The translation process as object of research

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The translation process, which includes a realistic translation brief, can be defined as every-thing happening, from the moment the translator starts working on the brief and the source text until he finishes the target text. It is all-encompassing, from every pencil movement and keystroke, to the use of all kinds of aids, and the entire process that is involved in taking decisions, solving problems and making corrections (Hansen 2003: 26).

Translation process research has developed into one of the most active fields within trans-lation studies. With other sciences of the mind like cognition research, consciousness studies and brain research, translation process research shares the interest in mental processes and actions. Better knowledge about the structure of individual translation processes and perso-nal translation styles is important for translator training and the recruitment of professional translators within international organizations, companies and translation agencies; key requirements that professional translators have to meet are the excellence and efficiency of workflows and optimal cooperation between colleagues with respect to revision processes and quality management. Looking for precise knowledge and deeper understanding of what is going on in the translator's mind during a translation is relevant for the development and improvement of computer-aided/-assisted translation and also for machine translation.

Empirical translation process research started about a quarter-century ago with several attempts to investigate translators' cognitive processes. Krings (1986), one of the pioneers, wanted to know what was going on in translators' minds, 'Was in den Köpfen von Überset-zern vorgeht'. Krings used an introspection method from experimental psychology, think aloud (TA), in combination with direct observation of the subjects. TA is still the most applied introspection method but since the end of the last century, several kinds of electronic tools and software applications have become available, like keystroke logging, screenshot recording, eye tracking and different kinds of imaging and scanning. In translation process research, several disciplines, methods, tools, data and results are combined in multi-method designs.

Empirical translation research

In an empirical study the researcher can focus on special parts of a phenomenon or try to carry out a more holistic investigation. Studying cognitive processes during a translation process

implies that many findings are based on subjective observations in complex situations, with a multitude of variables and data. In empirical translation research an overall aim is 'ecological validity', i.e. the naturalness of the investigated processes, but we have to cope with the fact that translators' profiles, their processes and the resulting translation products comprise a complex network of aspects from the translator's individual background, the conditions of the experiment, the text and also the observer/researcher, who have special interests.

Depending on the research issue, the study can be carried out as an observational study in natural settings or as an experimental study in controlled settings. In experimental studies the goal is obtaining results on at least an inter-subjective level that can be compared, replicated and generalized, and developing theories that can be confirmed and further developed. However, what characterizes experiments with human translation processes is that, due to their complexity, they cannot be replicated in exactly the same manner. The actual situation, especially conditions of time, translator and text, can never be kept exactly the same because of the influence of either personality features or the retest effect.

Research methods and tools

Empirical research is based on data systematically derived from the perception and observation of aspects of reality. In a research project data collection, analysis and interpretation entail choices with respect to the adequacy of the methods and tools in relation to the overall research question and the underlying research steps. In translation process research, qualitative and quantitative methods are used in a variety of combinations and triangulations.

Qualitative research is research not by statistical procedures or other means of quantification. It is interpretations of first-person approaches, i.e. people's reports on their lives, their experiences and observations, interactions and emotions. The assumption is that a person who experiences a phenomenon also can give the most precise description of it. Qualitative research is an attempt at in-depth understanding of a phenomenon, taking many variables into consideration. It is exhaustive study, interpreting phenomena in terms of the meaning people bring to them and looking for causal relationships and explanations.

Quantitative research, in contrast, is based on and proceeds from the researcher's ideas and hypotheses about observed dimensions and calculable and measurable categories. Often one phenomenon is isolated and investigated in large samples. An important quantitative method for the analysis of process data involves statistics.

The choice of qualitative and/or quantitative methods and decisions regarding combinations of methods is taken in relation to the particular research issue under study. However, as qualitative data can be coded and counted, and as quantitative data and results *always* need to be interpreted, both aspects will always be present.

Introspection methods

In empirical translation process studies, qualitative methods often employed are surveys and TA, a concurrent verbal report. Retrospection (R) which is a report taking place *after* the process has been used only a few times. The same is the case with concurrent collaborative translation protocols (CTP), where a pair or a group of translators talk together when translating the text.

With TA protocols (TAPs), it is expected that perceptions, thoughts and feelings during the process are verbalized. Introspection was introduced by the founder of experimental

psychology, Wilhelm Wundt (1911), and from the beginning, the reliability of the methods has been discussed. The questions asked were: do such reports really reflect mental processes and do they have an impact on these processes? In consciousness studies it is argued that first-person approaches (from the subject's perspective) provide data that cannot be obtained from a third-person perspective (the observer's), and that both are needed as they are complementary and irreducible (Velmans 2000: 334).

