Semantic Relations in Glosses and Explanations: Do They Help?

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Abstract

This paper gives an overview of current state of Estonian Wordnet and discuss the problem of word definitions in EstWN glosses and word explanation experiments. In this paper, the role of semantic relations in word explanations is discussed. Verbs and nouns are extracted from word definitions (glosses) of Estonian WordNet, and linked with semantic relations of the key word. The results are compared with a word explanation experiment where subjects have to explain as many words as they can within a limited time. Our aim is to tag word senses in Estonian WordNet definition field and find the semantic relations they have with the literals We compare the semantic relations found in dictionary definitions with these, that people give when they have to explain a word under time pressure. Besides improving our wordnet, we hope to find better guidelines for forming word explanations in general.

1 Introduction

In order to get the real meaning of a word sense in a dictionary, a good definition is needed. In wordnet type dictionaries, word senses are connected via semantic relations. In wordnets glosses, the defining units of a word sense, and semantic relations — the main organizing principle of the semantic network — stand separately from each other. Still, there have been projects to join these two types of entries in order to create a more integrated lexical resource [Langone et al., 2004; Harabagiu et al., 1999].

One of the main ideas behind the original Princeton WordNet has been testing psycholinguistics hypotheses on a larger scale [Miller et al., 1990]. If wordnet could be a model of the mental lexicon, then it should help us to explain how we can find an appropriate word as well. One possible hypothesis is, that semantic relations can help us to find word needed.

It is not so simple to evaluate the "goodness" of a definition or gloss. So it is difficult to decide, does the use of semantic relations make definitions better. To evaluate goodness of a word definition, we need some kind of experiment, where we can measure semantic relations used in word definition as independent variable, and reaction time or percent correct as dependent variable.

In order to find functioning of mental lexicon, we preferably need explanations that people give spontaneously, instead of contemplated and measured result of lexicographer's work, that tend to be in explanatory dictionaries, as lexical material for the study. Although it is rather difficult to find everyday situations where people explain each other words, there are some nice games that can be used as a basis for an experiment or observation. We used (almost) real-life Alias game to allure people to talk about words.

2 Estonian WordNet Glosses

The last version Estonian WordNet (EstWN) contains 14941 `WORD_MEANING` synsets by now[1].

There are 27961 different literals, 33517 word senses and 23620 semantic relations in EstWN. There are 9852 synsets that contain at least one gloss. A gloss contains 6.65 words as an average.

In contrast to [Langone et al., 2004] we made the annotating automatically, supposing that if a word mentioned in definition has any semantic relations, it should be used in sense most close to the word explained. Due to morphological richness of Estonian we used morphological analyzer for one-word lexical units.

For every word in gloss, its lemma is found, and for verbs, it is translated into keyword form. We used Estmorf program [Kaalep, 1997], over Internet[2] for lemmatization and finding part of speech. For each lemma its presence among EstWN literals is checked. If a correspondence is found, then these synonym sets are found, where this lemma is. These synset numbers are checked, whether they have any semantic relations with the main synset number. If yes, the word is tagged with the appropriate semantic relation.

Arising from the method, the number of semantic relations tagged in a gloss can not be bigger than the number of semantic relation the corresponding synonym set has. We have computed the proportion of usage in glosses for every relation that occur in EstWN at least 10 times. The results are in Table 1. Different types of holo- and meronyms are merged. Table 2 shows distribution of tagged semantic relations in EstWN glosses.

From these data we can see that hyperonyms are mostly used in glosses. The absolute number of 'has_hyperonym' relation is highest, although per cent of representation in glosses is higher at 'involved' and 'has_holonym' relations.

[1] The time this article was written
[2] `http://www.filosoft.ee/`

Petr Sojka, Key-Sun Choi, Christiane Fellbaum, Piek Vossen (Eds.): GWC 2006, Proceedings, pp. 191–198.

Table 2: Frequency of tagged semantic relations used in EstWN glosses. Relation 'has_hyperonym_LONG' is computed as containing any of parent hyperonyms (except the closest ones), and 'has_hyponym_LONG' is computed as containing any of children hyponyms (except the closest ones).

