Bug Report: A Study of Semantic Change during the Digital Revolution

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Abstract

Semantic change is a phenomenon that has been subject to a lot of research during the past few decades. However, a large part of the existing research has been conducted with the goal of finding causes of change or creating typologies in order to classify different types of changes. The present study has been conducted with the aim to examine how a specific extra-linguistic factor has affected a select few words. The extra-linguistic factor that is the focal point of this study is the rapid technological change during what is known as the digital revolution. This essay explores how the digital revolution has affected the uses of four words: *bug*, *web*, *mouse*, and *cloud*. The first part of this study was a collocational analysis of these four words. The results of the collocational analysis indicated that changes occurred during certain time periods. A closer context analysis was performed for each of the words on the time period during which a semantic change was suspected to occur. The findings of this essay are that all the examined words have gotten new technological meanings during the past 70 years, thus exhibiting semantic widening. All four words are currently polysemous words. Replacive change, meaning a change in the primary meaning of a word, is only apparent in *web*. The remaining words keep their primary senses throughout the examined period, and the new senses are added as periphery senses. The trends in the usage of these words indicate that it is possible that more of them will undergo replacive change, however, it is too early to tell.

Keywords

Contents

1. Introduction

"For both structural and cognitive reasons, natural languages are characterized by their plasticity, by the ease with which the representations borne by the units composing them are subject to change" (Robert, 2008, p. 55). The notion described by Robert is known as semantic change, or semantic shift. Semantic change is a concept which has been studied by linguists since the late 19th century, covering several branches of semantics. Attempts have been made to classify instances of semantic change into different categories. Furthermore, several different reasons have been presented as causes of semantic change.

Researchers often refer to two different types of factors that cause semantic change: Linguistic and Extra-Linguistic. Daiu (2015) discusses some of the linguistic factors, for instance, the influence of other languages, where borrowed words can cause older expressions to fall out of use. Furthermore, the existence of homonyms can cause semantic change. If two words appear the same but denote entirely different things, one of the meanings might be used less in order to avoid misunderstandings (Daiu, 2015).

Extra-linguistic factors range from human psychology to the environments we live in. One example of how human psychology works as an extra linguistic factor is discussed by Crowley (1992). He explains that words that have a negative, or taboo, meaning are often avoided. The use of metaphors and euphemisms, in place of the taboo expression, can cause semantic change. For instance, the taboo meaning might disappear and the alternative word, or the metaphorical sense, can become the main way to refer to something (Crowley, 1992, pp. 153–154) Another extra-linguistic factor is technological advances. For example, Riemer (2010, p. 373) mentions the verb *fly*. Today *fly* can denote being a passenger on an aeroplane, which would have been impossible before the invention of the aeroplane. Given that the speed of technological advancements has been much greater during the past few hundred years than ever before it should entail that many new meanings have been added to the English language. Harris (2014) maintains that technological advancements create new environments for people. New environments, in turn, cause semantic change.

Although technology is credited as a cause of semantic change, very little research has been done on how these types of changes actualize in our uses of words. Also, research done into the causes of semantic change tends to be more focused on establishing a typology, where researchers attempt to categorize semantic change (Ullman, 1962; Blank, 1999). In general, researchers have focused on the larger picture, dealing with the phenomenon of semantic change in a broader sense. This means that there has not been any closer analysis of how a specific extra-linguistic factor has affected semantic change.

Technological development has been rapid during the past two hundred years, initially with the industrial revolution at the turn of the 19th century, and more recently with the digital revolution from the 1950s onwards. This begs the question if the changes in language have occurred in a similar, rapid fashion. The aim of this essay is to explore how the digital revolution has affected the English language, this will be done by conducting a close examination of four words: *bug, web, mouse* & *cloud*. I believe that these words have undergone a semantic change during the past 70 years, they have therefore been chosen to serve as examples of the potential changes caused by technology. Thus, the research questions will be formulated as follows:

- How has the digital revolution affected the uses of the words *bug, web, mouse & cloud?*

- Are there any differences or similarities in the potential changes?

1.1 Background

Riemer (2010) explains that semantic change can affect both the connotation and the denotation of a word. A change in the connotation means that a word takes on new meanings that have either a more negative or more positive sense compared to before. The process when a word is downgraded and takes on a more negative meaning is known as pejoration. *Silly* is a word which has been downgraded. In Middle English, *silly* was used to refer to something happy or innocent, whereas today it is used to describe something dumb and foolish, which is a more negative sense, meaning the word has changed through pejoration. The opposite concept is amelioration, which is when a word takes on a more positive connotation. An example of amelioration can be found in the word *nice*, which in middle English was used to denote something foolish, but today it has taken on a significantly more positive denotation as it is used to describe something that is pleasant (Riemer, 2010, pp. 373–379).

