A FrameNet for Danish

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Abstract

This paper presents work on a comprehensive FrameNet for Danish (cf. www.framenet.dk), with over 12,000 frames, and an almost complete coverage of Danish verb lemmas. We discuss design principles and frame roles as well as the distinction of use of valency, syntactic function and semantic noun classes. By converting frame distinctors into Constraint Grammar rules, we were able to build a robust frame tagger for running Danish text, using DanGram parses as input. The combined context-informed coverage of the parser-fragnet was 94.3%, with an overall F-score for frame senses of 85.12.

1 The FrameNet concept

Classification of the lexicon is central to many aspects of linguistic research, and modern computational linguistics in particular has a need for robust classification systems to support on the one hand automatic analysis, on the other hand applicational tasks such as information extraction and question answering. As the pivot of the sentence, verbs play a special, integrative role in lexical ontologies. While noun ontologies are relatively easy to build around ISA/hypernym-relations, verbs are somewhat harder to classify because structural aspects are meshed with semantics, with complex combinatorial restrictions residing in both a verb’s meaning and its syntactic nature. While one of the largest ontological resources, WordNet (Fellbaum 1998), does cover verbs, but provides little structural-relational information, a number of other classification projects link verb classes to certain verbal-nominal combination patterns, providing information on the form, function and semantics of complements. For English, Levin’s original verb classification (Levin 1993) has been expanded in the VerbNet project (Kipper et al. 2006) to include non-np complements and employs 23 (25) thematic roles and 94 semantic predicates. In the FrameNet project (Baker et al. 1998, Johnson & Fillmore 2000, Ruppenhofer et al. 2010), semantic frames like Commerce are drawn up with roles like Buyer, Seller, Goods and Money, which are then associated with verbs (or nouns and adjectives) from corpus examples. Since the same verb may appear in more than one frame, verb sense lists are created implicitly, with no guarantee for full coverage. Conversely, the PropBank Project (Palmer et al. 2005) departs from syntactically annotated corpus data to assign both roles and argument structure to each verb consecutively. Both FrameNet and PropBank provide morphosyntactic restrictions, while FrameNet also adds ontological information on slot fillers.

For Danish, the target language of our own work, some semantic verb classification has been undertaken as part of the Danish DanNet project (Pedersen et al. 2008), covering ca. 3000 verbs with 6000 senses falling into 80 top classes, e.g. BoundedEvent + Physical + Location. However, while some incorporated adverbial material and reflexivity are provided as verb sense discriminators, no frame roles or systematic selection restrictions are listed. Earlier work comprises the STO database, with almost 6000 verbal entries of which 4/5 offer syntactic, and 1/5 semantic information (Braasch & Olsen 2004), and the Odense Valency Dictionary (Schösler & Kirchmeier-Andersen 1997), that classified verbal argument semantics through the semantics of pronoun complements, covering ca. 4000 verbs.

The project described here, launched in 2006, also regards valency as a useful stepping stone towards the semantic classification of verb structures, assuming that almost all subsenses of a given verb can be distinguished, and a full thematic role frame assigned, if the form, function and (noun) semantics of complements are known. Thus, using the DanGram parser’s valency dictionary (Bick 2001) as a point of departure, we manually assigned verb classes and thematic role frames to each valency “sense” of a given verb, using corpus data and dictionaries to check sense coverage, and adding sense-based distinctions for the broader valency senses where necessary. Syntactic functions and forms of complements were already implicit in the valency tags and could therefore be assigned semi-automatically. At the same time, our methodology of building semantic frames from “syntactic
frames” considerably facilitated locating and checking corpus examples, since all syntactic complementation patterns were already available - and searchable - in corpora annotated with the DanGram parser (Bick 2001), allowing focused inspection of semantic variation.

