How Translators Use Tools and Resources to Resolve Translation Problems: an Ethnographic Study

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Abstract

Research in Translation Technology is often carried out by people and teams that have little knowledge of how translators actually work. The present paper aims at partially filling that knowledge gap by providing a concise portrait of how human translators use linguistic resources and technology to resolve translation problems (ex: terminology, phraseology). It is based on quantitative and qualitative data gathered through a Contextual Inquiry study, conducted with 8 professional translators in Canada. The paper sheds light on questions such as: the types of translation problems encountered by translators, the kinds of resources they include in their toolbox, their tendency to use certain types of resource more than other and the way they assess solutions proposed by various tools to choose the most appropriate one for their needs.

1 Introduction

Research in Translation Technology (especially in the field of Machine Translation) is often carried out by people and teams that have little knowledge of how translators actually work. Yet, these technologies are often deployed in Computer Assisted Translation (CAT) contexts where the aim is to serve human translators. An increasingly popular example is the use of MT technologies in Post-Editing situations, where translators edit machine translated texts in order to rapidly fix errors, with the goal of increasing productivity compared to translation from scratch. In scenarios like these, translators might be better served by the research community if it was better informed about their workpractices. Our research attempts to bridge that knowledge gap, by providing researchers and developers with a concise portrait of how human translators work, based on their ethnographic observation in the workplace.

This paper reports on results from a Contextual Inquiry study conducted with 8 professional translators in Canada, and focuses on how they used linguistic resources and technology to resolve translation problems in their day to day work. By "translation problems", we mean difficulties encountered during the process of translation, such as terminology, phraseology and named entities.

The paper sheds light on questions such as: (a) What are the kinds of translation problems encountered by translators? (b) How do they chose which resources to include in their toolbox? (c) Do they use certain types of resource more than others? and (d) How do they assess solutions proposed by various tools and choose the most appropriate one for their needs? Whenever applicable, we discuss possible implications of our findings for people involved in the research, development, teaching and administration of Translation Technology.

2 The LOPLT Contextual Inquiry Study

LOPLT (Laboratoire d'observation des pratiques langagières technologisées) is a multidisciplinary team started at the Language Technology Research

Center in Gatineau, Canada. The first project carried out by this team aims at better understanding current workpractices of translators, with the goal of finding ways in which new technologies can best support them. During this first project, we conducted Contextual Inquiries with 8 professional Canadian translators translating from English to French. All had received university training in translation, and held full-time paid positions as translators.

Contextual Inquiry (Beyer and Holtzblatt, 1998) is a well know technique in Human Computer Interaction, where researchers observe and interview potential end-users while they are involved in their normal day to day work. While mostly used in product development contexts, this approach has also been used effectively for grounding technology research so that it is more likely to lead to technologies that end-users will adopt readily (Rogers and Bellotti, 1997, Désilets et al, 2008a).

Machine Translation researchers who are used to dealing with millions of words may be surprised by the small sample used in this study. However, our sample size (N=8) is typical of what is used for Think Aloud studies in usability engineering (of which Contextual Inquiry is an example). Practitioners and researchers in that field have found that robust, valuable and actionable insights can be gained, even with such small samples, and they report a rapidly diminishing return on the number of new issues being discovered after the fifth subject or so. This has been empirically verified by Nielsen and Landauer's seminal work (1993).