Semantic widening and narrowing are two categories of change which affect the denotation. Semantic narrowing refers to the process when a meaning becomes more specific. One example of narrowing is the word *meat*, which once meant *food*, as in any sort of food, whereas today it refers only to a specific kind of food. Semantic widening, on the other hand, is when the meaning of a word becomes broader. An English word which has undergone a semantic widening is *dog*, in the past the word was used to refer to a specific powerful type of canine, while in the present, *dog* is used to refer to any type of dog, small and big (Riemer, 2010, pp. 373–379). In short, narrowing and widening are when a denotation changes to describe something more or less specific than before.

This form of categorization has been criticised by some researchers (Rundblad, 1997; Riemer, 2010). Riemer (2010) maintains that these categories are not sufficient to explain all instances of semantic change, he goes on to explain that more categories are needed to account for all cases of semantic change. Riemer puts forth the importance of metonymy and metaphor. Metonymic change is when the meaning of a word shifts to something generally associated with the original meaning. One example of this phenomenon can be seen in the usage of the expression *the crown* to refer to personal monarchy, the object of *crown* was closely related to monarchy, and now it can denote monarchy.

The concept of metaphor is succinctly defined by Robert (2008) "Metaphor is the transfer of properties from one domain to another to create a new referential value: some of a term's semantic properties are selected (abstracted) and applied to another domain to designate a new entity in virtue of the properties considered shared by the two referents" (pp. 62–63). Usage of metaphors is accepted as one of the driving forces of semantic change. According to Haser (2003), metaphorization is the "foremost agent of semantic change" (p. 172) since it is possible to connect almost any two domains via metaphor. Traugott (1989, p. 50) gives the example of the usage of *to set on,* which was formerly used in the physical context setting a physical object down on something, whereas today it means to be insistent on something. Rundblad (1997) states that metonymy and metaphorization are the two most important causes of semantic change. She stresses that both metaphorization and metonymy are causes of semantic change,

whereas categories such as narrowing, and widening are results of change (Rundblad, 1997, pp. 26–27).

It is widely accepted that semantic change is a slow process. Words do not change meaning from A to B instantly. This is expressed by Zalizniak (2008) when she asserts that "semantic change from meaning A to meaning B normally involves a transitional phase of polysemy where a form has both meanings" (p. 218). This does not mean, however, that all polysemous words will lose their secondary meanings. In fact, as Traugott & Dasher (2001) state, in most cases words retain their polysemous meanings. What changes over time is the importance of the meanings. Regarding this, Rundblad (1997) notes that for semantic change to have occurred, the primary meaning of a word needs to have been replaced by a new or previously secondary meaning. The addition of a new meaning which only exists on the periphery should instead be regarded as additive stability, where the core sense of the word remains the same (Rundblad, 1997, p. 2). Thus, replacive change will be used in this essay to refer to instances where the primary sense of a word changes, and semantic change will serve as an umbrella term covering all forms of change discussed above.

2. Methodology

This study was conducted by two forms of analysis. Firstly, the collocates of the examined words were collected. This was done by searching the corpora by decade for each of the examined words. The corpora used were the Corpus of Historical American English (COHA), and the Corpus of Contemporary American English (COCA). These corpora were chosen because this is a study pertaining to the digital revolution, which originated in the United States. When searching the word collocates the corpora calculate Mutual Information (MI) scores to determine how strong the relation between the words is. For my study I only noted down words which display a MI-score above 3, since research has shown that this is a strong enough relation for two words to be considered collocates (Smyth, 2016). Furthermore, I limited my collection of collocates to nouns, verbs, and adjectives, since these word forms can give a better indication of which sense of the word was the most common occurrence in a given decade.

One issue with using MI-scores is that it can be somewhat misleading when examining collocates with low frequencies, for example a word pair occurring randomly together may get a high MI-score even though the words generally do not occur together. In order to counter this, in COHA, the searches were limited to frequencies higher than 3. When these searches did not produce five or more collocates meeting my criteria, a second search was done with a minimum frequency of 2. In COCA the frequencies could be limited to above 20 since this is a much larger corpus. This was done to assure that the most relevant collocates were used for this study. This choice was motivated by precedence set by Xiao and McEnery (2006), as they used similar frequencies when using collocational analysis as a method.

The collocate analysis for the present study was done for each of the four words for each decade, starting in the 1950s and ending with the 2010s. The results for each of the decades were then compared to see if a semantic change was indicated by the potential changes in the collocates of a given word.

