

Cacti or Cactuses? Evidence for Rule Generalization in English Plural Change

B Cadigan*

Abstract. English nouns ending in *-us* trace back to the second declension of masculine nouns in Latin, where the typical pluralization form would be to transform the *-us* into *-i* (Bengtsson 2021). This conflicts with the standard English pluralization pattern of adding the inflectional suffix *-s* or an allomorph of it to the end of a word. Even so, a number of these words have retained their Latin pluralization, including words like *cactus* (Bauer, Lieber, & Plag 2015). This study investigates pluralization of these words through the lens of DeCamp (1972)'s Rule Generalization, a linguistic phenomenon through which speakers carry "rules" they interpret from one word to other similar words. In the case of this study, the rule *-us* > *-i* is carried to words that do not have Latin origin, and thus should pluralize with the basic English method of adding *-es*. The study, consisting of a survey of respondents answering what the plural of certain words would be, shows an increasing trend toward the *-i* form in the youngest group of speakers (18-27), such as *cacti* and *platypi*, as compared to older speakers (40-59 and 60+). This study demonstrates strong evidence for conscious Rule Generalization through the change in how speakers produce *-us* plurals.

Keywords. Language change; English pluralization; Rule Generalization; Latin loan words; inflectional morphology

1. Introduction. English nouns ending in *-us* (referred to from here on as "*-us* forms") stem largely from Latin. In Latin, masculine words in the second declension end in *-us* and pluralize to *-i*, a rule that has carried over to English. Some words that did not originate from Latin, but instead sources like Greek, instead take on the typical English pluralization pattern of adding the inflectional morpheme *-s*. One example of this is *octopus*, a word of Greek origin that typically pluralizes to *octopuses* in English, despite the original Greek plural form *octopodes* (Bauer, Lieber, & Plag 2015). Many English speakers may not know the origin of a word or even how that origin determined the word's original plural, leading to confusion on what form to use.

I would like to thank Professor Joe Salmons for being a mentor for this project, as well as all those who helped distribute the survey, including my family and friends. Author: B Cadigan, University of Wisconsin-Madison (bcadigan@wisc.edu).

DeCamp (1972)'s 'Rule Generalization' proposes that many English speakers generalize the rules for one form to others, even if the resulting form is not what is dictated prescriptively. (Here, "prescriptive" means the form indicated by the "formal grammar," as opposed to what is commonly used (Campbell-Larsen 2021)). This process, DeCamp argues, is purely linguistic. Rule Generalization serves a function similar to that of hypercorrection, although hypercorrection is a sociolinguistic process, where speakers alter their language to fit with other groups, in a sort of social prestige marking (DeCamp 1972).

While Rule Generalization also serves to alter language in a similar way, it differs from hypercorrection in that speakers assume a rule from one known word or group of words applies to all similar words, resulting in new forms. This makes it a purely structural linguistic process, ignoring social pressures that might lead to language change (DeCamp 1972). The basis for Rule Generalization in pluralizing *-us* forms comes from the knowledge of Latin forms pluralizing as *-i*. Knowledge of this word class extends to other *-us* forms, leading to variation in plurals between *-es* and *-i*. This may occur due to a kind of foreignization, where words are seen as outliers, even if they are not, and are thus given a "foreign" plural form, as opposed to the more "native" English form (Costanzo n.d.). For example, speakers may know that *cactus*, when pluralized, becomes *cacti*, and then generalize that rule to other *-us* forms, resulting in words like *platypi*, which may disagree with its original plural. This study investigates pluralization of *-us* forms through the lens of DeCamp (1972)'s Rule Generalization, following in the steps of a pilot study that showed a trend toward the *-i* form in younger speakers. This pilot led to the hypothesis investigated in this study. The study explores whether younger generations of English speakers are progressively generalizing pluralization rules from common *-us* forms to other words, leading to an increase in *-i* pluralized forms.

Rule Generalization, foreignization, and hypercorrection are some of the processes that drive language change, a constant and eternal process that occurs in both complex and simple ways. All language is always changing, from the most basic phonetics to the most complex pragmatics. While the entirety of language change is outside the scope of this paper, this study seeks to add to the pool of knowledge on language change as it occurs. By documenting Rule Generalization in different age groups, we can catch change in progress. Comparing age is indicative of language change because young speakers will carry their form of language into the future, to teach even younger generations (Bybee 2015).

Through the course of this paper, we will outline the survey used to collect data, introduce the data for a number of words, and discuss the trends visible and possible causes for those trends. For the methods, we discuss the number of respondents and the process they went through, as well as two databases used to aid with analysis. In the data section, not every focus word (-us word) is presented due to limitations on the paper and to avoid redundancy. Most of the words not presented demonstrated no trend, discussed further in the discussion section. A number of possible explanations for the trends are presented and explained, with the possibility of frequency playing a role explored in depth. Finally, avenues for future research and more analysis are explored.