Nevertheless, the reader should be careful about using our observations with translators or translation tasks whose characteristics diverge significantly from those in Table 1. Although our sample was fairly varied in terms of organization type, years of experience, source text domain and length, it is somewhat limited in its coverage of countries (Canada only) language pairs (English to French only) and level of technical specialization (moderate only). The findings described in this paper may therefore be sensitive to variations in the last three characteristics. Finally, it is important to note that our study focuses on a context with moderate levels of automation where tools and resources are used to help translators resolve translation prob-

Organization type	freelance (2), academic (2), large (250+ employees) translation offices (4)
Language pairs	English to French (8)
Years of experience	1-2 (2), 2-5 (4), 5 & more (3)
Knowledge in specialized fields	All but 1 subjects had one or more fields of specialization: Aboriginal Affairs (1), Management (2), Social Sciences (2), Health (2), Technology (2), Legal (2), Environment (2), Education (2), Economy & Banking (1), Horticulture (1), feline studies (1)
Source text domain	Aboriginal affairs (1), Municipal affairs (1), Public administration (3), Education (1), Legal (2), Health (1)
Source text length	Avg: 2079, Min: 300, Max:7000
Professional translators	All (8)
Country	Canada (8)

Table 1: Characteristic of the observed translators and tasks.

lems. Our findings may thus not be as applicable to more automated contexts, such as MT post-editing.

3 Related work

The study presented in this paper uses a Think-Aloud Protocol (TAP). Although many studies of translation have been carried out using this technique over the last 20 years, most of them are of limited use for making design decisions to improve CAT tools, for the following two reasons.

Firstly, the ecological validity of many of those studies is questionable when it comes to designing CAT tools for use by professional translators. As reported by Kussmaul and Tirkkonen-Condit (1995), the early studies (Gerloff, 1986 and 1988; Krings, 1986 and 1986; Lörscher, 1986), were using foreign language learners and *"conditions were [...] completely different from those of professional translator training"* (p. 179). Moreover, the emphasis was often put on the foreign language learning process as opposed to the translation process. Although more recent studies have looked at actual

translators (Jääskeläinen, 1989 and 1993; Kiraly, 1990; Krings, 1987; Kussmaul, 1989a and 1989b; Lörscher, 1992a and 1992b; Tirkkonen-Condit, 1989 and 1992, Englund-Dimitrova and Jonasson, 1997, Kunsli, 2001, Jacobsen, 2002, Lauffer, 2002, Englund-Dimitrova, 2005), the sample of subjects usually included some students and semi-professional, as well as practicing professionals. In addition, the task was usually an artificial one designed by the research team and was carried out in artificial lab conditions. In contrast, our work has very high ecological validity because it focuses exclusively on professional translators and it observes them in their normal working environment, carrying out actual tasks that they would normally do.

A second limitation of existing TAP studies is that they mostly focused on the internal psycholinguistic processes of the translator, as opposed to their use of technology and linguistic resources. Some notable exceptions are: (a) Asadi and Séguinot (2005), who discuss briefly how their subjects used word processors; (b) Lauffer (2002), who talks briefly and qualitatively about their use of resources (including bilingual corpora); (c) Kunzli (2001), as well as Englund-Dimitrova and Jonasson (1997), who focus specifically on translator's use of linguistic resources and tools. Like the last two studies, the present paper specifically investigates how translators use linguistic resources and CAT technology in their day-to-day work.

The present work adds to the above body of knowledge in three ways. Firstly, it provides additional data which can be used to triangulate previously shown trends, sometimes confirming them but sometimes contradicting them (as in the case of unilingual versus bilingual resources). Secondly, it quantitatively and qualitatively describes new trends which have never been mentioned in the literature (for example, the use of private versus public resources). Finally, it discusses what these trends (whether known or new) might mean for people involved in researching, developing, administering or teaching Computer Assisted Translation technologies.

4 Findings

We now proceed with a description of what we observed in this study.

4.1 What types of translation problems did our subjects encounter?

By *translation problem*, we refer to any source language word or expression which presents a difficulty for a human translator (not machine) during the process of translation. During our observation, we considered that a word or expression presented a problem if the translator either: (a) searched for that expression in some tool or linguistic resource, (b) made a note to himself to investigate it later or (c) verbalized a thought process about the proper way to render it in the target language.