The second part of the analysis was a closer context analysis. The context analysis was performed by looking at the context a given word appeared in, for example, in the case of *web,* one context given was "…stories on the World Wide Web" (COHA), this token would be placed

in the *Internet* category. The tokens were categorized by using the Oxford English Dictionary (OED) and each token was placed in a category consisting of a definition of the word from the OED. The definitions which are marked as rare or obsolete were not included as categories. Furthermore, definitions from the OED which are very similar to each other were merged into a single category, such as two definitions of *web* where both definitions referred to a construction component, the only difference was that one of the definitions referred to such a component made of paper, and the other one referred to one made of plastic.

The context analysis was performed by taking random samples from a selected number of decades for each word. The decade selection was done on the basis of what was indicated by the collocate analysis. For example, in the case of *web*, a change was indicated to occur during the 1990s, therefore the closer context analysis was done starting in the 1980s, the decade before the indicated change, and moving forward. Since the frequencies of the words varies greatly, the sample sizes were determined by what is deemed necessary to achieve a confidence level of 90%. For example, when examining the contexts of the word *web* the sample size for the 1980s was 129 tokens, whereas the sample size for the 2010s was 267 tokens. In order to make a comparison possible, given the different sample sizes, the number of tokens in each category for a given decade were then divided by the sample size of that decade. Thus, a percentage could be calculated. When this was done, a comparison could be made in order to analyse how the definitions of the words have changed over time.

3. Results

3.1 Web

3.1.1 Collocate Analysis

Data from COHA and COCA reveal that the word *web* has become much more widely used during the period from 1950 onwards. In 1950 *web* occurred 5.99 times per million words, it remained at a similar level during the 1960s and 1970s. A rise in usage can be deduced during the 1980s where the frequency reached 9.64 per million followed by a large rise to 42.95 in the 1990s to 82.56 in the 2000s (See Appendix 5). A possible explanation for this large increase in usage can be found by analysing the collocates of *web*. During the 1950s the most common collocate, by far, was spider (See Table 1).

Table 1. Collocates of *web* (1950).

Collocate -2	Freq.	MI	Collocate +2	Freq.	MI
Spider	**16**	**13.99**	Tracks	**3**	**8.5**
Tangled	**3**	**10.11**	Society	**3**	**6.29**
Delicate	**3**	**8.37**	Life	**3**	**4.06**
Complex	**3**	**8.01**	Belts	**2**	**9.76**
Whole	**3**	**4.96**	Spun	**2**	**8.86**

This would indicate that the main usage for *web* was to denote a spider's web. However, the right collocates, such as *society* and *life* does not seem to be referring to a spider's web directly. Instead, this can be explained by another known sense of the word; "Something likened to a

cobweb, esp. in being a snare or means of entanglement, or in being delicate, intricate, or insubstantial" (OED, 2020d). The rise in usage during the 1990s was likely caused by the introduction of a new sense of *web*. For the first time in the examined decades, spider is not the most common left collocate of *web*, instead, it is far behind *world* and *wide* (See Table 2).

Table 2. Collocates of *web* (1990).

Collocate -2	Freq.	MI	Collocate +2	Freq.	MI
World	**102**	**5.98**	Site	**266**	**10.42**
Wide	**100**	**8.63**	Sites	**97**	**9.96**
Spider	**24**	**10.03**	Page	**31**	**7.29**
Visit	**17**	**6.21**	Browser	**21**	**11.75**
Use	**9**	**3.19**	Pages	**20**	**7.42**

This, combined with the fact that the most common right collocates are words such as *site, page* and *browser* is a strong indication that the most common sense of *web,* from the 1990s onwards, has been that which is used to denote the internet, or something related to the internet.

Another factor indicated by the data is that the meaning of *web* as in *spider's web*, is still used in similar frequencies in the 2010s as in the other examined decades. This is indicated by the fact that the MI-score of *spider* and *web* remains quite high, fluctuating between 9 and 14. There is a diminishing trend in the MI-score but considering that the limit for two words to be considered collocates is a MI-score of 3, there is still a strong connection between the words.

3.1.2 Context Analysis

The results from the 1980s show a large number of metaphoric uses of *web*. Two different forms of metaphor occur, instances where *web* is used to describe something with a complex structure make up 27.1% of the total uses of *web*, and something likened to a cobweb makes up 19.4% (see Appendix 1). The last major definition is that which denotes a spider's web which constitutes 26.4% of the examined sample. *Web* in the sense of the internet does not appear even once during the 1980s. This changes greatly during the following decade.

The results from the 1990s show that *internet* was the primary sense of *web* constituting 74.4% of the total number of tokens (see Appendix 1). The metaphoric uses previously mentioned still occur quite a bit, making up 8.1% and 4% of the total. The same holds true for the sense of spider's web with 6.3%.