Regarding introspection, in translation process research, researchers usually rely on the standard work by the cognitive psychologists, Ericsson and Simon (1993), about verbal reports as data and about the advantages and disadvantages of various methods. Their claim is that, 'think-aloud and retrospective reports do not influence the sequence of thoughts' (ibid.: xxii). In the studies with TA, during the experiments researchers try to eliminate social interaction between subject and observer as far as possible, because if the two interact, the subject will try to adapt the verbal report to social norms and this could distort the actual mental data. As Ericsson and Simon (ibid.: xiv) say, 'social verbalizations may be quite different from the sequences of thoughts generated by subjects themselves while solving problems, performing actions and making evaluations and decisions'. The observers should be present during the TA experiments, but they should remain invisible. To enhance the production of verbal data, Ericsson and Simon (ibid.: 83, 256) propose the use of prompts or reminders to make the subjects speak, with expressions like 'keep talking', or 'what are you thinking about?' Their opinion is that, 'reminders to verbalize of the "keep talking" variety should have a very small, if any, effect on the subject's processing'. There is still doubt about the impact of TA on the translation process. For many translators it does not appear natural to have to talk during their translation. As observed by Hansen (2005: 513), personal features like the translator's linguistic background and the translation direction have an impact on the applicability of TA and the quality and richness of the data.

Dialogue protocols, whereby pairs of translators talk together during the translation process, or 'joint translation protocols', when groups work in teams, are concurrent verbal reports. House (1988), Kussmaul (1995) and Séguinot (1996) introduced this kind of process research. They observed that the dialogic situation increases the amount of verbalization and that the data were more natural and richer than with individual TA. Kussmaul (1995: 11ff) also reported some disadvantages of this method, mainly because of social and psychodynamic interaction problems. Recently this method was applied by Pavlović (2007, 2009), who carried out a project on directionality using collaborative translation and video recording with subjects who had been trained in team work. It is Pavlović who proposed the term 'collaborative translation protocols' (CTP) for protocols obtained from this kind of task.

Retrospection, a report taking place *after* the process, was traditionally regarded as less being reliable. Subjects can have forgotten their problems, strategies and decisions, and they tend to distort the observations of their own process (Krings 1986: 68). As translation processes consist of many simultaneous thought processes, after the task has been finished it can be difficult to recall distinct thought episodes. The risk of forgetting, distorting and incomplete data increases proportionally to the length of the interval between the task and the retrospective report. With the replay function of software, where whole processes can be shown like a film, the retrospection method has become more reliable (see 'retrospection and replay' (R+Rp) in the next section). Lately this method has also been called 'cued retrospection'.

The integrated problem and decision report (IPDR) by Gile (2004) is another introspection method. Translators are asked to report *every* problem that they encounter during

the translation process, how they attempted to solve it, and why they decided on the solution that they adopted. They are also asked to indicate specifically the full references of all the outside sources that they have used in order to solve their problems. Gile describes several advantages of this method in translator training. With respect to IPDR for research purposes, he is more guarded (ibid.: section 2.4.3), especially because reporting takes time and effort, and students cannot always be relied on to do it thoroughly. A comparison of the two introspection methods, IPDR and R+Rp, is given in Hansen (2006b), where they were tested and compared systematically in terms of their applicability, their influence on the processes, and the richness of information about problems and decisions they provide.

The questions in relation to the choice and application of introspection methods that have been raised repeatedly are: what is it we actually discover from using these methods; how can we observe the translation process under *natural* conditions; and how can we enhance the ecological validity of the experiments?

Software and quantitative data

Introspection is often combined with observations via computer keystroke logging like, for example, Translog (Jakobsen and Schou 1999), PROXY (PACTE), and Inputlog (Van Maes and Leijten 2006). With software like Translog, the translation process – or better, the writing process – can be monitored without much impact on the translator's usual behaviour. The software provides quantitative data about the process, i.e. all cursor movements, changes and corrections, as well as the position and length of phases and pauses. These observation data are registered on a log file. They are generally considered to be 'objective' data. They can be counted and evaluated, but they still have to be classified, coded and interpreted. A further advantage of software for process research is that it makes it convenient to carry out experiments under different kinds of time pressure (see Hansen 2006c).

