Expertise and Environment in Translation

RICARDO MUÑOZ MARTÍN
PETRA Research Group
University of Las Palmas, Spain
munoz@cogtrans.net

Abstract:
The overarching goal of the research team *Expertise and Environment in Translation* (PETRA, Spanish acronym) is to study as many aspects of the translation process as possible under the same scope. PETRA is interested in expertise and its development, considers intuitive problem-solving in translation as related to emergence and construction of meaning, and interprets skills acquisition and development as routine interiorization and improvement of mental efficiency. Characteristic of PETRA's approach are theoretical feedback from cognitive linguistics, situated and embodied cognition, and (social) constructivism, and homogeneous research methodologies through internal standards. Research methods include pilot testing, subjects' and texts' profiling, non-invasive data collection, previous typing period, test repetition, post-test questionnaires, data triangulation, length *and* frequency to determine pause relevance, blind product cross-evaluation, statistical and ecological validity checks. Summarized results of Martín de León (2003), Lachat (2003), De Rooze (2003), Gómez (2006) and Conde (2009), and ongoing projects by Castro, Marín, Muñoz, and Perea illustrate the approach.
Key Words: Cognitive translatology, empirical research, expertise, methodology.

Resumen:
El objetivo general del equipo de investigación Pericia y Entorno de la Traducción (PETRA) es estudiar empíricamente tantos aspectos del proceso de traducción como sea posible. PETRA se interesa por el conocimiento experto (pericia), considera que la solución intuitiva de problemas se relaciona con la emergencia y construcción del significado, e interpreta la adquisición y desarrollo de habilidades en traducción como interiorización de rutinas y mejora de la eficiencia mental. La aproximación de PETRA se caracteriza por la interpretación de los datos con un marco de referencia inspirado en la lingüística cognitiva, la cognición situada e incorporada y el socio-constructivismo, y por la homogeneidad de la metodología mediantes estándares internos. Estos estándares incluyen pruebas piloto, caracterización de textos y sujetos, recogida de datos no invasiva, período previo de mecanografiado, repetición de las pruebas, cuestionarios ex post facto, triangulación de los datos, determinación de importancia de la pausa por su duración y frecuencia, evaluación ciega de la calidad de los productos y comprobaciones de la validez estadística y ecológica. La aproximación se ilustra con el resumen de resultados de Martín (2003), Lachat (2003), De Rooze (2003), Gómez (2006) y Conde (2009), y los trabajos en curso de Castro, Marín, Muñoz y Perea.
Palabras clave: Proceso de traducción, Pericia, resolución de problemas, adquisición.

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1. INTRODUCTION

PETRA unofficially started out in the year 2000, as an informal network of researchers from the Universities of Las Palmas and Granada (Spain)[1]. We are mainly interested in

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[1] As of June 2009, PETRA members are J. Jorge Amigo Extremera, Dr Alicia K. Bolaños Medina, María Castro Arce, Dr José Tomás Conde Ruano, Dr Ana Mª García Álvarez, Álvaro Marín García, Dr Celia Martín de León, Dr Ricardo Muñoz Martín (coordinator), José Ignacio Perea Sardón, and Marta Sánchez Valverde.

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translation *expertise* and our general aim is to help to draft a map of the cognitive aspects of the process of professional translating, an aim shared by many empirical researchers in the field, albeit *not* as coordinated as it could be. Here I would like to present the basics of PETRA's scope and to summarize the results and the research projects in progress. The main features of PETRA's approach might be described as follows:

- We are particularly concerned with building a theoretical model alongside empirical testing, so that the interpretation of data will *not* betray the aims of the experiments.
- We try hard to set group-internal research standards through a methodology which we try to adhere to in all the research projects we get involved in. That way, we hope that results of any research carried by the group can be compared with any other, thus allowing a much-needed feedback.

Let's have a closer look. We will start by the theoretical foundations, followed by the empirical methodology, to end with research results.

