</sub>	747
		<i>elementerna</i> ‘elements’	703
		<b>absolutism</b> ‘ <b>absolutism</b> ’	641
		<b>klerikalism</b> ‘ <b>clericalism</b> ’	569
		<b>statssocialism</b> ‘ <b>state socialism</b> ’	485
		<b>kommunism</b> ‘ <b>communism</b> ’	459
		<b>ateism</b> ‘ <b>atheism</b> ’	455
		<i>kvinnöemancipation</i> ‘women’s emancipation’	445
		<b>panslavism</b> ‘ <b>panslavism</b> ’	341
		<i>reaktionen</i> ‘reaction’	335
		<i>kvinnörelse</i> ‘women’s movement’	332
		<i>framtidstat</i> ‘future state’	242
		<b>kapitalism</b> ‘ <b>capitalism</b> ’	226
		<b>jesuitism</b> ‘ <b>jesuitism</b> ’	206
		<b>individualism</b> ‘ <b>individualism</b> ’	196
		<i>socia</i> ‘social’ <sub>ocr</sub>	174
		<i>ateistisk</i> ‘atheistic’	173
		<i>fredsidé</i> ‘idea of peace’ <sub>ocr</sub>	155
		<b>ultramontanism</b> ‘ <b>ultramontanism</b> ’	129
		<b>utilitarism</b> ‘ <b>utilitarianism</b> ’	124
		<i>kollektivistisk</i> ‘collectivistic’	122
		<b>kollektivism</b> ‘ <b>collectivism</b> ’	121
		<b>cesarism</b> ‘ <b>cesarism</b> ’	110
		<i>frihetsidé</i> ‘idea of liberty’	108

Turning back to the issue of socialism as a pivotal ism in both Swedish- and Finnish-language discourse in Finland, our findings harmonize with Marzec and Turunen [2018] who emphasize the role of socialism based on frequency and textual analysis, but we further note that looking at socialism in the context of all isms shows that it also had a synchronizing function between Finnish and Swedish. The breakthrough of socialism as a buzz word in the second half of the nineteenth century helped produce political and ideological isms also in Finnish that could be compared with counterparts in Swedish and other languages.

Careful analysis of text would provide more reliable interpretations to why socialism gained such a dominant role in Finnish-language discourse, but our enriched clustering with a cosine similarity to any word does also provide more information about the linguistic contexts of each

Table 4: Enriched clusters for Finnish and Swedish that contain word *socialism(i)*. Continuation.

1900–1917			
FINNISH		SWEDISH	
<i>sosialismi</i> ‘socialism’	75117	<b>socialism</b> ‘socialism’	15080
<i>kristitty</i> ‘christian’	72175	<i>socialdemokrati</i> ‘social democracy’	11030
<i>kristinusko</i> ‘christianity’	32542	<i>klasskamp</i> ‘class struggle’	2998
<i>kristillisuus</i> ‘christian’	18566	<b>anarkism</b> ‘anarchism’	1709
<i>rauhanaate</i> ‘pacifism’	1598	<i>socialdemokratien</i> ‘social democracy’	993
<b>kommunismi</b> ‘communism’	1548	<b>absolutism</b> ‘absolutism’	879
<i>pakanakansa</i> ‘pagan people’	760	<i>framtidstat</i> ‘future state’	533
<i>buddhalaisuus</i> ‘buddhism’	456	<b>individualism</b> ‘individualism’	512
<i>lristinuslo</i> ‘christianity’ <sub>ocr</sub>	428	<i>demokratien</i> ‘democracy’	496
<i>tinusko</i> ‘christianity’ <sub>ocr</sub>	383	<b>skandinavism</b> ‘skandinavism’	440
<i>käännitys</i> ‘conversion’	256	<b>syndikalism</b> ‘syndicalism’	387
<i>tristi</i> ‘?’ <sub>ocr</sub>	252	<i>fredstank</i> ‘pacifism’	342
<i>adventisti</i> ‘adventist’	243	<b>antisemitism</b> ‘antisemitism’	341
<i>alliansi</i> ‘alliance’	164	<b>marxism</b> ‘marxism’	286
<i>kristinuslo</i> ‘christianity’ <sub>ocr</sub>	161	<b>internationalism</b> ‘internationalism’	285
<i>tinuslo</i> ‘christianity’ <sub>ocr</sub>	147	<b>antimilitarism</b> ‘antimilitarism’	267
<i>buddalaisuu</i> ‘buddhism’ <sub>ocr</sub>	144	<b>kommunism</b> ‘communism’	256
<i>tristinusko</i> ‘christianity’ <sub>ocr</sub>	128	<i>historieuppfatning</i> ‘understanding of history’	236
<i>jumalausko</i> ‘faith’	127	<i>studentrörelse</i> ‘student movement’	170
<i>islami</i> ‘islam’	123	<b>aktivism</b> ‘activism’	168
<i>buddalaisuusi</i> ‘buddhism’ <sub>ocr</sub>	119	<b>revisionism</b> ‘revisionism’	166
<i>konfusius</i> ‘confucius’	118	<i>brandfackla</i> ‘bombshell’	142
<i>lristinusko</i> ‘christianity’ <sub>ocr</sub>	114	<i>kulturrörelse</i> ‘cultural movement’	134
<i>järkeisoppi</i> ‘philosophy’	111	<i>föbudsrörelse</i> ‘prohibition movement’	122
<i>tristinuslo</i> ‘christianity’	109	<b>försvarsnihilism</b> ‘defence nihilism’	117
<i>alkukristillisuus</i> ‘early christianity’	103	<b>nykterism</b> ‘prohibition movement’	112
<b>ungsocialism</b> ‘ungsocialism’	112		
<b>kollektivism</b> ‘collectivism’	110		
<b>modernism</b> ‘modernism’	109		
<i>samhällsrörelse</i> ‘social movement’	102		
<i>finshetersrörelsen</i> ‘finnish movement’	101		

ism. Tables 3 and 4 show how Finnish-language clusters with words associated with socialism include more religious (and to certain extent also scientific) terminology than the more political discourse visible in the Swedish-language clusters. Why socialist discourse was more prone to tap into a reservoir of religious rhetoric in Finnish than in Swedish requires further study. One possible explanation to this may lie in the fact that socialism was in Finnish to a higher degree than Swedish related more strongly to the so-called social question, that is social and political problematization of class issues, poverty and labor issues and that these issues also dovetailed with Finnish-language religious discourse around the turn of the century 1900.