Frequency	Semantic relation
4015	has_hyperonym
2142	has_hyperonym_LONG
253	has_hyponym
105	near_synonym
57	has_hyponym_LONG
36	has_holo_part
34	xpos_near_synonym, state_of
29	causes
27	be_in_state, antonym
21	involved
18	involved_patient
16	near_antonym
14	involved_instrument
13	has_mero_part
10	has_holonym
9	has_subevent
7	has_holo_member
5	is_subevent_of, has_mero_member
4	role, is_caused_by, involved_target_direction
3	role_instrument, role_agent, has_meronym, has_holo_location
2	involved_agent, has_mero_portion, has_holo_madeof
1	xpos_near_antonym, xpos_fuzzynym, role_target_direction involved_location, has_mero_location, has_holo_portion, fuzzynym

Still, we can state that the use of hyperonyms in glosses may be even higher, as when we add 'has_hyperonym_LONG' results to hyperonyms, we get absolute number 6157, and by computing relative representation in glosses, it would make 60.58 %. The relation 'has_hyperonym_LONG' represents these hyperonyms, that may occur in parent nodes in hyperonym hierarchy.

3 Word Explanations under Time Pressure

We have used word explanation experiments to evaluate the effect of semantic relations in word definitions. The well-known game "Alias"[3] is a good model for such an experiment. In fact, we have used real "Alias" games for our pilot studies.

"Alias" is a board game with cards having eight words on each, board and pieces and a time-keeping device. Normally, it is played in minimum 2 teams, each at least with 2 members. On every turn, one team member has to explain to others as many words as (s)he can. Turn time is limited to one minute. The team can move its piece on board as many steps as is the number of words they could guess. "In ALIAS you have to say it in 'other words'. The idea is to explain words using synonyms, opposites or clues so that your team mates guess as many words from the card as possible before the timer runs out. The team moves forward on the board the same amount as words guessed. The team to reach the 'Finish' first is the winner," tell the Alias game rules.

We carried out three pilot studies to test the method and find out, whether any semantic relations were used at word explanations under time pressure. They are referred as Experiments 1–3 in this paper, although it would do more justice to call them observations. In Experiments 1 and 2, we used a situation very similar to a real Alias game, the only difference was audio (both 1 and 2) and video (1 only) recording.

In Experiment 1, subjects were schoolchildren aged from 10 to 15, 4 female and 1 male. All were experienced Alias players, and therefore knew the rules of the game well. In Experiment 2, subjects were adults, aged 25–38, six female, one male. In both of these experiments, 1 and 2, the situation was as in real Alias game.

The material from Experiment 3 was recorded from public TV show, where Alias-like game was part of a task set for married couples. This was a bit different from an ordinary game, because there were no other team members, and only one person of the pair was to explain the words to the other. The basic rules were the same, it was not allowed to use word stem. We do not have data about previous Alias experience of these players, but certainly they must know well each other.

Gestures were allowed as explanation helpers in all Experiments, but they were not specially mentioned in instructions.

The word list to explain was not managed in any of these experiments. The words to explain were selected randomly from the Alias standard word set (about 3000 different words and compounds for Estonian version).

Word explanation dialogues were written down from audio or video recordings, respectively. The dialogues were tagged according to XML. At first stage, each guessing turn got a `<voor>` (*turn*) tag, and each utterance got a `<kys>` tag for telling and `<vas>` tag for guessing. Each turn was also provided with a `<target>` tag, having attribute `result`, that could have value '1' for positive result and '0' for negative result.

Tagging semantic relations in dialogues from the Experiments is a task independent from EstWN, as intersection of words used in all 3 experiments and EstWN is rather small (see Table 3).

3.1 Discussion of the Word Explanation Experiment Results

There were 505 glosses of words in EstWN that are at least in one Experiment.

There were 71 words that were common to all experiments, and 43 of them were in EstWN as well. Surely it is not enough for valid conclusions, but it can help us to find

[3] `http://www.nelostuote.fi/englanti/fp.php?id=englanti/alias`

Table 1: Per cent of tagged semantic relations in glosses of total number of semantic relations in EstWN.