In total, we observed 71 problems in the course of the eight 50 minutes interviews and subjects needed to carry out searches in tools or linguistic resources for 49 of them. Each problem was classified according to two independent axes. The first axis pertains to the degree of specialization, while the second one pertains to the nature of the problem (ex: Term, Named Entity). Table 2 lists the frequency of each type, as well as the frequency of resource consultations. We found that subjects carried out a total of 75 resource consultations, for an average of 1.05 consultation per problem overall.

Our data indicates that subjects experienced Language for Special Purposes (LSP) problems and Language for General Purposes (LGP) problems in about the same proportions. Although they were able to solve more of the LGP problems without consulting resources, they still accounted for a significant portion (41%) of all consultations. One possible implication of this finding for researchers and developers is that assisting translators with LGP problems might be an under investigated area, given that most CAT tools have focused on assisting with LSP problems.

4.2 What kinds of resources did our subjects include in their toolbox?

Collectively, our subjects included a wide variety of linguistic resources in their toolbox. A resource was considered to be part of the subject's toolbox if he opened it during the interview or if it was already opened when we arrived at the site. All in all, we observed the following resources:

- 3 large, public Terminology Databases (TERMIUM, GDT, OnTerm)

	Type	Num.	Num. with consultation	Examples
Axis 1: Specialisation	**Language for General Purpose (LGP)**	39	20	Junior High School / outcome / value for the money / Jordan / City Hall / Go Huskies!
	Language for Specialized Purpose (LSP)	32	29	adjunct professor / cover the allegation / MCH program
Axis 2: Nature of the problem	**Term**	27	24	adjunct professor / Junior High School / currency (Finance) / letter carrier depot
	Highly polysemic vocabulary	13	5	determine / outcome / step / grave
	Phrases (collocations, idiomatic expressions, phraseology)	12	7	value for the money / cover the allegation / wooden-hearted / on short notice
	Named entities	6	5	Jordan / Pearson International Airport / MCH Program / Kelowna accord
	Typography	2	2	Conservatives (capitalized or not) / City Hall (with or without hyphen)
	Cultural realities	1	1	Go Huskies!
	Official translation of a sentence	1	1	Official translation of a quote from a legal judgement
	Misc general language	9	4	Inconsistency / disempower / initially / young and growing population
	Total	71	49	

Table 2: Types of translation problems observed, with frequency for all cases (2ⁿᵈ column) and for those cases where the subject consulted a resource (3ʳᵈ column).

- private (to the individual) or institutional Terminology Databases built with 3 different products (MultiTerm, LogiTerm, and an in house system).
- private (to the individual) lexicons built using simple office suites (ex: Excel spreadsheets, MS-Word documents)
- 1 large, public general purpose bi-text (TransSearch)
- private (to the individual) or institutional Translation Memories built with 3 different products (Trados, Multitrans, LogiTerm)

- 2 private (to the individual) or institutional, unaligned archives of previous translations, either stored in a database or the file system
- 9 unilingual general purpose dictionaries (Multidictionnaire, Petit Robert, Merriam-Webster, Dictionnaire des cooccurrences, dictionary.references.com, Canadian Oxford, Trésor de la langue française, www.dictionary.com, urban dictionary)
- 2 unilingual thesauri (Dictionnaire analogique, Dictionnaire des synonymes de l'Université de Caen)
- 2 unilingual specialized dictionaries and lexicons (Dictionnaire de droit québécois, Lexique des noms géographiques)
- 3 bilingual dictionaries (LexibasePro, René Merteens, Robert & Collins)
- the source text being translated, as well as its partial translation
- bilingual documents related to the source text (ex: minutes of meetings being discussed in the source text)
- 2 instances of the client's Web sites
- 2 large, bilingual Web sites not directly related to the domain of the source text (gc.ca domain, Canadian Broadcasting Corporation)
- 3 large, bilingual Web sites directly related to the domain of the source text (CanLII, Canadian Federal Court, University of Ottawa)
- the whole Web in the source or target language (mined using Google search engine)
- 2 manuals of style (Guide du rédacteur, Le Ramat de la typographie)
- 2 spell and grammar checkers (MS-Word, Antidote)
- 1 database of newspaper articles in the target language

The length and variety of this list is somewhat astounding, given that we only interviewed 8 subjects for 50 minutes. Indeed, our subjects had an average of 10 resources in their toolbox. This list is richer than any that has been previously reported in the literature, including in recent studies like Kunzli (2001) and Lauffer (2002).