A growing trend can be discerned from the results. The definition of *web* as *internet* is growing ever more dominant, 74.4% of the total uses in the 1990s, 82.5% in the 2000s, and lastly 86.9% in the 2010s. The opposite holds true for the other senses of the word. The definition of *woven fabric,* for example, seems to be diminishing. Already during the 1980s this was a periphery meaning, making up 3.9% of the total, and the following decades decreased even more to not even occurring once during the 2010s.

3.2 Cloud

3.2.1 Collocate Analysis

The word cloud has become more popular during the examined time period. During the 1950s, *cloud* occurred 26.81 times per million words and during the 2010s it appeared 49.95 times per million words.

The most common collocate to the left of cloud during the 50s was *mushroom*, with a MI score of 11.89 (see Table 3.). This collocate can reasonably be assumed to be denoting the concept of a mushroom cloud, which appears when detonating a nuclear bomb. This is not surprising given that the nuclear bomb had been invented and used during the previous decade, therefore, it was a hot topic. Other left collocates were words such as *dense* and *layers*, which likely describe the sense of "a visible mass of condensed watery vapour" (OED, 2020b), as in the clouds we can see in the sky. The right collocates appear quite similar. No big changes in collocates appeared in the 1960s, with the exception of the left collocate *cosmic.* This might be due to the scientific theory of the Oort clouds which was first presented during the 1950s. Similar collocates appear from the 1970s onwards, there seems to be a connection between the word *cloud* and space, *Magellanic* is one of the top 5 collocates for every decade from the 70s, this refers to the Magellanic clouds which are two dwarf galaxies.

Table 3. Collocates of *cloud* (1950).

Collocate -2	Freq.	MI	Collocate +2	Freq.	MI
Mushroom	**12**	**11.89**	Formations	**3**	**9.71**
Sooty	**3**	**10.73**	Dust	**34**	**9.06**
Dense	**4**	**8.49**	Vapor	**3**	**8.93**
Transparent	**3**	**8.29**	Layer	**9**	**8.66**
Layers	**3**	**7.84**	Layers	**4**	**8.25**

There is a big change in the right collocates during the 2010s. New collocates have appeared, such as, *computing, storage,* and *provider* (see Table 4). This change can be explained by the emergence of online storage, which is also known as cloud storage. The sense of "a visible mass of condensed watery vapour*"* (OED, 2020b) is still apparent in the 2010s as it was in the 1950s, as indicated by the existence of the right collocate *funnel*, which is a type of cloud. Both *Oort* and *Magellanic* are two common collocates, so the use to describe space related phenomena is still apparent today.

Table 4. Collocates of *cloud* (2010).

Collocate -2	Freq.	MI	Collocate +2	Freq.	MI
Oort	**109**	**13.76**	Unknowing	**20**	**11.82**
Magellanic	**49**	**13.55**	Computing	**315**	**11.43**
Mushroom	**79**	**10.82**	Storage	**241**	**9.58**
Funnel	**27**	**9.71**	Atlas	**37**	**9.4**
Contracting	**31**	**9.12**	Provider	**63**	**8.94**

3.2.2 Context Analysis

The changes in the usage of *cloud* indicated by the changes of which words it collocated with is further signalled by a closer context analysis of the occurrences of *cloud* during the past three decades in COHA and COCA. The popularity of the different definition categories is quite similar when the 1990s and the 2000s are compared. The two most common uses of *cloud* during these decades were the sense of *watery vapour* and the sense of *smoke or dust floating in the air*. These senses together made up 57.7% and 63.3% in the 1990s and the 2000s respectively (see Appendix 2). During the 2010s, however, a significant change in the uses of cloud is indicated by the examined sample. The sense of *online storage* which did not occur once during the previous decades now make up 29.3 % of the total uses. Furthermore, the previously most popular senses decreased in popularity, *watery vapour* made up 30.4% of the total, compared to 45.1% during the previous decade. The same change can be seen in the dust related sense, a decrease from 18.3% in the 2000s to 10.3% in the 2010s (see Appendix 2).

3.3 Mouse

3.3.1 Collocate Analysis

Mouse occurred 8.76 times per million words in the 1950s. The popularity of the word remained at a similar level during the following decades, until the 1990s. During the 1990s, *mouse* occurred 19.08 times per million words, the corresponding number for the 2000s was 20.33. In the 2010s, it occurred 14.52 times per million words (See Appendix 5).

The most common left collocates of *mouse* from the 1950s that fit the criteria are *Mickey, cat, brown, field,* and *dead* (see Table 5.). These all seem to be connected to the rodent known as mouse. The same can be said for the right collocates considering the appearance of words such as *nests* and *traps*.