2 The Danish FrameNet

After 4 years, our framenet (inspection demo at www.framenet.dk) has a very good coverage for the DanGram lexicon, and while further senses and patterns are being added and existing ones revised, the overall number of lexemes is now fairly stable, at 6825, with an average of 1.77 frames and 1.46 senses per lexeme. At the time of writing, this corresponds to about 11.000 valency patterns and 12.075 different verb frames, roughly twice the volume of DanNet. We use 494 different verb categories1 (cp. Appendix 1) that are grouped using the original Levine senses and VerbNet numbering system, albeit with a modified naming system2 and expanded subclassification system. Thus, though syntactic alternations such as diathesis or word order are not considered frame-distinctor, we do deviate from WordNet and VerbNet by making a class distinction for polarity antonyms like increase - decrease, like - dislike, and for the self/other distinction (move_self, move_other). We also try to avoid large underspecified classes (e.g. change_of_state), while at the same time keeping the classification scheme as flat as possible, in order to facilitate the use of our categories as corpus annotation tags or Constraint Grammar disambiguation tags. We have therefore introduced classes like heat - cool, activate - deactivate or open - close, reducing the larger change_of_state to a kind of wastebin rest category.

3 Frame role distinctors: valency, syntactic function and semantic classes

The distignuional backbone of our frame inventory are syntactic valency frames like <vt> (monotransitive), <vdt> (ditransitive), <på\'vtp-ind> (prepositional ditransitive with the preposition “på” and a verb-incorporated ‘ind’-adverb). Each of these valency frames is assigned at least one (or more) verb senses, each with its own semantic frame. Depending, for instance, on the number of obligatory arguments, several valency or semantic frames may share the same verb sense, but two different verb senses will almost always differ in at least one syntactic or semantic aspect of their argument frame - guaranteeing that all senses can in principle be disambiguated exploiting a parser’s argument tags and dependency links.

For each of our 12.000 verb sense frames, we provide a list of arguments with the following information:

1. Thematic role (Table 1)
2. Syntactic function (Table 2)
3. Morphosyntactic form (Table 4)
4. for np’s, a list of typical semantic prototypes to fill the slot (Table 3)
5. An English language gloss / skeleton sentence

For about half the frames (46%), a best-guess link to a DanNet verb sense is also provided, based on semi-automatic matches on adverb incorporation and hypernym classification.

Our FrameNet uses 38 thematic roles (or case/semantic roles, Fillmore 1968), leaving out adverbial roles that never occur as valency-bound elements in a frame, but only in free adverbials (such as §COND for conditional subclauses). The 38 roles are far from evenly distributed in running text. Table 1 provides some live corpus data, showing that the top 5 roles account for 2/3 of all role taggings in running text.

| Theme | Agent | Attribute | Patient | Cognizer | Result | Location | Destination |
|-------|-------|-----------|---------|----------|--------|----------|-------------|
| $TH   | $AG   | $ATR      | $PAT    | $COG     | $RES   | $LOC     | $DES        |
| Theme | Agent | Attribute | Patient | Cognizer | Result | Location | Destination |
| 31.75%| 12.25%| 12.25%    | 5.12%   | 4.69%    | 3.78%  | 2.95%    | 2.86%       |

1 A smaller set of 200 frame senses was also established, with a hypernym-mapping from the more fine-grained set, in part to allow some generalisation when used in e.g. syntactic disambiguation rules, in part to facilitate robust cross-language comparison - and possibly transfer - of frame types.

2 We wanted the class names to on the one hand be real verbs, on the other to reflect hypernym meanings wherever possible. Therefore, we avoided both example-based names (common in VerbNet) and - mostly - abstract concept names (common in FrameNet) that are not verbs themselves.