Table 3 shows the frequency of use of each type of resource, both in terms of the number of problems for which it was consulted (3ʳᵈ column), and the total number of times that it was consulted

		#problems	#consultations
Nature	**Termino-lexi-cographic**	33 (67%)	39 (52%)
	Corpus	29 (59%)	36 (48%)
	Both	13 (26%)	N/A
Languages	**Multilingual**	42 (86%)	60 (80%)
	Unilingual	12 (24%)	15 (20%)
	Both	5 (10%)	N/A
Availability	**Public**	43 (88%)	58 (77%)
	Private	15 (30%)	17 (23%)
	Both	9 (18%)	N/A
Specialization	**Multidomain**	36 (73%)	49 (65%)
	Single dom.	22 (45%)	26 (35%)
	Both	9 (18%)	N/A
Quality control	**Tight**	36 (73%)	44 (59%)
	Moderate	23 (47%)	29 (39%)
	Open	2 (4%)	2 (2%)

Table 3: List of resource types and their use. Resource type (2nd column), number of problems for which at least one resource of this type was consulted (3rd column) and number of times it was consulted altogether (4th column).

(4th column). The later is different from the 3rd column because more than one resource of a given type was often consulted to resolve a same problem.

In order to make sense of this diversity, we classified the various resources according to several independent axes. While the Languages axis is self explanatory, the others require explanations.

Termino-lexicographic resources included dictionaries, Terminology Databases and lexicons. Corpus-based resources consisted of any body of texts that the subject searched in, including Translation Memories and bitexts, as well as documents related to the source text and Web sites.

For a resource to be considered multidomain, it had to include material from a wide range of domains (ex: TERMIUM) and it had to be a resource where our subjects searched without restricting by domain (either because the tool did not allow it or because that is not the way that our subjects employed it). Translation memories fell in the class of single domain resources when they were segregated by client or domain and the translator took advantage of that fact, but they were otherwise classified as multidomain.

For a resource to be considered public, it had to be available to anyone, possibly at a fee (ex: TERMIUM, and public Web sites). Private resources were ones which could only be accessed by certain translators, typically those working for a particular client or translation office.

Tightly controlled resources consisted of carefully crafted reference materials which were revised by linguists, terminologists or revisers. Moderately controlled resources consisted of reference materials which, while they may not be as carefully crafted and revised, are still produced by people working in reputed organizations. This included internal Terminology Database, as well as Translation Memories and bilingual sites produced by reputed organizations like the Government of Canada. Finally, open resources were ones that might have been produced by pretty much anyone. The only examples we observed of this were the use of Google to mine the totality of the Web, or all of Canadian sites in a given language.

The fact that subjects used such a wide variety of tools and resources may have important implications for developers. In particular, it seems there are no universal tools and new tools do not necessarily replace older ones. Terminology Databases do not seem to have eliminated the need for more conventional dictionaries and, in turn, Translation Memories and corpora like the Web have not eliminated the need for Terminology Databases. Therefore, researchers and developers of new technologies should think of their own tools as one of many and look for complementarity and synergy with existing ones. This may be important for the emerging practice of Post-Editing of Machine Translation outputs.

Another implication for tool developers comes from the fact that our subjects often needed to navigate between these different resources and this tended to interrupt their flow. Therefore, develop-

ers could enhance their tools by looking for opportunities to provide unified interfaces to multiple resources, while still showing the user the exact source that different solutions were taken from.