Semantic relation	% represented in glosses	n in synsets	n in glosses
involved	54.05	111	60
has_holonym	40.14	147	59
has_hyperonym	39.50	10164	4015
causes	39.19	74	29
has_subevent	37.50	24	9
near_synonym	29.17	360	105
is_subevent_of	20.83	24	5
has_meronym	16.33	147	24
xpos_near_synonym	13.60	250	34
state_of	11.26	302	34
antonym	10.98	246	27
near_antonym	10.81	148	16
role	9.91	111	11
be_in_state	8.94	302	27
is_caused_by	5.41	74	4
has_hyponym	2.49	10164	253

Table 3: Three experiments with word explanation game Alias.

Experiment	Guessing turns	Words explained	Incl those in EstWN	Words, matched with at least one other experiment
children	162	159	90	31
adults	183	180	91	35
married couples	295	284	199	86
Total	640	538	325	71(43[a])

[a] were found in EstWN

Table 4: Frequency of semantic relations used in EstWN glosses. This table represents only a subset of synsets, these, that were used in all Experiments.

Frequency	Semantic relation
191	has_hyperonym
105	has_hyperonym_LONG
14	has_hyponym
6	near_synonym
4	has_hyponym_LONG
3	state_of
1	role_instrument, involved_location, involved, has_mero_part, has_holo_part, causes, be_in_state, antonym

out tendencies and set up hypotheses that can be verified in future studies.

On next pages, there are all EstWN entries, where the word under explanation is found, and semantic relations that were used by subjects when explaining the word.

Figures 1–8 represent examples of explanation of words that were found among EstWN literals too. The examples begin with EstWN synset number and synset members after '@' and part of speech mark, in boldface. EstWN gloss follows in regular typeface. Semantic relations tagged in glosses are marked with '=', followed by relation name and synset they are pointing to. The next line represents WN 1.5 synset member that is the most close translation for the target word, together with its English gloss. Relations tagged in experiment dialogue utterances follow, with English translations. Extracts from utterances start from underlined titles, guesser utterances are preceeded with '⇒'. English translations of dialogue extracts are printed in typewriter font.

An important question is, whether the explanations used by the subjects coincide with EstWN glosses. There are examples of both extremes: almost full coincidence and completely different explanations. Almost full coincidence with English wordnet[4] gloss has word 'lovi' (*lion*, see Figure 1).

Less common features have Estonian definitions and word explanations for words like 'tina' (*tin*, see Figure 4).

The majority of Estonian glosses come from the The Defining Dictionary of Standard Estonian (DDSE). The rest of the material shows as well, that Estonian definitions differ from spontaneous explanations more than English definitions. This may be a hint of a tendency that Estonian lexicographers have considered encyclopedic features more important than these features, that are activated in the mental lexicon of a language user to explain these words.

[4] Version 1.5, on which InterLingual Index of EuroWordNet-2 project is based on

9434@n lovi(1) peam. aafrika savannides ja poolkorbetes elutsev suur pruunikaskollane kaslane=has_hyperonym-9431@n [a big brownish-yellow feline living mostly in African savannas and semideserts]

lion, king of beasts large gregarious predatory feline of Africa and India having a tawny coat with a shaggy mane in the male

hpr: loom == animal, beast

location: aafrika == Africa

spec: suur == large

syn: loomade kuningas == king of beasts

married couples: igavene <spec>suur</spec> sihuke <loc>aafrika</loc> <hpr>loom</hpr>, laia sihukse. <gesture>sirutab käed sulgudekujuliselt pea korvale</gesture> noh
⇒ LOVI(1)

`such a <spec>big</spec> <hpr>animal</hpr> in <loc>Africa</loc>, with a wide such <gesture>stretches hands around head, like parentheses</gesture>`

married couples: <syn>loomade kuningas</syn>
⇒ LOVI(1)

`<syn>king of beasts</syn>`

Figure 1: Almost full coincidence of word definition and word explanation: target word 'lovi' (*lion*) gloss (from WordNet 1.5) and explanation in Experiment (3).

4 Semantic Relations Used at Spontaneous Word Explanations

The transcribed dialogues were manually tagged for semantic relations. The set of tags was not limited to Wordnet relations, although semantic relations found in EWN were preferred as first choice. Our aim was to tag as much of an utterance as possible, so we added tags for extra-semantic information as well. The most frequently used extra-semantic tags were `gesture` (n=123, Experiments 1 and 3), `exinfo` (n=44, all 3 Experiments), The `gesture` tag was used to mark gestures that were used as essential part of explanations, deictic and emblematic ones in particular. As dialogues from Experiment 2 were not recorded in video, there are no gestures marked. The `exinfo` tag was used to mark external information: that is no semantic, nor gestures or linguistic. Usually it was used to mark utterances that carried information known to the teller and guesser only, eg. "your favorite [drink]" (from Experiment 3, married couples) or "that she explained earlier" (from Experiment 1, children).