3 In 780 cases multiple verb senses share the same valency frame - in other words, in 6.5% of cases, verb senses cannot be disambiguated on syntactic function and form alone, but need help from semantic (noun) classes.
Table 1: Thematic Roles

| Role | Percentage |
|------|------------|
| ACT  | 2.19%      |
| REC  | 1.75%      |
| BEN  | 1.65%      |
| EV   | 1.56%      |
| EXP  | 1.31%      |

Other roles: §STI - Stimulus; §REFL - Reflexive; §DON - Donor; §PATH - Path; §ORI - Origin; §EXT - Extension; §VAL - Value; §EXT-TMP - Duration; §MES - Message; §TOP - Topic; §SOA - State of Affairs; §CAU - Cause; §INS - Instrument; §MNR - Manner; §FIN - Purpose; §COMP - Comparison; §HOL - Whole; §PART - Part; §POSS - Possessor; §ASS - Asset; §CONT - Content; §COM - Co-role; §INC - Incorporated

Even in a case-poor language like Danish, we found some clear likelihood relations between thematic roles and syntactic functions (table 2). Thus, agents (§AG, §COG, §SP) are typical subject roles, while patients (§PAT), actions (§ACT) and results (§RES) are typical direct object roles, and recipients (§REC) and beneficiaries (§BEN) call for dative object function.

Table 2: Syntactic Functions

The prototypical frame consists of a full verb and its nominal, adverbial or subclause complements. Like most other languages, however, Danish employs also verb incorporations that are not, in the semantical sense, complements. The simplest kind are adverb incorporations, which we mark in the valency frame, but not in the argument list:

- kaste op (vomit) - <vi-op>
- slå fra (deactivate) - <vt-fra>
- komme ind på (discuss) - <på^vt-ind>

More complicated are support verb constructions, where the semantic weight and - to a certain degree - valency reside in a nominal element, typically a noun that syntactically fills a (direct or prepositional) object slot, but semantically orchestrates the other complements. While adverb incorporates are marked as such already at the syntactic level (@MV<)^4, noun incorporates receive an ordinary syntactic tag (@ACC), but are marked with an empty §INC (incorporate) role tag at the semantic level:

- holde kæft (shut up) - <vt-kæft>
- have brug for (need) - <for^vtp-brug>

One could argue that the real frame arguments (like the noun expressing what is needed in have brug for) should be dependency-linked to the §INC noun brug and the frame class marked on the latter, but for consistency and processing reasons we decided to center all dependency relations on the support verb in these cases, and also mark the frame name on the verbal element of support constructions.

Pp incorporates are in principle handled in the same way, with a syntactic @PIV tag on the preposition and an §INC role tag on its argument:

- træde i kraft (take effect) - <vi-i=kraft>

However, some of these incorporates, especially those containing dative case, which is otherwise extinct in Danish, can be said to be so “frozen” that a preprocessing stage can turn them into one token, assigning an adverb tag to the pp, and allowing the role-free adverb incorporation solution:

- have i sinde (intend) - <vt-i=sinde>

Independently of the one- or two-token treatment, incorporated pp's are treated alike in our FrameNet dictionary, as '-prp=noun' parts in the valency frame, without a separate argument line, the annotational difference being triggered solely by preprocessing conventions.

4 Frame annotation

One would assume that using argument information from our verb frame lexicon on the one hand and a functional dependency parser on the other,
it should in theory be possible to annotate running text with verb senses and frame elements, simply by checking verb-argument dependencies for function and semantic class. To prove this assumption, we implemented our annotation module in the Constraint Grammar formalism, choosing this particular approach in part because that made it easier to exploit the DanGram-parser’s existing CG annotation tags, but also to allow for later fine-tuning and contextual exceptions.