The subjects we observed seemed to know very well the strengths and weaknesses of the various resources in their toolboxes. For example, they would not waste time searching in resources where they felt they were not likely to find a solution to a given problem. One implication of this for researchers is that one has to be careful about using log analysis to infer the needs of translators, because the queries contained in such logs may be strongly conditioned by the users' knowledge of that tool's strengths and limitations.

4.3 Did our subjects use certain types of resources more than others?

Looking at Table 3, we see that our subjects made more use of termino-lexicographic resources than corpus-based ones, both in terms of number of problems and number of consultations. However, neither of those differences was found to be statistically significant at p=0.05. This indicates that corpus-based technologies have clearly made it into the mainstream and that translators are comfortable using them. They do not however seem to have replaced termino-lexicographic resources.

Our subjects overwhelmingly used more bilingual resources than unilingual ones and the difference was highly significant (p<0.001), both for the number of problems and consultations. This is consistent with what Krings (1986) and Kunzli (2001) observed but it contradicts the findings of Jääskeläinen (1991) as well as Englund-Dimitrova and Jonasson (1997). Note however that our subjects still needed to consult unilingual resources for 24% of the problems and that this accounted for 21% of all consultations. Our subjects typically consulted unilingual resources in order get a better feel for what a particular term or expression means in the source or target language or for finding synonyms that they might use in the target text. The predominant use of bilingual resources is an example of deviation from the principles taught in translation studies (Delisle 2003, p. 103). While the use of bilingual dictionaries is in no way considered prohibited, it is widely criticized by practitioners (Meyer, 1987) and translation teachers around the world.

Considering that our subjects' use of unilingual resources was non-negligeable and that some other studies have found unilingual resources to be more used than bilingual ones, technology developers and researchers might consider devoting more attention to tools which help translators mine unilingual corpora (for example, Barrière, 2009). This is an area that has received much less attention in CAT development, in comparison to bilingual text mining, in spite of the fact that unilingual corpora are available in much greater quantity and may thus represent a richer source than bilingual ones.

Subjects very predominantly used more public (78%) than private resources, both in terms of the number of problems and consultations. Both differences were found to be highly significant (p<0.001). To our knowledge, this is a trend that has never been studied before.

Overall, subjects used more multidomain resources than single domain ones, both in terms of number of problems and number of consultations and both differences were found to be highly significant (p = 0.003). These findings are consistent with Kunzli (2001) but not with Krings (2001), who observed a comparatively greater use of technical reference work (p. 474). A possible explanation for this difference is that the tasks observed by Krings were of a fairly technical nature. However, even in the case of moderately technical tasks like ours, the predominant use of multidomain resources is somewhat surprising since nowadays there are many tools which allow one to create resources tailored specifically to a particular domain or customer. We shall elaborate more on this in section 4.4.

Our subjects used significantly more tightly controlled resources than moderately controlled ones (p<0.05) and more moderately controlled resources than open ones (p<0.001), both in terms of number of problems and number of consultations. To our knowledge, this is a trend that has never been studied before.

An interesting observation is that our subjects had no qualms about searching for solutions in translated material, in spite of the fact that this is frowned upon in the field of Terminology and, to a lesser extent, in translation (for example, see Bowker, 2005). Indeed, 6 of 8 subjects searched bilingual Canadian Web sites, which means that more often than not, they were looking at translated solutions (in Canada, 70% of translation is done

in the En>Fr direction and all our subjects were translating in that direction). One can hypothesize that the subjects were simply confident in their ability to spot a badly translated solution (based on their experience and information provided by other sources) but our data does not allow us to say for sure.