2. Methods. An online survey was distributed through social media and word-of-mouth containing a randomized set of 50 words from a 138-word list. Each respondent had a different set of 50 words, which were randomly selected from among the 138. This randomization means not every word or focus word was offered to every respondent, done to prevent overwhelming respondents. Respondents were asked to provide the plural of each of the words on the list in a free response box. Among the 138 words were 24 focus words ending in -us. The word list was generated from a variety of sources, namely other lists of words ending in -us. A number of the words were also generated from memory, especially in the creation of the pilot study preceding this study. Some words that were used in the pilot study were removed from this study, including words like *radius*, which respondents attested to having different plurals depending on the context. While this was not attestable in the literature, the word was nonetheless removed to avoid similar confusion. The “nonce,” or nonsense, words were generated based on sound structure, with an attempt to present words that contained different sounds and had overall different structures. The full list of focus words is shown in Figure 1 in the next section. Aside from those focus words were a number of regular and irregular English plurals as filler.

In addition to the survey, interviews were conducted over the phone with seven respondents to reduce the possible effects of autocorrection software and typos. These interview respondents were accumulated from social media and ranged in age across all of the survey’s age groups. In these interviews, respondents were prompted with a word, to which they would respond with the plural form. Respondents in both the interviews and the survey were asked to provide their age, which was used in analysis to determine trends of change over time by separation into generations. The survey itself received 179 respondents across three age ranges:

18-27 (104), 40-59 (42), and 60+ (33). The survey included 28-39 as an age group, but it received no respondents. The age groups were originally selected based on arbitrary generational lines with relatively equal spacing, but narrowed down to fit the final data input. The respondent count is quite low in older age groups, limiting how much statistical analysis is useful, but trends were still visible among the respondents. Other demographic information such as gender identity and geographical information were also collected, although these factors did not present any correlation with the resulting data, and were thus left out of the results. The pilot study referenced within this paper used the same methodology and gained about 250 respondents from similar age groups. Less words and focus words overall were utilized in that study. Focus words removed after that study include *focus*, *radius*, *genius*, and *circus*.

To deduce what word may be the basis for Rule Generalization within the dataset, a database called SUBTLEXus was used. This database, constructed by researchers at Ghent University, compiles word usage from subtitles in American English movies to apply to larger word frequency studies overall. While film subtitles may not be a perfect indicator of real-world usage frequency, the database is nonetheless valuable for this study. This database was also used to consider word frequency effects on change.

An additional tool utilized was Google Ngram Viewer, which scans for inputted words across a variety of American English literary sources, mostly books, going back centuries. This was included with some words that showed the starkest changes across generations to highlight trends in literature as opposed to the survey respondents' speech. Note in the figures below, the y-axis on the graphs represents word frequency in literature, and the scale is not consistent across separate graphs so as to show significance between plural forms.

3. Results. Figure 1 lists the 24 focus words along with their “expected” pluralized forms, largely derived from Ball (1928) and Bauer, Lieber, & Plag (2015). The expected answers for only two words – *incubus* and *syllabus* – conflicted with or did not appear in Ball (1928) and did not appear in Bauer, Lieber, & Plag (2015). These responses were drawn from the pilot study, as this seemed to be more in line with common usage. One outlier, *rhinoceros*, is included despite not being a *-us* word due to its similar phonological structure and semantic meaning to *hippopotamus*. This was reflected in a small number of respondents answering *rhinoceri*. Among the focus words were 5 made-up words, known as “nonce” words. As such, they do not have an expected form, and that column is marked with “N/A.” The final column shows the overall

preferred form for each plural calculated by combining the answers from each age group. The result still shows a large preference for *-es* forms, despite the preference in younger speakers being the *-i* form for many of the words. This comes from the significant disconnect between younger speakers and older speakers in what plural form they prefer.

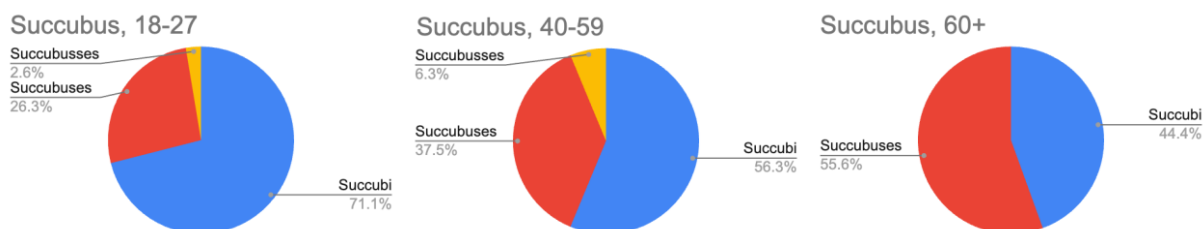
Word	Expected answer (Origin)	Overall results
Cactus	Cacti (Latin)	Cacti
Incubus	Incubi (Latin)	Incubi
Succubus	Succubi (Latin)	Succubi
Cilpus	N/A	Cilpuses
Hippopotamus	Hippopotami (Latin)	Hippopotamuses
Octopus	Octopuses (Greek)	Octopi
Platypus	Platypuses (Greek or otherwise)	Platypuses
Stimulus	Stimuli (Latin)	Stimuli
Nucleus	Nuclei (Latin)	Nuclei
Fungus	Fungi (Latin)	Fungi
Abacus	Abacuses (Greek or otherwise)	Abacuses
Colossus	Colossuses (Greek or otherwise)	Colossuses
Esophagus	Esophaguses (Greek or otherwise)	Esophaguses
Nautilus	Nautiluses (Greek or otherwise)	Nautiluses
Sarcophagus	Sarcophaguses (Greek or otherwise)	Sarcophagi
Syllabus	Syllabi (Latin)	Syllabi
Rhinoceros	Rhinoceroses (Greek or otherwise)	Rhinoceroses
Apparatus	Apparatuses (Greek or otherwise)	Apparatuses
Sinus	Sinuses (Greek or otherwise)	Sinuses
Genus	Genera (Latin, exception)	Genuses
Brachus	N/A	Brachi