As a first step, we wrote a converter program (framenet2cgrules.pl) that turned each frame into a verb sense mapping rule - a relatively simple task, since argument checking amounts to simple LINKed dependency contexts in the CG formalism:

```
SUBSTITUTE (V) (<fn:consist> <r:SUBJ:HOL> <r:PIV:PART/MAT> V) TARGET ("bestå" <mv> V) (1 (*) LINK *-1 VFIN LINK c @SUBJ LINK 0 <cc>) (c @PIV LINK 0 ("af") LINK c @P< LINK 0 <cc> OR <mat>) ;
```

In the example rule, apart from the <fn:consist> framenet class (implicitly: sense), argument relation tags (<r:....>) are added indicating a HOL role (whole) for the subject and a PART/MAT role (part/material) for the prepositional "af"-object, if the former is a concrete object (<cc>) and the latter a physical object (<cc> = concrete countable) or a material (<mat>). In the definition section of the grammar, such semantic noun sets are expanded to individual semantic prototype classes (table 3):

```
LIST <cc> = <cc.*>r <cloH.*>r <con> <fruit> <furn> <tool.*>r <V.*>r ; (subtypes, clothing, containers, fruits, furniture, tools, vehicles)
LIST <mat> = <mat> <mat-cloth> <cm-chem> <cm.*>r ; (materials, chemicals, mass nouns)
```

### Table 3: Semantic prototypes

Apart from semantic classes, the frame mapping rules in step one may exploit word class or phrase type (table 4). With noun phrases being the default, special context conditions will be added for finite or non-finite clausal arguments, adverbs or pronouns.

```
Form type
---
np | noun phrase or noun phrase in @PIV
refl | reflexive pronoun
fcl | finite subclause
iel | non-finite subclause
advl | adverb, adverb phrase or adverbial pp
pl | plural np
pron | impersonal pronoun (usually 'det')
adj | adjective
num | numeral
pp | prepositional phrase, not in @PIV
lex | incorporated lexical item
```

### Table 4: Morphosyntactic Form

For the second step, assigning thematic roles to arguments, we needed to either perform mappings on multiple (argument) contexts, or to target arguments and unify their function with the head verb’s new <r:...> tag in order to retrieve (and map) the correct thematic role from the latter. To the best of our knowledge, no current CG compiler allowed either method, so we had to make changes in the compiler code of the open source CG3 variant we were using, for the first time allowing unification between tag-internal string variables and ordinary tag and map sets.

```
MAP KEEPORDER (VSTR:§$1) TARGET @SUBJ (*p V LINK -1 (*) LINK *1 <r:ACC:.*>r) LINK 0 PAS LINK 0 (<r:ACC:<.*>(r)) ;
```

The rule above is a simple example, retrieving a thematic role variable from the verb’s accusative argument tag (<r:ACC:<...>) and mapping it as a VSTR expression onto the subject in case the verb is in the passive voice. Complete rules will also contain negative contexts (omitted here), for instance ruling out the presence of objects for intransitive valency frames.
While helping to distinguish between verb senses with the same syntactic argument frame, using semantic noun classes as context restrictions raises the issue of circularity in terms of corpus example extraction, and also reduces overall robustness of frame tagging, not least in the presence of metaphor. Therefore, all frame mapping rules are run twice - first with semantic noun class restrictions in place, then - if necessary - without. This way “skeletal-syntactic” (semantics-free) argument structures can still be used as a backup for frame assignment, allowing corpus-based extension of semantic noun class restrictions.

In a vertical, one-word-per-line CG notation, the frame-tagger adds <fn:sense> and <v:valency> tags on verbs, and §ROLE tags on arguments. So far, free adverbial adjuncts are not role-tagged. The example demonstrates a frame sense distinction for the Danish verb *nedsætte*. Dependency arcs are shown as #n->m ID-links.

Nu "nu" @ADVL #5→6 nedsætter "nedsetter" @mv #4→5 PR AKT @FS-STA #6→0 regeringen "regering" @HH #7→8 en "en" ART UTR S #8→9 kommission "kommission" @HH #9→10 nedsætter "nedsætte" @mv #10→11 der skal undersøge, hvordan ...

(Literally: Now establishes government-the a commission that shall investigate how …)

I Odenses Vollsmose er det først og fremmest miljøets manglende anseelse, der "der" @clb #5→11 nok @INDEF #6→11 NOM @SUBJ §AG #12→13 nedsætter "nedsetter" @mv #13→14 V PR AKT @FS-@SUBJ #13→5 forventningerne "forventning" @f-psych #15→14 UTR S DEF NOM @ACC §RES #9→11 der skal undersøge, hvordan ...