The fact that our subjects predominantly used resources which were public and multidomain, and that they did not shy away from using ones that were moderately controlled or might contain translated texts, is altogether good news for researchers and developers. It means that they can build useful tools based on material that is readily available on the Web, without overly worrying about domain, quality control (as long as it is produced by a reputable organization), nor direction of translation. Such tools will still be acceptable for translators, since they reflect what professionals already do. For example, it means that very large bitexts built from bilingual Web sites could be highly useful (Désilets et al, 2008). Another possibility, which is being investigated by the Office québécois de la langue française (www.inventerm.com), is to build Terminology Databases by crawling and indexing lexicons found on the Web sites of various reputable organizations.

4.4 How did our subjects assess solutions proposed by various tools?

Earlier we talked about the fact that our subjects did not shy away from resources which were multidomain, moderately controlled and contained mostly translated material in the target language. Some may find this to be a dangerous practice, but our data indicates that our subjects hedged that risk by exercising much critical judgment in deciding which solutions to choose or reject. In particular, they did not blindly trust any resource, even highly reputable ones like TERMIUM, or their client or employer's Translation Memory. This is evidenced by the fact that in 17 of 49 cases (35%), the translator continued searching after he had already found some relevant information in one resource, typically to help choose among alternatives, or to confirm his initial choice.

Another interesting observation is that our subjects seemed very adept at scanning a list of potential solutions, and rapidly sifting grain from chaff. This was particularly evident when they were eval-

uating the results of a corpus-based resource, for example, a list of Google hits, or a list of hits from a LGP bitext like TransSearch (Macklovitch et al, 2000). One corollary is that our subjects did not seem overly concerned with the precisions (in an Information Retrieval sense) of such lists of hits. It seemed that they were satisfied as long as at least one of the suggestions presented in say, the top 10, was appropriate for use in their context, and scanning that list to find an appropriate solution did not seem to represent much of a strain.

The findings described in this section have interesting implications for tool developers and researchers. The fact that our subjects were able to make efficient use of results lists that had moderate precision hints that it may be advantageous to err on the side of coverage as opposed to precision, in order to increase the chances that the translator will have at least some suggestions to work with. These findings also have implications for practitioners and CAT technology administrators. Indeed, many organizations that use Translation Memories put a lot of effort into screening content which goes into the memory, and even manually correcting alignment errors. Our observations indicate that, for certain translator populations at least, this effort may not be worth it, and that one might be better off letting the translator sift grain from chaff himself.

5 Conclusion and Future Work

We have used Contextual Inquiry to provide a partial portrait of how professional translators use tools and linguistic resources to resolve translation difficulties. A common theme in many of our findings is that our subjects used a wide variety of resources, many of which might be criticized by translation "purists", because they are either too loosely controlled (in terms of quality), are not specific enough to the domain of client or source text, or may contain translated target text. Yet, our translators allowed themselves to use such resources, because they felt confident in their ability to use their judgment to retain only appropriate solutions.

This is good news for CAT researchers and developers, because it means they can develop tools using easily accessible, public corpora, and that these tools are still likely to be useful to translators.

We plan to carry out additional Contextual Inquiries in order to refine our understanding of pro-

fessional translators' workpractices. In particular, we plan to observe a wider sample of subjects, including some who work on other language pairs, and on texts of a more specialized or technical nature. We also plan to observe translators working in a Machine Translation Post Editing context, in order to see how workpractices there may differ from those we observed in more conventional translation settings.

Acknowledgments

References

Barrière, C. (2009) *The Web as a source of informative background knowledge.* In proc. of "Beyond Translation Memories: New Tools for Translators", MT-Summit Workshop, Ottawa, *August 2*9th, 2009.

Beyer H., Holtzblatt K. (1998) *Contextual Design: A Customer-Centered Approach to Systems Designs.*, Morgan Kauffman.

Bowker, L. (2005) *Productivity vs quality? A pilot study on the impact of translation memory systems.* , Localisation Focus 4(1):13-20.

Delisle, J. (2003) *La Traduction raisonnée.* Ottawa: Presses de l'Université d'Ottawa, 604 p.

