

USER-FRIENDLY MACHINE TRANSLATION: ALTERNATE TRANSLATIONS BASED ON DIFFERING BELIEFS

David Farwell

Computing Research Laboratory
Box 30001/3CRL
New Mexico State University
Las Cruces, New Mexico 88003
USA
tel: (505) 646 5108
fax: (505) 646 6218
david@crl.nmsu.edu

Stephen Helmreich

Computing Research Laboratory
Box 30001/3CRL
New Mexico State University
Las Cruces, New Mexico 88003
USA
tel: (505) 646 2141
fax: (505) 646 6218
shelmrei@crl.nmsu.edu

Abstract

In this paper the authors present a notion of “user-friendly” translation and describe a method for achieving it within a pragmatics-based approach to machine translation. The approach relies on modeling the beliefs of the participants in the translation process: the source language speaker and addressee, the translator and the target language addressee. Translation choices may vary according to how beliefs are ascribed to the various participants and, in particular, “user-friendly” choices are based on the beliefs ascribed to the TL addressee.

1. Introduction

It is clear on a gross level that differences in the beliefs and knowledge of the target audience should affect the translation of a document for that audience. If the target audience, for instance, knows German, but not French, then the translation should be in German. At a finer level, the dialect that the audience is familiar with should affect the translation. Translations into English might be made profitably into American English, Australian English, British English, or Indian English. Differences in knowledge might affect the translation outcome as well. Translation of a technical article might be different if intended for specialists or for general consumption.

In this paper, we provide a method for taking into account these differing beliefs of different target audiences, and then crafting the translation in response to those assumed beliefs. We show how the analysis of one source language (SL) text can result in the generation of multiple target language (TL) texts, each variant dependent on the assumed beliefs of the target language audience.

To do this, we need to show both how beliefs enter into the analysis of the SL text and then how these can be used in the process of generating an appropriate TL text. Briefly, we suggest that the goal of the analysis process is to produce an interpretation, which is a coherent picture of the text based on the semantics of the text along with the inferences needed to integrate that semantic content with the rest of the discourse and with general world knowledge. While several alternate interpretations may be compatible with the same SL text, in this paper, we concentrate on the methods by which more than one TL utterance can be provided from the same interpretation.

We begin by developing notions of utterance context, discourse context, speaker intention and interpretation. We establish, for a specific example, interpretations for a SL utterance and its TL counterparts. We then outline a computational model of translation which provides a degree of formalization.

2. Background

As a context for discussion, we consider two differing translations into English of *el tercer piso* and *el segundo piso* in the following Spanish sentence taken from a news article about the Moscow real estate market in the early 1990's.

*... los 300 metros cuadrados del **tercer piso** estaban disponibles pero fueron aquilados ..., sólo queda el segundo piso*

While one translator has rendered these expressions as *the third floor* and *the second floor* respectively, another has rendered them as *the fourth floor* and *the third floor*. These two translations are clearly different. However, they are, in fact, both accurate and they are not necessarily logically inconsistent. How is this possible? We suggest the answer resides in differing beliefs the translators have about the beliefs of the author and addressees of the Spanish text and of the addressees of the English translation.

We hypothesize that first translator assumes that the author and addressees of the Spanish text share the translator's floor-naming convention and that the addressees of the translation also share the translator's floor-naming convention. Thus, the first translator interprets *el tercer piso* as being used to refer to, say, the fourth level of a building and *el segundo piso* as being used to refer to the third level and, in turn, refers to the fourth level as *the third floor* and to the third level as *the second floor*. If those assumptions are correct (and we do not have the crucial information to determine this), then the first translator's translation is equivalent to the Spanish text at least at the level of information content, given the assumption about the floor-naming convention of the target language addressees. Otherwise, the translation will require addressees of the translation to have access to information about alternative floor-naming conventions and make the appropriate inferences in order to arrive at the author's intended meaning.

We hypothesize that the second translator assumes that either the author and addressees of the Spanish text do not share the translator's floor-naming convention or, alternatively, that the addressees of the translation do not share the translator's floor-naming convention. Thus the second translator refers to the fourth level above ground as *the fourth floor* and the third level above ground as *the third floor*. If either of those sets of assumptions is correct (again, we do not have the crucial information to determine whether they are), then the second translator's translation is equivalent to the Spanish text at least at the level of information content. Otherwise, the translation will be less appropriate since the addressees of the translation will have to access information about alternative floor-naming conventions and make the appropriate inferences in order to arrive at the author's intended meaning.

