

On Semantic Classification of Modifiers*

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Abstract. To search a large dictionary for a collocation expressing a desired meaning, the human reader needs some kind of hierarchical structure that would facilitate such search. In this paper, fragments of semantic classification of modifiers are elaborated based on several highly modifier-productive nouns, namely, common nouns *person*, *action*, *look*, *corporation*, and *price*, as well the terms *coating*, *medium*, and *check*. By modifiers meant are adjectives, participles, or preposition phrases syntactically dependent on the nouns. The classification rubrics proved to be heavily dependent on the modified headword noun and are representative fragments of a Roget-like thesaurus. It is shown that the modifiers under consideration are rather selective in their use, similarly to standard lexical functions (LFs) by Mel'čuk, while for many nouns LFs can be absent. The obtained classification rubrics can be used for other English nouns and for other languages. Some deficiencies of the proposed rubrics are discussed.

1 Introduction

Let us consider modifiers of nouns in European languages. They are mainly adjectives (*beautiful flower*) or participles (*obliging woman*). However, these languages use, for the same semantic purposes, prepositional phrases (*person of importance*) and other nouns in attributive function: in preposition (*stone wall*) or postposition (Spanish *palabras clave* 'keywords'). We will refer to all such modifiers as *adjectivals*.

The most developed electronic lexical databases—WordNet [4] and EuroWordNet [6]—include ca. 20,000 different adjectivals for each language. Standard grammars divide them semantically into two large classes: descriptive and relational adjectivals. Some small classes of descriptive adjectivals are singled out, e.g., colors. As to relational adjectivals, no attempt to classify them semantically has been made in the frame of the mentioned projects.

I. Mel'čuk [3, 7] had introduced syntactical and semantic relationships between words called lexical functions (LFs). Among standard LFs there were proposed those for descriptive adjectivals: **Magn** 'large, intensive', **Bon** 'good', and **Ver** 'as it should

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be.’ For example, *high* = **Magn**(*temperature*), *beautiful* = **Bon**(*flower*), *authentic* = **Ver**(*signature*). Combining them with the negation **Anti**, the antonymous functions **AntiMagn**, **AntiBon**, **AntiVer** can be obtained: *bogus* = **AntiVer**(*marriage*). The specific value of a LF depends on its argument, so a given LF determines the meaning and the use of the corresponding adjectival. In other words, a noun to be modified imposes restrictions on selection of its adjectivals in texts.

This suggests that modified nouns could help to develop semantic classification of adjectival modifiers. To put it otherwise, the collocations ‘noun—its adjectival modifier’ are relevant for this purpose. Some references could be given on compiling collocations of this type [1, 2], but there have been no attempts to classify these collocations further.

If the majority of modificative collocations combine nouns with adjectivals in a free manner based only on their semantics, any classification would be unnecessary in linguistic applications. However, looking through large dictionaries—especially bilingual ones—one can notice that lexicographers understand well that numerous language-dependent modifiers should be given for each modifier-productive noun, to prevent uncommon combinations in both comprehension and composition of texts. To facilitate the selection of relevant combinations from this multiplicity, they should be classified.

In this paper, we develop a few small subtrees of semantic classification based on several modifier-productive English nouns. We intend to answer the following questions:

- Do the classification rubrics constructed for rather arbitrarily selected nouns depend on the selection of these nouns?
- Are these rubrics valid for other nouns and languages? Can they form an integrated classification system?
- Are lexical functions frequent among adjectival modifiers?
- What are advantages and disadvantages of the proposed classification rubrics?

We answer these questions by compiling and structuring several rather large modifier sets. For this, we analyze numerous examples and distribute them by the proposed rubrics. To reduce the total amount of examples given in the text without losing information on their available number, we preface each list of examples with an (*N*+) sign denoting that this partial collection includes not less than *N* modifiers we have found in general and terminological dictionaries. Any rubric may include both positive and negative estimates of the modificative feature, if this feature is scalable. Note that we do not specify the required word order within the collocations: e.g., the modifiers *average* and *of distinction* at the noun *person* correspond to the collocations *average person* and *person of distinction*.

