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THE DOUBLE NATURE OF NEGATIVE ANTONYMY

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1 Introduction

Antonymy is typically considered in the context of one-dimensional adjectives such as *tall-short* and *fast-slow*, where, intuitively, the positive counterpart, e.g. *tall*, references entities with much of a dimension (e.g, much height) whereas the negative, e.g. *short*, references entities *not* having much of the dimension (having little height). In accordance, on the syntactic negation theory of antonymy (Lehrer 1985; Heim 2006, 2008; Buring 2007), instead of being specified in the lexicon, antonyms are formed by a degree-negation operator, *little*, hidden in the logical form of words such as *short*.

One problem with this view is that in many antonym pairs our judgments as to which one is the negative one counter the theory's predictions. For example, while *dangerous, dissimilar, dirty* and *sick* reference existence (or much of) a property, we tend to consider them negative antonyms. In opposite, we tend to intuitively judge *safe, identical, clean* and *healthy* to be positive, despite the fact that, e.g., objects are considered *identical* (or *similar*) in, say, color iff *no* (or *not much*) *color difference* between them can be attested; individuals are considered *healthy* if they do *not* possess any serious disease; things are *clean* iff they are covered by *no* dirt, etc. To explain these judgments, previous work relates to negative cultural connotations, postulating that these may be dissociated from linguistic negativity; e.g., *old* is linguistically positive, despite any cultural connotations (Kennedy 1997).

This paper defends a different, arguably more adequate analysis of linguistic antonymy, which takes into account the fact than many adjectives are multidimensional (Kamp 1975; Klein 1980). This new analysis reveals that in many of the above cases negative connotations and linguistic negativity actually match. The crux is that negation may also play a role at a level higher than that of a single dimension. Logical (rather than degree-) negation can affect the operators that bind the different dimensions of a single multidimensional adjective.

Let us consider some examples of the workings of multidimensional antonyms. By default, native speakers intuitively judge entities as *identical* (generally, rather than with respect to color alone) iff they are identical in *all* of the respects that count as relevant in the given context. By contrast, they intuitively judge entities to be *different* iff they are different in *some* (at least *one*)

respect. Objects are considered *clean* iff dirt of *no sort*, dust, stains, etc., is attested on them, while they are considered *dirty* iff dirt of *some* sort is attested. Individuals with a slight cold are *not* strictly speaking *healthy*, since they are not *all* healthy, while one type of sickness suffices to count as *sick*, etc. Considering these, among many other examples, the following rather systematic generalizations emerge. The dimensions of **positive adjectives** like, e.g., *identical, healthy* and *clean* are integrated by means of **universal quantification**. By contrast, the dimensions of their **negative antonyms** are integrated by means of **existential quantification**.

A theory of antonymy whereby *negative antonyms are logical negations of their positive counterparts* predicts that the force of quantifier over dimensions will systematically vary in antonym pairs, because negated universals are existential and vice versa. For example, if

(i) in order to be considered 'healthy', one has to be healthy in *every* dimension, and

(ii) 'sick' is equivalent to 'not healthy',

it follows that:

(iii) in order to be considered 'sick', one has to *fail* to be healthy in at least one dimension.

Hence, for any set of predicates DIM, *healthy* is equivalent to $\lambda x.\forall Q \in DIM$, healthy-wrt(x,Q) iff *sick* is equivalent to $\lambda x.\neg\forall Q \in DIM$, healthy-wrt(x,Q). The latter reduces to $\lambda x.\exists Q \in DIM$, $\neg$healthy-wrt(x,Q). Let us call adjectives like *healthy*, whose dimensions combine via an implicit universal quantifier *conjunctive*, and adjectives like *sick,* whose dimensions combine via an implicit existential quantifier *disjunctive*. We see that at the multidimensional level positivity appears to be linked with universal generalizations (healthy in all respects, clean of any dirt type, etc.), i.e. *conjunctivity*, while negativity is linked with the existence of a counterexample (sick means not being healthy in all respects; dirty means not being free of any dirt-type, etc.), i.e. *disjunctivity*.

This proposal is supported by a corpus study (Sassoon 2012). The present paper aims to test it experimentally by means of acceptability judgments. The method of the corpus research revolved on the observation that exception phrases are indicators of universal or quasi-universal generalizations (von Fintel 1994; Hoeksema 1995; Moltmann 1995). This point can be illustrated by the contrast between the felicity of, for example, *everyone* (or *no one*) *is happy except for Dan* and the infelicity of #*someone is happy except for Dan*. In accordance, the above proposal predicts that speakers will generally judge exception phrases as felicitous when combined with conjunctive adjectives (because the dimensions of such adjectives combine via an implicit universal quantifier), but not with their negative antonyms, because the latter are equivalent to negations of their positive bases, and are therefore disjunctive. Their dimensions combine via an existential quantifier. The felicity contrast in (1a,b) illustrates this case. Furthermore, since negated universals are existential and vice versa, exception phrases are predicted to be felicitous when combined with negated disjunctive adjectives, but not negated conjunctive adjectives, as the contrast in (2a,b) illustrates.

(1) a. I am **healthy** except for high blood pressure (bp) ($\forall Q \neq bp$, Healthy-wrt(I,Q))
b.#I am **sick** except for normative blood pressure (#$\exists Q \neq bp$, $\neg$Healthy-wrt(I,Q))

(2) a.#I am **not healthy**, except for (normal) blood pressure (")
b. I am **not sick**, except for high blood pressure ($\neg\exists Q \neq bp$, $\neg$Healthy-wrt(I,Q), i.e. $\forall Q \neq bp$, Healthy-wrt(I,Q)).