Bunch of annotated relations can be called extra-semantic or linguistic, such as compounds (Figure 6), derivation and collocational information. The rules do not allow use of stem, but if it is already said by the person who guesses, then it was allowed to use in explanation as well. Most frequent in this group is tag `<ling>`, which was used to mark linguistic information: when teller instructed guesser to use another word, part of speech, or take only part of word, for example.

Table 5: Relations tagged in Experiment 1–3 dialogues by utterance type, grouped by relation type.

Relation	In teller utterances	In guesser utterances	Total
hpr	182	24	206
cohyp	52	136	188
syn	39	25	64
ant	30	2	32
hyp	13	13	26
xpossyn	4	13	17
Total	320	213	533
use	114	1	115
loc	85	3	88
spec	80	1	81
prop	53	1	54
sitcomp	43	0	43
action	33	0	33
time	25	0	25
involved	19	0	19
role	16	1	17
patient	13	3	16
entail	14	1	15
agent	10	2	12
Total	505	13	518
ling	57	0	57
compound	19	10	29
colloc	8	3	11
deriv	6	5	11
stem	10	0	10
Total	100	18	118
holo	31	1	32
part	20	8	28
mero	15	2	17
Total	66	11	77

The tagged semantic relations can be divided into thematic groups (Table 5).

The central semantic relations in EstWN like synonymy and hierarchical relations like hypo- and hyperonymy are used in word explanations much less than in thesaurus glosses. Unexpectedly frequently is used cohyponymy (as coordinates in EWN), often its usage is like antonymy, it is used to explain what the word *is not*. See Figure 2 for an example. High number of cohyponyms in guesser utterances is a result of misguessing.

Usage, location, specification, property and situation component are not special semantic relations in Wordnet, but they are important elements of frame (Fillmore, 1985). We hypothese that subjects use these relation to explain words that denote things that are rather palpable and usable, like tools, furniture etc. A big role in word explanation has connection to some prototypical place or hinting via some spatial relations, see Figure 5.

The example on Figure 4 is an interesting case of folk-theories used at word explanation.

Unexpectedly holo- and meronymy are represented very modestly in word explanations.

1322@n järv(1) suurem veega=has_hyperonym-436@n täitunud maismaanogu, mis ei ole otseses ühenduses merega

lake a body of water surrounded by land

cohyp: meri ==sea, jogi ==river

married couples: mitte <cohyp>meri</cohyp> vaid
⇒ JÄRV(1)

`not <cohyp>sea</cohyp> but`

married couples: mitte <cohyp>jogi</cohyp>, mitte <cohyp>meri</cohyp>, vaid
⇒ JÄRV(1)

`not <cohyp>river</cohyp>, not <cohyp>sea</cohyp> but`

Figure 2: An example of using co-hyponym relation (coordinates) in word explanation. Word 'järv' (*lake*) is explained as being *not* 'meri' (*sea*) or 'jogi' (*river*).

5 Problem of Polysemy

Probably one of the most interesting problems in word explanations under time pressure are homonyms. What meanings are preferred? This can be studied with homonyms as stimulus words. In random word conditions there happened to be some homonyms too.

One of such words is 'koor'. This is partially homonymous word in Estonian. Word forms in singular nominative (which is so-called base form in lexicon entries and as stimulus form in this play as well) are same, but other forms are different.

There are seven synsets in EstWN that contain literals 'koor' (see Figures 7–8). According to form homonymy, senses 1, 2, and 4 form one group and senses 3, 5, 6, and 7 second group. Two teams of players used different meanings to explain, so we cannot say, that one of the meanings is more or some other less activated in minds of native speakers of Estonian. Still, by the explanations it was difficult to tell, what meanings were exactly explained or what senses meant. So the senses explained can be grouped as 1 or 4 and 3 or 7.