Désilets, A., Brunette, L., Melançon, C., Patenaude, G. (2008a) *Reliable Innovation: A Tecchie's Travels in the Land of Translators.* Proceedings of the AMTA 2008. Waikiki, Hawaii, Oct 21-25, 2008.

Désilets, A., Farley, B., Stojanovic, M., Patenaude, G. (2008b) *WebiText: Building Large Heterogeneous Translation Memories from Parallel Web Content.* Proceedings of Translating and the Computer (30), London, UK. 23-28 November 23-25, 2008.

Englund-Dimitrova, B. , Jonasson K. (1997) *Translation Ability and Translatorial Competence : Expert and Novice Use of Dictionaries.* in H. Kalverkämper & B. Svane (Eds.), Translation and Interpreting. State and Perspectives. Proceedings from the Humboldt-Stockholm Symposium, Stockholm University, January 30-31, 1997.

Englund-Dimitrova, B. (2005) *Expertise and Explicitation in the Translation Process*, John Benjamins Publishing Company, 2005.

Jääskeläinen, R. & Tirkkonen-Condit, S. (1991) *Automatised Processes in Professional vs. Non-professional Translation: A Think-Aloud Protocol Study.* In S. Tirkkonen-Condit, ed. Empirical Research in Translation and Intercultural Studies. Selected papers of the TRANSIF seminar, Savonlinnä, 1988. Tabingen, Gunter Narr, pp. 89-110.

Kiraly, D. C. (1990). *Toward a Systematic Approach to Translation Skills Instruction*. Ph.D. Dissertation. Ann Arbor, U.M.I.

Kunzli, A. (2001) *Experts versus novices: l'utilisation de sources d'information pendant le processus de traduction. M*eta, XLVI, 3, 2001.

Kussmaul, P. and Tirkkonen-Condit, S. (1995) *Think-Aloud Protocol Analysis.* In Translation Studies, TTR: traduction, terminologie, rédaction, Volumen 8, numero 1, 1er semestre 1995, p. 177-199

Kussmaul, P. (1989a) *Toward an Empirical Investigation of the Translation Process: Translating a Passage from S.I. Hayakawa:Symbol, Status and Personality.* In Renate von Bardeleben, ed. Wege amerikanischer Kultur. Ways and Byways of American Culture.Aufsätze zu Ehren von Gustav H. Blanke. Frankfurt am Main, Lang, pp. 369-380.

Lauffer, S. (2002) *The Translation Process: An Analysis of Observational Methodology.* (2002) In F. Alves (Org.) Cadernos de Tradução: O processo de Tradução.

Macklovitch, E., Simard, M., Langlais, P, (2000) *TransSearch: A Free Translation Memory on the World Wide Web.* In Proceedings of LREC 2000, Athens, Greece.

Meyer, I. (1987) *Towards a New Type of General Bilingual Dictionary.* Ph. D. dissertation, University of Montreal.

Nielsen, J., Landauer, T. K. (1993) *A Mathematical Model of the Finding of Usability Problems*, Interchi'93, Amsterdam, The Netherlands, 24-29 April *1993*.

Rogers, Y., Bellotti, V. (1997) *Grounding Blue-Sky Research: How can Ethnography Help?* ACM Interactions, May-June, 1997.

Séguinot, C. ed. (1989). *The Translation Process.* Toronto, H.G. Publications, School of Translation, York University.

Tirkkonen-Condit, S. (1988). *Interpretation of Meaning in Translation.* In L. Laurinen & A. Kauppinen, eds. Problems in Language Use and Comprehension. AFinLA Yearbook 1988. Helsinki, Publications de l'Association finlandaise de linguistique appliquée (AFinLA), pp. 145-155.

Tirkkonen-Condit, S. (1989). *Professional vs. Non-Professional Translation: A Think-Aloud Protocol Study.* In Candace Séguinot, ed., The Translation Process. Toronto, H.G. Publications, School of Translation, York University, pp. 73-85.