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DOING LEXICAL TYPOLOGY WITH FRAMES AND SEMANTIC MAPS

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In this paper we present an approach to lexical typology which will be referred to as the "frame method". It was developed and tested in the Moscow Lexico-Typological Group and is currently used in all its projects, such as Majsak, Rakhilina (eds.) 2007, Britsyn et al. (eds.) 2009, Kruglyakova 2010, Reznikova et al. 2012.

Our main principle, taken from the Moscow semantic school (Apresjan 1974/1992, cf. also Firth 1957: 11), is that lexical meanings can be studied and reconstructed by observing the word's "surroundings", primarily their collocation. Then, they can be compared by procedures similar to those used in grammatical typology.

Section One will clarify the goals of lexical typology (LT), as we see them in relation to our method, and the method itself will be presented in more detail in Section Two.

Keywords: lexical typology, semantics, frame-based approach
JEL: Z

1. Principles and goals of lexical typology

Our aim is the synthesis of two schools of research, each well-established in their own right: the Moscow semantic school, with its methods of analyzing word-meanings, and grammatical typology. This section will show that this synthesis is not only possible, but in a sense natural, since the fundamental assumptions about language in the two approaches have a great deal in common. Once we have analyzed the strengths and limitations of the Moscow semantic school in Section 1.1, we then suggest some ways of overcoming these limitations, by adopting some tools from the typology of grammatical categories.

1.1 The Moscow semantic school

Dating back to the 1960s, the Moscow semantic school has an internationally recognized standing in lexical semantics. Its main, and very powerful, method is comparing a word's surrounding constructions and collocations to those of its near synonyms; one of its major finding was that there is no such thing as full synonyms in any language. Taking semantically related groups of words and exploring their differences proved to be an extremely effective lexicographic technique, as can be seen in some outstanding dictionaries, both Russian and bilingual, which were produced using this approach (Mel'čuk, Žolkovskij 1984, NEDS 2004, Apresjan et al. 1979, Mel'čuk et al. 1999).

The core of the method is to find contexts in which a word cannot be replaced by a given near-synonym, and determining which properties prevent its substitution. Bilingual dictionaries treat translational equivalents as a simple extension of near-synonymy into another language. This means that the procedure is just as valid for a broad typological study, even though it would require proportionally more time and effort.

The Moscow semantic school itself does not venture into typology. Its members, lexicologists and lexicographers maintain that the lexicon is a system which is highly motivated and structured based on principles of human cognition (Apresjan 2009). However their main practical goal is to create detailed descriptions, the so-called "lexicographic portraits", of individual lexemes. However, if we look beyond one language's lexical system and observe similar systems in others, a further task arises; to distill the typologically relevant features from the mass of features which are only intra-linguistically relevant.

1.2 Grammatical and lexical typology

We also turned to the field of grammatical typology for our research methods. This differs from LT, as it is several decades older and has developed its own standards of contrastive research, particularly with regard to grammatical categories (see, among others, Comrie 1976, 1985, Bybee, Dahl 1989, Corbett 1991, 2000 and Aikhenvald 2000).

Currently, the common consensus is that there is a limited universal inventory of grammatical meanings (Bybee, Dahl, 1989: 51-52; Plungian 2000: 233-238), from which each language "selects" a subset. The subsets can be quite different across languages. Moreover, it is common for multiple grammatical meanings to be expressed by a single marker or construction. Most typologists believe that the process is guided by a number of cognitive strategies, which also differ from one language to another (cf. Plungian 2000, Haspelmath 2003).

Accordingly, modern grammatical typology sees its main goals as A) describing the set of universal atoms of grammatical meaning, and B) determining the strategies which languages use when combining these meanings.

If we consider LT to be similar to grammatical typology in its attitude, the same needs to be true of their goals, which means that LT is in search of A) a universal set of lexical meanings, and B) the strategies of their combination in languages. We explore both topics in the following sections.

A) Universal features and oppositions

A grammatical category tends to have a limited number of elements; three persons, about two numbers (there are not many more even for systems with dual and paucal), about three tenses, etc. The structure of a category is usually highly visible, with clear-cut oppositions. A group of near-synonyms constituting a domain, on the other hand, is seldom so transparent; all the words in it have more or less the same meaning.

The closest thing to binary oppositions which can be found in the lexicon are antonyms. Bringing antonyms into the picture can often offer an insight into a word's meaning; e.g., *old* as opposed to *young* vs. *new* (*an old shoe/sailor* vs. *a young/*new sailor*) indicates animacy, or rather anthropocentrism, and we may reasonably expect a language to reflect opposition by having two words for 'old'[4].