2. THEORETICAL FRAMEWORK

2.1. Expertise

Expertise (Ericsson & Smith 1991, Ericsson 1996) is the property of a person who performs an operation or a set of operations in a limited domain with exceptional results when compared to others capable of performing the same operation. *Expertise* generally implies useful and large amounts of knowledge and fluent action, and it may depend on abstractions such as individual mental models, rather than on knowledge alone. In PETRA, we define translation *expertise* (*cf.* Sirén & Hakkrarainen 2002) as the *capabilities* which underlie the performance of human *expert* translators, including extensive domain knowledge, but crucially also heuristic rules that simplify and improve approaches to *problem* solving, metaknowledge and metacognition, and compiled forms of *behaviour* which afford great economy in skilled performance. It is therefore very different from compartmentalized, linguistic oriented conceptions of *competence*, which are deemed to be too static and focused on declarative knowledge, and lacking psychological reality. *Expertise* seems to provide a much more solid basis for empirical research. Some caveats, however, are important to remind:

First, *expertise* in translation is especially difficult to outline, since domain knowledge entails both translation-specific knowledge and also subject knowledge related to the text to be translated in every instance. We may assume translation-specific knowledge to encompass the bulk of declarative knowledge translators are expected to have, such as transliterating, converting units and measures, using the tools of the trade, etc. Thus, translation-specific knowledge might correspond to Shreve's (2002) redefinition of *translation competence* and also to some of the features Kiraly (2000) labels *professionalism.* Shreve's notion of *competence* may prove to be useful for translation schools to draft syllabi and to define graduation standards, but in metacognitive operations such as those involved in translating, the borders among all these concepts

seem rather fuzzy. For example, many aspects of Kiraly's *professionalism* do *not* seem translation-specific, but they are definitely part of what an *expert* professional translator should know or know how to do. How domain knowledge interacts with other facets of *expertise* is open to discussion but, in any case, in *expertise* the stress falls on procedural knowledge and cognitive styles.

Second, subject knowledge is usually far too varied to be operationally reduced when testing translators' *expertise*, since translators tend to learn it on demand in the very process of translating each original. The repetition of similar texts may result in the translator's subject knowledge moving form *passive* (recognition) to *active* (recall), and thus it may become a part of a translator's *expertise*, but at this stage of research it cannot be accounted for, since it would actually lead researchers to approach *expertise* as a personal, unique trait from which no generalization could be made. Hence, in PETRA we seek to describe the aspects of translation *expertise*, which are *not* subject-specific.

Third, translation *expertise* is *not* something that a person has or has *not*. Rather, it is a property in constant change throughout the lifespan of a translator. We may well think that would-be translators will need ten years of constant, relevant practice to fully develop it (Bloom 1985, Hayes 1989), but certainly *expertise* does *not* stay unaltered once developed, since it results from a process of efficient adaptation to certain working conditions, and these conditions are subject to change. Also, we can also optimistically assume that trainees start building some of their *expertise* in their training programs, but it seems likely that some people will come to school with some routines or abilities which might be considered a part of translation *expertise* already interiorized to a certain extent. To sum up, translation *expertise* is an individual property in constant evolution (a parallel might be drawn with the concept of *interlingua*, although they are definitely *not* the same). In order to study translation *expertise*, we need to set apart the influence of subject knowledge and to watch carefully the relationship between declarative and procedural knowledge.

2.2. Environment

One of the main worries in the cognitive research of translation processes is the gap between experimental psychologists and translation scholars, since the former provide us with models and methods but the latter feel rather uncomfortable with the ecological validity of the models and methods we borrow. Research in psychology usually involves a trade-off between control and ecological validity. Controlled variables are typical of laboratories, but we need to discern the extent to which findings in a laboratory can be extended to other environments, such as real-world working conditions. Otherwise, we run the risk of yet again producing a body of knowledge no one is interested in, since it doesn't seem to affect actual practice. This is a reasonable concern, although it is perhaps a little too early to discourage us from using cognitive science as a source. In such an initial stage as we are, when most experiments might be described as field research of some sort, this refusal would *not* be empirical, but speculative. Social psychologists share our concern, but that does *not* lead them to deny the validity of experimental psychology. They simply think they need to develop their own ways of finding reliable information on their object of study, and so does PETRA.

PETRA's outlook on this topic is that translation processes may be approached from at least four different perspectives: First, we may study some mental events, such as understanding or *problem* solving. These mental events are recursively used in several tasks of the translation processes, so that focusing on them (through observable *behaviour*) involves analyzing their role in different activities, such as reading, drafting, and revising. But we need *not* necessarily focus on isolated mental routines that we think may be part of translation *expertise*. At least, *not* yet, because we still do *not really* know what these mental routines and constructions might look like. Hence, empirical translation scholars usually centre on task performance in the subjects, and attempt to pin down what is relevant and what is *not* in their performance and results. Thus, a second approach is to focus on process subtasks, such as reading. In this case, there are several mental events, which concur, in a single task. Connections with mainstream research in experimental psychology will no doubt be a source of support for findings in both of these approaches. In fact, coherence with findings in cognitive science today may work in cognitive translatology as a touchstone and make up for the relatively scarce ecological validity of experimental settings.