Through software with a 'replay function' the writing process can be shown dynamically on the screen. As mentioned, in earlier process research, *retrospection* was regarded as being less reliable. A combination of retrospection with the replay function (R+Rp) has made the retrospection method more reliable because now the effect of *recognition* (Ellis 1995: 220) can be employed. As soon as translators see their own writing and revision processes on the screen, they begin to comment on them. An advantage of R+Rp is that it seems to be non-invasive. The replay has an even better effect than the retrieval cues with TA, and prompts like 'keep talking' are not necessary. As control experiments have shown (Hansen 2006b: 4), the observer can leave the room during R+Rp.

On log files, it is primarily aspects of time, i.e. pauses and phases (like the preparation phase, the drafting phase or the revision phase), that are shown in addition to changes and revisions. There is no or very little information about the translators' cognitive processes, i.e. what they are reflecting upon during the pauses and phases, or what resources or aids they refer to (especially if it is printed matter). It is still impossible to get to know what is really going on in the subjects' minds. In many studies TA is expected to fill this gap, at least approximately, but the question whether TA affects the naturalness of the translation process is not solved. This has been discussed by, among others, Jääskeläinen (2002), Jakobsen (2003), Hansen (2005) and Göpferich and Jääskeläinen (2009). In addition to TA and keystroke logging, other methods have been applied, like video recording (Lorenzo 1999), and a method from the field of psychology. one-way screen with audio link (Livbjerg and Mees 1999).

More recently several invisible, less invasive tools have become available for screen logging, a useful supplement to keystroke logging. Screenshot recordings register all the

changes taking place on the computer screen showing the participants' use of the Internet and electronic dictionaries. Screen logging is a considerable improvement. Without this software it had always been difficult to register the participants' use of electronic aids.

A newer method in translation process research is eye tracking, a method from psychology and brain research. Eye tracking provides information about gaze activity like eye fixations at millisecond intervals. Monitoring the fixations and movements of the eye, observers try to infer what word, or part of a text on the screen a person is attending at any particular moment. What researchers are interested in is, for example, the gaze time, mean fixation duration, text segments with 'longer-than-average' fixation, text segments that get the first fixation, the number of refixations. In process research, eye tracking is combined with keystroke logging and sometimes with screen logging (e.g. Eye-to-It 2006; Dragsted 2010). Other methods like pupillometrics, i.e. the study of the pupil size and pupil dilation when carrying out a task, are also applied (O'Brien 2008; Caffrey 2008). Eye tracking registers brain processes and the assumption is that eye movements and the pupil size are expressions or indicators of cognitive activity. At present in most projects, eye tracking is carried out using the Tobii 1750 eyetracker combined with the ClearView analysis software, or the Gaze-to-Word Mapping Module (GWM) developed by Špakov (2007), for the purpose of combining eye gaze and text automatically (Jensen 2008: 158). Data from eye tracking can be visualized and analysed by computer software as described by the international project Eye-to-It (2006). The objective of the project is an integration of several technologies like eye tracking, keystroke logging, EEG (electroencephalography), and the planning system ERP (Enterprise Resource Planning), a business management system which can handle a large variety of different data.

EEG is a tool which in combination with eye tracking and keystroke logging was expected to optimize the performance of professional translators (Eye-to-It 2006). EEG is the measurement of electrical activity produced by the brain as recorded from electrodes placed on the scalp. In fact, electrodes are placed on the scalp over multiple areas of the brain to detect and record patterns of electrical activity.

Ecological validity

Methods and tools can be classified according to the degree of their effect on the ecological validity of experiments. Qualitative methods like pre- and post-process questionnaires, pre- and post-process interviews and dialogues, and R+Rp can be regarded as being less invasive. Also software providing quantitative data like keystroke logging, screen logging and eye tracking do not absolutely affect the process, because the translator does not realize that the software is present. Concurrent verbalization like TA, individually or collectively, has an impact because, with some exceptions, it is not a natural situation. The same is the case with IPDR. With video recording researchers have different experiences. It can have an impact on the process because some subjects feel uneasy. EEG is a highly intrusive method that cannot be used if the goal is ecological validity.