2 Modifier Set for *Person*

One of the most modifier-productive English nouns, *person*, is the argument of various linguistic predicates, mainly evaluative. At the highest classification level, these modifiers are divided into the rubrics corresponding to *social*, *behavior*, *moral*, *intel-*

lectual, and *outward (physical)* features. Each rubric is then subdivided into more fine-grained rubrics, possibly overlapping.

Social features:

- **Significance** (33+): *average, beloved, dear, eminent, favorite, futile, great, highly descended, humble, important, in high position, influential, insignificant, inconspicuous...*
- **Juridical status** (21+): *accused, aggrieved, artificial, convicted, displaced, exterritorial, free...*
- **Reputation** (14+): *disreputable, esteemed, honorable, of excellent qualities, perfect, reputable...*
- **Publicity** (12+): *anonymous, familiar, famous, infamous, intimate, known, mysterious, new...*
- **Exceptionality** (19+): *average, common, curious, distinctive, exceptional, extraneous, normal...*
- **Prosperity** (12+): *impecunious, indigent, poor, rich, prosperous, poverty-stricken, superrich...*
- **Family status** (5+): *divorced, family, single, unmarried, widowed...*
- **Social class** (8+): *army, civil, country, navy, middle-class, rural, urban, working-class...*

Behavior features:

- **Sociability** (37+): *adaptable, affable, agreeable, bashful, boring, candid, cheerful, devious, difficult, direct, disagreeable, dreary, easy, easy-going, frank, forbidding...*
- **Breeding** (30+): *amiable, arrogant, attentive, audacious, backward, boorish, coarse, considerable, courteous, crude, cultural, daring, haughty, ignorant, ill-bred, impolite...*
- **Enterprise** (12+): *active, constantly occupied, creative, enterprising, inactive, inventive, sly, versatile...*
- **Practicality** (26+): *business-like, careless, economical, efficient, experienced, extravagant, helpless, idle, ill-advised, impractical, miserly, niggardly, practical, self-destructive, sober...*
- **Consistency** (16+): *accurate, careless, conscientious, executive, inaccurate, obliging, regular...*
- **Temper** (51+): *active, animated, ardent, capricious, energetic, enthusiastic, fearless, fervent, firm, grave, gushing, high-strung, highly strung, hot, hot-headed, hot-tempered, hysterical...*
- **Character** (32+): *arrogant, commanding, consequential, credulous, democratic, despotic, dreamy, easy, frivolous, genuine, haughty, imperious, inoffensive, intrepid, iron, lazy, lukewarm...*

Moral features:

- **Kindness** (26+): *aggressive, amicable, benevolent, brutal, cruel, friendly, full of kindness, heartless, hard, good, good-natured, kind, malicious, merciful, merciless, mild, nice, ruthless...*

- **Moral level** (29+): *corrupted, crafty, dirty, dishonorable, deceitful, disinterested, ethical, false, high-principled, ignoble, immoral, impartial, innocent, insidious, magnanimous...*

Intellectual features:

- **Education** (12+): *advanced, aware, backward, unenlightened, educated, competent, illiterate...*
- **Endowments** (11+): *able, capable, colorless, genial, gifted, talented, of no talent...*
- **Luck** (9+): *fortunate, happy, ill fated, ineffectual, lucky, successful, unlucky...*
- **Intellect in general** (31+): *banal, brilliant, clever, common, commonplace, cunning, immature, inquisitive, intellectual, intelligent, judicious, mature, meditative, observant, witty...*
- **Skills** (7+): *handy, skillful, skilled, unskillful...*

Outward features:

- **Age** (11+): *adult, aged, elderly, along in age, middle-aged, of a certain age, old, young...*
- **Health** (9+): *ailing, gouty, healthy, insane, rheumatic, sick, sickly, ulcerous, unhealthy...*
- **Hairs** (11+): *bald, bearded, curly, curly-headed, dark-haired, fair-haired, hairy...*
- **Eyes** (6+): *big-eyed, blue-eyed, brown-eyed, dark-eyed, grey-eyed, narrow-eyed...*
- **Skin** (14+): *black, colored, dark-complexioned, dark-skinned, of color, pale, tanned, white...*
- **Mood** (19+): *angry, blue, contented, discontented, displeased, dissatisfied, glad, merry, sad...*
- **Clothing** (14+): *dowdy, dressed up, frumpy, ragged, shabby, thread-bare, sleek...*
- **Neatness** (5+): *neat, sloppy, slovenly, tidy, untidy...*
- **Outward attractiveness** (19+): *attractive, beautiful, charming, disgusting, nice, ridiculous, ugly...*
- **Size** (6+): *big, broad-shouldered, large, narrow-shouldered, small, tiny...*
- **Height** (9+): *high, of medium height, stocky, short, squat, strapping, tall, thick-set...*
- **Strength** (8+): *decrepit, mighty, muscular, powerful, silky, sound, strong, weak...*
- **Build** (20+): *anorexic, athletic, delicate, emaciated, frail, gangly, leggy, long-legged, long-limbed, pear-shaped, spindle-legged, of fine physique, rotund, shapely, solidly built...*
- **Motion** (4+): *adroit, agile, clumsy, dexterous...*
- **Nutritional state** (16+): *bony, burly, corpulent, heavy, fat, lean, plump, obese, well fed...*
- **Physical deficiency** (12+): *blind, crippled, cross-eyed, disabled, dumb, handicapped...*

The abovementioned rubrics cover the vast majority of modifiers for *person*. As to the rest of them, the following should be taken into account:

- The closed set of **quantifying**, **determining**, and **demonstrative** modifiers (*all, some, many, few, both, another, certain, each, every, following, individual, next, other, particular, this, same, single, specific, mentioned, former, last, latter...*) is important to specify nouns in communication. It seems impossible to invent a common-language title for this set (maybe **which**). Note that such modifiers exist for every noun.
- Modifiers can form idiomatic expressions like *nether person* ‘the lower part of human body,’ whose meaning cannot be deduced from that of the components. For other nouns, idioms can be more numerous.

It is also unclear how to classify, even while replenishing the classification scheme, the modifiers like *dead, possible, special, catholic-minded*, etc. Assigning a separate rubric to each small group of modifiers makes the classification subtree too unbalanced. Otherwise, we have to assign the remaining items to the rubric **Miscellanies**, introducing thereby a “dump” for the “nonstandard.”

3 Modifier Sets for *Action* and *Look*

The noun **action** is a predicate with an abstract meaning, having no arguments except for the subject (who takes an action?). As to the modifiers, this predicate is an argument of at least two evaluative predicates. One of them reflects the correspondence of the action to the norms of the human community and reasonable behavior. The other reflects the method by which action was taken. Within the norm-oriented modifiers, there is an additional subdivision by the types of the norms under consideration:

- Correspondence **to the** norms **of**:
 - **Moral and law** (45+): *adequate, abominable, amoral, bad, callous, crafty, cruel, deserved, dishonorable, disgraceful, disgusting, disinterested, evil, fine, fitting, foul, good, heartless...*
 - **Common way of conduct** (11+): *boyish, diplomatic, gentlemanly, inexplicable, natural...*
 - **Reasonable conduct** (13+): *deliberate, foolish, idiotic, justified, logical, stupid...*
- **Method, means** or **objective of taking** the action: *belated, collective, covert, double, explosive, impressive, impulsive, joint, mental, overt, physical, preventive...*

The modifiers of the noun **look** are classified based on the estimate of the effect produced by the look, as well as on the emotional and physiological state of the look-taking person. All these estimates are made by an outer observer.

- **Outward effect** (14+): *bashful, comical, common, gentle, hangdog, idiotic, kingly, mischievous...*
- **Emotional state** (21+): *brave, cloudy, concerned, contemplative, contemptuous, contented, cowed, disappointed, downcast, ferocious, gentle, gloomy, guilty, injured, sulky...*
- **Physiological state** (5+): *haggard, healthy, robust, sickly, unhealthy...*

Outward effect and emotional state could be classified further based on the rubrics introduced for *person*.