Word	Expected answer (Origin)	Overall results
Knocus	N/A	Knocuses
Patterus	N/A	Patteruses
Callesus	N/A	Callesuses

Figure 1: Table demonstrating the “expected” answers for each focus word, with the overall preference of respondents. Answers marked with “N/A” are nonce words. Origins are drawn from Merriam-Webster and Bauer, Lieber, & Plag (2015).

The results from the survey were converted into graphs that demonstrate the percentage of each age group that provided a certain response.

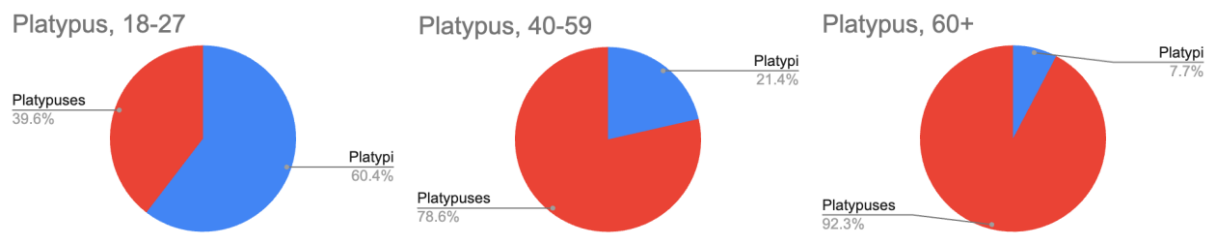
Based on the origin of the word *succubus*, and the results from the pilot study, the expected overall answer was *succubi*, as shown in Figure 1 (Merriam-Webster n.d.). The results for this word are shown in Figures 2.1a-c. *Succubi* was the prevailing overall answer, with younger respondents making up the largest portion of that response. Older respondents preferred *succubuses* over *succubi*, while younger respondents largely preferred *succubi*, indicating a change in favor of the *-i* form.



Figures 2.1a-c: Plurals of *succubus* by age group. A common alternative spelling, *succubusses*, is included as well.

The origin of *platypus*, as well as input from Ball (1928), indicated the preferred plural would be *platypuses* (Merriam-Webster n.d.). This was the most frequently chosen answer, but a major difference in age groups is evident, as seen in Figures 2.2a-c. Younger speakers preferred *platypi*, while older speakers overwhelmingly preferred *platypuses*, supporting a trend toward the *-i* form. Google Ngram Viewer data, which shows usage in printed books over time (that is, not

spoken data), conflicts with the trend indicated in the survey data, showing an increased preference for *platypuses* over time. This is shown in Figure 2.3.



Figures 2.2a-c: Plurals of *platypus* by age group.

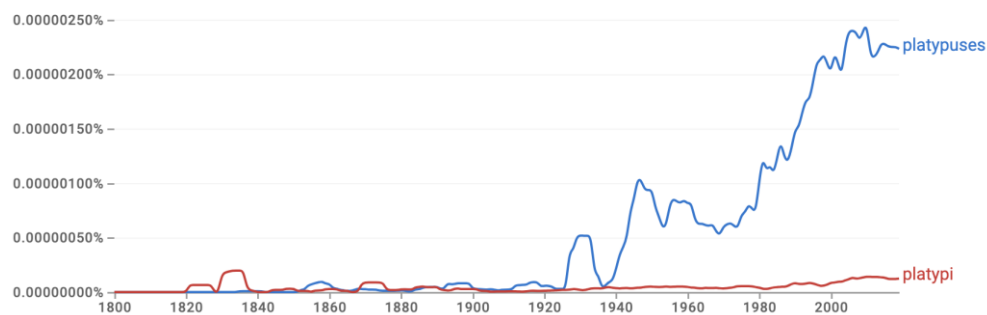
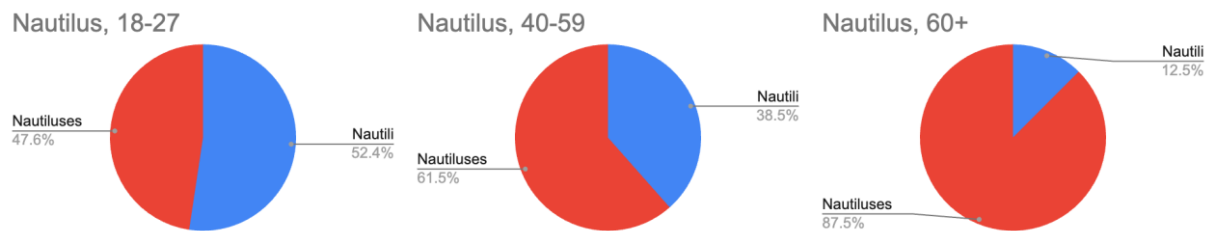