Missing links and challenges

Although we have tools and techniques for logging, recording, tracking, imaging, scanning and measuring, and though pauses, phases, cursor movements, changes, revisions, eye movements and fixations, pupil dilation, neurophysiological processes and the electrical activity of the brain can be registered, it is still crucial to establish the *connection*

between all the observations and the translator's thoughts, intentions, attitude, problems, strategies and decisions – and the quality of these decisions. With other sciences of the mind we share the condition that we still do not have direct access to the human mind.

Research involving human beings and their cognitive processes requires that we go beyond the exercise of registering measurable data. This we try via introspection methods, but they are not totally reliable. In process research with the purpose of improving translator training and professional translation, there is another important aspect: the research gains relevance as soon as observations and analyses of processes are combined with evaluations of the *quality of the translation products* resulting from these processes. If we want to know which of the observations during the translation processes display promising behaviour in terms of a useful final product, the target texts and the revisions during the process (different intermediate versions of the product or changes on a micro-level) have to be evaluated, but evaluations are not always reliable either (Hansen 2007).

A challenge in process research is that all the data obtained still have to be categorized, analysed, coded, interpreted and evaluated separately and/or in relation to each other, in a kind of integrative network of observation and description. Table 6.1 gives an overview of the combinations of methods and tools mentioned and the observed phenomena.

Key studies in empirical translation process research

Projects in the field can be divided into investigations of students' and/or novice or professional translators' processes, and overviews and discussions of methods and tools. In overviews, methods have been discussed by, among others, Jääskeläinen (2002), Krings (2005), Göpferich (2008) and Göpferich and Jääskeläinen (2009).

Projects

Several larger projects have been carried out. Translation, an action of high complexity, depends, among other aspects, on the translator's individual background, experience and

Table 6.1 Methods, combinations and observed phenomena

Some method combinations	Kinds of data	Observed phenomena in
Surveys (pre- and/or post-process)	alternately:	Profile
Keystroke logging + screenshot recording + TA + eye tracking		(Process + verbalization)
Current and final product evaluation		Product
Surveys (pre- and/or post-process)	QUAL + *quan*	Profile
Keystroke logging + screenshot recording + TA + eye tracking + retrospection with replay		(Process + verbalization)
Current and final product evaluation		Product
Surveys (pre- and/or post-process)	QUAN + *qual*	Profile
Keystroke logging + screenshot recording + (R+Rp)		Process
Post-process interview/dialogue		
Current and final product evaluation		Product
Eye tracking/pupil dilation + video analysis (processing speed) + post-process survey		Process with translation memory tools (TM)

linguistic and communicative competence, as well as psychological aspects and training and also the cultural, sociological, ethical and ideological conditions in the respective speech communities. In some of the earlier projects, researchers attempted to investigate the complex translation processes naturally and holistically, which means that if not all aspects, as many aspects of the translators' processes as possible and additionally the translators' profiles and the quality of their products were taken into consideration and combined. In most process studies the behaviour, competences, problems and strategies of students and professionals are investigated and also compared. In some experimental studies the focus is on more special aspects, like the subjects' degree of awareness, decision-taking, creativity, use of aids, or revision.

The first large-scale investigations were carried out by, among others, Krings (1986) and Lörscher (1991), who used TA. Their subjects were groups of students and/or professionals. The aim of Kring's project involving eight advanced learners of French was gaining insight into the translators' mental processes, their skills, translation problems and strategies when translating into their L1 (native language) and L2 (non-native language). Krings identified primary and secondary indicators of translation problems (Krings 1986: 121). In his analyses of the TAPs, he registered five strategies: the reception strategy, the strategy of finding equivalents, the reduction strategy, the evaluation strategy, and the decision-taking strategy (ibid.: 480ff). Many of Kring's observations are still valid, like, for example, his observations regarding inferencing, i.e. 'good guessing', as a strategy to solve reception problems (ibid.: 231); regarding the strategy of *reduction* where he observed that his subjects feared to leave out information 'Wiedergabezwang' (ibid.: 456); and regarding his observations of the strategy of 'Entmetaphorisierung', a reverbalization where metaphors are neutralized (ibid.: 355). Many of these observations were confirmed in later projects, for example Hansen (2006a).

Lörscher (1991) investigated translation strategies and patterns of combined strategies in translation processes – also in both directions of translation. He worked with students and professionals. One of his findings was that experiments with TA are useful for translator training because they improve students' ability to solve translation problems (ibid.: 279).