(Literally: In Odense's Vollsmose it is first of all the environment's lacking standing, that decreases expectations-the and increases problems-the.)

| frame slots | expressed surface arguments with frame roles | percentage of filled slots |
|-------------|---------------------------------------------|---------------------------|
| SUBJ        | 176831                                      | 90981                     | 51.45%                     |
| ACC         | 92610                                       | 71336                     | 77.03%                     |
| DAT         | 806                                         | 433                       | 53.72%                     |
| PIV         | 22718                                       | 22542                     | 99.23%                     |
| SC          | 15120                                       | 15120                     | 100.00%                    |
| OC          | 432                                         | 432                       | 100.00%                    |
| SA          | 6024                                        | 6024                      | 100.00%                    |
| OA          | 191                                         | 191                       | 100.00%                    |
| ADVL        | 92                                          | 92                        | 100.00%                    |

Table 5: Surface expression of arguments

Table 5 contains a breakdown of surface expression percentages for individual argument types. Apart from subjects in non-finite clauses, dative objects are the least obligatory category. Predicative arguments, of verbs like *være* (be), *blive* (become), are 100% expressed, and prepositional arguments (PIV) have almost as high an expression rate simply because most verbs have alternative valency frames of lower order (intransitive or monotransitive accusative) that the tagger would have chosen in the absence of a PIV argument. In other words, PIV arguments are strong sense markers, and there absence will sooner
lead to false-positive senses of lower valency-order than to PIV-senses without surface PIV.

On a random 5000-word chunk of the frame-annotated data, a complete error count was performed for all verbs. All in all, there were 566 main verb tags, 4 of which (0.7%) had been wrongly verb-tagged by the parser, in one case due to a spelling error. For 3 verbs (0.5%), the parser offered a wrong (same-form) lemma. Our frame tagger assigned 561 frames, missing out on 3 regular verbs, and (wrongly) tagging 2 of the false-positive verbs. Only 1 verb was not covered by the frame lexicon, suggesting a very good raw coverage (99.82%). In 15.7% of cases, the frame tagger assigned a default frame, usually a low-order valency frame without incorporates\(^5\). Of 562 possible frames, 478 were correctly tagged, yielding the following correctness figures:

|                  | Recall   | Precision | F-score |
|------------------|----------|-----------|---------|
| total            | 85.05%   | 85.20%    | 85.12   |
| ignoring parse errors | 85.51%  | 86.91%    | 86.20   |

Table 6: Recall and precision

These figures are an encouraging result, despite the “weak” (inspection-based) evaluation method. No other frame-/role-tagger could be found for Danish, but Shi & Mihalcea (2004), also using FrameNet-derived rules, report an F-score of 74.5% for English, while Gildea & Jurafsky (2002), using statistical methods, report F-scores of 80.4% and 82.1% for frame roles and abstract thematic roles, respectively. For copula and support verb constructions, not included in the earlier evaluations, Johansson & Nugues (2006) report tagging accuracies for English of 71-73%, respectively, but a comparison is hard to make, since we only looked at support constructions that our FrameNet does know, with no idea about the theoretical lexical “coverage ceiling”.

A break-down of error types revealed that 39% of all false positive errors (but only 5.7% of all frames) were cases where the human “gold sense” was not on the list of possible senses in the framenet database. \(^5\) false positives (13.3%) were caused by errors from the parsing stage (wrong lemma, auxiliary or syntactic tag). Ignoring these errors, i.e. assuming correct parsing input, would influence precision, in particular, and raise the overall F-score by 1 percentage point. As one might expect, default mappings accounted for a higher percentage (24.7%) among error verbs than in the chunk as a whole (15.7%), and contributed to almost a third of the “framenot-in-lexicon” cases.