A third approach may lead to study the connection and interplay of mental processes and/or task performance in different subjects pursuing a single goal, such as labour division and workflow within a translation team. This path has nearly *not* been trodden yet, simply because focusing on what happens in single subjects is already difficult enough. However, since translation teams do divide tasks into parts and stages, the relative success in their performance can shed light on aspects, which remain obscure when studied in just one person. Furthermore, subjects need to communicate in order to achieve their common goal, and protocols of this communications may safely be considered reliable, ecologically valid sources of information. This has been addressed already by translation scholars defending dialog protocols vs. think-aloud protocols (*e.g.* House 1988).

Finally, research may focus on the way (mental) translation processes are influenced by certain factors and standards in a community, such as productivity rates, or the specifics of quality expectations. Since the demands posed by clients from different sectors, such as book publishers and localization companies, are very different, divergent *behaviours* of both single subjects and teams may illustrate the way in which these factors modify *behaviour* and, probably, mental events as well. Now, cognition is far from being an easy object of study and there are many, sometimes even contradictory tenets and approaches. That is why we are so interested in developing a theoretical model to account for the results of our own empirical work.

2.3. Conceptual postulates

Celia Martín (2003) furthered the epistemological foundations of PETRA in her study of the implicit assumptions of (early) functionalism (Reiß & Vermeer 1984; Holz-Mänttäri 1984). To do so, she had to drop the cognitive paradigm of information processing (Fodor 1975) and to adopt second-generation cognitive approaches such as situated and embodied cognition. Both models view meaning as something, which

emerges in the minds of beings in ways that are *not* totally predictable, since a central executive is *not* foreseen.

Martín (2003, 2005) also rejected the notion of *culture* (Göhring 1978) as something static which can be broken down into paracultures, diacultures, idiocultures, let alone culturemes. Instead, she suggests we might be better served by notions such as *scaffolding* (Clark 1997) and *cultural models* (Quinn-Holland 1987). In PETRA we think that an intercultural approach to translation leads to overgeneralizations and introduces too many subjective stereotypes in the analysis of data, and hence it is as inadequate as the former, reductionist interlinguistic approach. Instead, we think of translation as an *interpersonal* phenomenon, where both language and culture roles are limited to what can be traced in the participants. The folk-theoretical approach to *intentionality* and the Western concept of *instrumental rationality* are also rejected, since they entail a disregard for uncontrolled and only partially controlled mental processes. As alternatives, Martín uses *cultural (personal) history* and *learning processes* (Suchman 1987, Hendriks-Jansen 1996), which let her approach both controlled and not-so-controlled processes as the result of interactions of parallel, semi-independent mental tasks. These theoretical stances undermine the hypothesis of translating as the implementation of a rational plan based on a hierarchy of goals, since it ignores bottom-up processes and the possibility of having several, unrelated goals in a text, whether conscious or *not*. From our point of view, function does *not* necessarily determine shape in text production, which is seen as a dynamic process (Dennett 1991) where plans and goals are assigned and reassigned on the go (Hendriks-Jansen 1996).

In brief, Martín (2005) hints that early functionalism presents an idealized translation process, focused on rational planning, which cannot explain an important amount of mental processes relevant to professional practice and training. Situated, embodied, and distributed cognition, however, seem to offer a wider framework (Muñoz in press 1 and 2) where action is *not* only guided by logical causal patterns.

3. RESEARCH METHODS

We are aware of the need of testing professionals, but *expertise* develops progressively and in-progress snapshots may be even more informative than winner-takers-all comparisons of novice trainees and translators who have been in the market for at least ten years. Hence, we decided we would try to map the progress in the acquisition and development of *expertise* and its relationship with *competence*: Whenever possible, the subjects of the tests belong to three groups: (i) university students with no experience in translation, who are expected to lack significant amounts of both *competence* and *expertise*; (ii) translation students about to obtain their degree, who are supposed to have acquired *competence* and who might have developed some levels of *expertise*, and (iii) professional translators with at least three years of uninterrupted, exclusive performance of translations, who should have started to develop their own cognitive styles[2]. Hence, we are working with *novices* and two different stages of *experienced* translators, and we plan to enlarge our scope to ("full") *expert* translators in the near

[2] The 3-year threshold was chosen as a rule of thumb to make sure that subjects had influences to develop their expertise at least throughout a period as long as usual translation training programs. See §3.1, below.

future. In any of our current experiments, there must be at least ten subjects in each group, and at least one group needs to be statistically significant on its own.