Table 5. Collocates of *mouse* (1950).

Collocate -2	Freq.	MI	Collocate +2	Freq.	MI
Mickey	**15**	**12.47**	Rat	**2**	**10.65**
Cat	**8**	**8.92**	Nests	**7**	**10.35**
Brown	**8**	**7.48**	Epidermal	**2**	**10.01**
Field	**5**	**6.02**	Traps	**2**	**9.23**
Dead	**3**	**5.13**	-	**-**	**-**

Similar results appear in the following decades, with the most common left collocate being *Mickey*, likely denoting the cartoon character known as Mickey Mouse. The technological sense of mouse denoting the computer tool known as mouse seems to become more popular during the 1980s, although it is only the 13th closest collocate with regards to MI-score. During this decade, *Grasshopper* and *Mickey* have MI-score of 12-12.2, whereas computer only has 4.98. Still, 4.98 is enough to consider the words collocates. Computer retains a similar MI-score of 5.06 during the 1990s. There is, however, a big change in the right collocates of *mouse* during the 1990s compared to the previous decades. In the 1980s, the collocates are words such as *Tumor, Brains* and *Ears,* all likely relating to the rodent. While in the 1990s words such as *click & pad* appear (see Table 6.). These are likely connected to the technological sense of *mouse*.

Table 6. Collocates of *mouse* (1990).

Collocate -2	Freq.	MI	Collocate +2	Freq.	MI
Grasshopper	**9**	**12.2**	Clicks	**4**	**9.33**
Mickey	**53**	**12.19**	Cartoons	**3**	**9.04**
Minnie	**6**	**11.4**	T-shirt	**5**	**7.86**
Rat	**3**	**7.75**	Click	**4**	**7.85**
Cat	**3**	**5.48**	Pad	**4**	**7.82**

3.3.2 Context Analysis

The context analysis of *mouse* indicates that this is a word where the primary meaning of the word has remained stable. The context analysis was done for the period from the 1980s to the 2010s, since there were changes in the collocations during this time frame. The stability of the primary meaning is indicated by the fact that in the examined samples, the sense of rodent makes up between 63.3% and 88.5% of the total uses of *mouse* (see Appendix 3). The technological sense of the word relating to computers does show a growing trend, this sense consisted of 4.3% of the whole sample taken from the 1980s and showed a continuous growth up until the present decade, where it makes up 26.6% of the total. The few periphery uses of *mouse* that showed up in the sample remain at very low and steady percentages during the examined period.

3.4 Bug

3.4.1 Collocate Analysis

Bug occurred between 5.09 and 7.74 times per million words from the 1950s to the 1980s. A rise in the usage of *bug* can be observed during the 1990s, at which time the frequency was 13,1 times per million words, reaching an all-time high of 22.9 the following decade. A slight decrease meant that *bug* occurred 18.25 times per million words during the 2010s (See Appendix 5).

During the earliest examined decade, the 1950s, *bug* only has three left collocates fitting this study's criteria: *potato, june* and *big*. Since potato bug and june bug are two species of insect these collocates indicate that the primary sense of bug during the 1950s was that which is used to denote a type of insect. Similar left collocates are the most prevalent during the 1960s as

well. One development indicated by the right collocates of the 1960s is the use of *bug* as a verb, which is signalled by the fact that the right collocate with the highest MI-score of 3.74 is the word *me*, as in the idiom *to bug someone* (See Table 7).

Table 7. Collocates of *bug* (1960).

Collocate -2	Freq.	MI	Collocate +2	Freq.	MI
Sow	3	10.23	Me	12	3.74
Blue	7	6.97	Out	8	3.06
Trying	4	5.49	-	-	-
Love	4	5.04	-	-	-
Eyes	3	3.85	-	-	-

Another development in the change of collocates can be found to appear during the 1980s. The two right collocates with the highest MI-score during this decade are *tap* with a MI-score of 9.51 and *electronic* with a MI-score of 7.97. Both of these collocates may indicate the increase or start of the usage of *bug* as a listening device. The verb form of *bug*, as well as the sense which denotes a type of insect, are both indicated by the right collocates with words such as *spray* and *me*. An additional sense of *bug* is hinted at by the appearance of *Y2K* and *millennium* during the 1990s. This may indicate a rise in the usage of *bug* to describe a malfunction in computer software, since the Y2K bug was a major issue faced by many a software programs when they failed to recognize the year 2000 as 00. Y2K is one of the strongest collocates of *bug* in the following decades. This technological sense of the word is furthermore indicated by the right collocate of "fixes"; bug fixes is what someone does when they correct software malfunctions. Furthermore, the left collocates of *software* and *computer* during the 2010s indicate that this sense has cemented itself to the word bug (See Table 8).

