Spanish diminutives and neocognitron-type neural processing

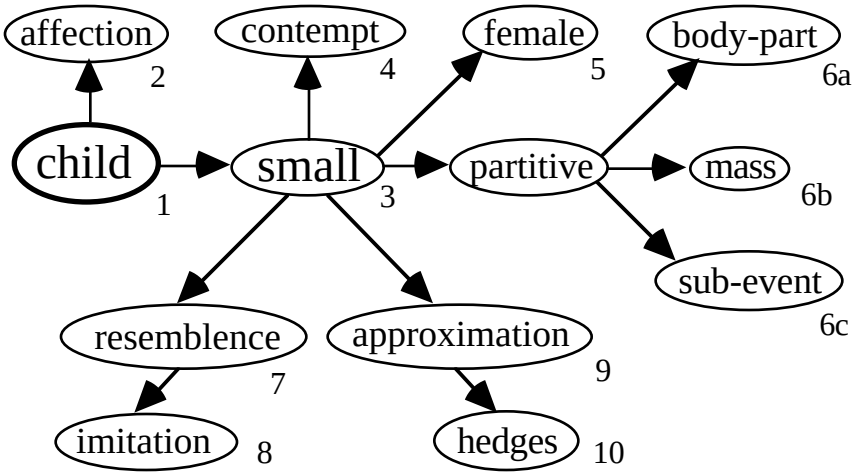
Harry Howard

Tulane University

The radial-category theory of diminutives

Jurafsky (1993) surveys a variety of genetically unrelated and geographically dispersed languages to uncover ten seemingly haphazard senses that reoccur among diminutive morphemes. He organizes these senses into the universal radial category of (1), in which all other senses are derived from the core sense of 'child':

1. Universal radial category of diminutives



The arrows represent the direction of change away from the core sense, and the numbers index the sequence of change. There is no room here to take up Jurafsky's many examples, but to give the reader an idea of the range of meanings covered, the table in (2) combines Jurafsky's examples of (1) drawn from English bound morphemes and the free morpheme *little*;

2.

	sense	bound forms	free "little"
[1]	child	duck**ling**	my **little** ones
[2]	affection	Bill**y**	my **little** friend
[3]	small	----	a **little** house
[4]	contempt	star**let**, child**ish**	you **little** so-and-so
[5]	female	major**ette**	the **little** woman
[6a]	body part	----	----
[6b]	mass	----	----
[6c]	sub-event	----	rest a **little**

[7]	resemblence	ham**let**	**little** finger
[8]	imitation	leather**ette**	----
[9]	approximation	green**ish**	a **little** tired
[10]	hedge	----	----

In this way, Jurafsky can tie the evolution of diminutive semantics into a broader theory of grammaticalization, in which meanings tend to become more abstract and more subjective or evaluative, vid. Traugott (1989), Sweetser (1990) and Heine et al. (1991).

Spanish diminutives, especially *-ito* vs.*-illo*

Spanish presents an interesting test case for Jurafsky's hypothesis of diminutive semantics, on two counts. On the one hand, it has a variety of productive diminutive suffixes, among which Lang (1990:101) lists those in (3):

3. Spanish diminutives: *-ito, -illo, -ico, -ete, -ín, -uelo*

On the other hand, it has the longest written record and greatest geographic diffusion of any Romance language, which should provide sufficient latitude for the tendencies in (1) to manifest themselves.

In this paper, we concentrate on the first two suffixes listed by Lang, *-ito* and *-illo*, which appear to be the most productive. The table in (4) exemplifies the senses of (1) that are attested by *ito* or *-illo*, in Andalusian Spanish:

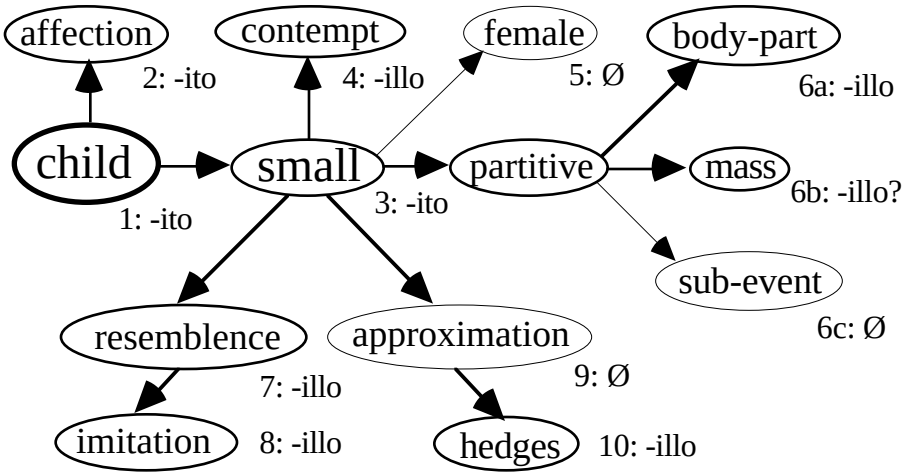
4.

	root	*-ito*	*-illo*
a)	gato	gatito	gatillo
	cat	1: kitten, 3: small cat	4: good-for-nothing cat; trigger (of a gun)
b)	tía	tiíta ~ tita	* tiílla
	aunt	2: 'auntie'	
c)	casa	casita	casilla
	house	3: small house	7/8: pigeonhole
d)	abogado	abogadito	abogadillo
	lawyer	3: small lawyer	4: third-rate lawyer
e)	barba	barbita	barbilla
	chin	3: small chin	6a: point of the chin
f)	picado	picadito	picadillo
	chopped finely	3: chopped very finely	6b: a mixture of finely chopped vegetables
g)	bomba	bombita	bombilla
	lamp globe	3: small lamp globe	7: light bulb
h)	mano	manita	manecilla

	hand	3: small hand	8: hand on a clock or watch
i)	verde	verdecito	?? verdecillo
	green	2: nice and green	
j)	pedazo	pedacito	pedacillo
	piece	3: small piece	10: insignificant piece

They instantiate the universal radial category of (1) as in (5):

5. Radial category of Spanish *-ito* and *-illo*



The question marks indicate almost unattested usages; the null sets indicate unattested usages.

The absence of a diminutive to name FEMALES [5] is to be expected in Spanish, given its highly productive system of masculine-feminine contrasts in grammatical gender, as exemplified in (6):

6 a) tío ~ tíos ~ tía ~ tías

uncle ~ uncles; aunts and uncles ~ aunt ~ aunts

b) niño ~ niña

child, boy ~ girl

c) gato ~ gata

generic cat, male cat ~ female cat

Thus no additional morphological mechanism is necessary. The absence of the SUB-EVENT usage [6c] apparently follows from a restriction against Spanish diminutives referring to abstract entities, as exemplified in (7):

7. amor ~ amorcito ~ amorcillo

love ~ *small love; little loved one ~ desultory love affair

The abstract meaning of 'love' is not preserved under diminutivization of *amor*; instead, the result is the affectionate sense applied to a concrete entity with *-ito* or a specific kind of 'event of loving' with *-illo*. The author does not know why Spanish has this particular lacuna, though one should not overlook the fact that Jurafsky's entire series of partitive usages [6a-6c] is only marginally attested in Spanish. Finally, the absence of the APPROXIMATION usage [9] may just be a gap in the data collected so far.