However, many more words have near-synonyms than antonyms. It is difficult to imagine lexical antonyms for *grass* or *house*, *golden* or *striped*, *embellish* or *burrow*. Even those words that do pair up rarely perfectly mirror one another's semantics. For example, taking the adjectives *live/dead* we find that they highlight different aspects of the opposition – while *dead* means biological death (*a dead cat, dead trees* etc.), *live* seems to be the default state for everything it is applicable to, so that when it is specifically mentioned, the resultant meaning is non-trivial, as in *a live performance* (not a recording), or *live snakes* (not toys)[5].

Thus, LT and grammatical typology deal with sufficiently dissimilar objects that the methods of one cannot be incorporated into the other without some modification.

There is an additional difficulty surrounding the usage of grammatical markers vs. lexemes. Grammatical markers tend to occur in texts with a much greater frequency. While a corpus of 200-300 thousand words should yield all the relevant contexts for reasonably common markers, 100 million is not always enough to illustrate the behavior of a lexeme. With rare words, billion-word corpora may be required.

B) Combination of meanings

It is well known that a grammatical marker in a given language generally has several functions, each used in a particular context, and that the diagnostic contexts differ across languages. Grammatical typologists collect relevant contexts from known languages to check the new data against them. When a context proves relevant to the category in question in a language, it is given a place in the typological questionnaire. When some of the contexts in a given language are found to have the same manifestation, this pattern is what characterizes the language typologically.

The same procedure can be used for a semantic domain, listing the relevant contexts and observing the patterns in their lexical explications, in different languages. If we use this approach, the main problem is technical; how best to select the vocabulary, contexts and languages. The next section presents our process in detail, using examples from some of our completed and ongoing projects.

2. Methodological foundations
2.1 Selection of languages

Deciding on the scope of an LT study is in itself a challenging task. The researcher begins with a list of the vocabulary relevant to the chosen domain in their native language, and goes on to include other languages. Their number and choice is another way in which LT differs from grammatical typology.

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[4] Indeed, Cuscan Quechua lexicalizes the opposition – it uses *thanta* for artefacts vs. *machu* and *paya* for men and women respectively (see Cusihuamán 2001; we thank Paul Hegarty for bringing this to our attention).
[5] On the assymetry of the Russian adjectives *živoj* 'live' / *mertvyj* 'dead', see Podlipentseva 2011.

GT requires several hundreds of languages, usually 200-400, which, furthermore, need to be distributed equally among genetic and areal groups (Bybee 1985, Bybee et al. 1994). Closely related languages are almost never used, lest their similarities distort the general picture[6].

The striking difference of LT in this respect is that related languages tend to be just as valuable to LT as those which are unrelated (cf. Rakhilina, Prokofieva 2004). While grammatical constructions take centuries to evolve, vocabulary is much more fluid. A single generation of speakers may witness words falling in and out of use, and word meanings changing dramatically. As a result, even close relatives, such as Russian and Polish, do not necessarily have many cognates in a given domain and even when they do, these words tend to have meanings which are quite dissimilar from their "cousins".

Verbs of swaying and shaking provide a good example of this. Russian has *kačat'sja, šatat'sja, kolyhat'sja, kivat'* and *kolebat'sja*, Polish *huśtać się, kołysać się, chwiać się, kiwać (się), chybotać (się)*, where only two pairs are related – *kolyhat'sja* to *kołysać się*, and *kivat'* to *kiwać (się)*. Of these, the non-causative reflexive *kiwać się* describes an oblong object bending while being fixed at the bottom, the top swaying freely. Many of the contexts it describes correspond not to the Russian *kivat'* but to *mahat'* 'to wave', such as *mahat' rukoj* 'to wave a hand'. The Polish *kołysać się*, likewise, has a different prototype than its Russian cognate; it can be used to describe a moving train, but not flapping curtains (Rakhilina, Prokofieva 2005).

As to the number of languages on the list, it does not seem realistic for LT to imitate the scope of grammatical typology, especially since preexisting resources such as dictionaries are seldom sufficient, and often unavailable. Nevertheless, we believe that, for LT, method takes precedence over scope. If the approach is typological, i.e. suited to accommodating different languages, a study can be considered typological, even if the data is limited. The most extensive of our own projects, the domain of swimming and floating, covers 50 languages (Majsak, Rakhilina (eds.) 2007), the vocabulary of pain covers 30 (Reznikova et al. 2012), rotation 17 (Kruglyakova 2010), sharpness and bluntness 15 (Kyuseva 2012). We have also found that even 15 languages allow some significant generalizations (it is worth noting that a dozen languages is also considered a valid sample for a general sketch of a grammatical category – see Haspelmath 2003).