Subjects are usually requested to take standard tests to determine their linguistic skills and general mental capacities (TOEFL, WAIS-III) and which are scored according to standard procedures laid down in test manuals. Sociolinguistic information is collected through questionnaires or semi-structured interviews. Students carry out their translations in computer classrooms during class-time, and professionals do them at their workplace, whenever possible. When time is *not* a variable in the experiment, no restrictions are imposed to finish any task. All subjects are volunteers and receive exactly the same information on the procedure and tools. The researcher who conducts the test is always the same person throughout the project and is *not* a teacher of the students, to avoid halo effects. Since experiments pose no risk for informants, subjects are usually misled into thinking of different goals of the experiment, and written permission to use their data is requested only afterwards, once the experiment is over and they have been explained the real research targets.

In general, all experiments run a pilot trial followed by two tests, where text order is changed from subject to subject, to avoid order effects. Original texts are always complete and must satisfy two conditions: they must be real or realistic translation commissions and they should *not* prompt any obvious ideological positioning in the subjects. We mainly work with the English-Spanish combination, to make it easier to any interested researcher to replicate the experiment with the same materials.

Since we are at least as much interested in automatized and uncontrolled mental processes, we never use think-aloud protocols, which cannot account for them (Börsch 1986, Gerloff 1986, Séguinot 1996). The usual instrument for data collection on the process is Translog 2000 (Jakobsen 1994). Translog 2000 is used according to the following protocol: subjects start all texts with a typing section where no translation is carried out and which will later on help us to discern the specific way each subject is using the computer in that session. Measurements regarding speed, typos, and so on when translating are then computed relative to their performance in the typing section. The text they type is usually a short news piece in Spanish related to the topic of the original, followed by the first fragment of the text they are to translate afterwards, so that subjects will have contextualized their task when they begin to translate. Relevance of pauses depends *not* only on their length, but also on their frequency in the subjects of the same test. That way we try to compensate the shorter length of pauses in professionals.

Translation protocols taken from log files are then recoded to ease both reading and computing, and originals and recoded translations are then analyzed using WordSmith Tools 4.0. We have sketched the concept of *saliency of phenomena* to account for the differences in pause frequency (*e.g.*, a pause in 20 out of 35 subjects is considered to point to a phenomenon which is more salient than that marked by a pause in 10 subjects). Saliency is then broken down according to subjects' groups: beginners, advanced students, and professionals, but also according to subjects' scores in working memory capacity, mental processing speed, and linguistic skills. Since we are trying to determine what makes an excellent translator and how to reach that *expertise*,

translation quality needs to be determined, and we do so by using at least four evaluators; one of them usually belongs to the largest group of subjects in the sample. Evaluation ways and procedures are free, so that evaluators may envision their task as grading, revising, correcting or proofreading the texts. Some restrictions do apply, however: evaluators need to classify every translation as *very bad, bad, good,* or *very good* (a modified scale inspired by Waddington 2000). Text order changes from one evaluator to the text (again, to avoid order effects; Conde 2009), unless otherwise required by the test, and texts from different groups are mixed. Correction is always blind, and evaluator tendencies are also taken into account.

4. INSIGHTS ON TRANSLATION PROCESSES

4.1. Problem identification

Christine Lachat (2003) rejected the difference between translation *problem* and translation *difficulty* (Nord 1991), since she found that this distinction lacks psychological reality. Translation *problems* were found to be usually complex and ill-defined, and Lachat found regularities in both *problem* identification and *problem*-solving strategies. This may well sound obvious, but it is actually one of the cornerstones of our work and had to be double-checked. Professionals make fewer pauses than advanced students, who in turn do fewer than *novices*, but univariable and conglomerate analyses did *not* show significant differences between professionals and advanced students. *Novices* took more time reading before they started to translate and they also needed more time to finish their drafts and made longer pauses, but did *not* devote much effort to revise their work. Advanced students took shorter time to read the original in advance but longer at revising, and professionals were the fastest at translating and took the longest to revise their translations. Interestingly, *novices* and professionals showed more variation within their respective groups than advanced translation students. A tentative explanation for this is that formal university training has an effect on the subjects' cognitive styles and *behaviours*, which become more similar, but later on they adapt and develop their abilities and skills to their specific workplaces and tasks. If this is so, then we might want to focus on the unproblematic segments, instead of the problematic ones, to determine what is interiorized in the training period. I'll come back to this point later.