Figure 2.3: Google Ngram Viewer graph of *platypus* plural usage over time

The expected answer predicted for *nautilus* in Figure 1 was taken from Ball (1928). The survey data supported that answer, with only the youngest group showing a slight preference for *nautili*, shown in Figures 2.4a-c. The oldest speakers strongly preferred *nautilus*, with that preference becoming weaker for the younger groups. Similar to *platypus*, a Google Ngram Viewer graph also shows the opposite trend, with *nautilus* passing *nautili* as recently as 1980, shown in Figure 2.5. In addition, the word has greatly declined in usage.



Figures 2.4a-c: Plurals of *nautilus* by age group.

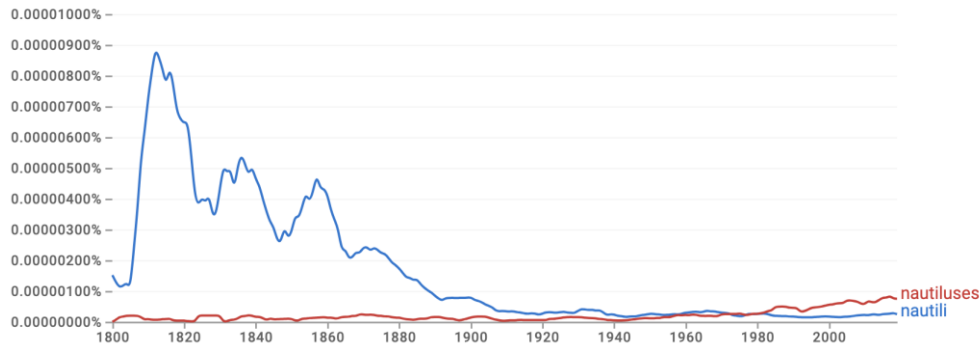
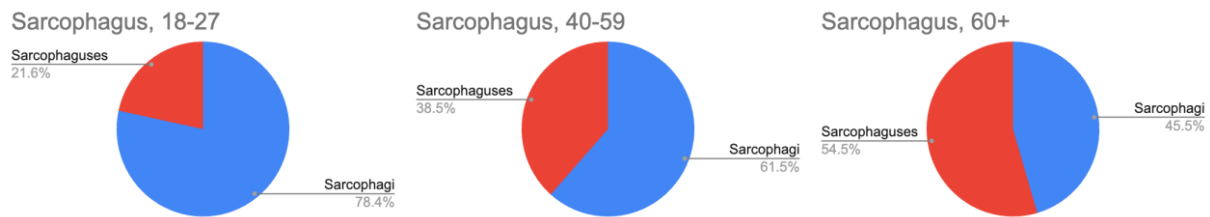


Figure 2.5: Google Ngram Viewer graph of *nautilus* plural usage over time.

The word *sarcophagus* is borrowed from Latin, according to Merriam-Webster. However, the original Latin word was derived from Greek, indicating the plural would most likely be *sarcophaguses* (Merriam-Webster n.d.). The final results show a complete difference from that expectation, as *sarcophagi* was preferred for all except the oldest group, and significantly preferred in the youngest group, seen in Figures 2.6a-c. Another pattern continues to be evident when referencing the Google Ngram analysis for this word, shown in Figure 2.7. *Sarcophaguses* is shown to be the most used plural throughout the graph.

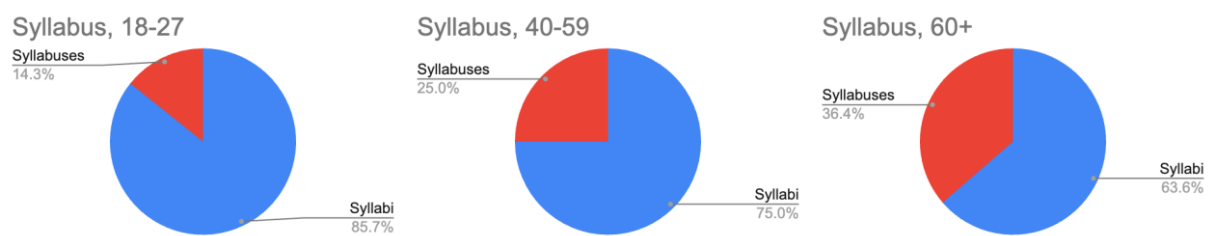


Figures 2.6a-c: Plurals of *sarcophagus* by age group.