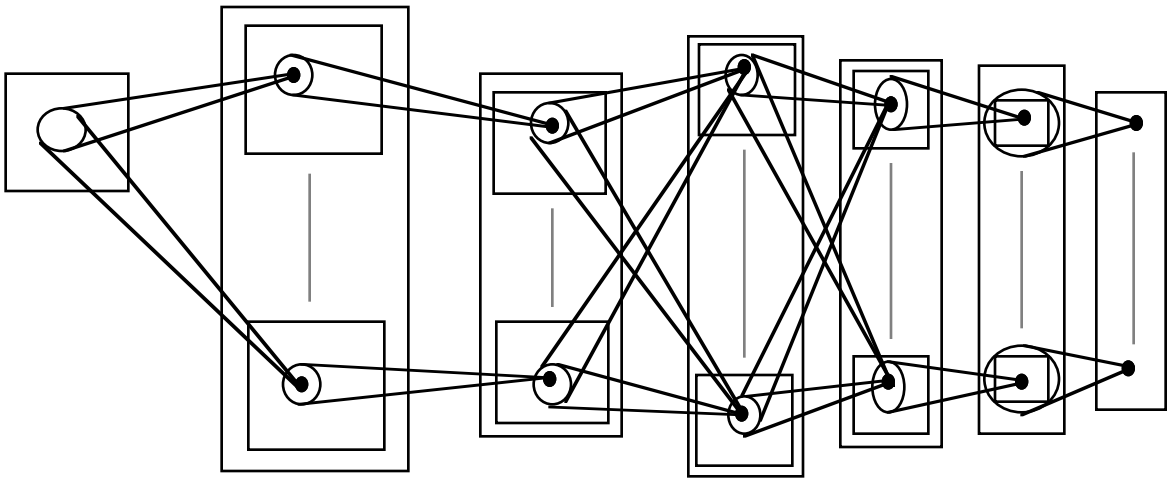
The challenge of *-itol-illo* and neocognitron-type neural processing

The radial organization of (1) and (5) offers no answers to several interesting questions. For instance, we would like to know why *-ito* and *-illo* trace out the paths that they do. In particular, we would like to know why *-ito* tends to have semantically transparent usages, while *-illo* tends to have less transparent, if not opaque, usages.

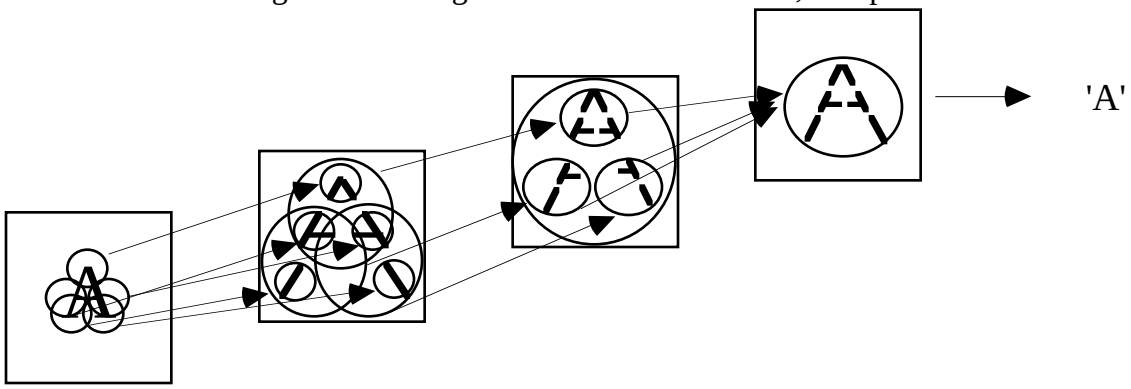
Neocognitron-type neural processing

The solution offered here is that the evolution from transparent to opaque usages – or from concrete to more abstract / subjective / evaluative meanings – is the result of neocognitron-type neural processing of the root morpheme. The neocognitron (Fukushima 1980, 1988, 1991, 1995) is a neural network model for deformation-resistant visual pattern recognition, based on the hierarchical structure of biological visual systems. In biological visual systems, simple features are first extracted from a stimulus pattern and then integrated into more complicated features. In such a hierarchy, a cell at a higher stage generally has a larger receptive field and is more insensitive to the position of the stimulus.