Although wordnets do not make difference between homonymy and polysemy, one possibility to distinguish them is by their position in hyperonymy hierarchies. If they are positioned in totally different hierarchy trees, they are homonyms. This does not stand for groups of 'koor' 1, 2, 4 and 3, 5, 6, 7. There are more metonymic or metaphoric groups inside form homonymy groups. 'Koor' (2) *cream* has a metaphoric meaning of covering on milk, but it belongs to food hierarchy, not to covering.

'Koor' senses 5 and 6 form a historically primary division of senses, belonging to *area* hierarchy. Senses 3 and 7 are derived by metonymy, and they belong to *group* hierarchy.

A group of very interesting cases is, where person who is explaining, tries to explain two homonymous senses, and with success.

3223@n mask(1) puidust, riidest, vahast, papist vm. materjalist näokate, mille eesmärgiks on muuta kandja mittetuntavaks v. teha ta teat. inimese v. olendi näoliseks

mask a covering to disguise or protect the face

sitcomp: karneval ==fancy-dress ball

location: näo ees ==before face

role: varjama ==to cover, to disguise

involved: mitte ära tundma ==not to be recognized

use: ette panema ==put ahead

married couples: <sitcomp>karneval</sitcomp> kui sul on siin <loc>näo ees</loc> midagi
⇒ MASK(1)

`<sitcomp>carnival</sitcomp> if you have <loc>before your face</loc> something`

married couples: <use>panen ette</use> sihuke et <role>varjata</role>
⇒ MASK(1)

`<use>I put on</use> to <role>cover</role>`

children: see on, <exinfo>ühe multika, ühe filmi nimi</exinfo> ja see on niimoodi, et sa <use>paned selle <loc>näo ette</loc></use> ja keegi <involved>ei tunne ära</involved>
⇒ MASK(1)

`that is <exinfo>a name of a cartoon, a name of a movie</exinfo> and <use>put it <loc>before face</loc></use> and nobody <involved>would not recognize</involved>`

Figure 3: An example of *involved*, *role*, *location* relations. Word explained is 'mask' (*mask*). Children used movie name in their explanation, it is tagged as *exinfo*, information normally known to teller and guesser only.

6 General Discussion

Semantic relations in glosses were found automatically, supposing that words are defined using meanings that are most closely related to them. Still, there can be mistakes that are caused by present state of EstWN: the most elaborated relation is hyponymy-hyperonymy, and that may be the cause of so big number of hyperonym relations in definitions. For example, in definition of 'järv' (*lake*), 'vesi' *water* is tagged as being hyperonym, sense 1 (*eq_synonym* with *water 5* in WN 1.5, Figure 2). Still, the meaning of sentence indicates, that it should be assigned sense 2 (*eq_synonym* with *water 6* in WN 1.5), and have relation as mero_madeof. In this sense, water is material of lake, not lake is a kind of water. But there is no relation between 'vesi(2)' and 'järv(1)' in EstWN.

The analysis of spontaneous word explanations has shown, that the number of relations or features used is much more diverse than the choice of semantic relations found in EstWN. People try to describe some other components of a typical situation connected to the word explained. In this field the relations used in EstWN is a limited choice, and in formal description it would be useful to use frames.

5230@n tina(1), Sn(1), inglistina(1) keemiline element, läikiv hobejasvalge väga plastiline metall=has_hyperonym-549@n ==tin, Sn

hpr: metall ==metal

use: valama ==to pour

time: vana-aasta ohtu ==New Years Eve

married couples: <use>valatakse <aeg>vana-aasta ohtul</aeg></use>
⇒ TINA(1)

`<use>poured <time>New Year's Eve</time></use>`

married couples: <use><aeg>vana-aasta ohtul</aeg> valatakse</use>
⇒ sampus
ei
⇒ olu
ei see sihuke <hpr>metall</hpr>
⇒ TINA(1)

`<use>poured <time>New Year's Eve</time></use>`
`⇒ champagne`
`no`
`⇒ beer`
`no such a <hpr>metal</hpr>`

Figure 4: An example of explanation via usage. Word explained is 'tina' (*tin*).