Figure 2.7: Google Ngram Viewer graph of *sarcophagus* plural usage over time.

Syllabus has both Latin and Greek roots, leading to a more ambiguous prediction for the overall form. The English word originates from a Latin word, which in part originates from a Greek word, a common trend amongst the focus words (*Merriam-Webster* n.d.). *Syllabi* was preferred for all age groups, with a similar number of respondents responding with *syllabuses* in each group, seen in Figures 2.8a-c. The margin between the *-i* and *-es* form is the largest for the youngest group, once again indicating a trend toward *-i* forms. The Google Ngram analysis supports this trend, with *syllabi* taking over as the most popular form around 1980, seen in Figure 2.9.



Figures 2.8a-c: Plurals of *syllabus* by age group.

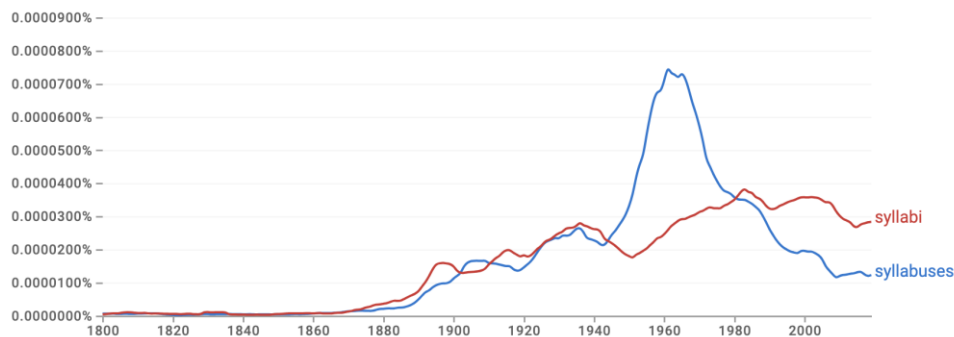
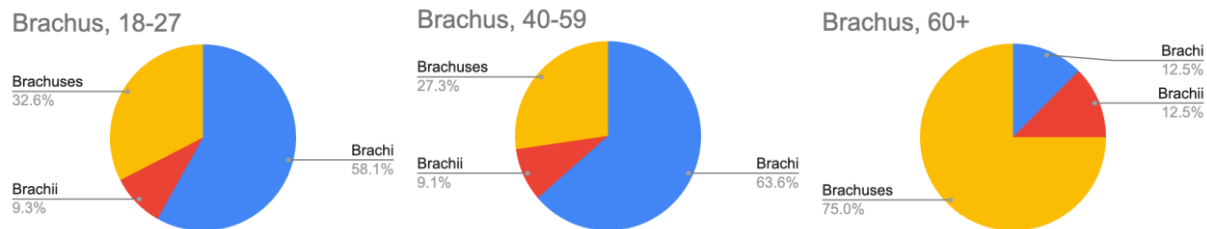


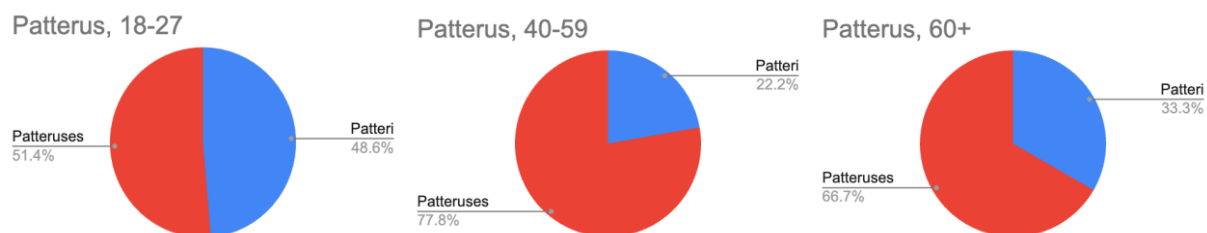
Figure 2.9: Google Ngram Viewer graph of *syllabus* plural usage over time.

Brachus, a nonce word, did not have an expected form, as it has no origin or common usage. The final results indicate *brachi* was preferred, although this preference was shaped almost entirely by the youngest group. A significant portion of the older group (75%) answered *brachuses*, with the preference for *brachi* becoming stronger with the younger groups, shown in Figures 2.10a-c.



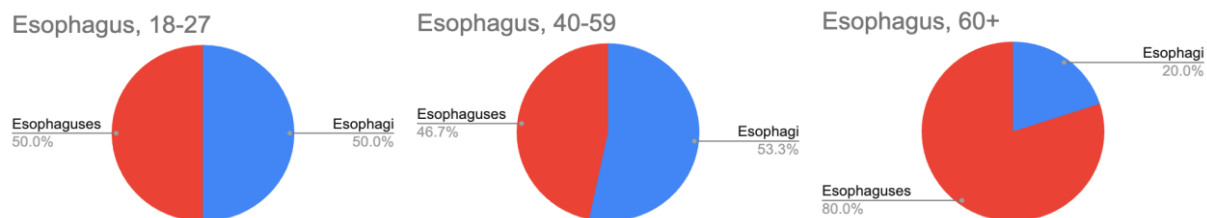
Figures 2.10a-c: Plurals of *brachus* by age group. A common alternative spelling, *brachii*, is also included.