Frequent verbs have a high sense ambiguity, and verbs with a high sense ambiguity were more error-prone than one-sense verbs, as can be seen from table 7. Thus, the verbs occurring in our evaluation chunk had 4.21 potential senses per verb (6.77 for the ambiguous ones), and the verbs accounting for frame tagging errors had a theoretical 10.08 senses each.

|                          | count | theoretical sense count | senses / verb | sense count in chunk (as tagged) |
|--------------------------|-------|-------------------------|---------------|---------------------------------|
| framenet lexicon verb types in chunk | 6825  | 9933                    | 1.46          | -                               |
| sense ambiguous frame error verbs | 243   | 1022                    | 4.21          | 275                             |
| sense ambiguous frame error verbs | 135   | 914                     | 6.77          | 167                             |
| frame error verbs        | 40    | 403                     | 10.08         | 51                              |

Table 7: Sense ambiguity per verb

6 Conclusion and future work

We have reported work on a comprehensive framenet for Danish, with over 12,000 frames, and a lexeme coverage of almost 100%. After conversion of ourframenet into CG rules, the combined parser-frametagger coverage was 94.3% (i.e. only 5.7% match-less default mappings), with an overall F-score for frame senses of 85.12.

Still, given the fact that almost 40% of frame tagging errors were due to missing frame senses, the current framenet should be checked against larger amounts of corpus data to identify senses not captured by our valency-based approach. In particular, noun-incorporations (e.g. finde sted - take place) may require further research, since the original DanGram valency lexicon only treated adverb incorporations, and all other incorporations were added in a piecemeal fashion.

On the frametagger side, our CG conversion approach should allow improvements by manually ordering or modifying frame-derived map-
ping rules, adding more complex context conditions where necessary. Finally, to confirm our intuition as to the effectiveness of the CG conversion approach, it should be compared to a scoring method where frame conditions are matched and counted individually against the parse tree. With either method, the Danish FrameNet could be used to annotate large corpora for manual revision, ultimately allowing hybridization with a statistical frame tagger.

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Appendix 1 - verb categories