Table 8. Collocates of *bug* (2010).

Collocate -2	Freq.	MI	Collocate +2	Freq.	MI
Marmorated	11	15.61	Zapper	14	14.9
Y2K	9	12.64	Infestations	7	12.12
Bix	8	12.07	Repellent	17	11.51
VW	24	11.87	Eaters	7	10.0
Stink	28	10.38	Fixes	16	9.99
Software (26th collocate)	7	5.13			
Computer (34th collocate	5	3.88			

While the insect related use of *bug* is still in use during the 2010s, as indicated by the collocates, the sense from the 1980s of *listening device* seems to have fallen out of use, since neither *tap* nor *electronic* appear as collocates. However, this might be that the use of *electronic* is no

longer necessary when describing a listening device, it is possible that just the use of *bug* is enough. Also, new terminology to denote listening devices might have arisen. A better view of this development is found in the second part of this study: the context analysis.

3.4.2 Context Analysis

The most common sense of *bug* in the examined decades remain that of small insect. It should be noted here that the results from the 1990s might be somewhat deceptive, this due to a significant usage of *bug* as a name in fiction, which is the cause of the "Other" category making up a third of the total uses from the 1990s (see Appendix 4). Therefore, the 1990s will be disregarded when looking for changes. With this in mind, a downward trend in the popularity of the sense of small insect can be discerned, decreasing from 60.9% in the 1980s to 36% in the 2010s. Another trend that is indicated is that the sense of defect or fault in a machine has become more common, rising from just 1.1% in the 1970s, 12.7% in the 1990s to 21.1% in the 2010s (see Appendix 4). Yet another change is the disappearance of the sense of a dishonest or contemptible person, which made up 3.2% in the 1970s and 2.6% in the 1980s, but never occurred in the following decades. *Bug* has several other periphery senses with low shares of the total uses of the word, these, which have not been mentioned above remain at a stable level across the examined time period.

4. Discussion

The collocate analysis on *web* indicate that for the decades between 1950 and 1980, the word remained relatively stable. The main sense of the word appears to be *spider's web*, as spider is the most common right collocate during these decades. A large change in the usage of *web* is indicated by the fact that during the 1990s, *spider* is only the third most common collocate, the two most common collocates during the 1990s are *world* and *web*. In fact, from the 1990s onwards, internet related words dominate both the right and left collocates. This would indicate that this an instance of replacive change, since the primary sense of the word seems to change (Rundblad, 1997). That this is an example of replacive change is also shown by the context analysis. *Web* in the sense of internet did not occur once during the 1980s but made up 74.4% of the total uses of the word in the 1990s. This percentage grows to 86.9% in the 2010s. *Spider's web* and metaphoric uses related to it show a diminishing trend, together constituting only 8.6% of the total uses during the 2010s. This diminishing trend could indicate that *spider's web* is falling out of use, but this is doubtful since spider is a high frequency collocate of *web* with a MI-score of 9.66 during the 2010s. In turn, this may indicate that both the senses of *spider's web* and *web* as pertaining to the internet will continue to exist in polysemy for a foreseeable future.

Cloud seems to have undergone a semantic widening in two regards. The results from the 1950s relate to either the sense of watery vapor or the notion of dust cloud, which can be similar in appearance. The first indication of a semantic widening is hinted at by the new appearances of collocates such as *Oort, Magellanic* and *Cosmic.* These collocates ascribe clouds as something that appear in space, where the sense of watery vapor can no longer be applied. This change, which seems to occur during the 1970s, does not, however, eliminate the sense of watery vapor, but rather adds to it. The second change is indicated by the appearance of the collocates *computing, storage,* and *provider,* which all relate to the sense of online storage. This change

occurred during the 2010s. Just like the previous change, this is not a question of replacive change since the cosmic sense and the sense of watery vapor are still prevalent.

The results from the collocate analysis of *cloud* are in part strengthened by the context analysis. As the context analysis shows, the *online storage* sense becomes one of the most used senses of the word, making up 29.3% of the total uses of *cloud*, compared to 30.4% of *watery vapour*. These numbers indicate that although *watery vapour* is still the primary sense of *cloud*, it is not as dominant as in the earlier examined decades. In the 2010s, it can be said that both *watery vapour* and *online storage* are the main senses of *cloud.* This then, is a matter of semantic widening, as the primary sense has not yet been replaced, although this might change in the next few decades due to the fast rise in usage of the *online storage* sense. For now, it is merely a further expansion of the polysemy of *cloud*.