Another nonce word, *patterus*, demonstrated a significant difference between the oldest and the youngest group, with the middle group being something of an outlier. The oldest group significantly preferred *patteruses*, while the youngest split almost in half between *patteruses* and *patteri*. The middle group leaned more toward *patteruses* than the oldest group by about 11.1%, seen in Figures 2.11a-c.



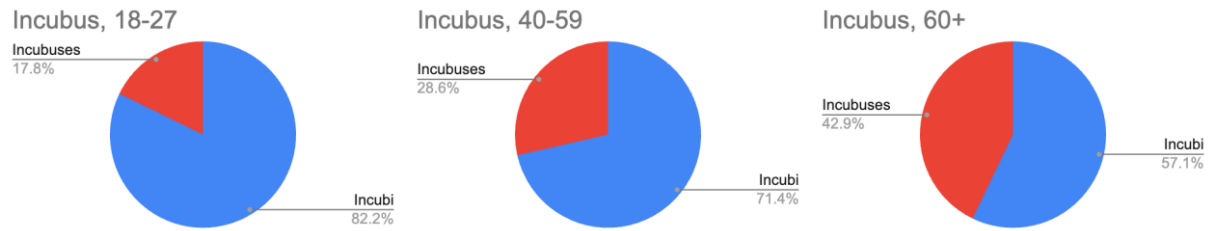
Figures 2.11a-c: Plurals of *patterus* by age group.

The word *esophagus* featured one of the most narrow margins between forms, with a 3.6% difference across all age groups. *Esophaguses* was preferred by 51.8% of all respondents, while *esophagi* sat at 48.2%. When comparing age groups, the younger groups showed a much stronger preference for *esophagi*, with 50% of the respondents providing that answer in the 18-27 group compared to 20% in the 60+ group, shown in Figures 2.12a-c.



Figures 2.12a-c: Plurals of *esophagus* by age group.

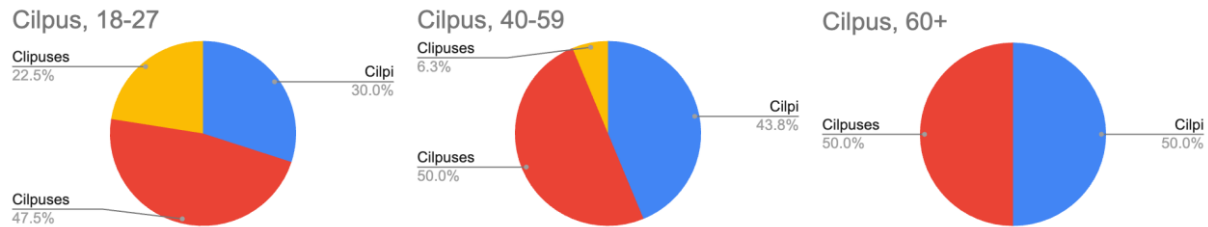
Incubus demonstrated a significant trend in accordance with the hypothesis, with *incubi* use increasing by 25.1% between the oldest and youngest group, seen in Figures 2.13a-c. This trend is one of the most potent towards *incubi* throughout the focus words. *Incubus* is similar in both form and meaning to *succubus*, one of the other most significant words demonstrating the *-es* > *-i* trend.



Figures 2.13a-c: Plurals of *incubus* by age group.

All of the forms shown above demonstrate a higher proportion for *-i* to *-es* forms in younger adults than in older adults and vice versa. This suggests the *-i* forms are becoming more prevalent as time passes (Bybee 2015).

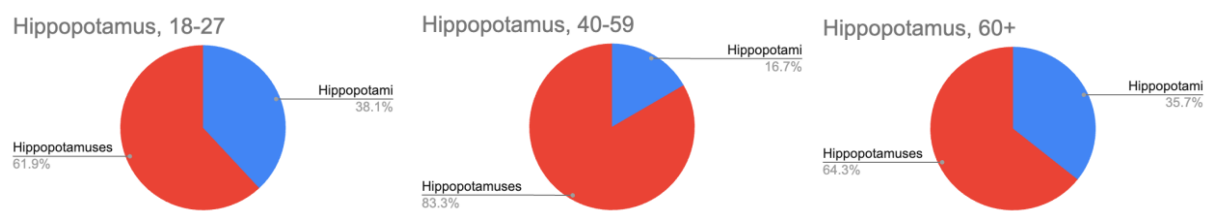
Most of the words that did not support the hypothesis were nonce words. *Cilpus*, one such nonce word, did not have an expected form. *Cilpuses* was overwhelmingly preferred, especially by the youngest speakers, shown in Figures 3.1a-c. The proportion of *-es* to *-i* forms was the strongest in younger speakers, as the ratio was smallest in the oldest speakers. If this word had existed for some time, this would indicate a trend toward the *-es* form for the word.



