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Antonym morphology in Esperanto

1 Introduction

Esperanto is a constructed language with a simple grammar and transparant morphology. While it is a constructed language not traditionally spoken by a single human community, it does fulfill other criteria of natural language: it has a speech community, a continuous history of use, written literature and accords with linguistic universals (Jansen 2007). The fact that it started out as a constructed language is not sufficient to dismiss it as a natural language, because it has since developed and evolved to meet the needs of its speakers. It is the most succesful planned language, with an estimated number of speakers ranging from 100.000 till 1 million.

Although Esperanto is clearly unique in its success as a constructed language, it has received relatively little attention from academic linguistics. This may be related to the fact that Esperanto has no normative community of native speakers, so it is not possible to consult intuitions on an arbitrary construction, except when it occurs in the existing literature which serves as a model to be emulated. The consequence of this is that while it is possible to attest what is grammatical through corpora and speaker knowledge, no Esperanto speaker is in the position to say what is not allowed, except for the the more trivial cases.

Although the lack of a community of native speakers, mixed vocabulary and simple grammar conforms to the features of a pidgin, Esperanto is not a pidgin, because it was deliberately planned and published with a grammar, vocabulary and sample translations. Although there do exist native speakers of Esperanto who have been taught the language as a secondary L1 at home, this phenomenon is not comparable to the complete immersion that comes with national languages. And since these native speakers are a minority and do not use Esperanto as their main, day-to-day language, it cannot be said that Esperanto has 'creolized' because of them; the vast majority of speakers still learn the language as a second language.

1.1 Research question

Gradable antonym pairs are characterized by several properties that distinguish a marked and an unmarked item of the pair, or alternatively, a positive and a negative polarity antonyms. Lehrer (1985) discusses these properties with regards to English and concludes:

> [...] we see that markedness not a general structural property of antonymy; rather it consists of a number of independent properties that are imperfectly correlated. However, none of these is in fact true of all antonym pairs.

However, since in Esperanto most antonyms are systematically formed using the very productive affix *mal-*, perhaps their markedness is more clearly related to their antonymy. The fact that antonyms are morphologically marked will make it trivial to find antonym pairs.

This relates to the controversial hypothesis of decomposable antonyms, also known as the syntactic negation theory of antonymy (Heim 2008), which states that instead of being specified in the lexicon, antonyms are formed by a predicate negation operator **little**, hidden away in the logical form of words such as 'short.' In Esperanto this is ostensively the case, since most antonyms are formed by an explicit version of this operator, which makes it an interesting case in point.

Research question: To what extent is antonym morphology in Esperanto indicative of or related to semantic negativity?

My hypothesis is that the antonym prefix of Esperanto (*mal-*) is predictive of negative polarity, and more systematically so than in English. I will employ the following tests for negative polarity:

- Measure phrases require positive polarity (Kennedy 2001)
- Ratio modifiers, 'twice' / 'x times', occur more with positive polarity adjectives (Sassoon 2008)

- Nominalizations of positive polarity adjectives are more frequent than those of negative polarity (Lehrer 1985)

While there are other tests, such as that positive antonyms are neutralized in questions or that negative antonyms produce stronger entailments, I will employ these tests because they are suitable for corpus study.

The outline of this paper will be as follows. First I will present some evidence of the productivity of the antonym morphology in Esperanto, then the main part of the paper, the three tests for markedness on antonym pairs. I will conclude with some additional measurements.

I will make use of two corpora. The first is an approximately 1 million word corpus compiled from Gutenberg sources, containing 36 works, translated and original literature, with a total of 743.623 words. The second corpus, the Tekstaro (corpus), is an approximately 4.3 million word corpus available online (Wennergren 2003), containing translated and original literature but also magazine articles.

1.2 Frequency spectrum of *mal*-antonyms and base forms

In order to see why the *mal*-prefix is a suitable object of study, I will demonstrate its pervasiveness and productivity in language usage.

To determine the productivity of an affix, it is useful to look at the frequency spectrum of a class of words. Baayen and Lieber (1997) describe a technique where the frequencies of words with certain affixes are compared. By looking at the frequencies of frequencies it is possible to gauge the productivity of an affix. In other words, we abstract from the distribution of the words and instead look at the distribution of their frequencies. There is a certain number of words which occur once, a number that occur twice, etc. The relation with productivity is that a highly productive affix can be recognized by the fact that most of its frequencies are in the lower end, because newly produced words will have low frequencies. An unproductive affix will, on the other hand, have a set of words associated with it that are frequent enough to be memorized as correct by speakers. Unproductive affixes can also be irregular and semantically non-transparant, as a consequence of having to be memorized, because if a word has to be stored in the mental lexicon in its own entry, it might as well take on a life on its own.