These intuitive judgments are supported by distributional patterns in naturally occurring examples of exception phrases in the corpus of contemporary American English (Davies, 2010).

The study investigated 1300 naturally occurring counts of the form 'Adj. except' with 8 antonym pairs in positive vs. negative (downward entailing) contexts, as in, e.g., (1) vs. (2), respectively. Significantly, an analysis of these examples supported both the view that negative antonymy systematically affects the force of quantifier over dimension, as predicted by a logical-negation theory of antonymy, and the view that the nature of negative polarity in multidimensional antonyms consists of reference to counterexamples to generalizations. Conjunctivity was measured by the frequency of tokens of the form 'Adj. except dim' (as in, e.g., *healthy except dim* or *very similar except dim*) out of the total number of tokens of the form 'Adj. except'. This frequency reflects the dominance of implicit universal dimension binding within the tokens of an adjective. Disjunctivity was measured by the frequency of tokens of the form 'not Adj. except' (as in, e.g. *not healthy except dim* or *hardly similar except dim*) out of the total number of tokens of the form 'not Adj. except'. This frequency reflects the dominance of implicit existential dimension binding within the tokens of an adjective.

An analysis of variance revealed significant differences ($F = 10.37$; $P = .0002$) as follows.

(i) In positive adjectives, conjunctivity is higher than disjunctivity.
(ii) In negative adjectives conjunctivity is lower than disjunctivity.
(iii) Conjunctivity is higher in positive adjectives than in their negative antonyms, whereas disjunctivity is lower.

Hence, patterns of usage support the proposal that positive and negative multidimensional antonyms are conjunctive and disjunctive, i.e. universal and existential on their dimensions, respectively. The main goal of the present paper is to test this proposal by means of an acceptability judgment survey with twice as many adjectives as there were in the corpus study (sections 2.1-2.3). If both acceptability judgments and corpus evidence support the theoretical proposal described above this would form strong evidence for it. In addition, the frequency data revealed a moderate to strong correlation between conjunctivity and the frequency of co-occurrence of adjectives with the degree modifier *perfectly* (a Spearman rank order correlation test yields $r = .77$, $t = 4.36$, $P < .0008$.) Hence, frequent modification by *perfectly* might form a cue for default conjunctive dimension binding. The present study aimed to replicate this result too.[1]

Finally, the paper presents an additional small scale study that tests the predictions of the proposal by means of a classification task in several types of circumstances (section 2.4).

2 Study I: conjunctive and disjunctive antonyms

2.1 Method

The participants were recruited using Amazon mechanical Turk (AMT) – an online labor market place where workers are paid small amounts of money to complete small tasks named HITs (Human Intelligence Tasks). It has been shown that AMT provides a quick and relatively cheap method to acquire high-quality experimental results that do not differ significantly in performance from standard experimental settings (Buhrmester et al. 2011). In survey 1, participants were payed 1 cent per hit consisting of a single item rating, with effective hourly rate of 5.14$. All in all 62 participants rated an average of 55 items per participant (SD = 58). 20 different participants rated each item. In survey 2, participants were payed 20 cents for filling out a hit consisting of 19 texts, with effective hourly rate of 5$. All in all 185 participants rated an

[1] If *perfectly* is also a cue of an upper closed scale and/or a maximum membership standard (Rotstein & Winter 2005; Kennedy & McNally 2005; Syrett 2007), there is a connection between scale and/or standard type and dimension binding type.

average of 61 texts per participant (SD = 102). 25 different participants rated each text. 49% of the texts were rated by females (76 of the 185 participants), with mean age 36 (33 for the 185 participants) and SD = 13 (12, respectively). Education in year was reported in 12% of the cases to be 9-12, in 71% to be 13-16 years, and in 16% to be more than 16 years (14%, 58%, and 28%, repectively, for the 185 participants).

The items included 18 pairs of positive and negative antonyms, all in all 36 adjectives. Survey 1 assessed positive vs. negative polarity rankings for these adjectives. The survey consisted of 100 randomly ordered hits, 36 of which included the adjectives investigated in this paper. The instructions said: "*This questionnaire is for native English speakers only. English speakers tend to classify adjectives as either 'positive' or 'negative'. For example, adjectives like 'tall' are considered positive, while adjectives like 'short' are considered 'negative'. Adjectives like 'clean' are considered positive, while adjectives like 'dirty' are considered 'negative'. Determine to what extent the following adjective is negative or positive on a 1 (perfectly negative) to 7 (perfectly positive) scale*." The instructions of each hit were followed by one adjective and a scale for ranking.

Survey 2 measured conjunctivity and disjunctivity. All the examples with a given adjective and its antonym began with a general question such as "how is Bill doing?", which was continued by 12 different answers, corresponding with 12 experimental conditions that table 1 illustrates with the antonym pair *healthy-sick*.

		How is Bill doing? Context adj	**How is Bill doing? Context antonym**
Positive	**Basic**	Healthy.	Sick.
contexts	**Dim 1**	Healthy except for high blood pressure.	Sick except for normal blood pressure.
	Dim 2	Healthy except for the flu.	Sick except for no flu.
	Dim 3	Healthy except for the chickenpox.	Sick except for no chickenpox.
Negative	**Basic**	Not healthy.	Not sick.
contexts	**Dim 1**	Not healthy, except for normal blood pressure.	Not sick, except for high blood pressure.
	Dim 2	Not healthy, except for no flu.	Not sick, except for the flu.
	Dim 3	Not healthy, except for no chickenpox.	Not sick, except for chickenpox.
Modified	**Mod1**	Perfectly healthy.	Perfectly sick.
contexts	**Mod2**	Slightly healthy.	Slightly sick.
	Mod3	Not all that healthy.	Not all that sick.
	Mod4	Rarely healthy.	Rarely sick.