4.2. Time pressure

Bart De Rooze (2003) replicated Jensen's (1999) experiments, with tougher conditions, for he used two originals which were 250 words long and which had to be translated in 12 and 8 minutes. The tests comprised four parts, since a second period of translating with no time limits was introduced between the typing and the first time-restricted translation. The evaluation showed that subjects tended to get poorer results when they translated at a pace faster than 200 words per 10 minutes. In average, the quality lowered by 15%, although the gap was wider in 50% of the subjects. Surprisingly, whereas no difference was recorded in professionals, 25% of advanced students obtained higher quality when translating under time pressure than when they did *not* have time restrictions. A non-significant correlation was found between this tendency and obtaining *good* grades in the

program, but this needs further research, since it might also be connected to some personality features. Another puzzling fact found by De Rooze (2003) was a general tendency to make a "minor" mistake (*e.g.* typos, spelling) in the first or second word after a pause. A tentative explanation might be that the reallocation of cognitive resources is *not* automatic and takes time, and if the subjects start with other tasks, these are less controlled until the reallocation is complete. Alternatively, *mistakes* right after pauses might indicate that subjects are still thinking on the *problem* they have just dealt with (see §5.2, below). Further research in this area should look at longer time-spans which go beyond usual attention spans, and which might be relevant for labour demands in the industry.

4.3. Natural translation

Gómez (2006) set out to test Harris' (1977) tenet that translation is a natural skill in humans, and thus compared advanced translation students with bilinguals, translating between English and Spanish, in both directions. The operational definition of bilingual was "(1) persons who think of themselves as bilinguals, (2) who obtained scores higher than 80% in tests for both languages, (3) whose father or mother are native English speakers (the other one being a Spanish native), (4) who live or have lived in Spain and who had secondary education, or else were enrolled in a university program, in an English-speaking country." Advanced translation students were all native speakers of Spanish, taking their last semester of the BA program at the University of Granada. All subjects were right-handed and 8 to 25 years old, the average being 22.

Bilinguals used more printed sources than students, who only used the Internet, and they took longer to translate in both directions. When translating into Spanish, no bilingual and only 50% of students read the text in advance, and 50% of each group performed some sort of revising after they typed the final full stop. Differences were *not* significant when translating into English. Bilinguals also made more pauses and corrected their texts more often, and they used twice as many different full-words than students when translating into English, and three times as many when translating into Spanish. Three evaluators (a bilingual, an English translation teacher and a Spanish translation teacher) graded the translations. They all gave better marks to the students when translating into Spanish, and the Spanish translation teacher and the bilingual evaluator gave better marks to the bilinguals when translating into English. Thus, it might be concluded that translation programs do modify the *behaviour* of the students—which probably reflect changes in their cognitive styles and/or in the development of their professional *expertise*—but, curiously, that these changes may *not* be reflected in translation product quality, probably due to the students' meager command of English, adequate for everyday usage, but still lacking for a professional endeavour. Further research in this area may focus on trying to answer two questions: How do translation students' communicative skills differ from those of bilinguals'? And what is the relationship between translation *problem* solving and general communicative strategies?

4.4. Evaluating translations

Quality and evaluation go hand in hand, but they are elusive notions, usually thought of as too subjective to reduce, but here we tried a novel approach, namely observing what

evaluators *really* did and how their *behaviour* related to their quality judgments. Conde set out to study the way people actually revise, grade, correct or proof-read translations, and his basic thesis was that, when studying translation quality, examining the *behaviour* of evaluators as reflected in their work might be as informative as analyzing the process of translating through log files to infer regularities in translators' *behaviours.*