In addition to the above translations, still others could be offered which conform more closely to the beliefs of the target addressees as these are assumed to vary from one situation to another. For instance, if the exact reference cannot be determined or expressed with certainty because it is unclear which floor-naming convention is being used, the translator might choose to simply convey what is clear, namely, the relationship between the two floors, offering a translation of *el tercer piso* as, say, *one floor* and *el segundo piso* as *the floor below*. This suffices to convey that rental space is scarce and expensive, satisfying the communicative goals of the author and the communicative needs of the target audience.

On the other hand, if the target audience consists of experts in Muscovite real estate, for whom the exact reference may be highly significant, the translator may wish to clearly indicate the ambiguous SL interpretations providing a translation of *el tercer piso* as *the third (or possibly fourth) story* and similarly with *el segundo piso*.

3. Framework: Beliefs and Inferencing

As a framework for this discussion, we take as given a beliefs ascription mechanism (such as that of Ballim & Wilks, 1990) for constructing the relevant recursively embedded viewpoints of the participants in the translation, an ontology (such as that of Mahesh, 1996) as a knowledge source for representing the beliefs within these spaces, and a default inferencing engine (such as that of Barnden, et al., 1994) for carrying out the inferencing over these beliefs within these spaces.

Following Ballim & Wilks, 1990, beliefs about a topic are collected together into a topic beliefs environment. Beliefs of an agent are collected together into a viewpoint which, in turn, contains various topic beliefs environments. The basic default rule for ascribing beliefs, then, is:

unless there is specific evidence to the contrary, agent1 ascribes its beliefs to agent2.

Evidence to the contrary consists of pre-existing beliefs in target agent's viewpoint that are contradictory to or inconsistent with the beliefs in the topic environment being ascribed.

Following Barnden, et al., 1994, we further assume the existence of a default (defeasible) inferencing engine which, when given a goal to prove, will evaluate all evidence chains that it can find for both the goal and its negation. Each step in the chain is given an evidence status such as certain, default or possible. The evidence for both the goal and its negation then receives such a status and a resolution procedure then determines the evidentiary status of the goal. In the example below, the rule has a default status, while the fact is certain. The result of combining the default rule with the certain fact is a default status conclusion. At the same time, the mechanism examines any evidence for the goal $\neg(\text{fly}(\text{tweety}))$, such as, say, that Tweety is a penguin or has a broken wing.

default inference rule:	$\text{bird}(x) \rightarrow \text{fly}(x)$
actual fact:	$\text{bird}(\text{tweety})$
default conclusion:	$\text{fly}(\text{tweety})$

4. Utterance Context

The utterance context consists of beliefs about particular people, places, events, etc. (e.g. author and addressee), about ontological classes of people, objects, events, etc., about language use and communication and about social and cultural conventions. It is what has often been referred to in the literature as knowledge of the world.

With respect to the specific example under consideration, the utterance context would include such beliefs of the translator as:

- in Europe (and elsewhere), people refer to the ground level of a multi-story building as *the ground floor*, the next level up as *the first floor*, and so on (regardless of the language),
- in the USA (and elsewhere), people refer to the ground level of a multi-story building as *the first floor*, the next level up as *the second floor*, and so on.

It would also include such beliefs as:

- the author is a Spanish speaker,
- the addressees of the text are Spanish speakers,
- Spanish speakers may be Spanish,

- Spaniards are Europeans,

This knowledge may then be accessed by the translator, ascribed to the author or addressees of the source language text or to the addressees of the translation and used for establishing a contextually coherent interpretation or for selecting a contextually appropriate expression.

5. Discourse Context

The discourse context consists of beliefs about the objects and events mentioned or implied during the discourse, the communicative state of the discourse and the “open issues” (objects or events whose connections to the context have yet to be established). It has been referred to as knowledge of the prior (linguistic) context.

With respect to our example, the discourse context would include such beliefs as:

- the commercial real estate market in Moscow is expanding rapidly,
- properties are renting at the equivalent of \$700 to \$800/m²/year,
- properties are renting at the third highest rates in the world (behind Tokyo and Hong Kong),
- properties are in high demand,
- the market is dominated by poverty, legal uncertainty and the principle of “the rich get richer”.

This knowledge may also be accessed by the translator, ascribed to the author or addressees of the source language text or the addressees of the translation and used for establishing a contextually coherent interpretation or producing a contextually appropriate expression.