Baayen's productivity index can be calculated by dividing the number of hapax legomena (word types which occur only once) of a given word formation process by the total number of its tokens (Hay & Baayen 2002). For the *mal-* prefix this is 1017 / 11025 = 0.0922. This index corresponds to the rate at which new types are expected when further tokens are sampled. This index is exceedingly high, predicting almost 1 new *mal*-type for every 10 *mal*-tokens that are sampled. Compare this to the productivity index for the English un- prefix: 0.005 (Hay & Baayen 2002).

Figure 1 shows the frequency distribution and density of all *mal*-antonyms, versus their corresponding base forms. The x-axis shows frequencies, while the y-axis shows the frequency of a given frequency (ie, the number of word types that have the frequency on the x-axis).

The graph for the frequency densities shows that the density of *mal*-words is smooth and has only one peak, ie., there is a unimodal distribution, which suggests that all derivations are transparant, as opposed to the graph in Baayen and Lieber (1997) showing a bimodal distribution caused by the presence of both opaque and transparant uses of a Dutch prefix.

Finally, it is striking that for the *mal*-words the number of hapax legomena (1017) is almost 8 times as large compared to that of corresponding the non-*mal*-words (129), and that is in spite of the fact that the corresponding non-*mal*-words have a total count of more than 7 times higher than those of the *mal*-words (83871 versus 11242). This suggest a high amount of productivity for the *mal-* prefix, but it could also mean that the *mal-* prefix is preferrably applied to more common words.

The next two graphs show vocabulary growth curves for *mal*-words. The x-axis shows the number of *mal*-word tokens considered, the y-axis the number of types encountered so far. So within the first 2000 tokens, there have been 500 different types.

Figure 2 shows the empirical growth curve (thick line) together with the number of hapax legomena (thin line), as well as a comparison with an interpolated version. Since the interpolated curve does not diverge from the empirical curve there is no reason to believe that there are non-random patterns in the data.

What is striking is that the growth curve is still very steep in the end, which predicts that the number of types will keep rising steadily as more tokens are considered. Since the curve for the hapax legomena

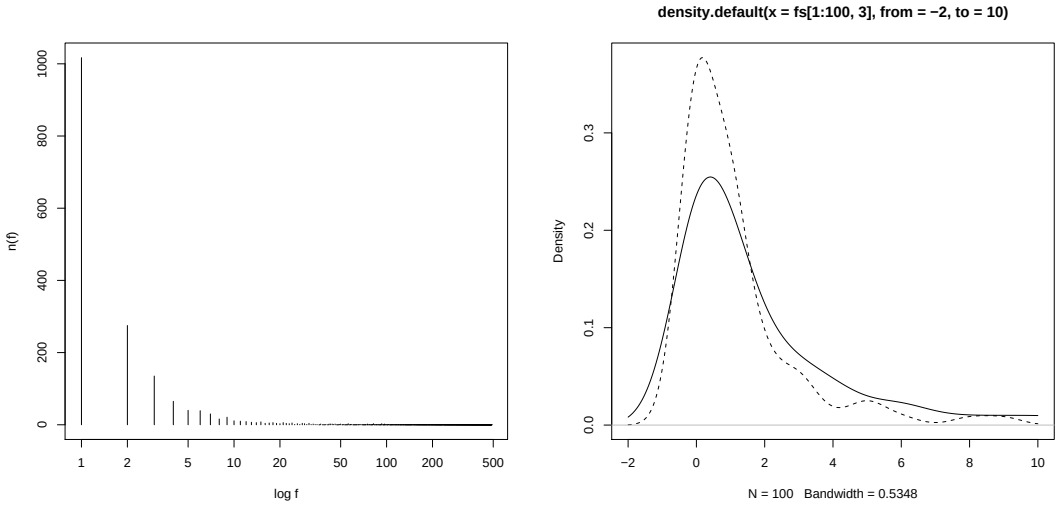

Figure 1: Left: frequency spectrum of *mal*-words on a logarithmic frequency scale, from gutenberg corpus. The x-axis has a logarithmic scale. Right: The solid line shows the frequency density of the first 100 frequencies of *mal*-words, the dashed lines the frequency density of the corresponding non-*mal*-words. From gutenberg corpus. Note that while the frequencies start with 1, the density curve is smoothed to the left.