#### 4.5 Separatism and its different domains

If words like socialism and rheumatism shows remarkable continuity through clusters, other isms seem to be less tied to their clusters. A surprising and illuminating example of this is separatism in both Swedish and Finnish. In Table 5, we present the enhanced clusters for it in the Swedish data set.

Most of the words similar to separatism in the 1860–1879 cluster are religious, philosophical or scientific notions, such as mysticism, Darwinism, human nature, negation or idealistic. By

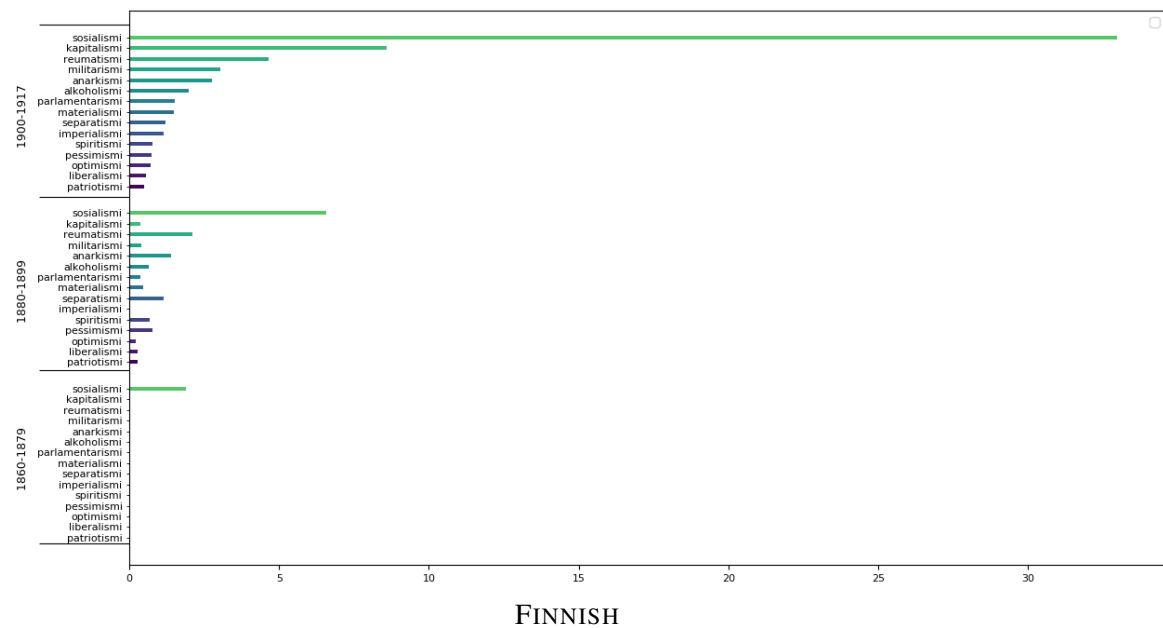
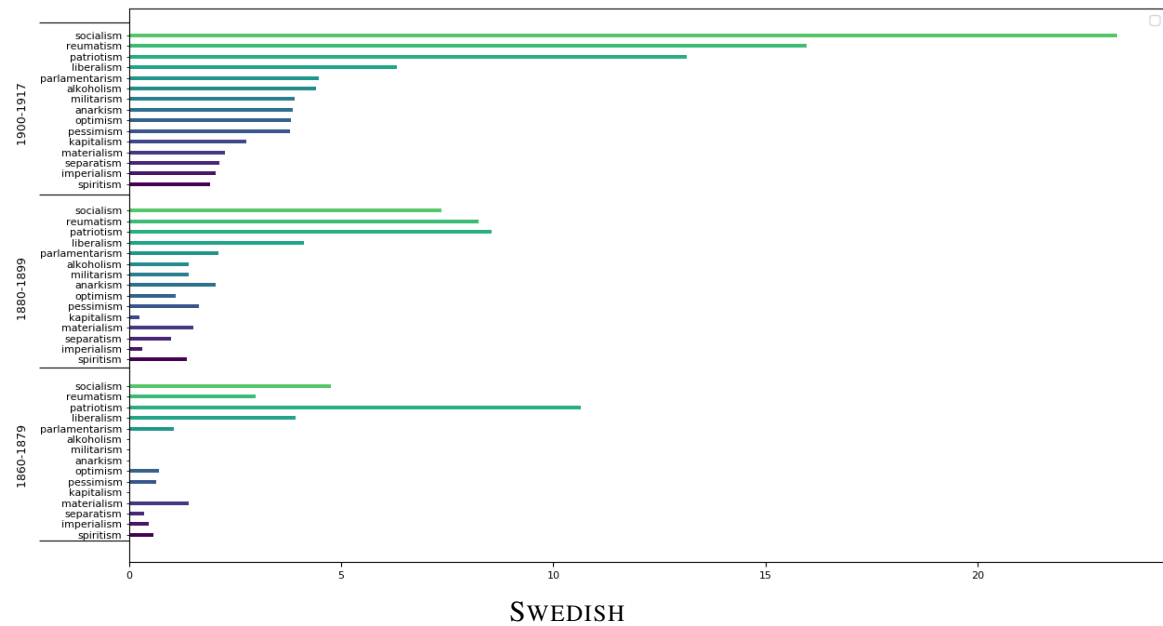


Figure 3: A selection of the most frequent words ending with suffix *-ism/ismi*. The x-axis presents relative frequency in items per million.

analyzing the clusters and reading sample texts from the period, we conclude that the cluster derives much from debates about religion and the historical experience of Lutheranism being threatened. In the period new scientific and philosophical strands of thought as well as contemporary religious revival movements seriously challenged the status of the dominant state church in Finland, and the notion of separatism seems to have been readily used in the ensuing debates.

The 1880–1899 cluster contains completely different set of words, including reference to ethnicity and language policy in the country, such as Finnishness, Fennomans and language policy, and contains rather emotional expressions, such as *agitation* and *fanaticism*. The outlier of pho-

tophobia also belongs to a similar discourse as the term was used metaphorically at the time to discuss things that could not be brought to the fore because of political tensions. Again with selected reading of texts we note that separatism is clearly clustered with words that are related to a contemporary discussion about national identity and national language.