In the research for his PhD dissertation, Conde (2009) examined the marks of 88 subjects (40 potential readers, 25 advanced translation trainees, 13 professional translators, and 10 translation teachers working at Spanish or Mexican universities), who worked on four sets of 12 translations each from English into Spanish, two of them on politics and the other two on technological processes of painting machinery. The number of actions did *not* correlate with the final judgment on the quality of a translation, and evaluators showed statistically significant differences in the number of actions on the texts, which did *not* parallel differences in judgment. Furthermore, the number of actions lowered constantly in all cases from text 1 to text 48, and this, again, did *not* have any effect on the judgment either. Marks seemed to concentrate progressively on more salient phenomena, which seemed to weight more on their evaluation. Texts were divided for analysis into three sections of roughly the same length (opening, central, and wrap-up), and Conde found that the correlation between the judgment and the central section was tighter than with the opening section and the wrap up. Our tentative explanation is that the evaluators underwent a learning process when confronted with sets of translations from the same original, and that they learned to concentrate on certain phenomena as their task progressed. Also, subjects disregarded some phenomena in opening sections, probably because they used those sections to contextualize their activity, an influence of their usual *behaviour* as regular readers. On the other hand, when they reached the wrap-up section, they probably had already a notion, if vague, of the quality of the translation.

A tendency to be more demanding or more lenient was also evident which divided subjects into two groups, and it did *not* correlate with the number of marks either. Subjects could also be divided into those whose marks tended to add, take off or modify copy in the texts and those who introduced marks and comments at the margins. The second style seems more pedagogically oriented, since it provides feedback to the translator, whereas the first group seems more user-oriented, since the main concern seems to be to modify the translation to improve its quality. The correlation between the number of actions and the final judgment was tighter in market-oriented evaluators. Interestingly, although work on *mistakes* correlated better with the final judgment, marks on *debatable* phenomena were much more common in most evaluators. In brief, this piece of research found that the three formal hypotheses tested were correct, namely that (a) there were general tendencies when evaluating translations across the sample; (b) there were other tendencies which correlated better with some groups, so that characteristic clusters of tendencies can be ascribed to addressees, translation trainees, professional translators, and translation teachers, and (c) that performing evaluations on series of translations from both the same and different original texts causes special effects mainly related to learning and making the task more efficient, but also some psychological effects, such as considering *very good* a translation which followed another one which had been deemed *very bad*.

5. EMPIRICAL RESEARCH IN PROGRESS

5.1. Text profiling

María Castro started to study reading and comprehension processes in translators, and she carried out a pilot study at the beginning of 2006 at the CBS to determine differences in the way subjects read when asked to (a) read (quiz for understanding followed), (b) read to summarize, (c) read to translate later, and (d) read while translating, in this order. The underlying hypothesis in Castro's project was that, as a goal-oriented activity, reading for translating (even without actually translating) might be a modified sort of *behaviour* whose main traces might be apprehended by combining an eye-tracker and Translog 2000. Castro (2007) reported her preliminary results, which showed that introducing an additional, concurrent task (tests b, c, and d) lead to a higher number of fixations and significantly higher scores in text comprehension quizzes. Also, reading speeds lowered when planning to translate (test c) and when translating (test d, where reading was measured independently of other activities such as writing). Finally, when reading to translate concurrently (test d), subjects shortened initial reading spans (*i.e.*, before they typed the first character) and made nearly no regressions (back reading).

All these data seem to point to a special, probably deeper and more thorough way of reading when translating or planning to translate, but also to a linear way of translating modified by textual features as appreciated by the subjects, which will lead to the recursive processes reported elsewhere in the literature. Castro is now following this second path to try to determine whether text complexity can be apprehended in a meaningful way and whether it can be related to recursive processes and translation difficulties.

5.2. Attention drops

Contrary to conventional wisdom in translation process research, we think that typos and other typing *problems* may be indicative of attentional lapses, which in turn might be significantly related to mental processing activities. A preliminary field research test (Muñoz 2009) showed that 51% of subjects' interventions to modify already entered copy were related to typos. Many typos happened right after the subjects had spotted something they wanted to fix (as proven by previous, short pauses and the following intervention), once the subjects had passed a point of no return in their motor activity, which was taken as a symptom of attention lapses or slow reallocations of cognitive resources to meet the demands of the task. This second possibility is also supported by the fact that interventions very often led subjects to enter new typos: 84% of sequenced interventions (more than one intervention on the same text segment) included a newly entered typo. Finally, subjects seemed to read in advance when translating, *i.e.* they will read the text segment which follows the one they are about to translate before they do. Data show that many typos seem to correspond to interference of this later segment, because they enter letters which correspond to words they will type when they translate the following segment which should *not* be present in their rendering of the segment they are currently translating. Interestingly, subjects will often change their renderings

when they spot a typo, so that these assumed attention lapses might have a beneficial effect on translation mental processes, letting subjects reconsider their original wordings. The analyses of solutions and overall text quality seem to support this possibility.