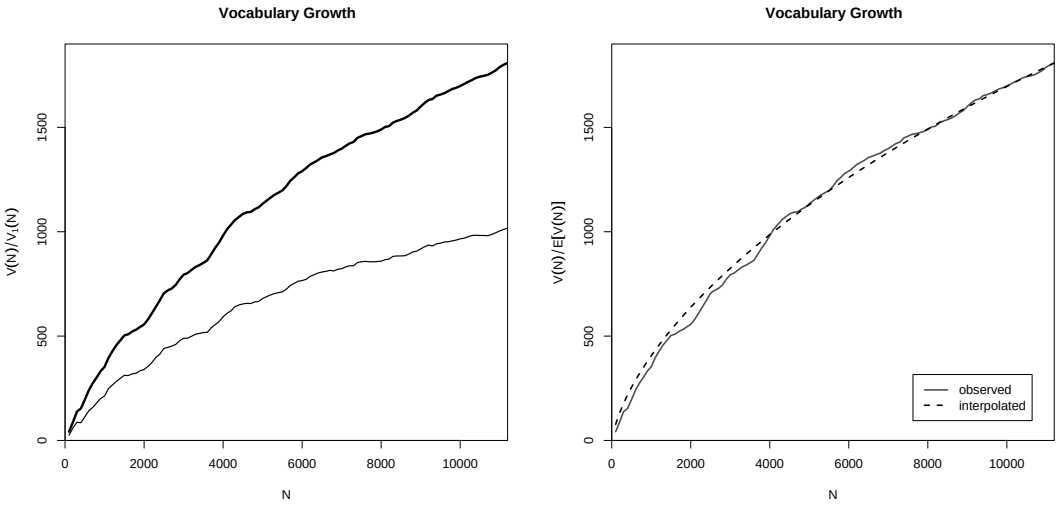

Figure 2: Left: Empirical growth curve of *mal*-words. The thin line is the number of hapax legomena. From gutenberg corpus. Right: Empirical growth curve with interpolated (expected) curve. From gutenberg corpus.

mal-marked	#	alternative	#
malbona (bad)	1349	*mava*	4
malkara (cheap)	30	*ĉipa*	3
malsama (different)	268	*diferenca*	52
maljuna / malnova (old)	274 + 230	*olda*	61
mallonga (short)	587	*kurta*	29
malalta (low)	356	*basa*	19

Table 1: *Mal*-marked antonyms and alternative forms, in Tekstaro corpus.

is also quite steep, it is clear that it is not just a fixed group of words larger than the sample that is being encountered, but a steady stream of truly productive one-off words.

1.3 *Mal*-marked antonyms versus alternative forms

Since the publication of the language, a lot of new words have been coined. Among these there have also been neologisms to complement the derived *mal*-antonyms. This started out chiefly in poetry, where the derived antonyms were felt to be too long and unnatural. If these neologisms would be in general use, it would conflict with the assumed representativeness for this study of *mal*-antonyms for antonymy in general in Esperanto.

Table 1 compares some of the most frequent *mal*-adjectives with alternative forms, with counts from the large corpus:

From these numbers it appears that there is a clear preference to use the original, *mal*-marked antonyms, instead of the alternatives.

All of these alternative forms, except '*diferenca*' and '*basa*', are neologisms introduced specifically to replace the *mal*-forms. '*Diferenca*' is derived from the noun '*diferenco*' (difference). '*Basa*', was originally restricted to low as in 'a low voice,' but has acquired some new connotations:

- "la landoj basaj", pli-malpli la nunaj Nederlando, Belgio kaj [...]
  ("the low countries", more or less the current Netherlands, Belgium and [...])
- sed la plej basaj, putraj, koruptaj agmanieroj
  (but the lowest, dirtiest, most corrupt behavior)

While it is impossible to generalize from this single figurative usage in the corpus, it seems entirely plausible that the derivational transparancy of 'malalta' blocks the figurative use to express 'low manners', which affords 'basa' the opportunity to take it on as an additional meaning.

With these results in mind it is clear that solely focusing on the *mal*-antonyms is justified, as the alternatives play a marginal role.

2 Antonym pairs and markedness

2.1 Adjectives and antonyms

Table 2 lists the ten most frequent adjectives in the gutenberg corpus, with their frequencies in the larger corpus on the right. The *mal*-antonyms of these adjectives occur significantly less often than the basic forms, in the large corpus (Wilcoxon signed rank test, p-value = 0.001953). In other words, the difference in frequencies between adjectives with and without *mal* his higher than could be expected from chance. This is the first indication that *mal-* occurs with negative adjectives. While it is not an actual test for polarity, the lower frequency is considered as a side-effect of other properties of negativity, such as non-neutrality (Lehrer 1985).