Naturally, a typological hypothesis, even if based on a small initial sample, serves as a framework which facilitates an examination of each additional language.

2.2 Dictionaries and corpora

Having determined the rough outlines of the domain in question, in one's native language, the next step is to consult bilingual dictionaries for translational equivalents. Any of the source words can be expected to have more than one translation into a given language, and it is equally common for several words to have the same equivalent. For example, Russian *tolstyj* corresponds to three Chinese adjectives - *hòu* 'thick and flat' (*hòu bèizi* 'a thick blanket'), *cū* 'thick and oblong' (*cū shéngzi* 'a thick rope'), and *pàng* 'overweight' (*pàng háizi* 'a fat child').

Sometimes the dictionaries are outdated or incomplete, so the data need to be rechecked. The quickest way to do this is a corpus search, provided there is a corpus for the language. If the words are reasonably common and the corpus large, their typical collocations and differences in usage should become clear.

A corpus may still contain outdated, peculiar or otherwise non-standard examples, so it is best to have them verified by a native speaker. For some languages without other resources, interviewing speakers is the only way to gather data. Experience suggests that the most efficient way is to leave these languages for later, so as to have a list of questions prepared in advance for the interview. In this sense, examples from corpora are valuable not only as illustrations of word usage, but also as a source of contexts which are potentially relevant to other languages.

2.3 Semantic features

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[6] Kibrik 1992, Kibrik 1998, however, claim that related languages are also suited for grammatical typology.

Groups of contexts from the corpus are analyzed in the tradition of the Moscow semantic school, in order to locate the differences. One of the key factors of predicates' distribution is the semantic type of the subject (for verbs) or the qualified entity (for adjectives). The distinction made most often and most consistently is that of animate (especially human) vs. inanimate subjects. Many languages have predicates specifically designated for one or the other.

Motion verbs are often found in these kinds of pairs – cf. the English *swim* vs. *float* and their numerous equivalents – Persian *šenā kardan* vs. *šenāvar budan*, Tamil *nīntu* vs. *mita*, Manyika *námún* VS. *fún* etc (see Majsak, Rakhilina (eds.) 2007) etc. Active vs. passive motion can be present as distinct concepts at high levels of abstraction (Plungian, Rakhilina 2007). Verbs of rotation appear to be a rare exception, divided not on the animacy of the subject but on the axis inside or outside of the rotating object, cf. Spanish *revolotear* / *rondar* vs. *girar* / *dar vueltas*, Koryak *kamlil* vs. *kavaljil*, etc.

The more participants there are in a situation, the more factors a researcher needs to take into account. For example, verbs of eating and drinking are structured around the type of subject (such as human vs. animal), object (in particular solid vs. liquid), and presence or absence of a specific instrument or quasi-instrument (teeth, tongue, spoon). Thus, in Russian we have *est'* ('eat' – solid food), *glodat'* ('gnaw' – animal agent, hard object such as a bone, with the teeth), or *lakat'* ('lap' – animal agent, liquid, with the tongue).

Even more intricate is the domain of cutting and breaking (Majid, Bowerman (eds.) 2007). Apart from the subject being in control, or not in control, of the situation, the lexical choice is affected by at least three other variables; type of object being destroyed, presence and type of instrument, and the end result, such as size and quantity of pieces. Russian distinguishes, among others, between *rvat'* ('tear' – soft object, by hand); *rubit'* ('hew' – hard object, an axe or similar instrument, in half or into big pieces); *rezat'* ('cut' – moderately soft object, blade-like instrument, esp. knife or scissors); *toloč'* ('grind; pound' – small hard objects, using millstones or mortar, into a homogeneous mass); *šinkovat'* (vegetables, knife or hatchet, very small pieces), and many others. Komi has the verb *jukavny,* meaning 'to splinter planks', which leaves no choice of object (wood), instrument (axe or knife), or result (splinters). Another Komi verb, *šarsköbtyny*, is an otherwise ordinary verb of breaking, but with an interesting addition; a ringing sound (Kaškin 2010).

With types of arguments and other relevant parameters listed like this, it may seem that we reduce each domain to a set of oppositions, as in component analysis (cf. Katz, Fodor 1963; Lehrer 1974). Indeed, we use semantic features to compare and contrast words across languages. For example, verbs of rotation are classified by the following characteristics:

- internal/external axis
- elevation over the landmark
- control
- single/repeated turn, etc.

This approach seems to be essentially the same as the features which Lehrer (Lehrer 1974: 61ff) uses to describe the vocabulary of cooking:

- use of liquids
- use of fat
- use of steam
- high/low heat
- long/short duration, etc.