4 Modifier Sets for *Corporation* and *Price*

The modifiers for the noun *corporation* are classified in the following way:

- Type of **business** (14+): *business, charitable, civil, commercial, industrial, insurance, political...*
- Type of **ownership** (19+): *aggregate, closed, government, joint-stock, municipal, private, public, publicly-owned, sole, sponsored, state-owned, stock, trustee...*
- **Size** and **disposition** (6+): *big, foreign, multinational, small, top, transnational...*
- **Interconnection** with other organizations (3+): *affiliated, main, subsidiary...*
- **Availability** and **efficacy** (6+): *advanced, backward, offending, insolvent, shell, thin...*

The modifiers for the noun *price* are classified rather specifically:

- **Level** of the price for:
 - **buyer** (22+): *attractive, bargain, dear, exorbitant, attractive, fabulous, fair, fancy, heavy, outrageous, outside, prohibitive, ransom, reasonable, smart, soaring...*
 - **seller** (13+): *asked, bed-rock, best, bottom, competitive, fair, honest, nominal, premium...*
 - **uninvolved observer** (10+): *buying, discriminative, dump, great, high, low, moderate, pegged...*

These three subsets overlap broadly. Nevertheless, it seems unreasonable to join them. Indeed, only an uninvolved observer can call a price *dump*, while the buyer qualifies it as *low* or *reasonable*, and the seller, as *fair*, *honest*, or *premium*.

- **Scope** of the price (51+): *administered, agreed, all-in, all-inclusive, asking, base, blanket, buying, carry-over, cash, ceiling, close, closing, consumer, contract, cost, current, going, export, import, list...*
- **Variability** of the price (10+): *determined, dropping, growing, fixed, flat, inflated, oscillating, pegged, reduced, standard...*

5 Modifier Sets for *Coating*, *Medium*, and *Check*

The noun *coating* is the value of the lexical function S_{res} (= result) of the predicate ‘to cover’ with four arguments: subject, object, means, and instrument. The corresponding collocations are numerous, since this is a term and a term-generating nucleus broadly used in technology. Among its modifiers, the arguments of *coating* occur in a specific way: the subject is not reflected, but additional circumstantial arguments are added: the goal of the coating and the main features of the coated object. Thus, the modifiers were classified as follows:

- **Object** (what is covered?) (4+): *airfield, deck, electrode, roadway...*

- **Contents** (with what is something covered?) (20+): *asphalt, brass, copper, enamel, lead, metal, oxide, paint, pigment, rubber, silicon, vitreous, zinc...*
- **Method** (by what way is it covered?) (13+): *cathodic, chemical-conversion, dip, sprayed, surfaced...*
- **Goal** (what for is it covered?) (19+): *anticorrosive, antifouling, antifreezing, antiradar, antisonar, antistatic, antirust, corrosion-resistant, decorative, diffusion...*
- **Main property** reached (10+): *bright, flexible, nonrigid, nonskid, protective...*

For the noun *medium*, we considered only sci-tech modifiers applicable to inanimate objects:

- **Contents** (7+): *agar, aqueous, gaseous, dielectric, fluid, liquid, nutrient...*
- **Main property** (46+): *absorbing, absorptive, arc-extinguishing, active, aggressive, bacteriological, enhanced, communication, conducting, cooling, corrosive, defined, dense...*
- **Structure** (12+): *amorphous, anisotropic, continuous, homogeneous, isotropic, solid...*
- **Scope** (5+): *extended, external, infinite, internal, unbounded...*

The noun *check* is a linguistic predicate with the following arguments: the checking subject, the object under check, and the object's parameter to be checked. In technology, the set of its arguments is broader:

- **Subject** (who or what is checking?) (2+): *author's, designer's...*
- **Object** (what parameter is checked?) (30+): *accuracy, consistency, credit, copy, grammar, health, identity, validity...* A peculiar subgroup is *dope, antidope, drug, antidrug*, with the same meaning.
- **Method** by which something is checked (11+): *automatic, comparative, competitive, graphical, logical, marginal, program, programmed, residue, statistical, summation...*
- **Quality** with which something is checked (9+): *accurate, all-round, attentive, careful, close, detailed, exhaustive, meticulous, permanent...*
- **Scope** of the check (9+): *built-in, current, external, internal, periodic, run-time, spot, static...*

6 Can Proposed Rubrics be Used for Other Words?

Though we have considered in detail only few nouns, they are rather productive in English, giving in total not less than 2,000 modificative collocations. Let us illustrate now that the same rubrics can be used for some other nouns belonging to the modifier-productive elite.