Early studies where specific issues were investigated with TA were, for example, Jääskeläinen (1999), who compared translation processes of students and professionals into their L1, Finnish. Jääskeläinen looked at the effect of the individual translator's *attitude* on the translation task. Because of small samples, her results were preliminary. In this early study Jääskeläinen already tried to trace the influence of TA on the translation process.

Tirkkonen-Condit (2000) describes a research project where she tried to find patterns of *uncertainty management*. She used the TAPs of six professional translators. Her preliminary result was that professional translators can tolerate uncertainty, and that tolerance of ambiguity is a personality feature. She points out that translators' personalities would deserve more empirical research. Recently, uncertainty management has been again the objective of an explorative study described by Angelone (2010: 18ff), who applies a 'dual methodology' of TA and screen recording.

Several large projects using software have been carried out. In her explorative study, *Expertise and Explicitation in the Translation Process*, Englund Dimitrova (2005) investigated the complexities of the translation process. She combined aspects of task performance, a macro-perspective, with an investigation of certain explicitations from a textual and process perspective, a micro-perspective. She studied the translation process of participants with varying experience and expertise, i.e. two senior professionals. two junior professionals, two translation students and three language students at university, who

translated from Russian into their L1, Swedish. Research methods and tools applied and combined were TA and computer logging. The purpose of the study was gaining insight into aspects of the competence and expertise of professional translators via a comparison of the processes of the groups of participants with different experience. One of the results of the study was that the expertise and competence of the two senior professionals became apparent during the initial planning of the task and in their way of merging text generation and revision during the process.

Translation competence is also the issue of a large-scale experimental research project carried out the PACTE group (2003, 2005, 2007). The group of 10 researchers seeks to get a better understanding of the psycholinguistic aspects of translation competence. They work with six languages and with translations into L1 and L2. The participants in their experiments are professionals working with foreign languages: expert translators and teachers of foreign languages, all with at least six years of experience. PACTE apply computer logging via PROXY and direct observation in order to collect data about the translators' behaviour, and additionally questionnaires and retrospective interviews with the replay of PROXY recordings. The PACTE group analyses both processes and products. They define different aspects of translation competence as proposed in their TC model (see PACTE group 2005: 610; PACTE group 2007: 330).

In a holistic longitudinal study, *From Student to Expert*, Hansen (1997, 2006a, 2008, 2010) investigated translation and revision processes from Danish into German and vice versa. In 1997 the participants were final-year students at the Copenhagen Business School. In 2007 the same participants – now professionals – participated in new experiments, carried out in their workplaces. An assumption was that every translator has his/her 'individual competence pattern' (ICP) and that this pattern 'can be recognized and identified in both (a) *her translation products* and (b) *her behaviour in the course of the translation process*' (Hansen 1997: 207). The objective of the study was via an observation of intra-individual and inter-individual variation over time, and comparisons of groups to discover factors that constitute success in translation, and thus improving the quality of translator training programmes (1997). Felicitous translation processes are defined in Hansen (2006a: 20). The first part of the project (1997–2005) consisted of five series of experiments and control experiments with Translog, with altogether 80 participants. The experiments, which were carried out individually, showed themselves to be quite useful in translator training because they had an excellent effect of awareness raising. Theoretically the study is based on interdisciplinarity and several methodologies and tools are employed. The following profile, process and product parameters proved to be relevant. Profile parameters define the subjects' individual, cultural and educational backgrounds, habits, life stories and self-evaluation of their processes, as well as ten years later, their professional careers, working conditions and experiences. This information was obtained via surveys and interviews. Process parameters are in both parts of the study management of time, actions and revisions during the translation processes (via Translog), the use of aids, and comments during an immediate R+Rp and a post-process dialogue that was transcribed and classified. Product parameters are the results of an evaluation of the final target texts and additionally the results of the participants' revisions during their processes. All data were combined and the results were triangulated. First comparisons of the results of the longitudinal study seem to confirm the assumption of 1997 that each translator has his or her ICP, an individual translation and revision style, which does not change considerably over time.