However there is a crucial difference. Component analysis assumes features to be independent, hence the tendency, popular during the 1960-80s, to describe both semantic fields and grammatical categories by exhaustively listing their features (Mel'čuk, Kholodovič 1970, Khrakovskij (ed.) 1989).

Our approach, on the other hand, is to view features as interdependent. They fall into gestalts, often so closely intertwined that selecting one argument restricts the others. For instance, if the subject of rotation is a bird, the axis is going to be external. Furthermore, a flying agent is

moving not just around the landmark, but above it (e.g. a hawk circling over its prey), while for other kinds of subjects, elevation is usually irrelevant.

Verbs of cooking from Lehrer (1974) also demonstrate the interdependency of features quite clearly. Intense heating can only last for a short time otherwise the food will burn; water, but not fat, is used in steaming, and so on.

Translating the idea into component-analytical terms, it can be said that along with truly equipollent oppositions (+/-), we find that some features are better represented as +/0. They are irrelevant for most of the domain and true for one or a few lexemes. For example, of all the verbs of breaking in Komi, sound is only relevant for *šarsköbtyny* (as it constitutes a part of its meaning), even though other actual situations of breaking may involve sound.

It naturally follows that the entries in a LT questionnaire must represent not all features multiplied by all values, but all gestalts – all meaningful clusters of features.

Individual features are still of great importance when we determine what exactly constitutes each particular gestalt, lest some aspect of the meaning get ignored. This is especially true for predicates with three or more arguments. The study of the verbs of cutting and breaking mentioned above (Majid, Bowerman (eds.) 2007) uses 61 video clips to represent various situations in the domain, yet even this was not sufficient to cover the full range of possibilities. Among the situations that were overlooked were the use of a stationary background object as an instrument (e.g. smashing things against a wall) and crushing or grinding into small pieces (see Kaškin 2010).

2.4 Frames

The gestalts or prototypical situations discussed above appear to be so closely related to the predicate's argument types, that a full set of arguments can serve as a sufficient representation of the situation. We believe that these sets, which we shall call "semantic frames", constitute the minimal unit of LT description.

To describe a domain, then, is to list all frames relevant to it, and for each frame to find its manifestation in all of the chosen languages.

For the domain of swimming and floating the relevant frames are; 1) active swimming, 2) passively drifting with the current, 3) floating on the surface, 4) traveling of vessels and people on vessels. The domain of swinging is richer, and so its frames include 1) swinging of a suspended object (e.g. a pendulum), 2) rocking, 3) bending of a tall object, 4) object being deformed by external force (a shaky bridge), 5) undulating surface of a liquid, and some others.

Note that these situations are different from the traditional understanding of frames (Fillmore 1976, 1982, currently used in FrameNet - see framenet.icsi.berkeley.edu). Traditionally, a frame is defined as a set of participants with their assigned syntactic roles. However, valence as such proves to be of little use to LT. Adjectives, for example, are mostly one-place predicates with next to no variation in the marking of their only argument, so if they are to be classified at all, the distinction has to be based on the semantic, rather than syntactic properties of the argument.

The same is often true for verbs. Verbs of swimming and drifting are nearly indistinguishable in the case marking of their arguments; the difference lies in the arguments' semantic class. Therefore, in our understanding of frames we choose to disregard case marking but include semantic types of the arguments. Frames correspond to individual entries on the LT questionnaire, used to gather expressions which represent them in a given language.

2.5 Frames and micro-frames

Grammatical typology, especially when searching for universals (Dahl 1985), has developed a procedure for working with questionnaires. It starts with a model of the category, such as the passive voice or subjunctive mood, already well-known from previous studies. Its individual properties are represented by the questionnaire entries. Going through them, the researcher looks

for the corresponding marker or construction in a particular language. The more entries the marker covers, the closer the language is to the prototypical model.

Unfortunately, LT does not yet have all the prototypical situations, or semantic frames, within a domain listed and ready to use. They too emerge gradually from the data. As mentioned above, the starting point for the questionnaire are contexts, as detailed as dictionaries and corpora can make them. Indeed, they are more detailed than the lexemes of any given language, with the additional subtleties added precisely because we do not know beforehand which distinctions may be relevant to lexicalization.

Some of the contexts turn out not to be distinguished in any of the target languages. They are then collapsed, not yet into a frame but into what we call a "micro-frame". Often these contexts are metonymically related, such as 'sound of wind/sound of trees in the wind' or 'stream flowing/something drifting with the current'. Micro-frames are still more specific than typical word-meanings. The way they are grouped into word-meanings need not be similar in all languages, yet often several languages do group them similarly. These tendencies in lexicalization indicate which features are more important for the domain.