Concerning the collocate analysis of *mouse,* collocates relating to the technological sense appear in the two decades of the 21st century. For example, the occurrence of *keyboard* with a MI-score of 9.76 in the 2000s and 9.41 in the 2010s. The MI-score of *computer* remains around 5 during these decades. The changes in collocates do not seem to indicate any instances of replacive change, since the primary sense of the word remains the sense of a species of rodent. What the collocational analysis seems to indicate though, is a semantic widening, or additive stability (Rundblad, 1997). Currently, *mouse* is an instance of polysemy, where the primary sense denotes the rodent, and one of the periphery senses denotes the computer related tool. The context analysis likewise shows a case of additive stability. The sense of *rodent* is dominant across all the decades examined in the context analysis, although it does show a diminishing trend, from making up 88.5% in the 1980s, to 68.4% in the 2010s. The computing related sense shows a growing trend, increasing from 4.3% in the 1980s to 26.6% in the 2010s. This is still very much a case of polysemy, where none of the senses are likely to disappear any time soon, which often is the case with polysemous words (Traugott & Dasher, 2001).

The collocate analysis of *bug* seems to indicate two instances of change, one during the 1980s, and another one during the late 1990s. The first change is signalled by the occurrences of the left collocates *tap* and *electronic,* likely referring to an electronic listening device. This does not appear to be a replacive change since the most common right collocates are related to insects during the 1980s. The second change appear to occur sometime during the 1990s which is hinted at by the appearance of *Y2K*, *millennium* and *computer* as left collocates of *bug.* Just like the first change, this seems to be a case of additive stability, due to the persisting existence of insect related collocates. This is further strengthened by the results of the context analysis, which indicated the same changes. The sense of *surveillance equipment* remains a periphery sense with a very minor part of the total uses of *bug. Defect in machine* is also a periphery sense, albeit one with a larger share of the total uses (21.1% in the 2010s).

The three words of *mouse, cloud* and *bug* all show similar development trends. All three are polysemous words and have gotten new technology related senses during the examined period. These changes, however, have not been instances of replacive change, but rather additive stability or semantic widening. The primary senses have not changed. It should be noted that *cloud* shows a quicker pace of change compared to *mouse* and *bug*, with the technological sense growing from not occurring once to making up 29.3% of the total uses, just in the span of a decade. This could mean that this could become a case of replacive change, where the main sense becomes *online storage*. *Web* differs from the other words, as it is the only word of this

study which has undergone a replacive change, the primary sense of *web* shifted from *spider's web* to *internet* during the 1990s.

Metaphorization is mentioned by multiple researchers (Haser, 2003; Traugott, 1989) as the most significant force driving semantic change. This may explain the changes seen in some of the examined words. For example, in the case of *web*, before the sense of *internet* started being used there existed, and still does, a metaphoric sense, used to describe something which is intricate and complex. The internet is a complex invention; hence it could be that early uses of *web* in the sense of *internet* referred to this complexity, and this metaphor became so widely used that *web* and *internet* became synonymous. Moreover, metaphorization likely played a part in the technological sense of *mouse* as well, purely due to the physical resemblance between a computer mouse and the rodent (the computer mouse itself being similar to the body of the rodent and the cable being similar to the tail of the rodent). Also, it is possible that metaphoric uses had an impact on *bug* and *cloud*, but if that is the case, it is unclear which semantic properties of the primary meanings of *bug* and *cloud* that are applied to the new technological domains. Possibly, the annoying property played a part in the case of *bug*, since just like insects, software malfunctions can be annoying.

5. Conclusion

This essay aimed to answer two questions. The first question I aimed to answer was how the digital revolution affected the uses of *bug, mouse, cloud,* and *web.* The main takeaway from the results was that new technological senses have been added to the existing definitions of the words. The other question aimed to compare the results to see if there were any similarities or differences in how these words were affected. One of the similarities was that the influx of new meanings to the words resulted in all four words existing in polysemy today. For three of the words this merely entailed cases of semantic widening. For the remaining word, *web*, a replacive change occurred where the primary sense shifted to the new sense denoting the internet. Since one of the rules of semantic change is that all instances of it first pass through a period of polysemy, it is possible that the study of these particular words was conducted too early. Today, the three words which have not undergone a replacive change exist in polysemy, this might mean that the primary senses of these words may change in a near or distant future. Considering the fact that some of the changes have been rapid, a follow up study could be conducted in the future. Also, since one of the limitations of this study is the fact that only four words are examined, it would be valuable to examine more words which have been affected by technological advancements in order to draw even more reliable conclusions.