8. Network architecture of the neocognitron



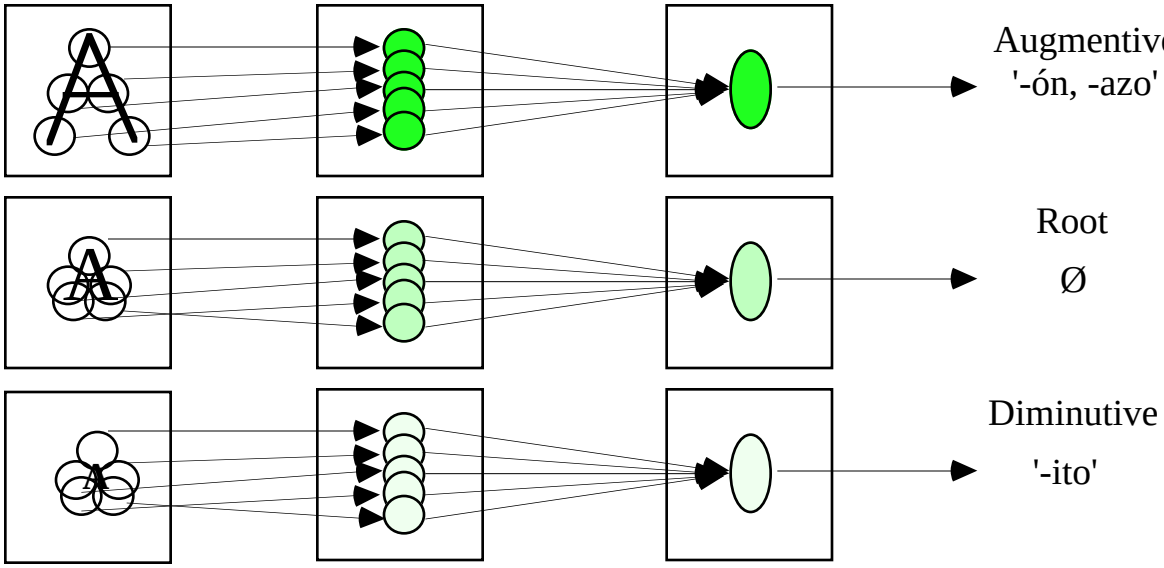
9. Neocognitron recognition of the letter ‘A’, simplified



Perception of size and completeness

In addition to this mechanism for recognizing the invariant visual qualities of an entity, we also need a mechanism for recognizing certain variant qualities, especially size. (10) is our first approximation to what is needed:

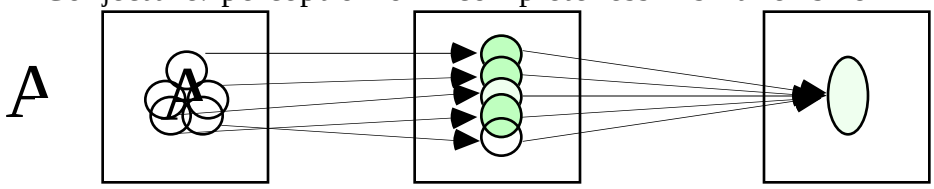
10. Collection of activation for size perception, as instantiated by affective morphology



The shading of the units corresponds to the level of activation of the neurons. The darkest units are the most highly activated; those that are perceiving the largest entities. It is this level of input that activates expressive morphology for larger than prototypical size, the augmentives. Conversely, the lighest units are the least highly activated; those that are perceiving the smallest entities. It is this level of input that activates expressive morphology for smaller than prototypical size, the diminutives. The middle levels of activation recognize prototypical size, which has no special marker and corresponds to the root form of a morpheme.

A result of this simple mechanism is that incompleteness can be perceived as smaller size, as diagrammed in (11):