Micro-frames can be compared to the units in the universal grammatical inventory; just as most languages group several of them together to be expressed by a single marker, micro-frames are clustered into frames, so that for each frame, a word exists in at least one language (and usually, more than one). A triple number, distinct from a plural, is rare; likewise, waterfowl swimming does not warrant its own frame and is conceptualized as similar to either swimming or motion of vessels, in the same way that flying insects (e.g. moths circling around a candle) are grouped together with either birds or eddies of wind.

While micro-frames must be relevant to the more detailed contrastive studies of languages, such as compiling a typologically oriented dictionary, broader frames are better suited to the task of comparing semantic fields.

2.6 LT maps

Maps are another tool of the grammatical typology, which can be adapted to the needs of LT. Grammatical maps represent an area of the grammatical system, such as modality or interrogative pronouns. The universal inventory of meanings form the map's nodes, and several nodes can be marked with a similar color to show that, in a given language, the meanings are expressed by the same marker. The pictures are then easy to compare across languages (see van der Auwera, Plungian 1998, Haspelmath 2003, Tatevosov 2004).

In LT, we build maps for larger entities, such as domains, or semantic fields, which would be similar to whole grammatical categories. The nodes, too, are larger: they represent frames rather than micro-frames. This is because lexical meanings vastly outnumber grammatical meanings. A map built from micro-frames would be too clustered by differences between individual lexemes, thus obscuring any useful generalizations. Therefore, we intentionally drop some finer nuances (such as the insects from the previous section) and operate at the level of entire lexical systems.

As with grammatical maps, the nodes that are often expressed by the same linguistic means are placed close together on the map. Two frames with a similar lexicalization cannot be separated by a third if it corresponds to a different word.

Lexical data is then placed on the map to show how the domain is divided into individual words in a given language, for further comparison between languages. As an example, let us take the domain of emptiness (Tagabileva 2011). The relevant frames for it were found to be a 'hollow shape', 'empty container', 'location empty of people', 'large space without objects on it' (e.g. 'a field without buildings'), 'small flat surface without things on it' ('an empty table'), and an 'empty hanger' (Fig.1). None of the languages surveyed lexicalized all of them, but at least one frame was lexicalized in each. Chinese and Russian (Fig.2), with *kong* vs. *kongxin* and *pustoj* vs. *polyj* respectively, only have the opposition of functional emptiness vs. hollow shape (it is worth noting that, while *kongxin* is a derivate of *kong*, *polyj* and *pustoj* do not share any

common roots). Serbian (Fig.3), in addition to emptiness (*prazan*) and hollowness (*šupalj*), has a word specifically for the absence of people - *pust*, at least in the dictionaries. Speakers and corpora appear to testify that the current usage is shifting. According to Tolstaya (2008), the distinction, present in Serbian until recently, used to be common to all Slavonic languages. The corresponding word in modern Russian, *prazdnyj*, has shifted its meaning from 'unoccupied' to 'idle' and is generally fading out of active use.
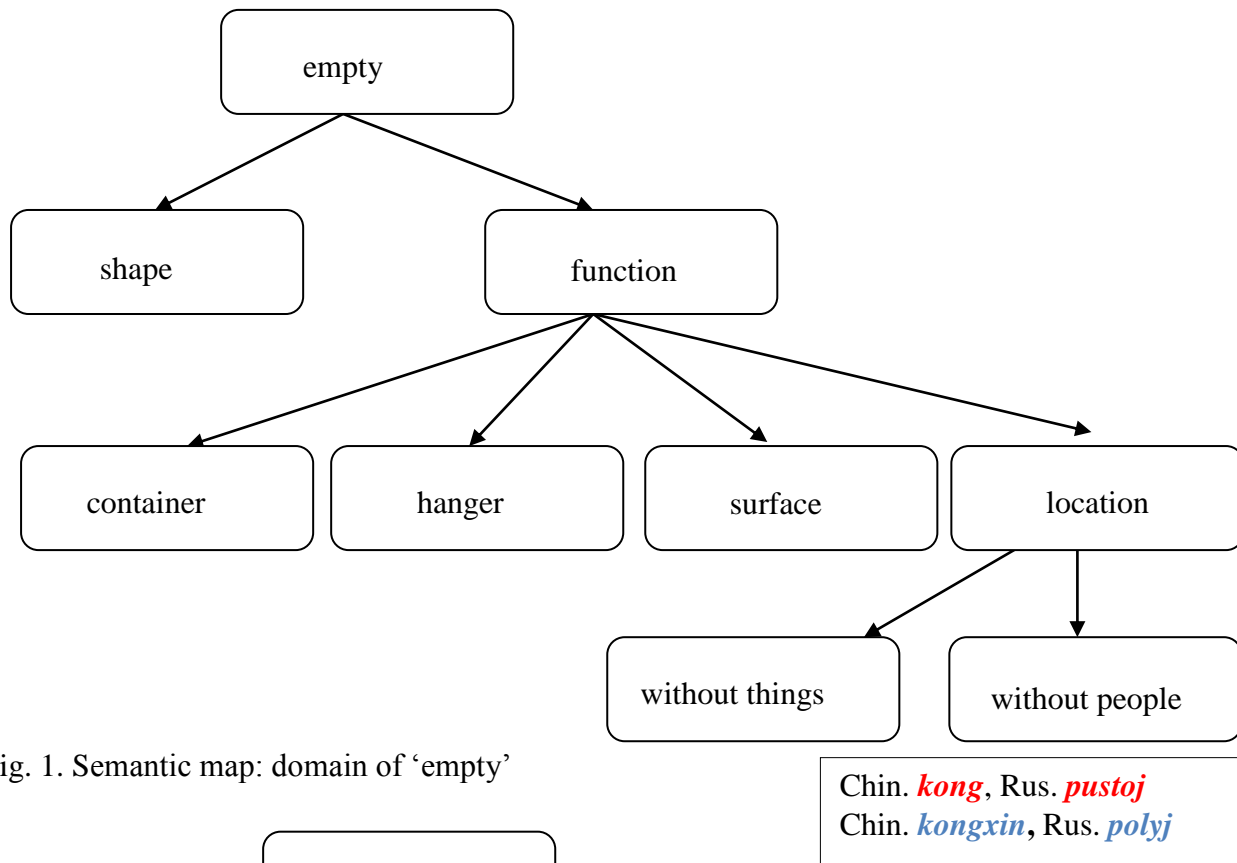