6. Interpretation

The process of translation begins with the translator’s identifying of the intention of the source language author in uttering a particular expression. The translator essentially begins with the assumption that what the translator believes about source language conventions, about cultural and social conventions of source language speakers and about people’s presumed knowledge of the world is the same as what the author believes except where the translator, explicitly or by implication, believes that the author’s knowledge differs. Similarly the translator assumes that the author’s beliefs about the source language addressees is the same as the translator’s except where there is explicit or implicational evidence to the contrary. These beliefs, the translator’s beliefs modified by that which the translator believes the author believes in contradiction to the translator, constitutes the utterance context for interpretation. The discourse context provides the foreground context for interpretation and the utterance context provides the background context.

The initial context for processing our example will contain certain beliefs on the part of the translator about the participants in the source language communicative event and the objects and events that have been described thus far (such as the belief that the referent of *Moscow* is in Russia, etc.) which have been drawn from the utterance context. In addition, the initial context will contain certain beliefs the translator assumes the author has about the objects and events described thus far (such as the belief that the real estate market in Moscow is booming, etc.) which have been drawn from the discourse context.

The initial task of the translator, then, is to assign to the author, for each expression E_i uttered, an intention on the basis of the form and semantics of the expression and the beliefs present in the context. For our example, the expressions *el tercer piso* and *el segundo piso* would be provided with semantic representations akin to $\mathbf{ix:floor(x)\wedge third(x)}$ and $\mathbf{ix:floor(x)\wedge second(x)}$ and the context contains beliefs akin to those described above in Sections 4 and 5.

The interpretation involves inferring a belief, the author's intention, that is informative and compatible with the context by inferencing from beliefs in the discourse and utterance contexts. For our example, the translator might infer that the author is referring to the fourth and third levels of the building given the semantic representations of the expressions uttered, that the author and addressees of the source language text are Spanish speakers, that many Spanish speakers are European, and that Europeans refer to the ground level of a multi-story building as *the ground floor*, the first level up as *the first floor* and so on. Note that there are other possible interpretations given alternative assumptions about who believes what (see the discussion of "alternative beliefs" below).

In addition it is necessary to determine the author's purpose in making reference to these particular levels of a particular building in the first place, that is, to determine whether the author intended to illustrate some point, to persuade the source language addressees to rent an apartment or some other motive. In this particular case, for instance, given that the Spanish expressions are part of a general news wire article, that the exact building is not identified in that article, and that the article was intended for a Spanish-speaking audience unlikely to be intimately concerned about specific floors in some building in Moscow, it is likely that the author's purpose is simply to provide evidence of the scarcity of space.

From these possible interpretations, the translator selects one as the author's intention. Assume in this case that this interpretation is that described in the previous paragraph.

7. Translation

The second step in the translation process is for the translator to express in the target language, with its different set of linguistic conventions, to the TL addressees, with their quite possibly different cultural conventions and, perhaps, different conventional knowledge of the world, the SL author's intention. The translator must produce an expression which invites at least that intention to be identified and, perhaps, other possible interpretations supported by the original SL text.

To begin this process, the SL discourse context prior to the analysis of E_j is subtracted from the SL discourse context that resulted from processing E_i . What remains represents the information added in processing E_i , including the beliefs needed to infer the author's intention from E_i 's semantic representation.

The next step is to replace the utterance and discourse contexts of the SL addressees by the utterance and discourse contexts of the TL addressees and to replace the discourse context of the SL author by the discourse context of the translator (as TL author). This may result in changes in the viewpoints in the TL discourse context and certainly entails changes in the TL utterance context. For instance, suppose that as a result of swapping out the SL utterance context for the TL utterance context, the European floor-naming convention is blocked in the TL addressee viewpoint by the preexisting belief that people refer to the ground level of a multi-story building as *the first floor*, the first level up as *the second floor* and so on. That is to say, the translator realizes that the floor-naming convention of the addressees of the translation is different from that of the addressees of the SL text.

The next step is to generate an utterance E_i^* , with a semantic representation such that one of its interpretations in the new TL context is equivalent to the information derived from E_i , in the original SL context, i.e., the fourth and third levels of a building. Assuming that the intention of the translator (as author), then, is to refer to the fourth and third levels above ground and assuming that the floor-naming convention of the TL addressees the relevant expressions will have semantic representations akin to $\mathbf{ix:floor(x)\wedge fourth(x)}$ and $\mathbf{ix: floor(x)\wedge third(x)}$.