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Appendix 1

Appendix 1: Context analysis of web

Definitions	1980 Count	%	1990 Count	%	2000 Count	%	2010 Count	%
Woven fabric	5	3.9	2	0.9	1	0.4	0	0.0
Something with a complex structure	35	27.1	18	8.1	7	2.8	9	3.4
Cobweb spun by spiders	34	26.4	14	6.3	9	3.7	8	3.0
Something likened to a cobweb	25	19.4	9	4.0	2	0.8	6	2.2
A strap or band woven strongly	3	2.3	1	0.4	1	0.4	1	0.4
System or network of interconnected parts	4	3.1	3	1.3	1	0.4	1	0.4
Internet	0	0.0	166	74.4	203	82.5	232	86.9
A membrane or thin sheet of tissue	0	0.0	1	0.4	0	0.0	0	0.0
Skin connecting the fingers or toes	1	0.8	0	0.0	1	0.4	1	0.4
Building materials and tools	1	0.8	2	0.9	0	0.0	3	1.1
Unknown	21	16.3	7	3.1	21	8.5	6	2.2
Total	**129**	**100**	**223**	**100**	**246**	**100**	**267**	**100**

Appendix 2

Appendix 2: Context analysis of Cloud

	1990		2000		2010	
Definitions	Count	%	Count	%	Count	%
Watery vapour floating in the air	88	40.0	96	45.1	80	30.4
Two large nebulae	15	6.8	9	4.2	13	4.9
Cloud-like mass of smoke or dust floating in the air	39	17.7	39	18.3	27	10.3
Local appearance of dimness or obscurity	7	3.2	3	1.4	2	0.8
Large number of insects or birds flying together	8	3.6	7	3.3	2	0.8
Anything that obscures or conceals	14	6.4	14	6.6	7	2.7
Figurative, Metaphor*	8	3.6	9	4.2	11	4.2
Used as a verb	4	1.8	4	1.9	9	3.4
Online storage	0	0.0	0	0.0	77	29.3
Other	37	16.8	32	15.0	35	13.3
Total	**220**	**100**	**213**	**100**	**263**	**100**

* For example," The names stirred a cloud of associations".

Appendix 3

Appendix 3: Context analysis of Mouse

Definitions	1980 Count	%	1990 Count	%	2000 Count	%	2010 Count	%
Rodent	123	88.5	137	75.7	119	63.3	175	68.4
A color	0	0.0	0	0.0	1	0.5	1	0.4
Something timid, weak, or small	4	2.9	6	3.3	5	2.7	1	0.4
Young woman	3	2.2	1	0.6	1	0.5	2	0.8
Computing	6	4.3	31	17.1	45	23.9	68	26.6
Other	3	2.2	6	3.3	17	9.0	9	3.5
Total	139	100	181	100	188	100	256	100

Appendix 4

Appendix 4: Context analysis of Bug

Definitions	1970 Count	1970 %	1980 Count	1980 %	1990 Count	1990 %	2000 Count	2000 %	2010 Count	2010 %
Small insect	47	50.0	70	60.9	84	53.5	65	33.3	89	36.0
A contemptible or dishonest person	3	3.2	3	2.6	0	0.0	0	0.0	0	0.0
Obsessive interest in something	7	7.4	3	2.6	10	6.4	6	3.1	15	6.1
Defect or fault in a machine	1	1.1	0	0.0	20	12.7	14	7.2	52	21.1
Virus, Germ	9	9.6	5	4.3	7	4.5	15	7.7	23	9.3
Volkswagen	3	3.2	2	1.7	4	2.5	4	2.1	4	1.6
Electronic surveillance equipment	2	2.1	7	6.1	5	3.2	6	3.1	13	5.3
A self-important, pompous person	3	3.2	0	0.0	0	0.0	0	0.0	0	0.0
To annoy	8	8.5	12	10.4	6	3.8	12	6.2	25	10.1
To listen or record with listening device	2	2.1	2	1.7	1	0.6	1	0.5	1	0.4
To run away, Flee	4	4.3	5	4.3	4	2.5	6	3.1	7	2.8
Other (Names, "Bug eyed")	5	5.3	6	5.2	16	10.2	66	33.8	18	7.3
Total	**94**	**100**	**115**	**100**	**157**	**100**	**195**	**100**	**247**	**100**

Appendix 5

Appendix 5: Frequencies per million words

Words	1950	1960	1970	1980	1990	2000	2010
Web	**5.99**	**5.67**	**6.3**	**9.64**	**42.95**	**82.56**	**89.26**
Bug	**5.09**	**7.63**	**5.92**	**7.74**	**13.1**	**22.9**	**18.25**
Cloud	**26.81**	**29.19**	**29.85**	**30.61**	**40.73**	**32.84**	**49.95**
Mouse	**8.76**	**7.8**	**9.62**	**11.06**	**19.08**	**20.33**	**14.52**