11. Conjecture: perception of incompleteness ≈ smaller size

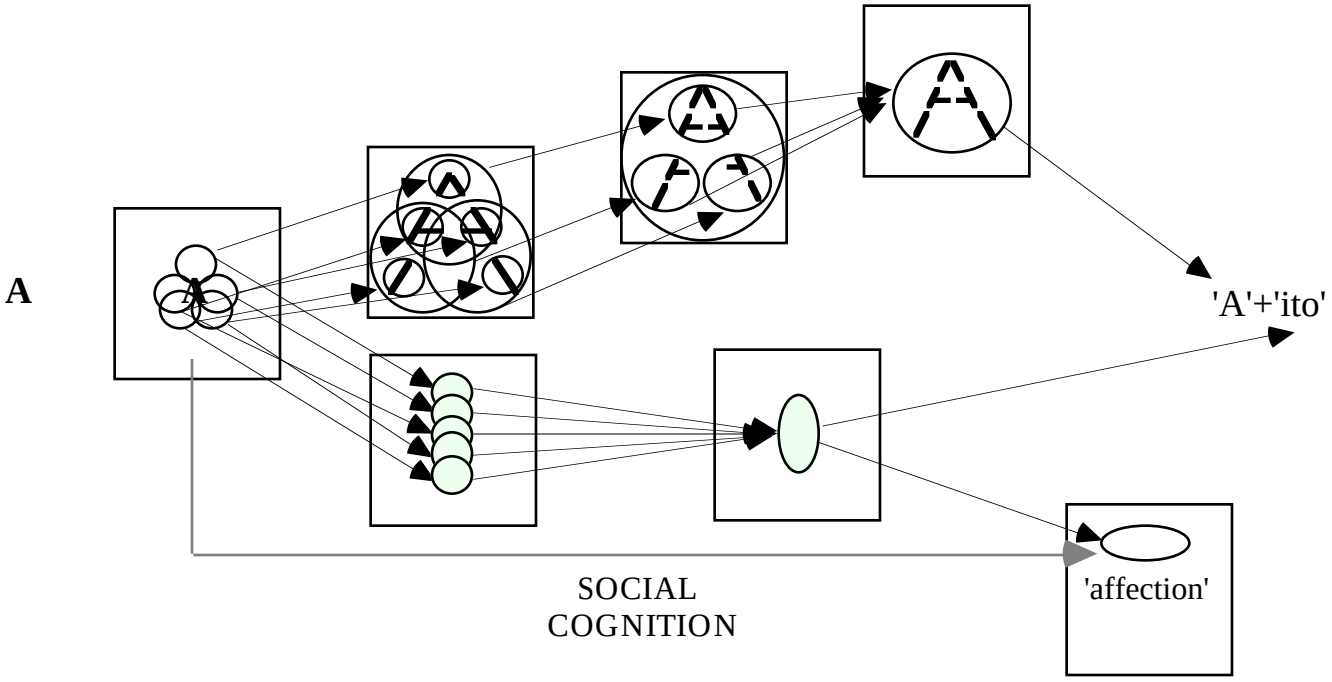


That is to say, the perception of an incomplete entity leads to a less-than-prototypical activation of the size pathway, which can be interpreted as less-than-prototypical size. This is the key to the difference between the transparent / opaque bifurcation between *-ito* and *-illo*.

The diminutive in *-ito*

Returning to the specifics of Spanish, we would say that the senses of *-ito* correspond to the most direct instantiation of these two mechanisms.

11. Neocognitron recognition of the CHILD [1] and SMALL [3] usages of *-ito*, simplified



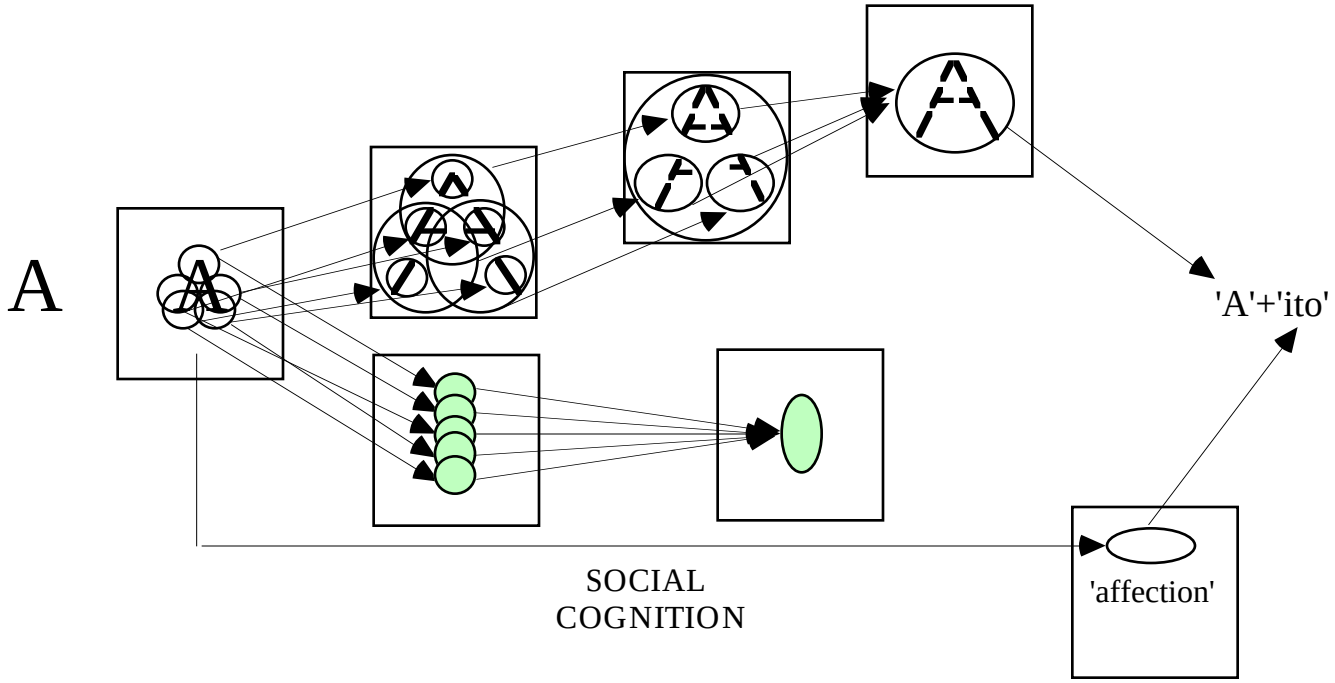
The idea is that the CHILD [1] usage springs from the prototypical small thing that humans are concerned with, namely their own children. The SMALL [3] usage is a generalization of this usage to any other entity.