Table 1: Survey 2 "Conjunctivity and disjunctivity", examples of the conditions

First, 3 dimensional conditions assesed the felicity of the form "A except dim" with three different dimensions per adjective A, namely the felicity of exception phrases modifying non-negated adjectives, i.e., adjectives in positive contexts. In such contexts, exception phrases should be weakening implicit universal quantifiers over dimensions. High felicity ranks would therefore suggest that the implicit quantifier mediating an adjective's interpretation in different uses is universal or quasi universal. Low felicity rates would suggest a non universal force.

Second, 3 corresponding "Not A except dim" conditions assessed the felicity of exception phrases modifying adjectives in negative contexts, i.e. contexts in which adjectives are in the scope of negation. High felicity ranks would suggest that the implicit quantifier mediating

interpretation is existensial, and therefore, when the adjective is in the scope of negation it is interpreted as universal on its dimensions. Low felicity rates would suggest non existential force.

Third, 2 basic conditions assessed the felicity of adjectives in positive and negative contexts, as in *Bill is healthy* and *not healthy*, in attempt to control for the reduced felicity of adjectives – and in particular negative antonyms – in negative contexts (cf. *Bill is unsucceful* vs. ?*not unsucceful*; Giora 2006). Hence, the **conjunctivity** of an adjective A was modeled as A's averaged felicity in the positive context dimensional conditions (the felicity of "A except dim") minus A's felicity in the positive context basic condition (the felicity of "A"). **Disjunctivity** was modeled as A's averaged felicity in the negative context dimensional conditions (the felicity of "not A except dim") minus A's felicity in the negative context basic condition ("not A"). The question is whether the occurrence vs. absence of negation is associated with differential felicity of exception phrases, even if the effect of negation itself on felicity is factored out. The predictions were a tendency of positive adjectives to be more conjunctive than disjunctive, and more conjunctive than their negative antonyms, for which an opposite tendency towrd disjunctivity was predicted.

Finally, 4 modified conditions assessed the felicity of adjectives preceded by modifiers, including *perfectly, not all that, slightly* and *rarely*. Based Sassoon's (2012) corpus study, acceptability of modifiers like *perfectly* was predicted to reflect conjunctivity, and based on the interesting morphosyntacx of the negative modifier *not all that*, its acceptability was suspeted to cue dimension binding too (either conjunctivity or disjunctivity). *Slightly* and *rarely* are interesting for reasons that, unfortunately go beyond this paper's space and scope.

The 432 resulting target texts (36 adjectives time 12 conditions) were counterbalanced into 72 lists. Each list was published in AMT in the form of a hit with 19 texts, including 17 fillers (sentences of other 3 experiments) and 6 target texts (1 basic, 3 dimensional, and 2 modified). The adjectives in different target texts in a list were never identical, and they were counterbalanced for positive vs. negative contexts and antonyms. Each list began with a clearly good and a clearly bad filler. The remaining texts in a list were presented in a randomized order, and so were the lists. The instructions said: *"** This hit is for English native speakers only! ** Rate the following sentences by how natural they sound to you as an English native speaker. For example, to me, the sentence "Bill didn't see anything" is a perfectly natural sentence, so I give it '7'. However, the sentence "Bill saw anything" is perfectly unnatural (me or my friends would never use such a combination of words), so I give it '1'. Notice that you have to rate ALL sencences in order to complete the hit and get credit for it."*

2.2 Results

2.2.1 Polarity

As table 2 shows, the antonym pairs divided to positive vs. negative antonyms, such that the positive ones ranked on average above 4.15 (M = 5.9, SD = .93), and the negative ones ranked below 3.4, with the exception of the borderline 4 ranking for *conservative* (M = 2.15, SD = .85). A Wilcoxon signed-ranks test for 18 negative and positive antonym pairs confirms that the adjectives that are classified as positive are judged to be significantly more positive than those that are classified as their negative antonyms (W = 171, n = 18, z = 3.71, P = .0002). This relation holds of all of the pairs. We can therefore proceed to test whether positivity and negativity are associated with conjunctivity and disjunctivity, respectively.

	POS ADJ:	M	SD	NEG ADJ:	M	SD	M_{pos} - M_{neg}
1.	Healthy	**6.6**	**0.58**	Sick	**1.5**	**1.12**	5.1
2.	Good	**6.45**	**0.74**	Bad	**1.1**	**0.30**	5.35
3.	Identical	**4.15**	**0.85**	Dissimilar	**2.8**	**0.81**	1.35
4.	Similar	**4.5**	**0.81**	Different	**3.4**	**1.02**	1.1
5.	Typical	**4.2**	**1.08**	Atypical	**3.2**	**0.93**	1
6.	Normal	**5.65**	**1.28**	Abnormal	**1.8**	**0.68**	3.85
7.	Familiar	**5.8**	**0.75**	Unfamiliar	**2.6**	**0.97**	3.2
8.	Clean	**6**	**1.73**	Dirty	**1.65**	**1.01**	4.35
9.	Safe	**6.5**	**0.67**	Dangerous	**2**	**1.00**	4.5
10.	Innovative	**6.2**	**0.98**	Conservative	**4**	**1.30**	2.2
11.	Clever	**6.4**	**0.97**	Unclever	**1.7**	**0.71**	4.7
12.	Excellent	**6.9**	**0.30**	Terrible	**1.1**	**0.44**	5.8
13.	Tasty	**6.25**	**0.62**	Tasteless	**1.45**	**0.67**	4.8
14.	Happy	**6.65**	**1.11**	Unhappy	**1.55**	**1.16**	5.1
15.	Beautiful	**6.55**	**1.32**	Ugly	**1.15**	**0.48**	5.4
16.	Intelligent	**6.7**	**0.90**	Stupid	**1.4**	**1.32**	5.3
17.	Experienced	**6.2**	**0.75**	nexperienced	**2.40**	**.97**	3.8
18.	Successful	**6.7**	**0.90**	Unsuccessful	**1.65**	**0.79**	5.05
TOTAL	**Means**	**5.90**	**0.93**	**Means**	**2.15**	**0.85**	**3.72 (1.7)**

Table 2: The means and standard deviations of the antonym polarity rankings of 25 participants per adjective.