A project using eye tracking, which seems especially relevant with respect to the interests of the translation industry, is O'Brien's study, 'Processing fuzzy matches in Translation

Memory tools'. With five participants, students of translation, O'Brien (2008) investigated translators' interaction with TM tools and especially their cognitive load involved when translating different levels of 'fuzzy matches'. Fuzzy matches are segments that appear in a translation memory but cannot be used and require a new translation in the new text. As O'Brien (ibid.: 80) argued, 'Since the introduction of Translation Memory (TM) tools in the mid-to laté nineties, there has been an increasing downward pressure on the rates paid for translating words'. She then tried to find out whether reduced rates for translations with TM with 'exact matches' are justified. In order to measure the participants' cognitive effort, she used both quantitative methods, processing speed (calculated via the software for video analysis, ClearView) and pupil dilations recorded by the eye tracker, and she added a qualitative investigation via a post-process survey where the participants were asked to rate their perceived editing effort for each match. O'Brien's results show no clear correlation between the mental effort measured via processing speed and the survey, and the results from measurements via pupil dilations. Further research with a larger number of participants and with professional translators would be necessary. However, as O'Brien points out, it is difficult to recruit participants with totally equal competences – this is important in order to eliminate effects from other parameters than the level of the fuzzy matches.

Lately, two new large-scale, long-term projects have been started, 'TransComp (The Development of Translation Competence)' at the University of Graz, and 'Capturing Translation Processes (CTP)' at Züricher Fachhochschule (ZAHW).

The 'TransComp' project, which is chaired by Göpferich (see Göpferich 2009), is an experimental study exploring the development of translation competence. Methods and tools applied are keystroke logging via Translog, screenshot recording, and TA or retrospection using the replay of the recordings. Partly also eye tracking will be applied. Participants in the study are 12 students who will be observed over a period of three years, and ten experienced professional translators. Some of their translations will be compared. The overall goal of the study is to improve and develope research methodology and to improve methods of translator training. For the transcripts of introspection data an XML annotation system has been developed. The materials and data used in the 'TransComp' project as well as the XML transcripts will be made available to the scientific community in an asset management system, an open source-based storage, administration and retrieval system for digital resources (see ibid.: 35).

The Zürich project, 'Capturing Translation Processes (CTP)', is chaired by Ehrensberger-Dow (see Ehrensberger-Dow and Massey 2008). It is a large-scale, longitudinal study investigating the development of the translation and revision competences of students, novice translators and experienced professionals at different points in their careers. The experiments with the professionals will be carried out in cooperation with an industry partner, who will place staff members at the disposal of the project on a regular basis. One of the goals of the project is to gain insight into the translators' genuine workplace practices – they will be observed in their workplaces. Also 'CTP' is a multi-method project in both naturalistic and also controlled settings, where translations within individuals and between groups, different kinds of processes with and without TM, translations of different types of texts and several language combinations and directions will be compared. The methods applied are: ethnographic observations (profile), interviews, keystroke logging via Inputlog, S-notation and progression graphs, screenshot recordings (Camtasia), and eye tracking (Tobii T66). Cue-based retrospective verbalizations will also be used and they will be transcribed and then coded and analysed with the support of Hyper RESEARCH, which is a qualitative data analysis software program. The objective of the study is the

improvement of translator training at universities, an optimal training of workflow efficiency and output quality at all levels of proficiency. The data, transcriptions and texts from the 'CTP' project will be made available in an asset management system.

Weaknesses: how to add rigour to process research

What makes translation process research fascinating is the complexity of the research object and the work with the participants. Not only are the processes complex, but the human beings carrying out the processes are complex, and the texts and situations differ. That is why shortcomings in process research cannot be totally avoided but they can be controlled and described.

A weakness that is typical of translation process research is that samples are small and personal features of the subjects like their individual backgrounds have been neglected. Results of process research with students (Hansen 2004: 91) have shown that at least every third participant has significant individual characteristics that have an impact on their processes.

The question of ecological validity is not solved. Though a method, software or technical tool is regarded as non-intrusive, like, for example, the pre-process surveys, keystroke logging and screenshot recordings, participants have to be informed about the experiment and the methods used before it starts. This is a general ethical requirement regarding research with human beings as participants. Knowing about the experiment and feeling observed may have an impact on the results because nervousness or stress changes the participants' mental processes and the intensity of this impact cannot be measured precisely.

The reliability of single methods and the credibility of elicited data is an often-discussed issue (Hansen 2004, 2005, 2006a: 33ff; Göpferich and Jääskeläinen 2009). Potential problems of borrowing or adopting tools and methods from other disciplines or of an adoption of theoretical paradigms in empirical process research are dealt with by, for example, Malmkjær (2000: 165) and Muñoz Martín (2010: 181).