| Groups                | Verbal Classes (494) |
|-----------------------|----------------------|
| Aux and simple construction verbs (30) | be_copula, be_place, consist, be_name, be_part, be_like, be_attribute, be_valid, lack_itr, become, become_be, become_part, get_part, do, work, work_as, work_for, function, do_leisure, take_action, resist, train, have, have_attr, have_part, lack, contain_have (6) must, can |
| Puttning (22)         | put, put_deposit, put_spatial, funnel, raise, lower, flow, pour, spread, coi, uncoil, spray, heat, cover_ize, pollute, fill, uncover_ize, cover, uncover, adorn, confine, park |
| Removing (16)         | remove, exclude, come_off, banish, empty, wipe, clean, steal, rid, cheat, exonerate, peel, mine, unhire, reform, renouce |
| Taking and Bringing (9) | transfer, send, moveO, take, bring, carry, transport, pull, push |
| Giving and Getting (20) | give, sell, accrue_to, contribute, salary, future_having, supply, equip, man, burden, buy, gain, obtain, employ, get, lose, cause_gain, exchange, trade, berry |
| Handling (20)         | lean, study, get_to_know, forget, check_if, read, hold, grasp, keep, handle, hide, throw, pelt, discard, hit, beat, hit_goal, hurt, spank, bump |
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|----------------------|
| Manipulating Entities |
| (79) | (19) poke, (20) touch, touch_exp, (21) cut, crush, perforate, prune, (22) combine, add, absorb, connect, integrate, associate, contrast, link, note, register, exempt, scramble, group, bond, fasten, cling, (23) separate, divide, split, unattach, differ, (24) colouring, lighting, (25) mark, write, note, label, transcribe, imitate, (26) make, grow, breed, cultivate, create_food, prepare_food, prepare, create, create_finish, create_semantic, shape, deflect, turn_into, convert, modify, perform, rehearse, adjust, process, (27) cause, interact, implement, (28) spawn, (29) appoint, predestine, characterize, portray, name, declare, declare oc, proclaim, assume, predict, behave, role_as, role_oc, role_sc, now, think, regard_as, remember, classify, divide, choose |
| Perceiving and emoting |
| (20) | (30) see, hear, sense, undergo, notice, watch, listen, percep, stimulus_subj, (31) affect_exp, emote_obj, like, dislike, obey, disobey, emote, suffer, marvel, attract, repel |
| Wanting |
| (14) | (32) wish, prefer_to, prefer_oc, long, (33) judge, accuse, praise, speak affect, analyze, (35) hunt, capture, search, investigate, rummage |
| Speaking and meeting |
| (33) | (36) socialize, socializeO, play, encounter, fight, dispute, (37) explain, quote, dedicate, inquire, interrogate, teach, tell, identify, speak_mnr, speak_tool, talk, discuss, say, suggest, hint, answer, refuse, advertise, lie, speak_emot, advise, concede, elaborate, emphasize, promise, invoke, reveal |
| Body |
| (32) | (38) sound_biom, eat, drink, booze, chew, swallow, dine, thrive, feed, digest, (40) sound_body, excrete, breathe, show_emot, gesture, body_moveO, politing, bodystate, body_moveSA, die, pain, hurt_self, change_bodystate, (41) body_care, comb, dress, undress, serve, (42) kill, kill_method, subjugate |
| Emanating |
| (8) | (43) light_emission, sound_emission, make_noise, smell_emission, substance_emission, reflect, burn, emit |
| Changing |
| (27) | (44) destroy, collapse, (45) break, deform, heat, cool, alter, activate, deactivate, open, close, improve, worsen, tighten, loosen, change_process, decay, increase, decrease, oscillate, double, changeS, calibrate, repair, therapy, solve, damage |
| Moving and Placing |
| (35) | (46) lodge, enter, invade, usurp, permeate, (47) exist, persist, endure, depend, moveS_fluidic, moveO_fluidic, |
| Mdes of Movement |
| (19) | (50) change_body_pos, body_pos, (51) move_dir, rise, fall, leave, roll, run, vehicle, steer, dance, chase, accompany, reach, (52) avoid, (53) linger, delay, rush |
| Measuring |
| (7) | (54) measure_tr, measure_itr, cost, contain_quant, fit, assess, bill |
| Starting, stopping and ongoing |
| (14) | (55) start, begin, start_movement, complete_process, continue, stop, end, hinder, halt, establish, unestablish, run_obj, sustain, (57) weather |
| Influencing |
| (13) | (58) urge, beg, (59) force, (60) order, demand, summon, (61) try_to, test, (62) plan, (63) enforce, (64) allow, welcome, (65) facilitate |
| Social interaction |
| (24) | (66) consume, economize, (67) forbid, (68) pay, (69) refrain, (70) rely, (71) conspire, (72) help, benefit, detriment, affect, punish, (73) cooperate, participate, vicariate, (74) succeed, fail, (75) neglect, (76) limit, (77) approve, reject, (78) indicate, confirm, (79) devote |
| Handling conflicts |
| (19) | (80) liberate, (82) withdraw, (83) cope, (84) discover, (85) defend_phys, defend_cog, attack, (86) correlate, relate, compensate, match, (87) focus, comprehend, (88) mind, (89) agree, (90) exceed, vanquish, exaggerate, (91) matter |
| Rest - resource allocation, complex operations |
| (23) | (92) institutionalize, (93) adopt, (94) risk, (95) surrender, (96) acquit, (97) base, deduce, (98) confront, (99) ensure, insure, (100) own, belong_to, (101) patent, (102) promote, (103) require, (104) spend_time, (105) use, serve_as, serve_to, (106) void, (107) include, involve, (108) math |