2.2.2 Dimension binding in polar antonyms

Table 3 presents the means of the 18 mean judgments of 25 participants per adjective for each one of the four groups of positive and negative adjectives in positive and negative contexts (the means per adjectives are found in the appendix). As the table suggests and a Wilcoxon signed-ranks test confirms, adjectives are significantly more felicitous in positive than in negative (negated) contexts, either with an exception phrase ($W = 512$, $n = 36$, $z = 4.2$, $P < .0001$) or without one ($W = 652$; $n = 36$; $z = 5.12$, $P < .0001$). In addition, positive adjectives are more felicitous than their negative antonyms, either when modified with an exception phrase ($W = 373$, $n = 35$, $z = 3.05$, $P < .003$) or without one ($W = 457$, $n = 35$, $z = 3.74$, $P = .0002$).

Hence, in order to use the felicity of exception phrases as a test for universal dimension binding, we have to factor out the effect of negation. Thus, as explained above, for each adjective A, we take A's conjunctivity to be reflected by the felicity of "A except dim" minus the felicity of "A", and A's disjunctivity to be reflected by the felicity of "not A except dim" minus the felicity of "not A". We also take the difference between A's conjunctivity and disjunctivity, 'Conj-Disj', to uniformly reflect an adjective's tendency toward universality and away from existentiality on its dimensions. As Table 4 shows and a Spearman test for the significance of a rank order correlation confirms, there is a moderate to strong correlation between the 1 to 7 positivity rankings of the 36 adjectives and their conjunctivity minus disjunctivity scores ($r = .71$; $t = 5.9$, $P < .0001$).

POS A:	M	SD	**POS A:**	M	SD	**NEG A:**	M	SD	**NEG A:**	M	SD
A:	6.20	1.08	**Not A:**	5.20	1.64	**A:**	5.66	1.35	**Not A:**	4.17	1.73
A except:	5.34	1.59	**Not A except:**	3.56	1.81	**A except:**	3.90	1.85	**Not A except:**	3.68	1.84

Table 3: Means and standard deviations of the felicity judgments of 25 participants per item in the conditions 'A', 'not A', 'A except dim' and 'not A except dim', for three dimensions per adjective.

	POS ADJ:	Conj +5	Disj + 5	Conj-Disj	**NEG ADJ:**	Conj +5	Disj + 5	Conj-Disj
1.	Healthy	4.61	2.05	2.57	Sick	1.2	3.03	-1.83
2.	Good	4.85	4.31	0.54	Bad	4.43	5.12	-0.69
3.	Identical	4.73	3.84	0.89	Dissimilar	4.44	5.82	-1.38
4.	Similar	4.74	5.47	-0.72	Different	4.26	4.73	-0.47
5.	Typical	4.72	3.84	0.88	Atypical	3.37	3.8	-0.43
6.	Normal	2.99	3.1	-0.11	Abnormal	2.72	5.23	-2.51
7.	Familiar	3.86	3.99	-0.13	Unfamiliar	3.66	4.41	-0.75
8.	Clean	4.9	0.63	4.27	Dirty	1.56	4.88	-3.32
9.	Safe	2.56	1.45	1.11	Dangerous	1.99	4.72	-2.73
10.	Innovative	4.6	4.26	0.34	Conservative	4.51	5.07	-0.56
11.	Clever	4.02	3.64	0.38	Unclever	4.76	4.71	0.05
12.	Excellent	2.45	3.83	-1.38	Terrible	2.55	3.16	-0.61
13.	Tasty	3.43	3.76	-0.33	Tasteless	2.92	3.71	-0.79
14.	Happy	4.69	1.54	3.15	Unhappy	2.75	4.31	-1.57
15.	Beautiful	4.61	4.38	0.23	Ugly	2.48	4.47	-1.99
16.	Intelligent	4.11	3.44	0.66	Stupid	3.02	3.95	-0.93
17.	Experienced	4.61	4.04	0.57	Inexperienced	4.62	5.19	-0.57
18.	Successful	4.15	2.88	1.26	Unsuccessful	3.04	4.77	-1.73
TOTAL		**4.15**	**3.36**	**0.79**		**3.24**	**4.50**	**-1.27**

Table 4: For each adjective A, A's conjunctivity is the felicity of "A except dim" minus the felicity of "A"; A's disjunctivity is the felicity of "not A except dim" minus the felicity of "not A".