The advantage of investigations with several different methods and tools is that they can complement and/or corroborate each other. For example, if via keystroke logging a pause is registered during the translation, the stop appears at a special part of the text, where the participant may have a reception or production problem – the use of aids can be registered via eye fixations (screen recording) or observation of the use of dictionaries. After the pause the observer can register what happens on the screen, i.e. if it is just that writing continues or if changes or revisions occur perhaps immediately after the pause (as to what happens in the non-pause, see Hansen 2006a: 206). The observer can combine all these data derived from the pause (position, length), eye fixations (e.g. from checking the Internet) and actions after the pause. All the results triangulated may give an idea as to what the translator's thoughts and decisions during the process may have been. However, these are observations from the third-person perspective and they are still assumptions. The results of these observations can be complemented and confirmed by observations from the first-person perspective, i.e. via the reports of TA and/or retrospection.

Adding rigour via control experiments

Categories and findings are affected primarily by (i) methods, (ii) observers, (iii) set-ups (also the direction of the translation), and (iv) texts. These effects can be controlled and minimized by manipulating factors.

The effect of a method applied can be controlled via experiments with the same source texts, the same participants but different methods/tools in a kind of criss-cross design (see Hansen 2006b). In such control experiments it is important that all the other parameters are kept equal, for example, that the same direction of translation is used with both methods.

In addition, the results of surveys and interviews can be controlled. Useful methods from psychology and social sciences are, for example, the test-retest method, which is used to estimate the consistency and reliability of participants' answers by correlating first results with the results of a second survey with the same questions, sometime later (usually 1–2 months later). In order to check the reliability of the results of interviews or post-process dialogues, the participants can be asked to confirm and correct the written protocol of the interview.

Observers' effects can be partly controlled via similar criss-cross experiments with the same source text, the same participants, at first with presence and then absence of an observer during the experiments. As mentioned, R+Rp can be carried out without the presence of an observer in the room. The effect of teaching is a relevant aspect, but also this effect can be partly controlled. The same experiments can be carried out under identical conditions, at first with subjects whom the researcher has taught and then with subjects the researcher does not already know. However, the teaching effect will always be present, even in experiments with experienced professionals.

As mentioned in Hansen (2003: 34), with introspective methods like TA and retrospection, participants need concepts and terms with which to express their thoughts. Most likely, participants only mention phenomena they have learnt to talk about at some point in their lives. Different traditions regarding language learning and translator training in different speech communities have an impact on the translation processes and the phenomena mentioned during introspection. Such differences will have to be described and taken into consideration, especially when applying an asset management system for international comparisons and explanations.

Looking to the future

New research tools and new methodological challenges will show up. Interesting software that may be applied in process research in combination with other methods and tools is, for example, FaceReader. The software is capable of automatically analysing facial expressions while a person carries out a task (see Noldus Information Technology 2010). As they say on their website, 'Combining facial expressions with other data offers researchers a wealth of opportunities for gaining new insight into human behavior'.

In many areas of translation and especially in professional translation, computer-aided/-assisted translation (CAT), translation memory systems (TMS), electronic databases and machine translation (MT) is used. These electronic tools are rapidly being improved and new issues will be investigated regarding the interface between MT and human translation. Text revision will become increasingly important, especially as machines can never be made liable for translation errors.

A challenge will be the multitude of variables and the integration of the elicited data and results in relation to the main objective(s) of the study. Some projects may become oversized in relation to their purpose, or they may be difficult to manage and lack transparency. With the tendency towards large-scale, multi-method approaches with multiple techniques, software and modern researchware, research logistics, i.e. planning the track of the study from start to end, will be crucial. As a procedure to overcome these difficulties,

Hansen (2004, 2006a, 2010) proposes *integrative description*, which is a dynamic process of, on the one hand, precise in-depth analyses, categorizations and descriptions of isolated observations and data of relevant parameters, and on the other hand, synthetic integrative descriptions of the results in relation to each other and the main objective of the study.

Related topics

translation process, empirical research, quality, process research, research methods

Further reading

Copenhagen Studies in Language (CSL): Since *CSL* 24 (1999), the translation process has been the special issue of several publications. The articles reflect the development of cognitive translation process research with different introspection methods and software like Translog – lately also combined with eye tracking.
Meta 2005-2, which is devoted to the special issue of processes and pathways in translation and interpreting is a collection of key articles addressing translation process research from different angles.
The PACTE group have meticulously investigated psychological aspects of translation competence, with software, different methods and several language combinations. Based on their results they developed a translation competence model.

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