The final step is to provide the possible alternative interpretations of E_i^* , given the initial TL discourse context and TL utterance context.

8. Alternative Beliefs Affect Readings

There are many potential scenarios beyond the few presented above that were derived from the observation that the author used Spanish to address the readers of the original article. So, for instance, the translator might have considered the fact that the building referred to was in Moscow as being significant. This, coupled with the assumption that Russians appear to follow the ground-level-as-first-floor convention (as in the US), would imply that the author was referring to the third and second levels above ground in the original text. Alternatively, the translator might have considered the fact that the real estate agent that was quoted was speaking Russian as being significant. This, again coupled with the assumption that Russian speakers appear to follow the ground-level-as-first-floor convention, would lead to the translator to assume that the author (indirectly through the real estate agent) was referring to the third and second levels above ground. Other facts might lead to still other conclusions. For example:

- the real-estate agent is Turkish and Turks follow the ground-level-as-ground-floor convention,
- the real-estate agent was addressing the reporter (author) in Spanish and Spaniards follow the ground-level-as-ground-floor convention,
- the real-estate agent was speaking to a Japanese person, the Japanese have a taboo on *fourth floor* and the real-estate agent knew the addressee knew that in this situation you use the ground-level-as-ground-floor convention even though the ground-level-as-first-floor convention is the established one in both Russia and Japan.

In other words, those facts identified by the translator as relevant to establishing the author's intention are crucial to determining that intention. What is more, an author's intention may not have to do with describing an event or state of affairs or presenting their thoughts on some topic. It might just as well have to do with communicating a mood or emotion, some sensory image. Language as a resource for communication provides the author with form as well as meaning which can be manipulated to such ends and so form cannot be discounted in translation. Finally, a “context”, while actually very specific in comparison with all possible contexts for all possible expressions for achieving all possible purposes, can be rather large, abstract, and/or vague (e.g., providing coherence with respect to a Marxist framework or Freudian framework or Catholic framework or some combination of such frameworks). That is, if an interpreter can identify one or another such framework as an organizing principle to the written or spoken discourse, especially if it can be expressly attributed to the author, then it to might have to be taken into account.

We claim here, without demonstration, that familiarity with such frameworks or adherence to such frameworks on the part of the intended target audience may also be crucial in determining the appropriate translation.

9. Conclusions

We have argued here first that a pragmatics-based approach provides a much more explicit framework for reasoning about the many choices that translators must make in producing a translation. The central assumption of the approach is that language is vague and texts radically underspecify the interpretation. This is why translators must interpret utterances against a context of beliefs about the world, about the components of the utterance context and about the topic and related individuals and states-of-affairs.

One implication of this approach to translation, then, is that the beliefs of the translator and the way in which the translator reasons with them account for the eventual form of the translation. Those beliefs and the relevant reasoning should therefore be the focus of any critical analysis of translation quality. We need to ask:

- which beliefs are supported by the text (and how),
- which beliefs are supported by world knowledge (and how),

- which beliefs are supported by linguistic conventions (and how),
- which beliefs are supported by socio-cultural conventions (and how).

More importantly, we have argued that such an analysis of the beliefs of the target addressees will result in translations that are more appropriate for the audience of the translation. We have argued this point for a particular case where there were differing socio-cultural conventions at work between the participants in the SL exchange and those in the TL exchange. Such conventions include the one we have discussed (namely, the floor-naming conventions) as well as a wide variety of others, such as number naming (formerly, British English *billion* is more than American English *billion*), temperature naming (degrees Celsius are not the same as degrees Fahrenheit) and even more subtle and, perhaps, unconscious conventions. Translations, to be user-friendly, must attempt to determine the convention in use in the SL exchange and then identify whether or not these conventions will be shared by the target addressees. Producing the target language text, then, may or may not involve using the convention favored by the target addressees, but will certainly involve determining the common usage conventions, sophistication, and goals of the target audience.

We have argued also that user-friendly translation requires such a beliefs analysis in cases where the inference from the direct references of the SL author to the author's purpose cannot be replicated easily by the target addressees given their beliefs. Such situations potentially occur fairly often and include most cases of figurative language, ellipsis and cases where the author's purpose is expressed through some aspect of the linguistic form of the SL utterance. In such situations, the translator must focus on communicating the author's purpose rather than on the author's actual reference.

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