Moreover, a two-way factorial analysis of variance for 2 matched samples of 18 negative vs. 18 positive adjectives with 2 repeated measures, conjunctivity and disjunctivity, reveals a significant interaction ($F = 27.93$, $P < .0001$), due to which neither is the main effect for antonym polarity significant ($M_{pos} = 3.75$, $M_{neg} = 3.87$; $F = .2$, $P = .66$), nor is the main effect for conjunctivity vs. disjunctivity ($M_{con} = 3.69$, $M_{dis} = 3.93$; $F = 1.51$, $P = .23$). Furthermore, a Wilcoxon test confirms the significance of the 4 relevant simple effects. Positive adjectives are more conjunctive than disjunctive ($W = 107$, $n = 18$, $z = 2.32$, $P < .021$), while negative adjectives are less so ($W = -169$, $n = 18$, $z = -3.67$, $P = .0002$). In addition, positive adjectives are more conjunctive than their negative antonyms ($W = 141$, $n = 18$, $z = 3.06$, $P < .003$), while negative adjectives are more disjunctive than their positive bases ($W = 139$, $n = 18$, $z = 3.02$, $P < .003$). To illustrate the interaction, the adjectives in figure 1 are ordered by the difference between their conjunctivity and disjunctivity values. Thus ordered, all the positive adjectives fall at the left side of the figure, and all the negative ones fall at the right side, with but few exceptions, including the balanced negative adjective *unclever*, and the positive adjectives *similar* and *excellent*, which are markedly less conjunctive than disjunctive.

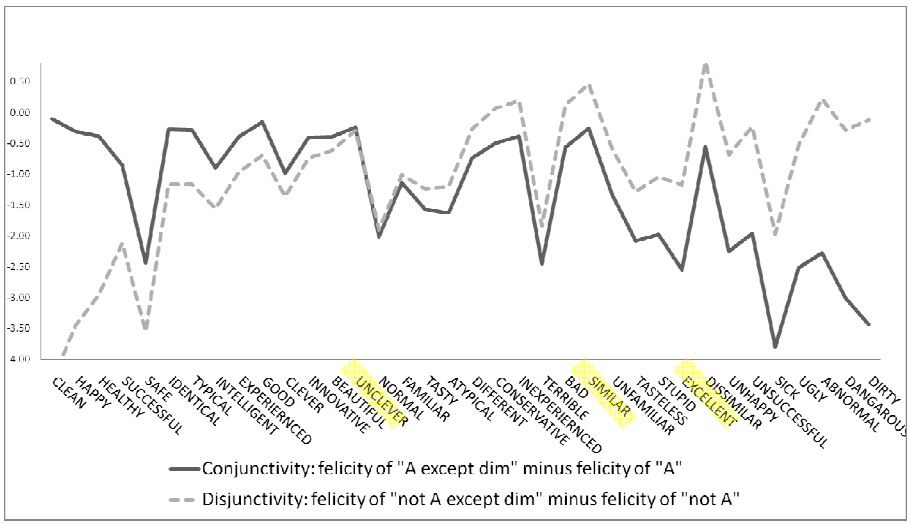

Figure 1: Interaction between dimension binding (conjunctivity vs. disjunctivity) and antonym polarity.

2.2.3 Modifiers as cues for dimension binding

The Spearman rank-order correlation test for 36 matched pairs yields a moderate to strong correlation between mean judgments per adjective of felicity with *perfectly* and universality over dimensions, Conj-Disj ($r = .71$, $t = 5.88$, $p < .0001$), as well as between felicity with *perfectly* and an adjective's positivity ($r = .72$, $t = 5.97$, $p < .0001$), and a weak to moderate correlation between mean judgments per adjective of felicity with *not all that* and universality ($r = .44$, $t = 2.84$, $P < .008$), as well as positivity ($r = .35$, $t = 2.19$, $P < .036$).[2] Furthermore, the felicity of *perfectly* is higher in positive ($M = 4.92$, $SD = 1.72$) than negative ($M = 2.68$, $SD = 1.67$) antonyms ($W = 171$, $n = 18$, $z = 3.71$, $P < .0001$), and so is the felicity of *not all that* ($M_{pos} = 5.12$, $SD = 1.83$; $M_{neg} = 4.22$, $SD = 1.93$; $W = 135$, $n = 18$, $z = 2.93$, $P < .004$).[3] Finally, a Mann-Whitney comparison of the 14 strictly more conjunctive than disjunctive adjectives and the rest yields higher felicity of *perfectly* ($U = 262.5$, $z = -3.5$, $P < .0005$), and of *not all that* ($U = 208$, $z = -1.74$, $P < .082$) with the former.

2.2.4 The distribution of exception phrases

Finally, as a bonus, results pertaining to the distribution of exception phrases more generally can be provided, confirming their restriction to universal or quasi-universal sentences. The sentences in table 5 occurred amongst the fillers of survey 2. As the table shows, exception phrases are more felicitous within universally quantified statements than existentially quantified ones ((1a) vs. (1b)) and negated universal ones ((2a,c) vs. (2b); (3a) vs. (3b), (4a) vs. (4c)).

[2]The correlation of conjunctivity with felicity is weak to moderate for *perfectly* ($r = .41$, $t = 2.64$, $P < .013$) and *not all that* ($r = .34$, $t = 2.14$, $P < .04$). Also, a weak negative correlation between the felicity of *slightly* and positivity was only significant at 1-tailed P with 90% confidence ($P = .095$). Other correlations did not enter significantly.

[3]With *slightly* again we only obtain 1–tailed P significance at the 90% level ($P = .09$) for higher felicity with negative antonyms ($M = 4.59$, $SD = 1.83$) than their positive bases ($M = 4.18$, $SD = 1.78$).