- The nouns *human, man, woman, child, boy, lad, chap, fellow, guy, girl, lass* differ from *person* only by sex, age and/or literary style. All rubrics for *person* prove to be directly applicable to these nouns as well. However, this does not mean that specific modifiers are the same: for the same meaning, specific modifiers expressing this meaning can be quite different for different nouns.

- For the noun *glance*, similarly to *look*, modifiers reflect an emotion expressed (*admiring, amused, conspiratorial, cool, disapproving, furious...*) and the manner the glance is cast (*backward, casual, cursory, fleeting, hasty, passing, penetrating, probing, quizzical, searching, sidelong...*).
- For the nouns *agency, organization, enterprise, firm, venture, house* all rubrics of *corporation* are valid.
- For the terminological nouns *index* and *indicator*, the some semantic arguments of *coating* are applicable: a parameter under evaluation (*aerodynamic, acoustical, viscosity...*), an estimate (*low, unprecedented, high...*), and a method (*absolute, aggregative, analytical, basic, main, integral...*).

A tentative analysis of modifiers for Spanish nouns *persona, acción, mirada, compañía, precio, capa, medio*, and *inspección*, approximately corresponding to the considered English nouns, has shown that the English-oriented rubrics are totally applicable to these Spanish analogues. This proves that the rubrics can be used across languages.

7 Can the Proposed Rubrics Form an Integrated System?

The rubrics introduced above form only several slightly overlapping disjoint classification sub-trees, while overall dimensions of the total classification can be clarified on the basis of a more massive analysis. However, we can consider these rubrics as representative fragments of an integrated classification system.

At the upper level, nouns in any language are divided into two large semantic classes: those for living beings (in their vast majority, humans) and for inanimate entities, which can be the names of predicates (actions, processes, properties, etc.) or objects (natural or artificial).

Living beings are characterized in social, behavioral, moral, intellectual, and physical aspects. For them, morals and laws are introduced as usual way of life and behavior. They have an emotional and physical state, opinion, etc.

For inanimate objects, the rubrics reflect at least the following aspects:

- Active semantic valencies of a given predicative noun, namely: subject (agent), object (patient), objectives and way of functioning, materials and tools to be used, structure, temporal and spatial scope of functioning, etc. Some of these roles can be played by the entities considered by traditional grammars as circumstantial.
- Passive semantic valencies, namely: size, efficacy in reaching the objectives and readiness to function (for organizations), important consumption features (for products), etc.
- Passive co-valencies, which can be illustrated by the example of the triple *price, buyer, and seller*. These notions are co-subordinated to the predicate *selling*, meanwhile the set of modifiers for *price* depends on the two main participants of the selling situation and an indirect participant (uninvolved observer).

Qualitative modifiers characterize the scalable parameters of nouns. The scalable parameters with various or continuous values or only two opposite values can be considered at an axis (scale). For example, nearly all modifiers characterizing *pros-*

perity of a person can be roughly ordered from *poverty-stricken* to *superrich*. Many entities have their own temporal and spatial scope, and then modifiers can characterize the variability of these values within this scope.

The scalable parameters sometimes correspond to the standard lexical functions **Magn**, **Bon**, and **Ver**. However, the considered nouns are so versatile entities that it turns to be difficult, if possible at all, to unambiguously specify these LFs for them. For example, it is quite unclear what properties of *person* (a common word) or of *coat* (a technical term) should be taken as **Magn**, **Bon**, or **Ver**. The properties usually described by LFs are lost in the multiplicity of modifiers. However, the use of these modifiers is rather selective, similarly to the standard LFs. According to Mel'čuk [3], some highly restrictive modifiers can be considered as nonstandard lexical functions, though without further research the use of this term seems a mere slogan.