Fig. 1. Semantic map: domain of 'empty'

Chin. **kong**, Rus. **pustoj**
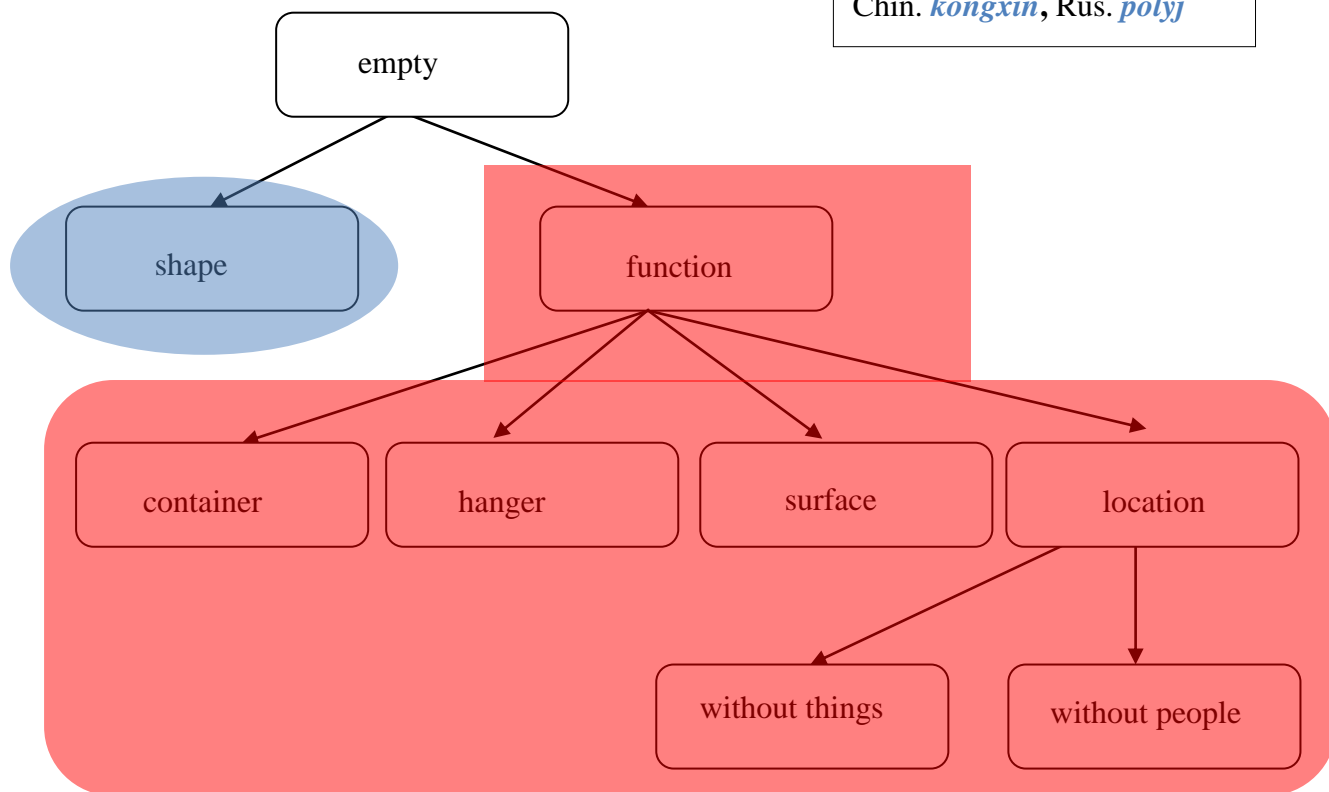Chin. **kongxin**, Rus. **polyj**