The 1900–1917 cluster is again different from the previous two and contains more general political lexis. Again, it seems that the notion of separatism had been included in a new discursive domain. Now, the word clusters with words that relate to state structures and even the context of the Russian empire. Separatism had become embedded in discussions about independence, the role of Finland and as a nation.

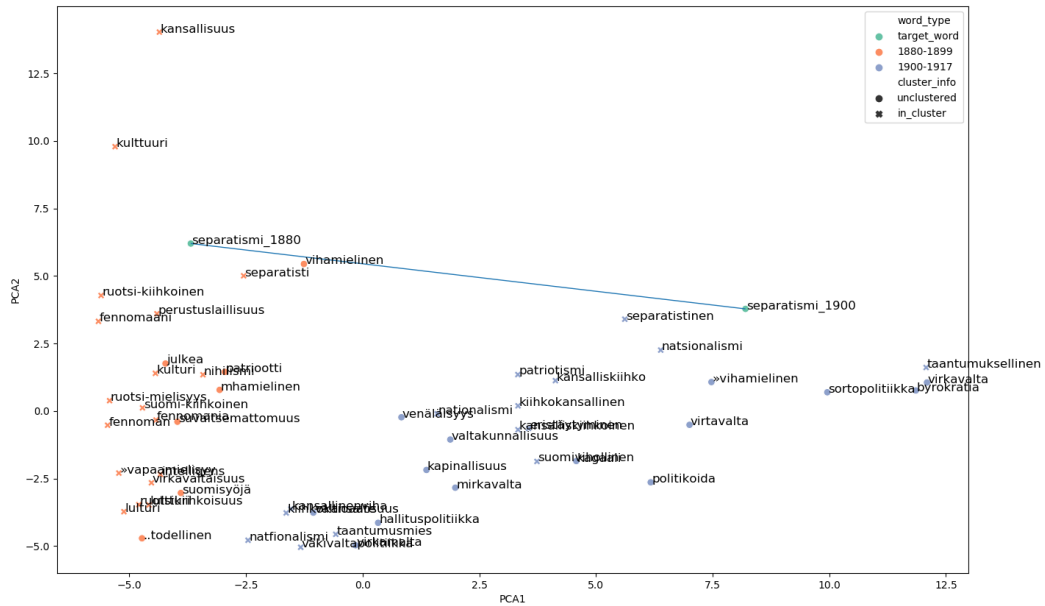
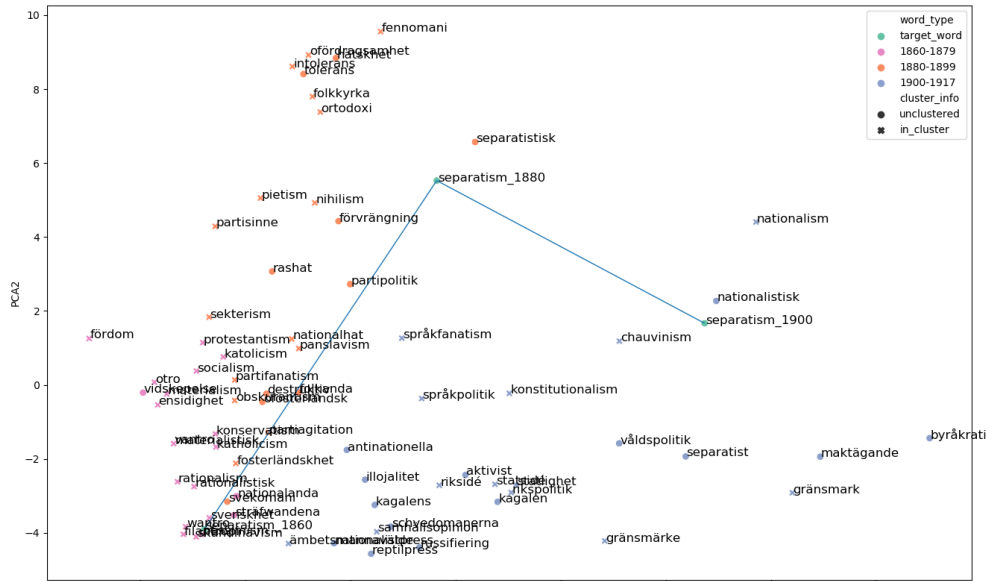
All in all, in three consecutive double decades separatism at first had a mostly religious context, when it was adopted into a discourse relating to ethnicity and the language question which is so central to the period, and finally it spread into a more general political discourse in which Finland's status as a part of the Russian empire was discussed.

The Finnish-language clusters for *separatismi*, presented in Table 6, suggest a similar development, but given the language divide in the country, the perspective is slightly different. The Finnish data set does not include a cluster for the period 1860–1879 as the word occurs less than a hundred times and as a consequence is excluded from our models. The periods for 1880–1899 and 1900–1917 point at separatism that is first dominated by the language question and then in the early twentieth century being dominated by the issue of Finland's status in the empire and nationalism in general. Interestingly, however, the Finnish-language cluster for 1880–1899 contains more words that relates to the Svekoman, that is the Swedish-language movement, and the Swedish-language cluster includes more words relating to Fennomans, that is the Finnish-language movement. Together with a reading of a selection of the sources, we see how the discourse on separatism is quite similar in both languages, but is directed toward the “opposing” side. (Obviously, the language question was interwoven with issues of class and the urban-rural divide as well, so it is not as simple as talking about only two sides, but the general pattern is clear.) The Finnish-language cluster for the period 1900–1917 is also clearly similar to the Swedish-language counterpart, but again the vocabulary presents two different, but overlapping, perspectives.

The change in the distribution of *separatism* seems to be related to a change in the dominant context in which it was discussed (from a religious context to a political context). The shift in cluster entails some degree of semantic change, but it is also clear that separatism as a highly abstract term could lend itself to many different themes or topics, and thus it seems the change in dominant themes themselves is more important for the changing clusters than the changes in meaning of the word. An alternative interpretation would be that separatism was a polysemous word in which the different separatisms (those relating to religion, the language issue or the national question) coincided and that different senses dominated in different time slices, but a reading of sample sentences does not support this interpretation.

The distributional shift of separatism is to some extent visible from changes in the nearest neighbours of the word presented in Figure 4. They visualize a shift from the time slice 1880–1899 to 1900–1917 in both languages. The outlook can be interpreted in a similar way as the clusters produced by Affinity Propagation, but have a slightly different selection of words.