Comparing the ratios from the two corpora indicates that they are not significantly different. A Wilcoxon signed rank test results in a p-value of 0.9057. Taking all the counts from the corpora and dividing them by the respective number of tokens in the corpus yields relative frequencies, which makes

	adj	*mal*-ant.	ratio	adj	*mal*-ant.	ratio (ant/adj)
grand- (big)	1390	481	0.346043	8160	3191	0.391054
tut- (whole)	1023	0	0	6413	0	0.000000
bon- (good)	872	198	0.227064	4777	1349	0.282395
kar- (precious)	494	9	0.018219	1042	30	0.028791
sam- (same)	470	29	0.061702	2685	268	0.099814
bel- (beautiful)	551	42	0.076225	2786	216	0.077531
jun- (young)	382	274	0.717277	2638	1288	0.488249
long- (long)	477	124	0.259958	1950	587	0.301026
nov- (new)	498	230	0.461847	4405	1371	0.311237
alt- (high)	261	66	0.252874	1660	356	0.214458

Table 2: Adjectives in gutenberg corpus (left) and Tekstaro corpus (right).

it possible to do a correlation test. The correlation is 0.924812 (Spearman's rank correlation, p-value $<$ 0.001). This indicates that the two corpora are sufficiently representative of each other for our purposes.

The total number of adjectives in the large corpus is 343120 (not counting 73341 participles with adjective marking, eg., 'mi estas skribanta', 'I am writing'), with 321757 non-antonyms and 21363 *mal*-antonyms. This means that the ratio of *mal*-antonyms to all adjectives is 6.2261 %, which will be used as a rough first estimate of expected frequencies to compare with further counts.

Furthermore it seems that there is a particularly high number of adjectives, namely 8.041686 % of the total number of words. This is more than three times as high as the count for English in the BNC[1] (2.421849 %). This is probably not an artefact of the large amount of fiction in the Esperanto corpus, because when the search in the BNC is restricted to fiction, the percentage remains as low as 2.229581 %. Stranger yet, when the search in the Esperanto corpus is restricted to magazines (at 1.4 million words still a sizeable part of the corpus), the percentage of adjectives is even higher at 10.53739 %. From these observations we can conclude that Esperanto has a genuinely high usage of adjectives compared to English. A very tentative explanation for this could be that the adjectives allow to make up for less specific and extensive vocabulary, while at the same time being easier to understand by being more descriptive.

2.2 Measure phrases

Measure phrases in Esperanto occur in at least three varieties: with adjectives, nouns and verbs:

1. adjective: "... proksimume dek centimetrojn longa" (approximately 10 centimers long)
2. noun: "... havas ordinare la altecon de 3-4 metroj" (ordinarily has the height of 3-4 meters)
3. verb: "mi eltrovis, ke la tegmento altiĝas 12 metrojn aŭ plu" (I found out that the roof becomes-the-height of 12 meters or more)

Out of the 508 occurrences of 'meters' (including centimeters and kilometers etc.), 276 are prefixed by a quantity. Of these measure phrases, 41 are with an adjective, 23 with a noun, and 5 with a verb. See table 2.2 for a breakdown by word type. Almost all of the measure phrases are with non-*mal*-words such as long (24), high (21) and wide (10). The exceptions to this:

(1) "Kiam estas refluo kaj la akvo malleviĝas per du metroj aŭ pli" (When there is low tide and the water falls with two meters or more)

(2) "Ni ne povis vidi pli malproksime ol unu metron" (We couldn't see farther than one meter)

The first two sentences, (1) and (2), are not true exceptions, because the *mal*-word and the measure phrase are not in the same clause, instead the measure phrase modifies the verb in (1), or only implicitely in (2), if we take an elliptic reading ('farther than one meter far').

(3) "mi falis tre rapide tridek metrojn malsupren" (I fell very rapidly thirty meters downwards)

[1] British National Corpus (Davies 2004)

adj	count
longa (long)	18
alta (high)	13
larĝa (broad)	9
dika (thick)	1

verb	count
longas (has-the-length of)	2
malleviĝas (descends)	2
altiĝas (becomes-the-height of)	1

noun	count
alteco (height)	6
longeco (length)	3
diametro (diameter)	2
distanco (distance)	2
interspaco (space in between)	2
longo (length)	1
dikeco (thickness)	1
alto (height)	1
spaco (space)	1
profundecon (depth)	1
malproksimeco (away-ness)	1
fokusdistanco (focus distance)	1
larĝeco (width)	1

Table 3: Breakdown of measure phrases by word type

(4) "... milojn da kilometroj malproksime" (thousands of kilometers away)

The third sentence, (3) is a measure phrase, but the *mal*-word is marked with an accusative of direction/movement. This is comparable to the English 'into' instead of 'in'. Although the *mal*-word clearly modifies the measure 'meters', it could be the accusative which licenses the *mal*-marked antonym.