5.3. Routine interiorization

In translation process research it is generally assumed that the subjects' *problem*-solving *capabilities* are improved or benefit from cognitive resources freed by routine interiorization. Álvaro Marín departs from a wide perspective on creativity, which is understood as present in activities such as understanding, and an operational definition which equates it with *problem* solving and mental structure building. The Tower of Hanoi test has also been used to triangulate data. His preliminary, unpublished results show a complex landscape where some subjects do seem to improve in their *problem* solving activities, mainly due to the time gained by fast, uneventful renderings, whereas some others do *not* seem to benefit from this additional time. Some weak correlations point to possible links between scores for working memory capacity and English language skills, on the one hand, and taking advantage of the extra time allotted by certain kinds of uneventful renderings. *Good* comprehenders seem to outperform other subjects.

5.4. Research tools

We need more tools to be able to apply fine-grained analyses and also to study large quantities of data. José Ignacio Perea (2005) developed a morphosyntactic, bilingual (English-Spanish) tagger and lemmatizer, which we creatively dubbed *Petra Tag I.* The application follows Leech (1993), EAGLES and *Text Encoding Initiative* norms and uses the tag set described in Civit (2002). Perea has developed it with Visual Studio .NET, an object-oriented programming environment which lets programmers develop applications based on Petra Tag I very easily, and he is distributing it for free, upon request (see http://www.petraweb.org). The application can be used to detect errors, to correct the style, to automatically extract terminology, and also as a base of a translation memory or an automatic translation program. Hence, it can be used in professional as well as in learning or research tasks. So far, Petra Tag I has ca. 10.000 entries and an accuracy of 93.35% in Spanish (far less in English), and comes with a small application to load and save texts, tag and lemmatize them, and do simple and complex searches. Nevertheless, the real contribution or Perea's tagger and lemmatizer is that it is the first translation oriented application for analyzing texts, and may be the base for future, more complex tools. Drawing from findings in other research threads in PETRA, Perea is now developing a customizable tool for assisted translation revisions.

6. OUTLOOK

Thus far, our research seems to point that there are indeed regularities in the ways different groups approach translation tasks and in the results they obtain. Hence, there may be a correlation between the development of *expertise* and the training stage the subjects are in (where training includes personal experience, also at the workplace).

Expertise development may start at the training program, when it includes *intensive,* relevant practice, but wanting linguistic and communicative skills in the subjects may render the advantage ineffective, as far as product quality is concerned. Formal training seems to have an effect on the *behaviour* and cognitive styles of advanced students, although some individual differences seem to point to subjects' differing ways of conceiving the tasks and their goals as possible explanations, or else to prior cognitive developments or personality.

Once we finish the ongoing projects, we think we will be ready to move one step further. Alicia Bolaños is focusing on the relationship between scores from standard tests in experimental psychology and data collected from translation processes. Ana Mª García centres on pedagogical strategies to improve mental abilities in translation students, and Celia Martín is looking at the influence of preconceived notions of meaning, language, communication, and translation—as evidenced in the metaphors they use—on the way subjects translate, and on their results in terms of quality.

Major drawbacks, however, are still there. For instance, time pressure has been studied in a quite unrealistic setting, and we would like to move to determine the curve productivity-quality in working conditions and longer periods, such as one hour, and one day. And we would also like to study the possible differences between long and short translation tasks in research. Definitions of novice students, advanced students, bilinguals and *experienced* (*not* necessarily *expert*) translators deserve more study and, to do so, safer strategies to profile subjects in more detail are probably in order. The maturity of the subjects is probably a distorting variable in our research, since novice students tend to be younger than advanced students, who in turn are usually younger than *experienced* and *expert* translators. Also, instead of *problem* identification and *problem* solving, we think we should shift focus to comprise unproblematic segments as well, and try to determine their natures and whether there is an order and a pace in the interiorization of routines that lead to longer, more frequent, successful solutions. The wealth of data is such that the task now seems impossible to undertake unless we develop a computer program to automatically extract regularities from Translog log files and other sources of data. Suggestions, criticisms and help are more than welcome.

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