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488@n seen(1) kand- ja kottseente maapealne viljakeha

mushroom fleshy body of any of numerous edible fungi

location: mets ==forest

part: kübar ==pileus

involved: korjama ==to mushroom, to pick

use: marineerima ==to pickle

cohyp: lilled ==flowers, mustikad ==bilberries, blueberries, marjad ==berries

married couples: <loc>metsas</loc> kasvavad <part>kübarad</part> peas
⇒ SEEN(1)

`grow in <loc>forest</loc> <part>caps</part> on`

married couples: <use><loc>metsas</loc> korjame</use>
⇒ <cohyp>lilli</cohyp>,
⇒ <cohyp>mustikaid</cohyp>
korvi
⇒ <cohyp>marju mari</cohyp> <use>marineerin neid</use>
⇒ SEEN(1)

`<use><loc>in forest</loc> we pick</use>`
`⇒ <cohyp>flowers</cohyp>,`
`⇒ <cohyp>bilberry</cohyp>`
`with basket`
`⇒ <cohyp>berries, berry</cohyp> <use>pickle them</use>`

Figure 5: An example of using spatial relations. Word explained is 'seen' (*mushroom*).

7915@n kild(2), katkend(1), fragment(1), katke(1) väike osake, katke millestki suuremast v. terviklikumast

selection, extract, excerpt a passage selected from a larger work; "he presented exerpts from William James' philosophical writings"

7914@n kild(1), tükk(2) asja, eseme purunemisel v. lagunemisel tekkinud väike tükk

fragment a piece broken off of something else; "a fragment of rock"

compound: klaasi- ==[piece of] glass

married couples: <compound>klaasi</compound>
⇒ KILD(1)

`...<compound>of glass</compound>`

married couples: <compound>klaasi-</compound>
⇒ <spec>killud</spec>
<ling>ainsuses</ling>
⇒ KILD(1)

`...<compound>of glass</compound>`
`⇒ <spec>pieces</spec>`
`<ling>singular</ling> English`

Figure 6: An example of explaining word with compound.

1176@n koor(1), pealiskiht(2), kest(2) kova v. sitke, kuid suhteliselt ohuke pealmine ainekiht millelgi ==eq_has_hyperonym:cover, natural covering,

covering a natural object that covers or envelopes

ant: sisu ==content

compound: puu- ==bark

loc: peal ==on, upon, over

2796@n koor(4) puuvilja, marja, mugula vms. kest=has_hyperonym-1176@n ==peel

compound: pähkli- ==nut[shell]

1177@n koor(2) piima seismisel selle pinnale kerkiv rasvarikas kiht, kasut. kohvi vm. toidu tegemiseks

cream the part of milk containing the butterfat

children: see on <prop>mingi <loc>asja, peal</loc>, et sa ei saaks <ant>sisu </ant> kätte</prop>
⇒ kaan
ei, <compound>puu</compound>. <compound>pähkli</compound>
⇒ KOOR(1, 4)

`this is <loc>on something</loc>, so that you could not get <ant>content</ant>`
⇒ `lid`
`no, <compound>wood</compound>. <compound>nut</compound>`

Figure 7: An example of explaining polysemous word 'koor'. In contrast to Experiment 1 (adults) (Figure 8), children explained the 'covering' meaning. It can be translated as 'bark' or 'shell' into English, and both of these are used by children in their explanations.

1178@n koor(3) suurem kollektiiv ühiseks laulmiseks, harvemini orkestripalade esitamiseks.

chorus a group of people assembled to sing together

consort, choir a family of similar musical instrument playing together

9440@n koor(7) paljude helide=has_hyperonym-361@n, häälte=has_hyperonym-361@n üheaegne kostmine

chorus any utterance produced simultaneously by a group; a chorus of boos

involved: laulma (üheskoos) ==to sing (together)

adults: <involved>laulavad</involved> <spec>üheskoos</spec>, aga <lex>mitte tegusona</lex> vaid, mis see on
⇒ KOOR(3, 7)

`<involved>sing</involved>`
`<spec>together</spec>, but <lex>not verb</lex>`
`but what it is`

3070@n koor(5), oreliväär(1) kirikus pikihoone lääneotsas olev rodu, millel paikneb orel

choir the area occupied by singers; the part of the chancel between sanctuary and nave

3072@n koor(6), altariruum(1) kiriku idaosas olev ruum (v. pikihoone idaosa), kus asetseb peaaltar

bema, sanctuary, chancel area around the altar of a church for the clergy and choir; often enclosed by a lattice or railing

Figure 8: An example of explaining polysemous word 'koor'.