The last sentence, (4), with the adverb *malproksime* (far / away) seems to be a counterexample to the hypothesis. The word '*malproksime*' is an exception to the otherwise succesful hypothesis that measure phrases require positive, non-antonyms. There are no measure phrases of meters with '*proksime*' (nearby).

Perhaps conceptually '*malproksime*' is positive, and conceptual considerations take priority over morphological ones. Interestingly, the word from which '*malproksime*' is derived, '*proksima*' is defined as "Apartigita per malgranda distanco"[2] (separated by a small distance), so its definition references a negative antonym. Looking at the frequencies of '*proksime*' and '*malproksime*' reveals another insight: they are almost the same, the former occurring 560 times, the latter 569 times. This confirms the irregular nature of the word, because other antonym pairs conform to the expectation that one is more frequent than the other.

It can be concluded that the typical measure phrase of 'quantity measure adjective' occurs only with non-*mal*-adjectives, as would be expected from the hypothesis. Except for *malproksime* / *malproksimeco*, this also goes for measure phrases with verbs and nouns.

2.3 Ratio modifiers

In Esperanto 'twice as ADJ' and 'x times as ADJ' are all expressed using the same regular suffix, prefixed with a numeral and followed by the comparative forming word '*pli*'. Examples:

(5) la distanco al Stokholmo estas multoble pli longa.
(the distance to Stockholm is many times longer)

(6) Lia loĝejo efektive estis dudekoble pli granda, ol la loĝejo de la muso
His living quarters were effectively twenty times as big as those of the mouse.

Without the comparative forming '*pli*', what is expressed is often not a degree, but more something along the lines of 'for two distinct reasons':

(7) ĉar pirati ies plum-frukton sen ties permeso kaj poste eĉ nei sian misfaron estas konduto duoble neakceptebla.
(because plagiarizing someone's pen labor and later even denying one's mistake is conduct twice unacceptable)

[2]Reta Vortare de Esperanto, `www.reta-vortaro.de`, a multi-lingual dictionary of Esperanto maintained by volunteers.

adj	A *-oble pli* ADJ	B *pli* ADJ	C *-oble pli mal-* ADJ	D *pli mal-* ADJ	A/B	C/D	$\frac{A/B}{A/B+C/D}$
granda (big)	37	758	0	64	4.8813 %	0 %	100 %
bela (beautiful)	11	149	0	2	7.3826 %	0 %	100 %
multa (much)	5	121	0	4	4.1322 %	0 %	100 %
longa (long)	5	111	0	12	4.5045 %	0 %	100 %
alta (high)	4	227	0	37	1.7621 %	0 %	100 %
fia (shameful)	3	5	0	0	60.0000 %	-	-
feliĉa (happy)	3	53	1	11	5.6604 %	9.0909 %	38.3721 %
bona (good)	2	525	1	99	0.3810 %	1.0101 %	27.3859 %
potenca (powerful)	2	52	0	0	3.8462 %	-	-
ĉarma (charming)	2	11	0	0	18.1818 %	-	-
forta (strong)	1	182	1	15	0.5495 %	6.6667 %	7.6142 %
saĝa (wise)	1	51	0	6	1.9608 %	0 %	100 %
aĝa (aged)	1	169	0	0	0.5917 %	-	-
dika (thick/fat)	1	12	0	8	8.3333 %	0 %	100 %
oportuna (oportune)	1	20	0	0	5.0000 %	-	-
ofta (frequent)	1	20	0	9	5.0000 %	0 %	100 %
luma (bright)	1	8	0	7	12.5000 %	0 %	100 %
grandioza (enormous)	1	6	0	0	16.6667 %	-	-
efika (efficient)	1	21	0	0	4.7619 %	-	-
distanca (distant)	1	1	0	0	0 %	-	-
ĝoja (joyful)	0	5	1	5	0 %	20.0000 %	0 %
facila (easy)	0	67	1	44	0 %	2.2727 %	0 %

Table 4: All occurences of '-oble ADJ' (twice / x times ADJ)

(8) Mi estas duoble bonŝanca, ĉar mi naskiĝis kiel anglo [...] kaj judo.
I am twice lucky, because I was born as an Englishman [...] and jew.

Because of this I will restrict the following counts to those with "*pli*," which guarantees that results are only about gradable adjectives.

Of the 88 matches (see table 4) in the large corpus for the phrase 'twice as ADJ' and 'x times as ADJ' in Esperanto, only 5 of them were with a *mal*-antonym:

(9) "estas ankoraŭ dekoble pli malforta" ("was still ten times weaker")

(10) "tio estis centoble pli malbona ol"
"that was a hundred times worse than"

(11) "multoble pli malfacilan" ("many times harder")

(12) "Tio estis unu el tiuj ridetoj, kiuj estas milionoble pli malĝojaj ol larmoj"
That was one of those smiles that are a million times sadder than tears

(13) "oni trovas ke la reĝo estas sepcent-dudek-naŭ-oble pli feliĉa ol la tirano kaj la tirano samoble pli malfeliĉa ol la reĝo."
"one finds that the king is seven hundred and twenty nine times happier than the tyrant and that the tyrant is the same number of times more unhappy than the king."