Obviously, the partial rubrics introduced above do not fit to any sci-tech thesaurus. Indeed, the words appearing in such thesauri are mostly names of artifacts (technical products), with the 'genus-species' relation between them as the basic one, while the relations discussed above are much richer.

On the other hand, many of these rubrics, after corresponding changes, can be identified with those in the most developed natural language thesauri like Roget [5]. In spite of that the latter is already 150 years old, it remains the most popular thesaurus for English, seemingly because of its recurrent modernizations. The basis structure of such thesaurus is also a hierarchy, though it includes the set of abstract notions that characterize such semantic roles as subject, object, goal, method, etc.

The titles of our rubrics have been selected understandable for the potential users of any dictionary or collocation database. For purely practical reasons, common words and word combinations have been taken for them. However, in this way we sometimes can obtain poorly defined, partially synonymous, or even ambiguous titles. For example, while selecting the title *Moral features* within the classification for *person*, some vacillations are inevitable among synonymous variants, say, *moral aspects* or *moral characteristics*. This means that a synonymous group (synset) with the dominant titled *moral features* should be formed (this is easy if the dictionary is implemented as a computer-based system rather than a paper book), to facilitate retrieval of this rubric with a query containing any synonymous option coming first to the user's mind.

Note that if we use totally disambiguated scientific constructs for these titles (they sometimes occur in the Roget thesaurus), the users without any linguistic background would not recognize such artificially constructed terms. Such users might not even understand which of the given terms is broader in meaning. Hence, we suggest small hierarchies forming a classification system of synsets, to facilitate end-user's navigation through the whole title hierarchy.

8 Deficiencies of the Proposed Classification Scheme

Our analysis has shown that splitting the set of modifiers into subgroups with subtitles motivated by their common semantic elements is quite possible. However, the implementation of the idea reveals some its deficiencies:

- The development of a rather complete set of rubrics for all relevant nouns is not easier than compilation of a new Roget-like thesaurus, for any given language. Such a task seems affordable only for several hundred of the most modifier-productive nouns.
- One cannot directly use the classification principles of existing thesauri, since the classification should be carried out on different grounds for different headwords. For example, the rubrics can be related to semantic valencies for some nouns and to classes of properties for the other ones.
- It is usually impossible to select non-intersecting co-subordinated rubrics. A typical example is *character* versus *temper* for *person*. It is unclear if these notions are overlapping synonyms or two different sub-rubrics of a single rubric (as we have given it in our classification), or sub-rubrics of two different rubrics, *intellectual features* and *physical features*.
- Even when two given rubrics seem non-intersecting, the corresponding groups of modifiers can intersect, since the same versatile modifier could appear in two or more rubrics at the same time. For example, the modifiers *high* and *low* at *prices* are equally used by the buyer, seller, and uninvolved observer.
- Only few nouns permit one-level (flat) classification. Usually, a classification subtree for a noun contains several levels. The variability of levels seems to be inevitable.
- Not for all rubrics an easily understandable title can be proposed. For example, we failed to invent a good “layman” title for the set of quantifying and determining adjectives.
- Sometimes, some modifiers do not fit in any rubric among those already introduced. In such cases, an individual rubric can be allotted to each of them, or they all can be included into a special rubric *Miscellanies*. The latter strategy poses an obstacle to information retrieval.
- As it was already mentioned, easy search within the joint hierarchy of rubrics requires synonymous titles, since to remember or construct the “correct” title for each rubric is practically impossible for the user.

9 Conclusions

A method of classification of modifier sets based on the semantics of modified nouns is proposed. On this stage, we cannot propose how to automate the classification process; however, even after solving the problem for several hundred of the most modifier-productive nouns, the obtained classification scheme will be of both practical and theoretical value.

From a practical viewpoint, the rubrics of modifiers in dictionaries or collocational databases speed up the search of the desired modifiers, both for comprehension and composition of texts: otherwise the user would have to look through large alphabetically ordered lists of all possible options.

In theoretical perspective, the proposed classification is a contribution to lexical portrayal method. The more numerous the modifiers for the given noun, the more precise the lexicographic portrait based on their classification.

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