Improving graphic sign language using a word grammar

Evaluation and redesign of international standard traffic and safety signs

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The human language machine is not restricted to one language. It can process English and Chinese. It is not restricted to the tongue and the ear but can deal with muscles and the eye as well (dance, language for the deaf). The grammar for word languages is more or less universal and describes how to design a correct and efficient word sentence. So, there are three questions:

Is a word grammar applicable for a visual sign language? When the answer is yes, the next question would be:

Does the application of word grammar rules, improve sign understanding? When the answer is yes, the next question would be:

What is wrong with today's sign design?

1 Is a word grammar applicable for a visual sign language?

1.1. The grammar for denial

In a word grammar the form for denial is adding a denying element: *not*, *no*, *none*, *no*where, *no*body *n(o)*either, *dis*-honest, *in*convenient, *non*-infectious, *un*likely. Visual forms for denial are similar: the color red, strikethrough and double strikethrough (cross). These visual grammar rules are well understood and international. See the signs at the right [2] [3].

1.1.1 Position grammar for denial

The position of the denying element is relevant (*Do not kill him.* And *Kill not him).* In this ghost driving sign[4] the position of the driver is not clear. Is he the red car or is he a black car? In this case misunderstanding is lethal.

The two general denials (red border, strikethrough, red strikethrough) in these signs[5] are not related to the denied element e.g. by position. It is unclear what is not allowed. A general denial is applicable in simple languages such as two word sentences used by children, two years of age.

1.1.2 Grammar for complex denials

So far simple denials were discussed: *yes/ not*. In real life, denial can be more complex by adding conditions for denial.

1) These two green signs on a ferry door say: *This is an exit door but only to be used in case of an emergency.*

2) These three emergency exit signs are for exits too but the meaning is: *Not to be used in case of emergency.*

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[2] *No smoking in bed.*

[3] *Don't stand on the toilet.*

[4] *Wrong way driving* is the common wording in English. This might be interpreted as *being lost*. This wording does not express the serious meaning. The Dutch wording *Ghost* driving is used here. More about this sign: http://www.humanefficiency.nl/public/wrong_way_driving_signs.shtml

[5] *No smoking in bed* and *Children are not allowed to play near toilets and showers on this camping.*

3) According to denial word grammar rules in language, 2 x no=yes, *not unattractive* is *attractive.* This text graphic[6] has one denial in words and two graphical denial elements. This anti ghost driving traffic sign has two denials (overall red triangle and red car). The bottom one shows a drivers a total of eight denials trying to stop him becoming a ghost drivers. According to word grammar denial rules, the meaning of this sign in Vienna is: *Please continue ghost driving.*

Sign designers seem to be so anxious that their *no* is not understood, that their grammar is: the next graphical denial does not eliminate the previous one but adds up.

4) Confusing is the use of red to attract attention as well. Sensitivity of the human eye for red is rather low by the way. The bridge sign does not mean: *Do not open the bridge.* More confusing is the use of red for *yes.* The red in the emergency exit sign does mean: *Do not enter in case of emergency* but *Look here.*

In 1977 using a synonym was lethal for 583 passengers in Tenerife. The pilot used the synonym *OK* meaning *OK for take-off* and the air traffic controller's interpretation was *OK for route clearance.*

1.2. The grammar for plurals

In word grammar the form for plurals is adding letters to the singular form: one book, two books. Such a multiplier rule applies to signs[7] as well.

There are words for general plurals (books, men) and specific combinations of elements (dictionaries, families). This also applies to signs.[8]

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[6] The Dutch text is saying: *You are not what you eat.*

[7] *This package of meat is sufficient for 4 persons.*
Please line up in rows of 6 skiers.
Assembly point in case of emergency.
Combinations of ships towing each other should not overhaul each other.

[88] *Pedestrians only.*
Assembly point on a ferry in case of an emergency. More about this sign:
http://www.humanefficiency.nl/public/pictogram_muster_station.shtml
Car park places for families (more space to load and unload children).
Not *Men's t*oilets but *Elevator, downward only.*

1.3. The grammar for adjectives

In a word grammar an element can be restricted by adding a restricting word: a *long* car, a *tall* car, a *passing* car. When the element or the restriction (the noun) is absent, misunderstandings can arise, especially when three dimensional restrictions are communicated in a two dimensional sign. When the element (the noun) is omitted the reader has to learn the meaning of the sign. Size adjectives for cars are simple three dimensional: height, width and length. Adjectives for nautical signs are more complex because there are invisible dimensions like under water, current, tide and wind.