The remaining 83 matches were with non-*mal*-antonyms, apparantly conforming to the expectation that 'twice' and 'x times' prefer positive items. However, the expected average frequency of *mal*-adjectives predicts about 5.5 ocurrences.

But from the 5 occurrences that were found, (13) could be discounted because the antonyms have the discourse function of contrast, and (10) could be discounted because good/bad are outliers in other

languages as well (see eg., Sassoon (to appear), who reports that 'twice as bad' is twice as frequent as 'twice as good'). The adjective in (11) is conceptually positive (in the BNC 'twice as hard' has 22 matches, 'twice as easy' zero). The remaining two antonyms in (12) and (9) seem to be genuinely negative. Looking at the frequencies shows of the last three adjectives shows that for *facila* and *ĝoja*, the corresponding *mal*-antonyms are more frequent than their base forms, and the distribution of *feliĉa* and *malfeliĉa* roughly corresponds to the distribution of 3 to 1 in table 4. This means that these exceptions are not just exceptional with ratio modifiers, but are generally atypical.

In all the results do support the hypothesis, but with a few exceptions.

2.4 Nominalizations

From the table of adjectives and their antonyms we can study the frequency of their nominalizations. There are two possible nominalizations: directly affixing a noun ending (*-o*) to the root, or using the affix *-eco*, denoting an abstract quality. The affix *-eco* serves to emphasize and restrict the meaning to an abstract quality. It is comparable to the English suffixes -ness, -ity and -ship. For adjectival roots the suffix is in some cases superfluous, eg., size can be expressed both as '*grando*' and '*grandeco*,' whereas 'greatness' can only be expressed by '*grandeco*'. For noun-roots the suffix differentiates from the normal meaning, as with '*homo*' (human) and '*homeco*' (humanity). The advice in grammar textbooks is to use the suffix only when necessary. Some examples:

- granda (big) → grando (size), grandeco (size, greatness)
- longa (long) → longo (length), longeco (length / longness)
- homo (human/NOUN) → homa (human/ADJ), homeco (humanity)

	-o	*-eco*	sum	nom/adj	ant.	*-o*	*-eco*	sum	nom/adj
grand	12	156	168	0.020588		2	17	19	0.005954
tut	164	16	180	0.028068		0	0	0	-
bon	452	174	626	0.131044		698	60	758	0.561897
kar	0	2	2	0.001919		0	2	2	0.066667
sam	190	5	195	0.072626		3	15	18	0.067164
bel	124	319	443	0.159009		8	10	18	0.083333
jun	6	224	230	0.087187		3	80	83	0.064441
long	143	49	192	0.098462		0	4	4	0.006814
nov	7	13	20	0.004540		1	5	6	0.004376
alt	104	111	215	0.129518		0	2	2	0.005618

Table 5: Nominalizations in Tekstaro corpus

See table 5 for the nominalization counts in the larger corpus. For most of the adjectives the basic form has a higher ratio of nominalizations than the *mal*-antonym. The one notable exception to this is '*malbono*' (bad / evil). The counts for the other exceptions are too low to draw conclusions: *malkareco* (cheapness) [3] and *malsameco* (difference). For the latter this is probably related to the fact that 'difference' is preferrably expressed as '*diferenco*' in Esperanto.

Comparing the ratios of nominalizations of *mal*-adjectives and non-*mal*-adjectives does not indicate a significant difference. However, if we leave out the more irregular words *tut-* and *kar-* because they have zero counts, and *bon-* for which the antonym has a higher count than the non-antonym, the difference is significant after all (Wilcoxon test, p-value = 0.01563). This supports the hypothesis that nominalizations of *mal*-marked antonyms are less frequent than those of their base forms.

Another phenomenon is that apparantly the *mal*-antonyms favor the use of the *-eco* suffix, except for the outliers '*malbono*' (the bad) and '*malbelo*' (the ugly). This may be because some of the nominalizations without *-eco* solely express a neutral concept like length or size, which do not have a common sense antonym, while the nominalizations with *-eco* aditionally can express the presence of the quality or

[3] I have ommited from this count one instance where '*karoj*' occurred as a pronounciation guide for a name, and another where '*karo*' occurred in a list of word forms not in use.

characteristic described by the adjective from which it is derived, which does have an antonym. However, a test for statistical significance does not produce a significant result for the ratios between -o and -eco nominalizations given *mal-* or non-*mal*-adjectives (Wilcoxon signed rank test, p = 0.327), so the effect is not strong enough or the sample too small.