This can be explained by the nature of the procedure used to produce the visualization. PCA is a dimensionality reduction technique and does not explicitly do any clustering therefore each word can be among the nearest neighbours for any number of other words while Affinity Prop-



#### FINNISH

Figure 4: PCA plots of *separatism(i)* and its nearest neighbours across time slices. Words marked by × are part of the separatism cluster in their respective time slice.

agation assigns a word to exactly one cluster so that, for instance, *socialism* and *katholicism* are separated in clusters of their own. The difference between outputs demonstrates an added value of the clustering, which selects only one word split among many possibilities provided by embeddings. At the same time, this also means loss of information, especially for polysemous words.

1860-1879	1880-1899	1900-1917
<i>separatism</i> 'separatism' <i>mysticism</i> 'mysticism' <i>naturalism</i> 'naturalism' <i>darwinism</i> 'darwinism' <i>moral</i> 'morality' <i>tidsanda</i> 'zeitgeist' <i>krass</i> 'crass' <i>utopi</i> 'utopia' <i>materialistisk</i> 'materialistic' <i>otro</i> 'incredible' <i>rationalistisk</i> 'rationalistic' <i>wantro</i> 'misbelief' <i>menniskonaturen</i> 'human nature' <i>tidehvarfvets</i> 'the age (genitive)' <i>materialism</i> 'materialism' <i>materialist</i> 'materialistic' <i>konservatism</i> 'conservatism' <i>idealism</i> 'idealism' <i>rationalism</i> 'rationalism' <i>negation</i> 'negation' <i>abstraktion</i> 'abstraction' <i>idealistisk</i> 'idealistic'	<i>separatism</i> 'separatism' <i>rent</i> '?' <i>finskhet</i> 'Finnishness' <i>fennomanins</i> 'Fennomania' <i>fennomani</i> 'Fennomania' <i>svenskhet</i> 'Swedishness' <i>fennomanin</i> 'Fennomania' <i>vikingsparti</i> 'Viking party' <i>språkpolitik</i> 'language policy' <i>publicistisk</i> 'journalistic' <i>partilagitation</i> 'party agitation' <i>partiyrta</i> 'party delirium' <i>partifanatism</i> 'party fanaticism' <i>språkgräl</i> 'language quarrel' <i>språkfanatism</i> 'language fanaticism' <i>språkfråga</i> 'language question' <i>språkfrågan</i> 'language question' <i>ljusskygghet</i> 'photophobia'	<i>separatism</i> 'separatism' <i>riksidé</i> 'national idea' <i>ocr</i> <i>statsidé</i> 'state idea' <i>ocr</i> <i>rikspolitik</i> 'national policy' <i>bourgeoisins</i> 'bourgeoisie' <i>byråkratien</i> 'bureaucracy' <i>samhällsopinion</i> 'societal opinion' <i>sträfvanden</i> 'aspirations' <i>rikskomplex</i> 'national complex' <i>nationalitet</i> 'nationality' <i>ocr</i> <i>santryska</i> 'true Russian' <i>ocr</i> <i>ambetsmannavälde</i> 'officialdom' <i>gränsmärke</i> 'borderline' <i>gränsmark</i> 'borderline' <i>ocr</i> <i>riksenshet</i> 'national assembly' <i>samhällskraft</i> 'social force' <i>statlighet</i> 'statehood' <i>frihetssträvande</i> 'freedom-aspiring' <i>wäldets</i> 'domination/empire' <i>riksmakt</i> 'national power' <i>själfhärskarmakten</i> 'autocratic power'

Table 5: Swedish clusters containing word *separatism*

1880-1899	1900-1917
<i>separatismi</i> 'separatism' <i>ruotsi-kiihkoinen</i> 'Svekoman' <i>ruotsinmielinen</i> 'Swedish-minded' <i>ruotsalaisuus</i> 'Swedishness' <i>viikinki</i> 'Viking' <i>ruotsi-mielinen</i> 'Swedish-minded' <i>fennomaani</i> 'Fennoman' <i>epäkansallinen</i> 'anti-national' <i>viikingit</i> 'Vikings' <i>separatisti</i> 'separatist' <i>ruotsikko</i> 'Swedish-minded' (person) <i>miikinki</i> 'Viking' <i>ocr</i> <i>pöppö</i> '?' <i>miikingit</i> 'Vikings' <i>ocr</i> <i>suomimielinen</i> 'Finnish-minded' <i>ruotsi-mielisyys</i> 'Swedish-mindedness' <i>wiitinki</i> 'Viking' <i>wiilinki</i> 'Viking' <i>ocr</i> <i>miitinki</i> 'Viking' <i>ocr</i> <i>ruotsimielinen</i> 'Swedish-minded' <i>suomi-kiihkoinen</i> 'Fennoman' <i>fennoman</i> 'Fennoman' <i>henkiheimolainen</i> 'like minded' <i>dagbladilainen</i> 'member of the Dagblad circle' <i>miiking</i> 'Viking' <i>ocr</i> <i>fennomani</i> 'Fennoman' <i>wiiking</i> 'Viking' <i>ocr</i> <i>fennomaaninen</i> 'Fennoman' <i>ruotsikiihkoisuus</i> 'Svekomania' <i>wiilinki</i> 'Viking' <i>ocr</i> <i>miikinkilehti</i> 'Vikings' newspaper' <i>ocr</i> <i>suomenmielinen</i> 'Finnish-minded' <i>ocr</i> <i>miikinkiläinen</i> 'Viking (adjective)' <i>ocr</i> <i>ruotsinmielinen</i> 'Swedish-minded' <i>ruotsiliihloinen</i> 'Svekoman' <i>ocr</i> <i>herranlentukka</i> 'class of the lords' <i>miikingilehti</i> 'Vikings' newspaper' <i>ocr</i> <i>epälansallinen</i> 'anti-national' <i>ocr</i>	<i>separatismi</i> 'separatism' <i>nationalismi</i> 'nationalism' <i>natsionalismi</i> 'nationalism' <i>opportunisti</i> 'opportunist' <i>natsionalismi</i> 'nationalism' <i>ocr</i> <i>eristäytyminen</i> 'isolation' <i>kansalliskiihko</i> 'nationalism' <i>intelligens</i> 'intelligence' <i>länsieurooppalainen</i> 'Western-European' <i>rotutaistelu</i> 'race struggle' <i>vapaamielisyys</i> 'liberalism' <i>ocr</i> <i>sanomalehdistö!</i> 'press' <i>antipatia</i> 'antipathy' <i>kansallinenviha</i> 'national anger' <i>kiihkokansallisuus</i> 'national fervour' <i>eristäytyä</i> 'self-isolate' <i>liittolaisuus</i> 'alliance' <i>vihamieli-syy</i> 'hostility' <i>ocr</i> <i>kansallinenylpeys</i> 'national pride' <i>kielipolitiikka</i> 'language policy' <i>kansallinenliike</i> 'national movement'