	M	SD	MED		T	P
1a. You can observe this in **any** relationship, except for rare cases	5.44	1.75	5.00	a>b:	5.27	.0001
1b. You can observe this in **some** relationship, except for rare cases	2.64	2.00	1.00			
2a**. Everyone** is dancing, except for Bill	6.80	0.80	7.00	a>b:	8.44	.0001
2b**. Everyone** is **not** dancing, except for Bill	2.96	2.13	2.00	c>b:	3.12	.0031
2c**. No** girl is playing, except for Mary	4.92	2.31	6.00	a>c:	3.85	.0004
3a**. Anything** we do works well, except for this thing	5.09	1.50	5.00	a>b:	6.33	.0001
3b**. Not anything** we do works well, except for this thing	2.17	1.75	1.00			
4a**. Most** of these books are liberal, except the newest one	6.20	1.30	7.00	a>c:	11.8	.0001
4b**. Most of** these books are conservative except the newest one	6.12	1.56	7.00	a>d:	2.72	.009
4c**. Not most of** these books are liberal, except the newest one	1.83	1.31	1.00	d>c:	6.55	.0001
4d. **Few of** these books are liberal, except the newest one	4.92	1.96	5.00	2a>4a:	1.97	.055
4e. **Most** students are happy except the new ones	5.36	1.72	6.00	a>e	1.95	.057
5a. His office is tidy, except **where** the coffee cups are	6.32	1.12	7.00			
5b. His office is not messy, except **where** the coffee cups are	6.12	1.34	7.00			

Table 5: The distribution of exception phrases

Moreover, although felicitous, quasi universal quantifiers, like *most* that conveys roughly 'almost all', seem to be slightly less good than strictly universal ones, at a 90% level of confidence ((2a) vs. (4a)). Moreover, the significant difference between negated *most* in (4c) and *few* in (4d) suggests that *few* can be analysed as quasi universal conveying roughly 'almost no'.

In addition, significantly, negative universals and quasi universals are less good than positive ones ((2c) vs. (2a); (4d) vs. (4a)). Finally, in the felicituous (5a,b), the exception phrase weakens a locative adjunct of an adjective (like *everywhere* or *anywhere*). Together with the data about dimensional uses of exception phrases, this suggests that exception phrases form a good tool for the investigation of the default force of implicit operations in grammar more generaliy.

2.3 Discussion

The hypotheses were confirmed supporting the proposal that at the multidimensional level positivity is linked with conjunctivity, i.e. universal generalizations (healthy in all respects, clean of any dirt type, etc.), while negativity is linked with disjunctivity – the existence of a counterexample to a positive generalization (*sick* conveys not healthy in all respects; *dirty* conveys not free of any dirt-type, etc.). Thus, the dimensions of positive adjectives like *healthy* tend to combine via an implicit universal quantifier (*healthy* $\Leftrightarrow \lambda x.\forall Q \in DIM_{healthy}$, healthy-wrt(x,Q), whereas those of their negative antonyms tend to combine via an implicit existential quantifier (*sick* $\Leftrightarrow \lambda x.\neg\forall Q \in DIM_{healthy}$, healthy-wrt(x,Q). The latter reduces to $\lambda x.\exists Q \in DIM$, $\neg$healthy-wrt(x,Q)).

These results are significant as they complement those of a corpus study. Each methodology (corpus analysis vs. judgment investigation) has its pros and cons, but converging results prove the predictive strength of a proposal. Notice also that the rank-order correlation for 30 pairs representing conjunctivity and disjunctivity values as measured by corpus frequencies vs. mean acceptability judgments is significant ($r = .45$, $t = 2.63$, $p < .014$).

The new account is economic in that dimensions need to be lexically specified only for positive adjectives, thereby explaining their cognitive prominence. In addition, as a default dimensions are conjoined. Negative antonyms reference negated dimension conjunctions,

explaining their relative complexity and so-called negative connotations. Furthermore, the cognitive adequacy of the account is supported in that modifiers like *perfectly* and *not all that* seem to provide cues for universal dimension binding, explaining how speakers might figure out which adjectives are positive and conjunctive.

Does the fact that speakers regard borderline entities as e.g. *neither healthy nor sick* speak against a logical-negation analysis of *sick*? A number of studies suggest the contrary. Gaps characterize also logical negations (Solt, S. & Gotzner, N. 2010). However, an analysis of the facts by means of a special adjectival negation, more in line with, e.g., Heim (2008), can proceed as follows. Multidimensional adjectives may be optionally associated with a degree function f_A from entities x to the number of their dimensions which are true of x, e.g., $f_M(\text{healthy}) = \lambda x \in D_x.|\{D \in DIM_M(\text{healthy}): [D(x)]_M = 1\}|$. On such an analysis, **conjunctivity** reduces to interpretations relative to a maximum standard – $|Dim_M(\text{healthy})|$ (or alternatively 0), and **disjunctivity** reduces to failure to reach this end. If $[\text{healthy}(x)]_M = 1$ iff $f_M(\text{healthy})(x) \geq |DIM_M(\text{healthy})|$ (which reduces to $\forall D \in DIM_M(\text{healthy}): [D(x)]_M = 1$), the antonym interpretation may be derived through antonymy negation: $[\text{sick}(x)]_M = 1$ iff $[\neg\text{healthy}(x)]_M = 1$ (which reduces to $\exists D \in DIM_M(\text{healthy}): [\neg D(x)]_M = 1$).

These strict universal vs. existential interpretations may easily shift to quasi universal vs. existential ones, 'mostly healthy' and 'not mostly healthy', respectively, by decreasing the maximum standard of *healthy* and increasing the minimum standard of *sick*, such that $[\text{healthy}(x)]_M = 1$ iff $f_M(\text{healthy})(x) >> |DIM_M(\text{healthy})|/2$, which reduces to $|\{D \in DIM_M(\text{healthy}): [D(x)]_M = 1\}| >> |\{D \in DIM_M(\text{healthy}): [D(x)]_M \neq 1\}|$ (x is healthy in most respects), whereas $[\text{sick}(x)]_M = 1$ iff $[\neg\text{healthy}(x)]_M = 1$, which reduces to: $\neg(f_M(\text{healthy})(x) >> |DIM_M(\text{healthy})|/2)$ (x is not healthy in most respects). Notice that this interpretation is compatible with entities being either borderline or even sick in most respects. The latter option yields a quasi-universal interpretation for negative adjectives ('mostly sick'). The data in this paper is not incompatible with that, as existentials and quasi universals are less appropriate with exception phrases than quasi universals and strict universals are, respectively (cf. 2.2.4).