From the attested nominalizations of antonyms it is clear that Esperanto is more systematic and free in its word formation than a language such as English. In English, words such as *smallness, *oldness and *lowness are not allowed, while size, youth and height are, although they do not derive from productive affixes.

It can be concluded that, barring a few exceptions, Esperanto does accord with the pattern that nominalizations of unmarked adjectives are more frequent than those of marked antonyms, and that this is probably related to the fact that nominalizations of non-*mal*-adjectives are additionally tasked to express neutral concepts, as opposed to only positively expressing the presence of the quality denoted by the adjectival root.

3 Additional data

3.1 Comparatives with and without antonyms

	A *pli* (more)	B *malpli* (less)	B/(A+B) ratio
non-*mal*-adjective	7459	1004	11.8634 %
mal- adjective	616	12	1.91082 %
total	8075	1016	11.1758 %
ratio ant./total	7.6284 %	1.1811 %	

Table 6: More- and less-comparatives with and without antonyms, from Tekstaro corpus

	A more ADJ / comparative ADJ	B less ADJ	B/(A+B) ratio
'un-' adjective	669 / 28	135	16.22596 %
any adjective	38879 / 188582	7293	3.10665 %
ratio un-/total	0.30642 %	1.85109 %	

Table 7: Comparatives for English in the BNC

Table 6 shows counts of the four possible configurations of comparatives in Esperanto. A chi-squared test shows that the results are highly significant ($p < 0.001$), which means that whether the comparison is with '*pli*' or '*malpli*', or with mal-antonym or not, has a strong effect on the frequencies. There is a strong tendency towards comparisons with non-antonyms (89%), and an even stronger tendency for comparisons with 'more' (92%).

If we consider the ratio of antonym verus non-antonym adjectives, which is about 6.2%, we find that more/*pli* comparisons with antonyms, 616 exceeds the expected value by just one fifth given this ratio. Antonyms with less/*malpli* comparisons on the other hand are more than 5 times lower than the expected value, possibly due to the duplication of 'mal': 'less unhappy' is 'malpli malfeliĉa' in Esperanto. Due to the systematic application of *mal-* it might be the case that the two occurrences of *mal-* are dropped as a sort of 'double negation elimination.'

Table 7 compares this with English, with counts from the BNC.

From the ratios it appears that English more strongly prefers more-comparisons to less-comparisons than Esperanto: in English 97% of comparisons are with 'more', in Esperanto 89%. Perhaps this is because of the asymmetry in English of having a suffix for more-comparatives (harder) but not for the opposite (less hard).

	A *pli* ADJ	B ADJ	C *pli* *mal-* ADJ	D *mal-* ADJ	A/B	C/D	$\frac{A/B}{A/B+C/D}$
profunda (deep)	2	676	2	19	0.00296	0.10526	2.734 %
dika (thick/fat)	3	367	3	205	0.00817	0.01463	35.839 %
laŭta (loud)	3	207	2	117	0.01449	0.01709	45.882 %
longa (long)	4	1950	4	587	0.00205	0.00681	23.138 %
vasta (vast)	4	570	2	108	0.00702	0.01852	27.481 %
facila (easy)	6	383	6	521	0.01567	0.01152	57.633 %
saĝa (wise)	6	544	2	262	0.01103	0.00763	59.098 %
kara (precious)	7	1042	4	30	0.00672	0.13333	4.797 %
riĉa (rich)	10	735	3	455	0.01361	0.00659	67.358 %
proksima (near)	11	587	13	462	0.01874	0.02814	39.975 %
forta (strong)	18	1199	2	365	0.01501	0.00548	73.260 %
juna (young)	32	2638	19	1288	0.01213	0.01475	45.125 %
alta (high)	40	1660	11	162	0.02410	0.06790	26.192 %
bona (good)	52	4777	18	1349	0.01089	0.01334	44.928 %
granda (big)	109	8160	10	3191	0.01336	0.00313	80.998 %

Table 8: Breakdown of some of the first 1000 comparatives with *pli*.

If we take the English prefix un- as a representative antonym marker, we can compare comparatives with antonyms in English and Esperanto. Here it appears that Esperanto more strongly prefers positive comparisons given the prefix, probably due to the already mentioned duplication of *mal-*.

Table 3.1 lists a selection of counts of word types in the first 1000 comparatives, those of which did not have zero counts for the *mal*-adjectives. The last column lists the ratio of non-*mal*-adjectives to *mal*-adjectives, normalized for frequency. There appears to be a lot of variance, so it can be concluded that there is no markedness effect in comparatives, as there has been in the previous sections.