Table 6: Finnish clusters containing word *separatismi*

## V DISCUSSION AND FUTURE WORK

### 5.1 Embeddings and semantics

As we have shown in this paper, the comparison of word embeddings trained on various time periods is a fruitful method for analysis of historical newspapers. Diachronic analysis using vector models is a rapidly growing research field in computational linguistics (see, for example, recent surveys of this topic [Kutuzov et al., 2018, Tahmasebi et al., 2018]).

The most recent research involves using contextual word embeddings reviewed in Ethayarajh [2019] and exemplified in BERT [Devlin et al., 2019] and ELMo [Peters et al., 2018]. They output a separate vector for each word mentioned based on its context. These models make possible tracing differences in word usage across time, though as far as we are aware these models were applied to trace an evolution of a single word—e.g., [Martinc et al., 2020a,b]—rather than detecting evolution of groups of semantically related words.

Another research direction is aimed at continuous time representation [Dubossarsky et al., 2019, Gillani and Levy, 2019, Rosenfeld and Erk, 2018, Yao et al., 2018]. These methods reveal gradual semantic changes over time and do not require dividing the data into discrete time slices.

Finally, much effort is contributed into development of cross-lingual embeddings [Ruder et al., 2019], which put words from two or more languages into the same vector space and thus enable direct comparison of data from various languages. We suggest that using any of these approaches—namely, contextual, continuous and cross-lingual embeddings—or their combination might be a productive next step, which would allow us to deeper understand historical development of complex political notions.

### 5.2 Digital humanities and the study of political vocabularies

The analysis of the history of political thought is not tied to the newest advances in natural language processing, but analyses drawing on them often create space for new interpretations in studying the political imaginaries of past people. In this study on isms as nodes of everyday political thinking in nineteenth-century newspapers from Finland, we have produced new and



reliable ways of charting and visualizing the expansion of the vocabulary of isms. Especially noteworthy in our method is that it can grasp developments in word use that relate both to growth in frequency and change in the distribution of the word. This way our findings regarding the importance of socialism as a political keyword are not surprising to someone with good knowledge of the political vocabulary in Finland, but our method shows the sheer amounts and pivotal role of socialism in a way that has not been possible before. Nor has there been any attempts to compare the discourse of socialism across the language divide in Finland. The findings relating to separatism are different in the sense that we were not expecting to find anything out of ordinary relating to that word. We were rather surprised that it emerged as a interesting case based on a semi data-driven perspective.

Our cases relating to socialism and separatism also indicate that the relationship between distribution and meaning as pointed out in the so-called distributional hypothesis [Sahlgren, 2008] is not as straightforward as sometimes believed.<sup>4</sup> While there is a link between the change in distribution and semantic change, this link seems to be easier to capture in clear cases of polysemy than in rather vague and flexible terms such as the isms under study here. Isms are often also in hierarchical relations to one another, especially when being qualified in some way. For instance, the words state socialism (*statssocialism*) and municipal socialism (*kommunalsocialism*) found in 8 of which the former clusters together with socialism, but not the latter, suggests that the clustering is rather being related to social meaning than to strict conceptual meaning.

While word embeddings and other methods analysing the distribution of terminology are increasingly looking for new avenues in studying multilingual corpora, we further want to point out that the case of isms may be a fruitful avenue for developing multilingual approaches. Dealing with Finnish and Swedish in one country showed that the historical translatability between the language (even if Finnish is less prone to introduce new isms) can be very useful in studying political vocabularies and thinking in different linguistic contexts — when combined with good contextual knowledge that takes into account linguistic and political specificities relating to the languages at stake.

## VI ACKNOWLEDGEMENTS

We are grateful to Simon Hengchen and Mark Granroth-Wilding for the help with data preparation. This work has been supported by the European Union Horizon 2020 research and innovation programme under grants 770299 (NewsEye) and 825153 (EMBEDDIA).

## References

- Domagoj Alagić, Jan Šnajder, and Sebastian Padó. Leveraging lexical substitutes for unsupervised word sense induction. In *Thirty-Second AAAI Conference on Artificial Intelligence*, 2018.
- Cesare Cuttica. To use or not to use ... the intellectual historian and the isms: A survey and a proposal. *Études Épistémè*, 23, 2013. ISSN 1634-0450. doi: 10.4000/episteme.268. URL <http://journals.openedition.org/episteme/268>.
- Jacob Devlin, Ming-Wei Chang, Kenton Lee, and Kristina Toutanova. BERT: Pre-training of deep bidirectional transformers for language understanding. pages 4171–4186, 2019.
- Haim Dubossarsky, Simon Hengchen, Nina Tahmasebi, and Dominik Schlechtweg. Time-out: Temporal referencing for robust modeling of lexical semantic change. In *The 57th Annual Meeting of the Association for Computational Linguistics (ACL)*, 2019.
- Max Engman. *Språkfrågan: Finlandssvenskhetens uppkomst 1812-1922*. Svenska litteratursällskapet i Finland, 2016. ISBN 978-951-583-354-9.
- Kawin Ethayarajh. How contextual are contextualized word representations? comparing the geometry of BERT,

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<sup>4</sup>We thank Antti Kanner for pointing this interpretation out to us.