Moreover, the association of multidimensional adjectives with measures of number of dimensions true of entities explains the felicity of certain cross polar nomalies. One dimensional cross polar comparisons like *the ladder is shorter than the house is high* are more felicitous than corresponding comparisons like ??*the ladder is higher than the house is short* (Buring 2007). By contrast, *her brothers are more similar than they are {different, dissimilar}* and *her brothers are more {different, dissimilar} than they are similar* are good in the interpretation "the cardinality of the similarity (difference) dimensions true of her brothers is higher than that of the difference (similarity) dimensions true of them". These two cardinalities are comparable, especially when based on one and the same set of dimensions in the context of utterance. Other cross polar nomalies might be explained by means of multidimensionality such as *more apparent than real, more dead than alive* (in a metaphoric sense), and *more positive than negative***.**

Next we turn to study II to test whether entities that violate one of the dimensions of a conjunctive adjective classify within or outside the denotation of the adjective, and how they compare to entities that do not violate a dimension but have lower dimensional degrees overall.

2.4 Study II: classification of entities violating a dimension

2.4.1 Method

Four groups of 25 participants were recruited via AMT. They read the following instructions. *Please read carefully the short paragraph and then answer ALL of the following questions. Notice that this survey is intended for English native speakers only. Consider a context in which health of individuals is measured by their values in medical blood tests for* D1, D2 and D3. *Imagine that Dan has the optimal degree in two of these tests, but he is not within the norm in the third. Conversely, imagine that in all these tests, Sam's levels are within the normative range, but they are the lowest possible normative values. Thus, all in all, Dan's average score on the tests is higher than Sam's.* The dimensions D1-D3 varied between groups. The 'stable dimension' groups had *blood pressure, cholesterol and sugar (a measure of diabetics)*, and the 'transient dimension' groups had *pneumonia, flu and chickenpox*. The instructions were followed by 3 yes-no questions: *Is Dan healthy?, Is Sam healthy?* and *Is Dan healthier than Sam?* Moreover, AMT workers often provide fast and therefore possibly approximate responses. Hence, the participants of the 'justified-answer' groups were asked to justify their answers (each question was followed by an open question *why?*), while the others were not.

According to the proposal explored in this paper, a high rate of 'no' answers was expected for the first question (for Dan isn't healthy in all respects), a low rate of 'no' was expected in the second question (for Sam *is* healthy in all respects), and a high rate was expected again in the third question (for Dan is healthy and Sam isn't). Additionally, the rate of 'no' for the first question was expected to be higher in justified-answer and transient dimension groups.

2.4.2 Results and discussion

Sam was regarded healthy in 94% of times, and Dan was regarded as healthier than Sam in but 18% of times. These response patterns suggest that participants did not compare Sam's mean in the dimensions to Dan's mean. Had they done that, they would have judged Dan to be healthier than Sam, but they didn't. Arguably, their default interpretation of *healthy* involved implicit universal quantification over dimensions. However, Dan was regarded as *not healthy* in only 64% of the answers. Apparently, slightly more than a third of the participants were willing to compromise for a weak, quasi universal interpretation such as 'healthy in most dimensions'.

A closer look at the results in table 6 suggests that instability of dimensions and justification of answers play a role. The justified-answer group with transient respects confirmed the expectations best (76%, 4% and 80% no's), whereas the non-justified answer group with stable dimensions failed to confirm them. A Chi square test shows that dimension type, stable vs. instable, is associated with classification of entities violating a dimension ($\chi = 7.003$; $P < .009$), whereas justified vs. unjustified categorization decisions are almost but not quite significantly associated with classification ($\chi = 2.57$; $P < .109$).

Overall, instable dimensions prevent a shift from 'all' to 'most' in most categorization decisions – 69% 'no' answers to question 1 (CI = [56%,81%], P = .05) vs. 43% in cases of stable dimensions ([30%-57%]). Additionally, justification of categorization decisions prevents a shift from 'all' to 'most' in most categorization decisions – 64% 'no' answers to question 1 (CI = [50%,76%], P = .05), vs. 48% 'no' answers in unjustified decisions ([35%,62%]).

'NO'%	**Justified answers**			**Unjustified answers**		
	Is Dan healthy?	Is Sam healthy?	Is Dan healthier than Sam?	Is Dan healthy?	Is Sam healthy?	Is Dan healthier than Sam?
Transient dimensions:	76	4	80	63	0	71
Stable dimensions:	52	8	84	33	21	63

Table 6: Percentage of 'no answers in 4 groups of 25 participants differing by the stability of the dimensions and the precision level of the response.

In sum, in the circumstances described in this task, most people tend to say that one disease is sufficient for classification of entities as *not healthy*, supporting a conjunctive interpretation for *healthy*, but many times people are willing to compromise, supporting 'most' as a possible basis for interpretation. The comparative *healthier* tends to either be determined by denotation membership (healthy entities are healthier than non healthy ones), or by number of dimensions true of entities (3 > 2).

3 Conclusions

The positive results obtained in this study, although preliminary, deepen our understanding of antonymy and multidimensionality. The study of these topics will profit if the generality of the proposal and its consequences (e.g., its connections to the scale-structure of adjectives and to vagueness) are explored further in the future both in theory and in practice.