For the AFFECTION [2] sense of *-ito*, consider the reasoning of Taylor (1995), with respect to Italian diminutives:

12. Human beings have a natural suspicion of large creatures; small animals and small children on the other hand can be cuddled and caressed without embarrassment or fear. The association of smallness with affection is thus grounded in the co-occurrence of elements within an experiential frame. Taylor (1995:145)

The usage can only be derived at a higher level of processing, at which such affective information becomes available. If it is used enough, it can become conventionalized as an alternative meaning, as in (13);

13. Conventionalization of the AFFECTION [2] usage of *-ito*, simplified



In this way, we can postulate a direct association between the three transparent usages.

The diminutive in *-illo*

The opaque meanings of *-illo* correspond to interruptions of the two mechanisms of processing, that lead to the extraction of more abstract features from the root morpheme.

To start with, Jurafsky explains the RESEMBLANCE [7] and IMITATION [8] usages of the diminutive as in (14):

14 a) RESEMBLANCE [7]: the diminutive marks an object that resembles the source object in form or function, but is smaller. (Jurafsky 1993:429)

b) IMITATION [8]: [the diminutive] maintains the notion of resemblance from sense 7, but the category differs in two ways. First, the nouns of this category are viewed as

> imitations or copies of natural objects, often body parts. ... Second ... the diminutive does not necessarily mark a smaller object. (Jurafsky 1993:430)

Jurafsky (1993:427) proposes the metaphor in (15) to link these two senses of the diminutive to the central SMALL [3] sense:

15. CATEGORY CENTRALITY IS SIZE or MARGINAL IS SMALL

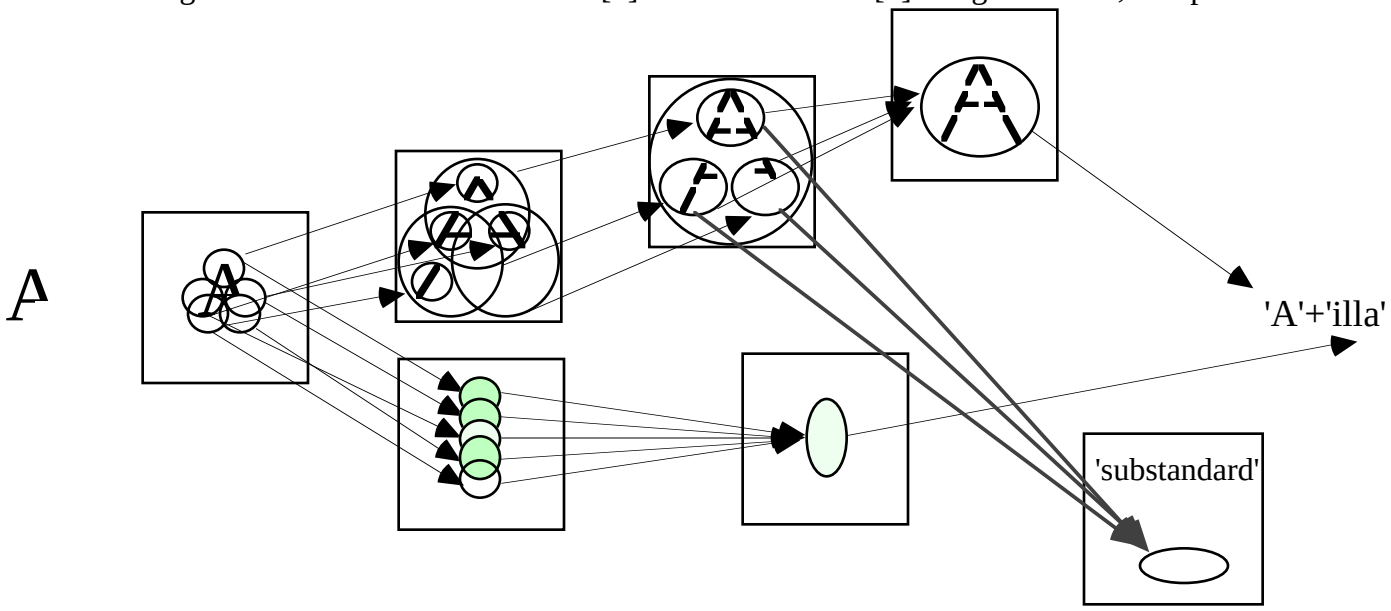
Note that this is not an explanation of why

From the neocognitron perspective, we would say that category marginality actual follows from the fact that marginal entities do not have all of the parts that the central entity has. (16) states this conjecture:

16. RESEMBLANCE [7]/IMITATION [8]: An entity A' that lacks some parts of another entity A tends to be perceived as smaller than A, vid. (11).

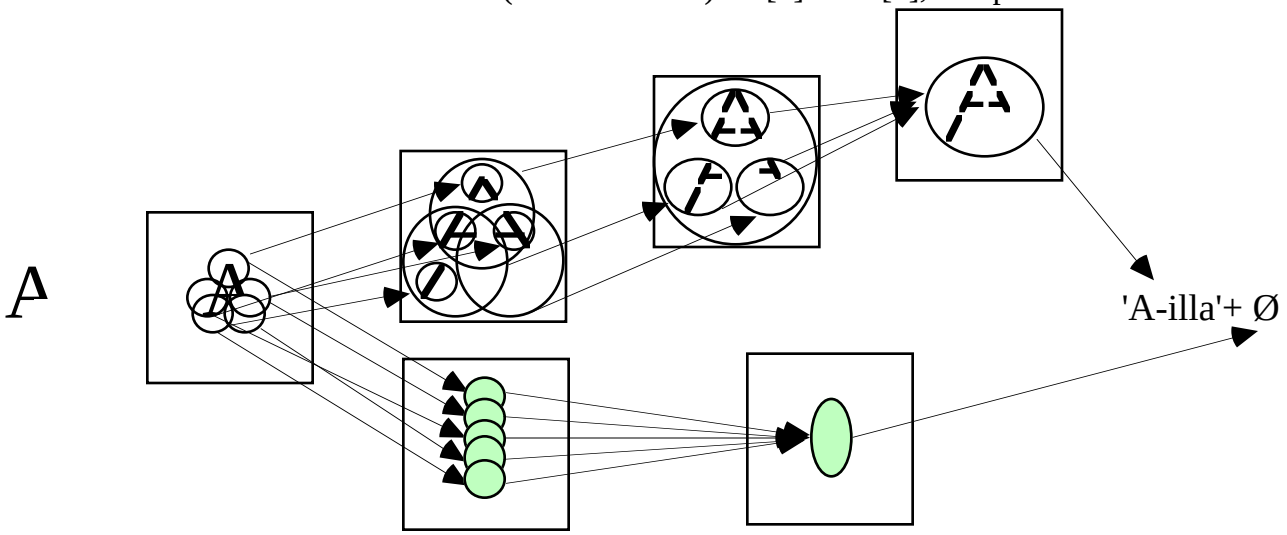
(17) gives an approximation to the network architecture:

17. Recognition of the RESEMBLANCE [7] and IMITATION [8] usages of *-illo,* simplified



It is possible for this semi-opaque diminutive to become completely opaque, as given in (18):

18. Conventionalization (lexicalization) of [7] and [8], simplified



As for the CONTEMPT sense [4] of the diminutive, Jurafsky (1993:426) proposes the metaphor in (19) to link it to the central SMALL sense [3]:

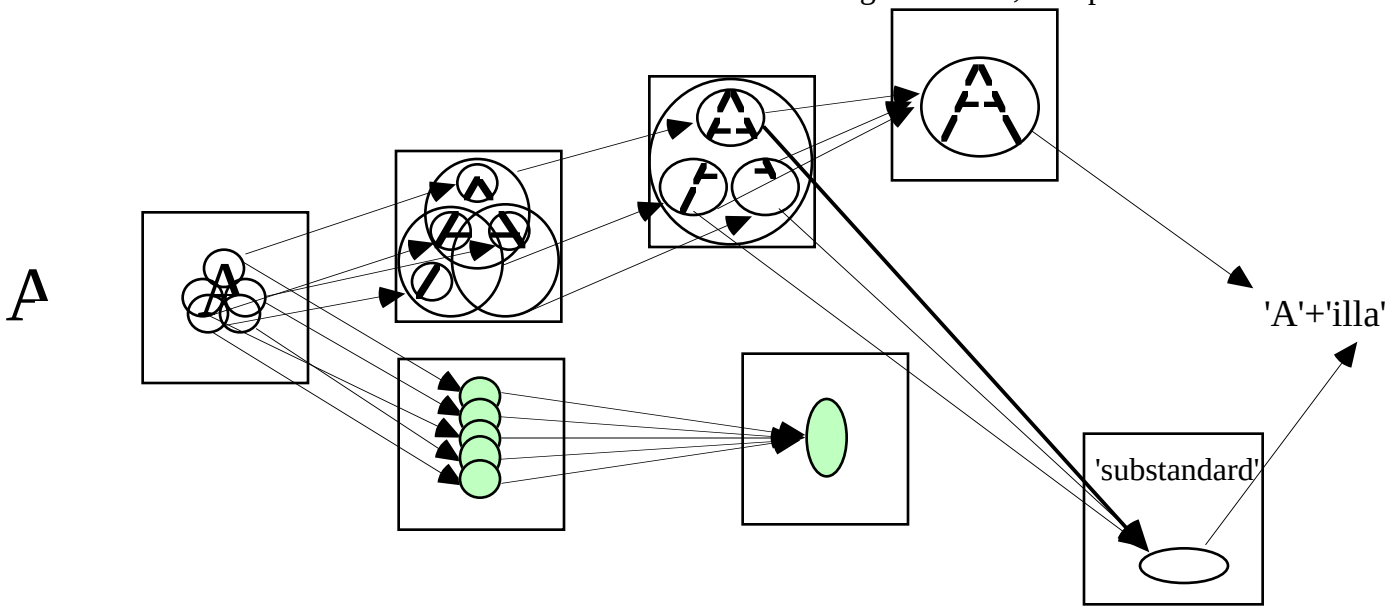
19. POWER AND IMPORTANCE ARE SIZE

However, under the neocognitron perspective, there is a close relation between incomplete constituency and 'substandardness', as stated in (20):

20. An incomplete entity A' associated with a complete entity A can be perceived as substandard with respect to A.
    a) If A has a moral quantitative standard, A' is less than A → CONTEMPT [4]
    a') If A has a physical quantitative standard, A' is less than A → APPROXIMATION [9]
    a") If A has social quantitative standard, A' is socially insignificant w.r.t. A → HEDGE [10]
    b) If A is a body part, A' is a part of A → BODY-PART [6a]
    b') If A is a mass noun, A' is a unit of A → MASS [6b]
    b") If A is an event, A' is a subevent of A → SUB-EVENT [6c]

(21) displays how these perceptions of comparison can be conventionalized:

21. Conventionalization of the substandard usages of *-illo*, simplified



In this way, we can reduce the variety of senses recognized by Jurafsky into a handful of primitive relations that follow directly from the perception of entities in terms of their parts and size.

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