Similar observations can be done for equatives. Of the 82 matches for 'same ADJ kiel' (as ADJ as) in Esperanto, 7 are with *mal*-words. This is about two fifths more than expected from the average frequency of *mal-* with adjectives (5.1). Table 9 summarizes some of the counts. Contrary to the comparatives, here it does seem to be the case that non-*mal*-words are usually preferred.

3.2 Degree modifiers

Kennedy & McNally (2005) present a table demonstrating that the words which the degree modifiers 'very,' 'well' and 'much' apply to are largely complementary. Table 10 shows similar counts for Esperanto.

It appears that the distributions of 'well' and 'very' are similarly complementary as in English. But for the corresponding word for 'much' things are not as clear cut. It does not seem to be a frequently used degree modifier, from the small survey I performed.

4 Conclusion

The researche quostion can be answered in the affirmative: it does seem to be the case that in Esperanto antonym morphology co-occurs with all the symptoms of negative polarity adjectives that we reviewed. This can be attributed to the fact that most of the adjectival roots in Esperanto are conceptually positive, leading the corresponding antonym to be negative; but it also strengthens the case that Esperanto behaves very much like other natural langauges.

However, and perhaps suprisingly, Esperanto is not more systematic in this regard than English. There are exceptions such as the words '*facila*' (easy) and '*proksima*' (nearby), which are conceptually negative in most languages. But these exceptions do not occur in a single test of negativity, they diverge from the other predictions of marked antonyms as well.

adj	A *same* ADJ *kiel*	B ADJ	C *same* *mal-*ADJ *kiel*	D *mal-*ADJ	A/B	C/D	$\frac{A/B}{A/B+C/D}$
granda (big)	4	8160	0	3191	0.000490	0.000000	100 %
bona (good)	4	4777	0	1349	0.000837	0.000000	100 %
bela (beautiful)	3	2786	3	216	0.001077	0.013889	7.1952 %
alta (high)	3	1660	0	356	0.001807	0.000000	100 %
trankvila (tranquil)	1	538	1	162	0.001859	0.006173	23.1429 %
gaja (cheerful)	0	557	1	289	0.000000	0.003460	0.0 %
nova (new)	0	4405	1	1371	0.000000	0.000729	0.0 %
supera (superior)	0	245	1	45	0.000000	0.022222	0.0 %

Table 9: Some occurences of 'same ADJ kiel', including all *mal*-words, excluding 63 (non-*mal*) adjectives occurring only once.

	bone (well)	tre / treege (very / VERY)	multe (much)
informita (informed)	8	0	0
edukita (educated)	17	0	0
konata (known)	57	15	2
ŝatata (liked)	0	12	1
surprizita (surprised)	0	6	1
konfuzita (confused)	0	5	0
bezonata (needed)	0	5	0
uzata (used)	2	1	4
influita (influenced)	0	0	3

Table 10: Distribution of degree modifiers with deverbal adjectives in Tekstaro corpus

The case for *mal*-antonyms and negativity could be strengthened in future research by questionnaires, which should study neutralization in questions, evualativity and entailments.

4.1 References

Baayen, R. H. & Lieber, R., (1997) "Word Frequency Distributions and Lexical Semantics." *Journal of Computers and the Humanities*, vol. 30 pp. 281-291.

Davies, M. (2004-) 'BYU-BNC: The British National Corpus.' Available online at `http://corpus.byu.edu/bnc`

Hay, J. & Baayen, R. H. (2002), "Parsing and productivity." In Booij, G. and van Marle, J. Yearbook of Morphology 2001. Kluwer Academic Publishers, pp. 203-235.

Heim, I. (2008). "Decomposing Antonyms?" *Proceedings of Sinn Und Bedeuting 12*. Oslo.

Jansen, W. (2007). "Woordvolgorde in het Esperanto: normen, taalgebruik en universalia" (Word-order in Esperanto: norms, usage and universals). PhD thesis, LOT Utrecht.

Kennedy C. (2001). "Polar opposition and the ontology of 'degrees' ". *Linguistics and Philosophy*, vol. 24, pp. 33–70.

Kennedy, C. & McNally, L. (2005). "Scale structure, degree modification, and the semantics of gradable predicates." *Language*, vol. 81, number 2.

Lehrer, A. (1985). "Markedness and Antonymy." *Journal of Linguistics*, Vol. 21, No. 2 (Sep., 1985), pp. 397-429

Sassoon, G. W. (2010) "The Degree Functions Of Negative Adjectives." *Natural Language Semantics*, to appear.

Wennergren, B. (2003-). "Tekstaro de Esperanto." Esperantic Studies Foundation. Available online at `www.tekstaro.com`