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Appendix

	CONTEXT:	**POS**		**NEG**		**CONTEXT:**	**POS**		**NEG**	
I.	**POS ADJ:**	**M**	**SD**	**M**	**SD**	**NEG ADJ:**	**M**	**SD**	**M**	**SD**
1.	Healthy	5.57	1.60	2.51	1.86	Sick	2.20	1.52	2.23	1.64
2.	Good	6.51	0.93	5.61	1.51	Bad	6.13	1.10	6.75	0.57
3.	Identical	6.46	0.85	4.45	2.22	Dissimilar	3.80	2.12	3.57	1.99
4.	Similar	5.79	1.53	5.11	1.60	Different	5.31	1.57	4.57	1.88
5.	Typical	5.43	1.61	3.52	2.15	Atypical	3.21	1.97	3.52	1.98
6.	Normal	3.60	2.10	2.26	1.25	Abnormal	1.84	1.09	2.36	1.50
7.	Familiar	4.95	2.03	4.07	2.03	Unfamiliar	4.41	2.03	3.61	2.09
8.	Clean	6.62	0.64	1.59	1.02	Dirty	3.23	2.02	5.59	1.56
9.	Safe	3.79	2.35	2.41	1.87	Dangerous	2.07	1.59	3.28	2.30
10.	Innovative	6.14	1.27	4.43	2.07	Conservative	5.59	1.72	4.19	2.18
11.	Clever	4.56	1.88	3.77	2.02	Unclever	3.20	2.01	2.51	1.73
12.	Excellent	4.16	2.23	2.63	1.68	Terrible	4.20	2.30	3.45	2.30
13.	Tasty	4.91	2.00	3.52	2.22	Tasteless	3.44	2.09	1.91	1.22
14.	Happy	6.13	1.17	3.11	2.05	Unhappy	4.15	2.41	4.19	2.27
15.	Beautiful	5.94	1.23	2.90	1.64	Ugly	4.31	1.97	3.71	2.02
16.	Intelligent	5.71	1.37	4.40	2.15	Stupid	4.43	2.28	4.16	2.01
17.	Experienced	5.74	1.52	5.40	1.54	Inexperienced	5.71	1.55	3.99	2.21
18.	Successful	4.15	2.35	2.32	1.65	Unsuccessful	2.96	2.03	2.60	1.68
TOTAL		**5.34**	**1.59**	**3.56**	**1.81**		**3.90**	**1.85**	**3.68**	**1.84**
II.	**POS ADJ:**	**M**	**SD**	**M**	**SD**	**NEG ADJ:**	**M**	**SD**	**M**	**SD**
1.	Healthy	**5.96**	**1.30**	**5.46**	**1.71**	Sick	**6.00**	**1.38**	**4.20**	**1.77**
2.	Good	**6.67**	**0.62**	**6.30**	**1.20**	Bad	**6.70**	**0.62**	**6.63**	**0.70**
3.	Identical	**6.73**	**0.62**	**5.61**	**1.34**	Dissimilar	**4.36**	**2.13**	**2.75**	**1.61**
4.	Similar	**6.04**	**1.33**	**4.64**	**1.92**	Different	**6.04**	**1.02**	**4.84**	**1.93**
5.	Typical	**5.71**	**1.77**	**4.68**	**1.93**	Atypical	**4.84**	**1.59**	**4.72**	**2.03**

6.	Normal	**5.61**	**1.24**	**4.16**	**2.07**	Abnormal	**4.12**	**2.10**	**2.13**	**1.23**
7.	Familiar	**6.09**	**1.10**	**5.08**	**2.08**	Unfamiliar	**5.75**	**1.48**	**4.20**	**1.85**
8.	Clean	**6.73**	**0.75**	**5.96**	**1.31**	Dirty	**6.67**	**0.62**	**5.71**	**1.37**
9.	Safe	**6.23**	**0.79**	**5.96**	**1.37**	Dangerous	**5.08**	**2.08**	**3.56**	**2.21**
10.	Innovative	**6.55**	**0.78**	**5.17**	**1.80**	Conservative	**6.09**	**1.25**	**4.12**	**1.97**
11.	Clever	**5.54**	**1.78**	**5.13**	**1.54**	Unclever	**3.44**	**2.12**	**2.80**	**2.17**
12.	Excellent	**6.71**	**0.61**	**3.80**	**2.28**	Terrible	**6.65**	**0.63**	**5.29**	**1.79**
13.	Tasty	**6.48**	**0.83**	**4.76**	**2.08**	Tasteless	**5.52**	**1.56**	**3.20**	**1.98**
14.	Happy	**6.43**	**0.82**	**6.57**	**0.71**	Unhappy	**6.40**	**0.85**	**4.88**	**1.36**
15.	Beautiful	**6.33**	**0.99**	**3.52**	**1.84**	Ugly	**6.83**	**0.38**	**4.24**	**1.73**
16.	Intelligent	**6.61**	**0.82**	**5.96**	**1.23**	Stupid	**6.41**	**0.94**	**5.21**	**1.66**
17.	Experienced	**6.13**	**1.26**	**6.36**	**0.83**	Inexperienced	**6.09**	**1.35**	**3.80**	**2.19**
18.	Successful	**5.00**	**2.02**	**4.44**	**2.26**	Unsuccessful	**4.92**	**2.15**	**2.83**	**1.55**
TOTAL		**6.20**	**1.08**	**5.20**	**1.64**		**5.66**	**1.35**	**4.17**	**1.73**

Table 7: Means per adjective of the felicity judgments of 25 participants of: I. 'A except dim' and 'not A except dim', for three dimensions per adjective, and II. 'A' and 'not A'.