Figures 3.1a-c: Plurals of *cilpus* by age group. A common typo, *clipuses*, is also shown.

Despite having originally Greek origins, *hippopotamus* is cited as being a *-us* > *-i* plural in the Oxford guide to English Morphology, leading to a prediction of *hippopotami* as the plural

(Merriam-Webster n.d.; Bauer, Lieber, & Plag 2015). However, even the youngest speakers preferred *hippopotamuses* in the data, seen in Figures 3.2a-c. Even so, the data does not show a conclusive trend, as the proportion of forms is similar for the youngest and oldest age groups. This could indicate an overall preference for *-es* forms, although it makes a stronger argument for there being no overall trend, as the proportional difference between forms is similar in the oldest and youngest age groups. This is a similar trend as seen with *patterus*, but to a lesser intensity. The Google Ngram analysis shows a brief period where *hippopotamuses* was the dominant plural form, only to be overtaken by *hippopotami* around 2000, seen in Figure 3.3.



Figures 3.2a-c: Plurals of *hippopotamus* by age group.

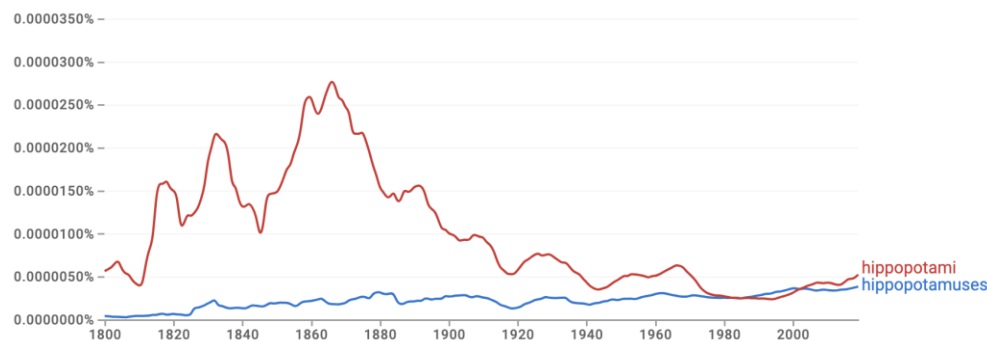
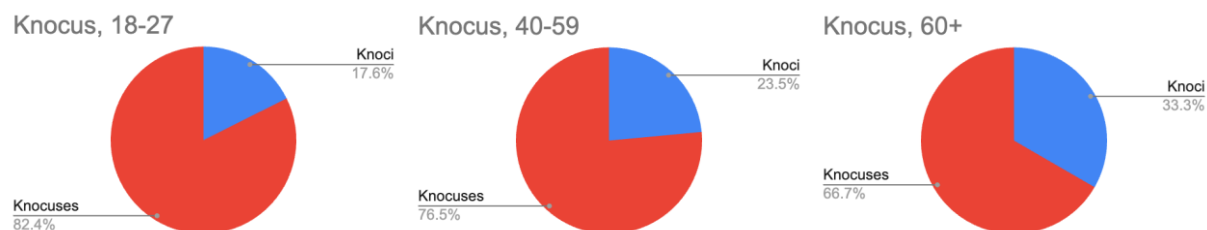


Figure 3.3: Google Ngram Viewer graph of *hippopotamus* plural form usage.

The nonce word *knocus* demonstrated very little difference between age groups, demonstrated in Figures 3.4a-c. *Knocuses* was preferred by all age groups. However, the proportion of *knocuses* to *knoci* responses was higher in the youngest group, which would indicate a trend toward *-es* forms, especially if it were a real word.



Figures 3.4a-c: Plurals of *knocus* by age group.

The three graphs above demonstrate a possible opposite trend: a preference toward *-es* forms in younger speakers, shown through a higher proportion of *-es* to *-i* forms in the lowest age group, or no trend at all, shown as a similar proportion across all age groups. The data is inconclusive for these words as to possible trends, due to small sample numbers. Additionally, another of the nonce words, *callesus*, demonstrated very little to no trend, having too many alternative spellings to draw any cohesive conclusions. These spellings often resembled the real word *callus*, indicating the nonce word was likely too close to that word, leading to confusion.

Data from interviews was compared to data from the survey, but there were no significant differences to report.

4. Discussion. The data indicates a strong trend in pluralization of *-us* forms toward the *-i* plural. This supports the first part of the hypothesis, as multiple words were found to be pluralized with *-i* more often in younger audiences than in older audiences. Younger speakers are generalizing rules more often than older speakers, most likely from the pairing of *cactus-cacti*. *Cactus-cacti* was chosen as the rule being generalized for two reasons. The first reason was that the results from the word *cactus* were among the most unanimously irregular, with only ~7.1% of total respondents answering *cactuses*. The second reason is that *cactus* is the most frequently used word of the 19 real words in the dataset, according to the SUBTLEXus database and Bengtsson (2021). Additionally, the pluralization of *cactus* into *cacti* has remained relatively stable in corpora for centuries (Bengtsson 2021). Another significant option is *fungus-fungi*, being the second most frequently used in SUBTLEXus, and even more unanimously irregular than *cactus*, with only ~5.7% of speakers answering *funguses*. If either of these pairings are the reason younger speakers prefer *-i* forms for similar words, this would provide significant evidence for DeCamp's Rule Generalization. A final determination on whether this generalization is the product of factors like foreignization or formality is outside the scope of this study.