- ELMo, and GPT-2 embeddings. In *Proceedings of the 2019 Conference on Empirical Methods in Natural Language Processing and the 9th International Joint Conference on Natural Language Processing (EMNLP-IJCNLP)*, pages 55–65, Hong Kong, China, November 2019. Association for Computational Linguistics. doi: 10.18653/v1/D19-1006. URL <https://www.aclweb.org/anthology/D19-1006>.
- Brendan J Frey and Delbert Dueck. Clustering by passing messages between data points. *science*, 315(5814): 972–976, 2007.
- Nabeel Gillani and Roger Levy. Simple dynamic word embeddings for mapping perceptions in the public sphere. In *NAACL HLT 2019*, page 94, 2019.
- William L Hamilton, Jure Leskovec, and Dan Jurafsky. Cultural shift or linguistic drift? comparing two computational measures of semantic change. In *Proceedings of the Conference on Empirical Methods in Natural Language Processing. Conference on Empirical Methods in Natural Language Processing*, volume 2016, page 2116. NIH Public Access, 2016.
- Simon Hengchen, Ruben Ros, and Jani Marjanen. A data-driven approach to the changing vocabulary of the ‘nation’ in English, Dutch, Swedish and Finnish newspapers, 1750-1950. In *In Proceedings of the Digital Humanities (DH) conference 2019, Utrecht, The Netherlands*, 2019.
- H. M. Höpfl. Isms. *British Journal of Political Science*, 13(1):1–17, 1983. ISSN 1469-2112, 0007-1234. doi: 10.1017/S0007123400003112. URL <https://www.cambridge.org/core/journals/british-journal-of-political-science/article/isms/36C46DBC3F69FB510E33A0D6C6888DFF>.
- Matti Hyvärinen, Jussi Kurunmäki, Kari Palonen, Tuija Pulkkinen, and Henrik Stenius, editors. *Käsitteet liikkeessä: Suomen poliittisen kulttuurin käsittehistoria*. Vastapaino, Tampere, 2003. ISBN 978-951-768-130-8.
- Helge Jordheim. Introduction: Multiple times and the work of synchronization. *History and Theory*, 53(4):498–518, 2014.
- Helge Jordheim. Synchronizing the world: Synchronism as historiographical practice, then and now. *History of the Present*, 7(1):59–95, 2017.
- Osmo Jussila. *Suomen suuriruhtinaskunta 1809–1917*. WSOY, Helsinki, 2004. ISBN 978-951-0-29500-7.
- Yoon Kim, Yi-I Chiu, Kentaro Hanaki, Darshan Hegde, and Slav Petrov. Temporal analysis of language through neural language models. *ACL 2014*, page 61, 2014.
- Jussi Kurunmäki and Jani Marjanen. Isms, ideologies and setting the agenda for public debate. *Journal of Political Ideologies*, 23(3):256–282, 2018a. doi: 10.1080/13569317.2018.1502941. URL <https://www.tandfonline.com/doi/full/10.1080/13569317.2018.1502941>.
- Jussi Kurunmäki and Jani Marjanen. A rhetorical view of isms: an introduction. *Journal of Political Ideologies*, 23(3):241–255, 2018b. ISSN 1356-9317, 1469-9613. doi: 10.1080/13569317.2018.1502939. URL <https://www.tandfonline.com/doi/full/10.1080/13569317.2018.1502939>.
- Andrey Kutuzov, Elizaveta Kuzmenko, and Lidia Pivovarova. Clustering of Russian adjective-noun constructions using word embeddings. In *Proceedings of the 6th Workshop on Balto-Slavic Natural Language Processing*, pages 3–13, 2017.
- Andrey Kutuzov, Lilja Øvrelid, Terrence Szymanski, and Erik Velldal. Diachronic word embeddings and semantic shifts: a survey. In *Proceedings of the 27th International Conference on Computational Linguistics*, pages 1384–1397, 2018.
- Geoffrey N. Leech. *Semantics*. Penguin, Harmondsworth, 1974. ISBN 978-0-14-021694-3.
- Eetu Mäkelä. Las: an integrated language analysis tool for multiple languages. *The Journal of Open Source Software*, 1, 2016.
- Jani Marjanen, Ville Vaara, Antti Kanner, Hege Roivainen, Eetu Mäkelä, Leo Lahti, and Mikko Tolonen. A National Public Sphere? Analyzing the Language, Location, and Form of Newspapers in Finland, 1771–1917. *Journal of European Periodical Studies*, 4(1):54–77, June 2019. ISSN 2506-6587. doi: 10.21825/jeps.v4i1.10483. URL <https://neruda0.ugent.be/jeps/article/view/10483>.
- Matej Martinc, Syrielle Montariol, Elaine Zosa, and Lidia Pivovarova. Capturing evolution in word usage: Just add more clusters? In *Companion Proceedings of the Web Conference 2020 (WWW ’20 Companion)*, April 20–24, 2020, Taipei, Taiwan, 2020a.
- Matej Martinc, Petra Kralj Novak, and Senja Pollak. Leveraging contextual embeddings for detecting diachronic semantic shift. In *LREC*, 2020b.
- Wiktor Marzec and Risto Turunen. Socialisms in the Tsarist Borderlands. *Contributions to the History of Concepts*, 13(1):22–50, June 2018. ISSN 1807-9326, 1874-656X. doi: 10.3167/choc.2018.130103. URL <http://berghahnjournals.com/view/journals/contributions/13/1/choc130103.xml>.
- Tomas Mikolov, Kai Chen, Greg S Corrado, and Jeffrey Dean. Efficient estimation of word representations in vector space. In *NIPS*, 2013.
- Tuula Pääkkönen, Jukka Kervinen, Asko Nivala, Kimmo Kettunen, and Eetu Mäkelä. Exporting Finnish digitized