Fig. 2. Semantic map: domain of 'empty' in Russian and Chinese
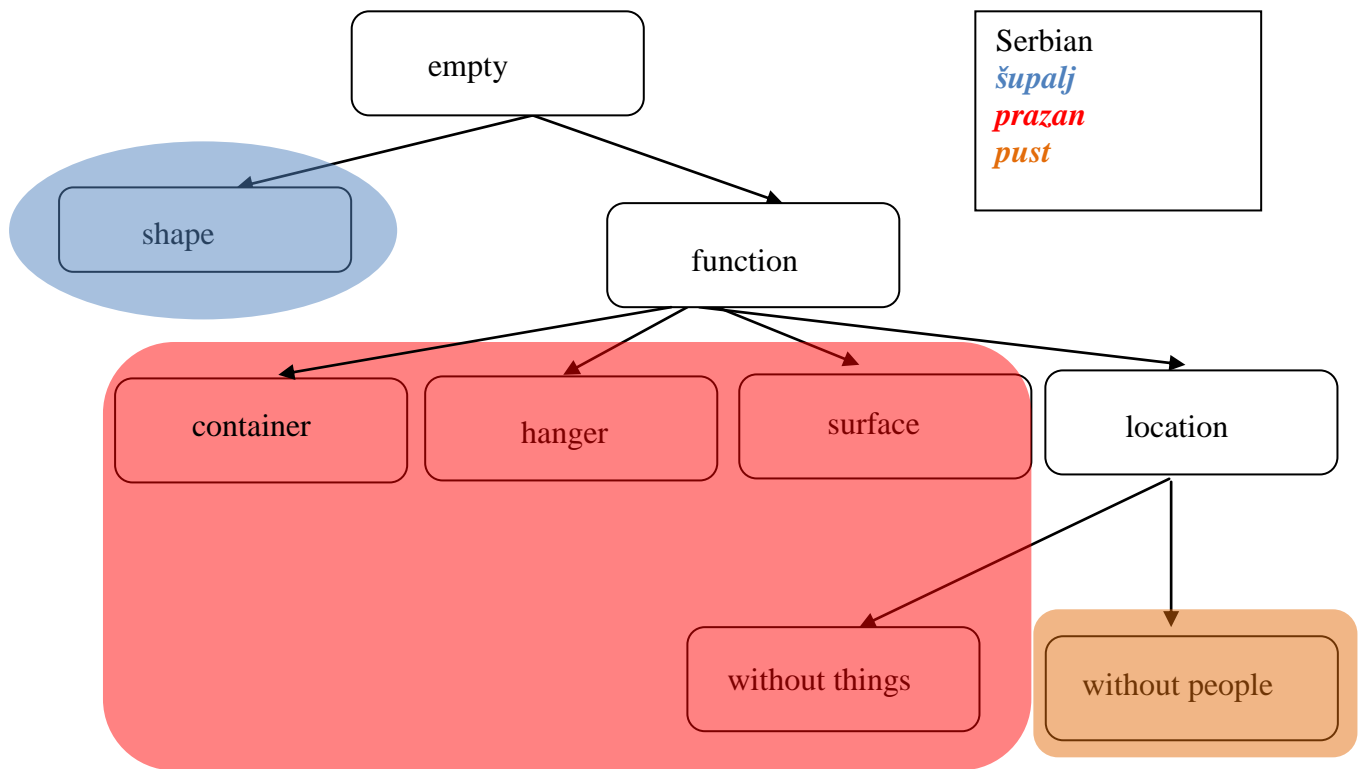
Fig. 3. Semantic map: domain of 'empty' in Serbian