2. Does the application of word grammar rules, improve sign understanding?

The previous chapter showed that rules for word grammar can be applied to signs. Will signs having a correct word grammar lead to better understanding?

2.1. Grammar, denial, and human performance

Not understanding this square sign is not lethal. Not smoking in bed goes without saying. It might be lethal for 30%[9] of the readers of this sign who think the meaning is: *no beds available, do not move the bed, do no sleep in the bed, take care of earth shakes, and bed with high hand rail.*

More serious are the problems with international emergency exit signs. The effect of saying *no* (using the colour red) is that 35% of the readers will not use the emergency exits with a red sign. The red sign is common practice in the US. 100% will use an emergency exit when the signs says *yes* (green). The green sign is the European standard.

2.2. Grammar, adjective, and human performance

These international road traffic signs show the adjective only. They are understood by 46% of the readers. The experimental road traffic signs below, include a noun (a car). 37% more readers (63%) do understand the signs with a noun.

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[9] The experimental results are based on the sign explanations of 50 subjects. For each sign the number of explanations is approximately 20.

The Austrian triangle shaped ghost driving sign is a candidate for the European standard. The 40 readers needed 11 seconds to draw a conclusion. 18% of the readers do understand that there is some directional problem. 5% does refer to the ghost driving danger and might not be killed within a few minutes.

The Dutch anti ghost driving sign has a clear direction adjective (*Go back*). The 27 readers needed 5 seconds to draw a conclusion. 88% of the readers refers to a directional problem. 12% explicitly refers to ghost driving.

2.3.   Grammar, plurals, and human performance

According to word grammar this blue sign means: *For adult males and little girls.* This red elevator sign does not mean: *Don't overload the elevator* nor does it mean *Do not hangout here.*

13% of the readers supposes that this International safety sign on ferries only applies to families. In that case a logical conclusion would be*: Life boats for gay couples are elsewhere.*

Using restricted plurals in signs for unrestricted plurals, impairs communication when the restriction is relevant. 60% of the readers do not refer to the family restriction for this blue Ikea park sign.

3 What is wrong with today's sign design?

A sign is first *detected*, then read followed by *recognition* (in case of a familiar sign). When the sign is *selected* as relevant follows *decision* and *action* (Riemersma 1989[10]). The focus of these kinds of models is visual: on readability and recognition. A premise is that the reader know the sign. Memory as a basis for communication has some risks.

  a) A training and in some cases an exam is needed. In practice the exam is passed even in the case the meaning of some critical signs is not understood. 19% of the car drivers understands the maximum car width sign. 12% of the readers understand this Dutch anti ghost driving sign that is in use now for more than three decades.

  b) After obtaining his driving license a driver might forget the meaning of sign and his memory can gradually change the interpretation of a sign to a more logical one. 40% of the licensed car drivers changed the correct interpretation (max. length) in the wrong interpretation (max. width). They

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10 Riemersma, J.B.J. (1989). Waarnemen van weg en omgeving en rijgedrag. In C.W.F. van Knippenberg, J.A. Rothengater, en J.A. Michon eds.), Handboek Sociale Verkeerskunde. pp. 403- 4 14. Assen: Van Gorcum.

almost are non-car drivers again, as 30% of the readers who do not have a car nor a license, gave the *maximum width* interpretation as well.

c) For public transport and safety signs there is no training and passengers don't need a license for a sea ferry trip. 83% of the readers does not understand this emergency sign.

d) The requirements for costs, efficiency, safety and comfort increase. Consequently, systems become more and more complex. More restrictions and exceptions have to be communicated. Technical options increase as well (dynamic, personalized information, more media become available). When memory is the basis for signs, a permanent sign education would be needed.

These risks and the experimental results show that memory is no option as a basis for a sign system. What to do? Biological evolution has chosen another way that enables humans to deal with a complex environments. When a few sophisticated facts and rules are available in human *memory*, then human *thinking* can create and interpret a large variety of messages. Even unforeseen messages in an unfamiliar context can be communicated.

The memory based car length sign is understood by 19% of the licensed and experienced car drivers. The unfamiliar thinking based boat length the sign is understood by 58% of the unlicensed readers seeing the sign for the first time without any explanation. The other 42% might understand the sign when they would be familiar with the similar sign for car length. Even the complicated shallow bank sign is understood by 38% the readers (again: not familiar with boats, first time presentation, and no explanation given).

For a plain sign language, user licenses and user memory are a dead end.

For a plain sign language, sign designers should be licensed and their memory should contain cognitive psychology, e.g. psychology of language.