- historical newspaper contents for offline use. *D-Lib Magazine*, 22(7/8), 2016.
- F. Pedregosa, G. Varoquaux, A. Gramfort, V. Michel, B. Thirion, O. Grisel, M. Blondel, P. Prettenhofer, R. Weiss, V. Dubourg, J. Vanderplas, A. Passos, D. Cournapeau, M. Brucher, M. Perrot, and E. Duchesnay. Scikit-learn: Machine learning in Python. *Journal of Machine Learning Research*, 12:2825–2830, 2011.
- Matthew Peters, Mark Neumann, Mohit Iyyer, Matt Gardner, Christopher Clark, Kenton Lee, and Luke Zettlemoyer. Deep contextualized word representations. In *Proceedings of the 2018 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies, Volume 1 (Long Papers)*, pages 2227–2237, 2018.
- Radim Řehůřek and Petr Sojka. Software Framework for Topic Modelling with Large Corpora. In *Proceedings of the LREC 2010 Workshop on New Challenges for NLP Frameworks*, pages 45–50, Valletta, Malta, May 2010. ELRA.
- Alex Rosenfeld and Katrin Erk. Deep neural models of semantic shift. In *NAACL HLT 2018*, pages 474–484, 2018.
- Sebastian Ruder, Ivan Vulić, and Anders Søgaard. A survey of cross-lingual word embedding models. *Journal of Artificial Intelligence Research*, 65:569–631, 2019.
- Magnus Sahlgren. The distributional hypothesis. *Italian Journal of Linguistics*, 20:33–53, 2008.
- Ivo Spira. *A conceptual history of Chinese -isms: The modernization of ideological discourse, 1895-1925*. Number Volume 4 in *Conceptual history and Chinese linguistics*. Brill, 2015. ISBN 978-90-04-28787-7.
- Ivo Spira. Chinese isms: the modernization of ideological discourse in China. *Journal of Political Ideologies*, 23(3):283–298, September 2018. ISSN 1356-9317, 1469-9613. doi: 10.1080/13569317.2018.1502937. URL <https://www.tandfonline.com/doi/full/10.1080/13569317.2018.1502937>.
- Nina Tahmasebi, Lars Borin, and Adam Jatowt. Survey of computational approaches to diachronic conceptual change. *arXiv preprint arXiv:1811.06278*, 2018.
- Zijun Yao, Yifan Sun, Weicong Ding, Nikhil Rao, and Hui Xiong. Dynamic word embeddings for evolving semantic discovery. In *The 11th ACM Conference on Web Search and Data Mining*, 2018.

## A ANNEX 1: ISM CLUSTERS FOR FINNISH DATA

Table 7: Clustering obtained for Finnish words ending with ism suffix. We show cluster words and their frequencies in the respective time slice, sorted by frequency. Cluster *representatives* are marked with italic.

1860-1879		1880-1899					
<i>sosialismi</i>	172	<i>sosialismi</i>	5115	<i>realismi</i>	1029	<i>pietismi</i>	370
		anarkismi	1120	pessimismi	614	<i>materialismi</i>	367
		nihilismi	602	idealismi	351	ateismi	167
		militarismi	328	symbolismi	291	metodismi	147
		kommunismi	316	naturalismi	279	dualismi	105
		parlamentarismi	312	optimismi	182	despotismi	101
		kapitalismi	301				
		liberalismi	236	separatismi	924	<i>hypnotismi</i>	733
		radikalismi	171	<i>patriotismi</i>	231	spiritismi	542
		boulangismi	163	fanatismi	126	alkoholismi	527
		kosmopolitismi	128				
		protestantismi	115	organismi	415	<i>reumatismi</i>	1706
		baptismi	108	<i>magnetismi</i>	328	<i>teismi</i>	119
1900-1917							
realismi	2097	sosialismi	75117	militarismi	7062	<i>kapitalismi</i>	20681
pessimismi	1192	<i>anarkismi</i>	5630	imperialismi	2796	talismi	388
<i>idealismi</i>	591	terrorismi	2063	despotismi	661	industrialismi	346
naturalismi	794	kommunismi	1548	absolutismi	350	suurkapitalismi	302
pietismi	476	sialismi	910	tsarismi	318	barbarismi	225
impressionismi	342	syndikalismi	524	huliganismi	270	tpitalismi	178
aforismi	262	individualismi	398	panslavismi	202	lpitalismi	166
humanismi	242	nihilismi	397	vandalismi	194	tapitalismi	155
symbolismi	231	ateismi	341	bolshevismi	194	pitalismi	137
panteismi	230	antimilitarismi	306	hellenismi	187	lapitalismi	113
egoismi	201	revisionismi	288	<i>klerikalismi</i>	147	kapitalismi	104
kubismi	169	sofalismi	178	klerkalismi	146		
asketismi	154	remisionismi	139	germanismi	104	parlamentarismi	3413
fatalismi	152	indimidualismi	127			<i>liberalismi</i>	1156
altruismi	150	rialismi	117	separatismi	2008	radikalismi	645
mystisismi	141	darwinismi	111	<i>natsionalismi</i>	1852	feodalismi	438
klassisismi	123	antisemitismi	102	optimismi	1580	opportunisti	420
ratsionalismi	119			patriotismi	993	dualismi	293
		> <i>sosialismi</i>	832	nationalismi	657	valtiososialismi	235
materialismi	3232	.. <i>sosialismi</i>	316	fanatismi	589	protestantismi	213
spiritismi	1327	sionismi	221	nalismi	134	gmerkantilismi	140
hypnotismi	623	vegetarismi	196	anakronismi	129		
monismi	449	” <i>sosialismi</i>	170	natfionalismi	120	alkoholismi	4312
<i>darwinismi</i>	435	. <i>sosialismi</i>	163			kunnallinensosialismi	1085
modernismi	174	sosialismi	133	fotsialismi	203	<i>alloholismi</i>	105
marxismi	148	’ <i>sosialismi</i>	126	<i>fofalismi</i>	151	holismi	158
pragmatismi	113	sosialismi	108	anarfismi	126		
				fofialismi	123	teismi	598
organismi	1009	<i>reumatismi</i>	9629	<i>onnismi</i>	517	tarismi	175
magnetismi	433	matismi	180	onanismi	265	<i>turismi</i>	126
<i>mikro-organismi</i>	130	nivelreumatismi	158				
						<i>reumatismi</i>	212
<i>mekanismi</i>	564					. <i>reumatismi</i>	122

## B ANNEX 2

Table 8: Clustering obtained for Swedish words ending with ism suffix. We show cluster words and their frequencies, sorted by frequency. Cluster *representatives* are marked with italic.