Korean (Fig.4) distributes words between frames more evenly. There is no distinction of hollow object vs. empty container; an empty glass and a hollow gourd would both be described as *thengpita*. This situation is opposed, on the one hand, to locations, *konghehata*, irrespective of whether they are empty of people or things, and on the other, to working surfaces and hangers, *pita* (Sorokina 2010).
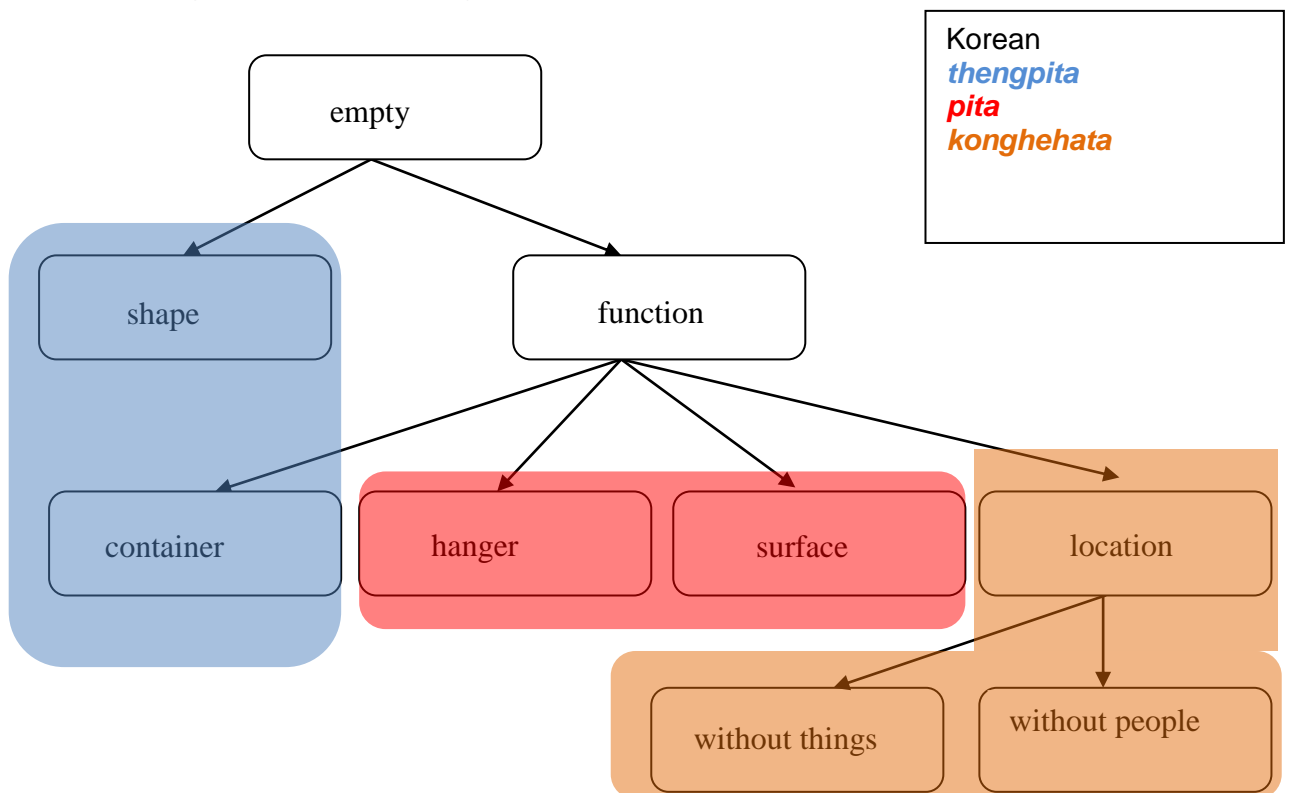

Fig. 4. Semantic map: domain of 'empty' in Korean

Semantic maps of this kind offer a ready and intuitive way to grasp the domain as a whole and how different languages structure it. The maps clearly demonstrate that LT in our approach is a typology not just of lexemes but of lexical systems. The ambition behind it is similar to that of the WALS (http://wals.info) at the Max Planck Institute (Leipzig), which records the distribution of attested systems across the world.

Conclusion

Different approaches to LT (for their review, see Rakhilina, Plungian 2007, Koptjevskaja-Tamm 2008, Evans 2010) give this new branch of linguistics different goals, theoretical and practical, and all equally fascinating. Our own approach to LT focuses on actual word-senses, semantic domains and lexical systems as they are. The end result may take the form of a multilingual (ideally universal) dictionary with situations, or semantic frames, as entries. Obviously, the sheer scope of this task makes its significance theoretical rather than practical.

We believe that semantic fields are structured after a limited number of basic patterns, and we hope to gradually learn to extract these patterns even from a small initial selection of languages. Then recognizing the structures would help us predict the behavior of words as new languages are observed or as known meanings evolve and change, which has always been an extremely interesting target for linguistic studies.

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