The words that demonstrated the Rule Generalization pattern the strongest were *platypus*, *nautilus*, *succubus*, *sarcophagus*, *syllabus*, *incubus*, and *brachus*. Several of these words were likely unknown or little-used to speakers, making them the best candidates for Rule Generalization. The SUBTLEXus database logs these as around the middle of the words in the dataset, leaning towards the bottom end of frequency. If Rule Generalization is acting here, confusion around the word and its meaning would lead to speakers generalizing plural rules to those forms. Several respondents indicated confusion around the nonce word *brachus* and the word *succubus*, indicating their plurals were likely the result of Rule Generalization. This confusion was indicated in a final question in the survey asking which words respondents had the most trouble with.

Some plurals demonstrated a lack of change between age groups, remaining stagnant. These words include *cactus*, *octopus*, *stimulus*, *nucleus*, *fungus*, *abacus*, *rhinoceros*, *apparatus*, *sinus*, *colossus* and *genus*. Just under half of these words pluralized to *-i* overall, namely *cacti*, *octopi*, *stimuli*, *nuclei* and *fungi*. The other half pluralized as *-es* or other specific plural forms (*genera* for *genus*). The lack of change may mean the forms of these words are more cemented in the lexicon, possibly due to a frequency effect. If the words are used more often, they may be more resistant to change (Newberry et al. 2017). When compared to the SUBTLEXus database, seven of the eight most used words in the database out of the 19 real focus words showed little change in this study. This would be a strong indication that a frequency effect is occurring, as the most used words showed the least change across age groups. Three of the words – *stimulus*, *genus*, and *abacus* – sat near the bottom of the list, so a frequency effect is most likely not in practice for these three; rather, some other factor is limiting change. A small number of words also showed a change that possibly conflicted with the hypothesis or were inconclusive. These words were *cilpus*, *hippopotamus*, *callesus*, and *knocus*. Three out of these four words are nonce words. While there was not an overall trend toward the *-es* forms in younger speakers in these words, there was not a noticeable trend toward the *-i* form either, presenting a possible conflict to the hypothesis.

Conflict among Google Ngram Viewer results and results from respondents was widespread, as words like *sarcophagus* demonstrated little to no change in literature, but did demonstrate change in the survey. This could be a result of formality differences between spoken word and written prose, but this has not been attested to in research. It is possible that speakers

would say one form, but expect someone writing in a professional manner to use another form. Another possible solution is that the change simply is not evident in literature or Google Ngram yet. The change in *sarcophagus* may be relatively recent, so it would take written words more time to catch up to spoken words. If that were the case, Google Ngram results would change to reflect the survey results in the next few years.

As explained in the introduction to this paper, comparing age groups is indicative of language change as it is occurring. This study has captured language change actively in progress, indicating a view into the future of English. The implications of current change documented in this study are that the change will continue, cementing a new version of certain plurals in the English speaker lexicon, which could spread to literature and education. This phenomenon is also most likely not limited solely to *-us* forms. Instead, it is likely pervasive amongst several irregularities in English, within pluralization or otherwise. This could be researched further.

Future research into this area could use similar methods to explore more pluralization or other smaller linguistic trends through the lens of Rule Generalization. Further research into the specific results of this study should seek to explain the trends present. The results demonstrate that there is a trend, but there is not a conclusive answer as to why some words change more than others, or why younger speakers appear to generalize rules more often than older speakers. Possible explanations include a frequency effect, as previously stated, effects from popular culture or changes in education, as these drive much of language change, since a word not used often can change slightly due to one of these factors and eventually spread until it is taught (Newberry et al. 2017). This serves to demonstrate that many factors can play into how a language changes, and they can overlap in many ways. These are not necessarily at play within this survey, but drive wider language change.

Data from interviews provided support for the written forms respondents gave on the survey. This data did not differ significantly enough from the survey to garner further analysis. However, some words, such as *callesus*, were given new plural forms not commonly used in the survey, such as *calleses*. This is most likely due to a misunderstanding of the spelling of the word when hearing its phonological form. Additionally, two interview respondents with backgrounds in non-english education referenced grammatical literature that acknowledged the change in pluralization of animal words ending in *-us*, namely *octopus*, *platypus*, and *hippopotamus*. These respondents said the literature has stated more strongly in recent years that

-es is the prescriptively indicated plural form for these words. This conflicts with the results of this study, which show younger speakers prefer the opposite form. However, it aligns with the Google Ngram results for many of these animal words, indicating literature may prefer the -es form, but there is still a disconnect with younger speakers. There was no literature found by the researcher to support this observation. Further research could look into English grammar literature to see if educational points have changed on this topic.

5. References.

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