1820-1839				1840-1859			
patriotism	232	patriotism	581	organism	410	pietism	505
fanatism	165	egoism	560	mekanism	217	<i>protestantism</i>	342
<i>despotism</i>	153	fanatism	431	<i>magnetism</i>	170	katholicism	155
		<i>socialism</i>	294	galvanism	124		
		pauperism	290				
		despotism	254	rheumatism	101		
		kommunism	160				
		liberalism	136				
		radikalism	105				
<b>1860-1879</b>							
patriotism	2664	<i>socialism</i>	1263	despotism	923	egoism	1024
<i>liberalism</i>	1148	katholicism	988	<i>radikalism</i>	585	realism	388
materialism	461	protestantism	846	ultramontanism	458	<i>idealism</i>	183
konservatism	446	kommunism	363	bonapartism	337	heroism	153
dualism	347	nihilism	282	klerikalism	177	mysticism	142
parlamentarism	341	katholicism	272	imperialism	150	naturalism	115
absolutism	265	mormonism	240	carlism	141	dilettantism	106
optimism	228	pauperism	211	federalism	136		
pessimism	209	skandinavism	211	republikanism	115	<i>organism</i>	1575
rationalism	158	jesuitism	207			mekanism	992
konstitutionalism	139	spiritism	188	<i>fanatism</i>	1710	magnetism	328
anakronism	137	panslavism	163	terrorism	325	statsorganism	120
protektionism	135	darwinism	112	vandalism	233		
sofism	100	ateism	102	cynism	190		
				chauvinism	115		
<i>rheumatism</i>	571	baptism	360				
reumatism	305	<i>pietism</i>	205	antagonism	336		
galvanism	151	separatism	118	<i>schism</i>	323		

Table 8: Clustering obtained for Swedish words ending with ism suffix: continuation

1880-1899			
<i>socialism</i> 5560	patriotism 4792	egoism 3057	boulangism 1128
katolicism 2154	<i>liberalism</i> 2705	<i>materialism</i> 1003	terrorism 707
anarkism 1975	konservatism 1806	pietism 547	<i>klerikalism</i> 569
protestantism 1408	parlamentarism 1688	formalism 482	panslavism 341
militarism 1366	radikalism 1455	ateism 455	kapitalism 226
nihilism 1181	protektionism 1222	rationalism 276	hellenism 206
antisemitism 911	chauvinism 950	obskurantism 221	partikularism 180
absolutism 641	despotism 868	positivism 221	imperialism 151
statssocialism 485	opportunism 344	indifferentism 213	bonapartism 143
kommunism 459	skandinavism 311	industrialism 136	ultramontanism 129
journalism 244	konstitutionalism 259	asketism 131	kollektivism 121
bimetallism 212	republikanism 203	barbarism 123	cesarism 110
jesuitism 206	feodalism 101		
nationalism 198		realism 2295	fanatism 3086
individualism 196	mekanism 3237	naturalism 1134	pessimism 1382
utilitarism 124	hypnotism 1811	<i>idealism</i> 834	cynism 846
germanism 115	<i>magnetism</i> 932	symbolism 561	optimism 839
	idiotism 287	mysticism 422	<i>skepticism</i> 548
<i>baptism</i> 641	jordmagnetism 175	dilettantism 309	heroism 320
mormonism 503	galvanism 169	sofism 309	fatalism 310
sektarism 366	somnambulism 138	humanism 216	lokalpatriotism 112
metodism 259	bypnotism 132	kosmopolitism 171	
finlandism 223	atavism 106		reumatism 5735
laestadianism 132		spiritism 1123	ledgångsreumatism 1381
fennicism 106	schism 1263	kannibalism 383	rheumatism 1262
	antagonism 863	<i>buddism</i> 175	<i>matism</i> 274
separatism 829	<i>dualism</i> 467	muhamedanism 166	ledgångsrheumatism 188
<i>partifanatism</i> 278	statsorganism 146	buddhaism 151	ledgångsrheumatism 126
språkfanatism 273		spiritualism 103	
nepotism 121	aforism 283		organism 5713
	darwinism 276	<i>alkoholism</i> 1364	mikroorganism 621
vandalism 572	<i>darwinism</i> 165	pauperism 231	<i>djurorganism</i> 110
<i>anakronism</i> 298	vegetarianism 154	morfinism 129	
			<i>amerikanism</i> 161

Table 8: Clustering obtained for Swedish words ending with ism suffix: continuation

1900-1917							
socialism	15080	idealism	1113	<i>anarkism</i>	1709	<i>egoism</i>	2942
parlamentarism	2231	<i>materialism</i>	694	terrorism	1600	fanatism	2496
<i>liberalism</i>	2034	individualism	512	syndikalism	387	cynism	900
konservatism	2034	spiritism	506	antisemitism	341	heroism	482
imperialism	1637	pietism	415	antimilitarism	267	fatalism	252
radikalism	1438	mysticism	266	kommunism	256	partifanatism	219
absolutism	879	sofism	260	feminism	242	lokalpatriotism	172
klerikalism	818	journalism	189	jesuitism	180	altruism	145
konstitutionalism	695	humanism	179	revisionism	166	klassegoism	106
protektionism	650	indifferentism	178	nihilism	125	knutpatriotism	102
skandinavism	440	kosmopolitism	167	ungsocialism	112		
opportunism	288	rationalism	158	kollektivism	110	<i>kapitalism</i>	2399
marxism	286	obskurantism	156			militarism	2346
internationalism	285	ateism	146	<i>nationalism</i>	5398	despotism	917
proportionalism	245	asketism	138	patriotism	4254	industrialism	732
demokratism	234	atavism	129	separatism	1079	tsarism	568
statssocialism	204	dogmatism	121	chauvinism	1002	barbarism	169
aktivism	168	monism	114	språkfanatism	373	utilitarism	142
oktobrist	136			suometarianism	363	feodalism	132
försvarsnihilism	117	realism	1785	fariseism	134	storkapitalism	128
monarkism	112	<i>naturalism</i>	560				
modernism	109	impressionism	319	katolicism	1363	vandalism	703
		symbolism	247	protestantism	726	<i>byråkratism</i>	426
alkoholism	2829	dilettantism	245	kannibalism	338	formalism	496
vegetarism	245	kubism	225	buddism	261	anakronism	423
darwinism	193	klassicism	183	<i>buddhism</i>	154	nepotism	117
kommunalsocialism	145			muhammedanism	150	servilism	106
<i>vegetarianism</i>	130	slavism	317				
nykterism	112	<i>germanism</i>	240	<i>organism</i>	6627	hypnotism	528
		panslavism	211	mekanism	2332	<i>magnetism</i>	362
antagonism	943	hellenism	141	mikroorganism	453	idiotism	133
<i>dualism</i>	415	pangermanism	130	samhällsorganism	125	jordmagnetism	116
statsorganism	177						
parallellism	105	<i>reumatism</i>	6423	optimism	2565	baptism	207
		rheumatism	820	<i>pessimism</i>	2023	mormonism	125
<i>schism</i>	3237	muskelreumatism	142	skepticism	563	sektarism	121
skism	167						
		ledgångsreumatism	1811	<i>aforism</i>	396	<i>polism</i>	182
<i>turism</i>	448	<i>matism</i>	470	finlandism	221		