PHYSIOLOGICAL STRESS DURING SIMULTANEOUS INTERPRETING: A COMPARISON OF EXPERTS AND NOVICES

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1. Introduction

Conference interpreters work under conditions which psychologists generally consider to involve objective stress factors: the constant information load, the time factor, the tremendous amount of concentration required, fatigue, the confined environment of the booth, etc. Several empirical studies have confirmed that simultaneous interpreting is indeed a high-stress occupation.

Following an overview of relevant stress studies carried out so far, the paper presents a pilot study which was part of a research project carried out under the author's supervision at the University of Vienna aimed at examining the stressfulness of simultaneous interpreting (SI). Two objective physiological parameters (pulse rate and skin conductance level) were monitored during SI in an attempt to determine whether experts (experienced conference interpreters) and novices (student interpreters) differ in their physiological stress responses.

2. Job stress

There is general agreement that job stress results from the interaction of the individual and the conditions of work. It can be defined as the harmful physical and emotional responses that occur when the requirements of the job do not match the capabilities, resources or needs of the worker. According to the NIOSH (National Institute for Occupational Safety and Health), working conditions play a primary role in causing job stress. However, the role of individual factors must not be ignored. Exposure to stressful working conditions (job stressors) can have a direct influence on workers' safety and health. At the same time, individual and other situational factors can intervene to strengthen or weaken this influence. Differences in individual characteristics, such as personality and coping style, are important in predicting whether certain job conditions will result in stress. In other words, what is stressful for one person may not be a problem for someone else. Although the significance of individual differences cannot be ignored, scientific evidence suggests that certain working conditions are stressful for most people (e.g. heavy workload, infrequent rest breaks, long hours of work, inability to cope with the volume and complexity of work, poor social environment, lack of training, lack of control, job insecurity,

unpleasant or dangerous physical conditions such as noise, poor lighting, poor ventilation, poor temperature control, or ergonomic problems). (For a detailed description see NIOSH 2003).

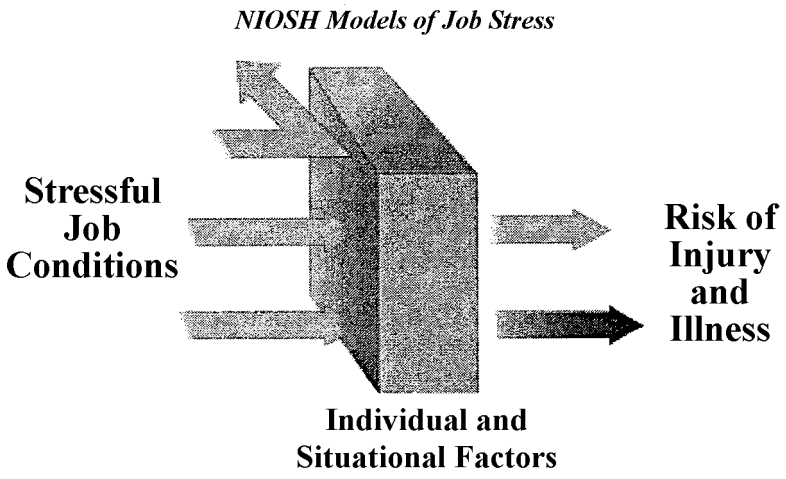

Figure 1. NIOSH Model of Job Stress

Stress triggers off an alarm in the brain, which responds by preparing the body for defensive actions. The nervous system is aroused and hormones are released to sharpen the senses, quicken the pulse, deepen respiration, and tense the muscles. This response (sometimes called the fight or flight response), which is biologically preprogrammed, is important because it helps us defend ourselves against threatening situations. Short-lived or infrequent episodes of stress pose little risk, but when stressful situations go unresolved, the body is kept in a constant state of activation, which increases the rate of wear and tear and may ultimately compromise the body's ability to repair and defend itself. Stress is what life is about: it is part of our wholeness. But when stress becomes distress, it is destructive. Stress research, therefore, should consider the level of stress, presence of stressors, responses to stressors, coping abilities, and physical signs of distress.

3. Interpreting and stress

3.1. Intuitive perception of interpreting stress

There is general agreement among conference interpreters that their profession is a very demanding one. It requires a maximum of attention and concentration

over prolonged periods of time. The need to cope with different (often highly difficult) subjects, different speakers and accents, the possibility of failure at all times, etc. are among the factors that are generally regarded as contributing to stress. The literature abounds with intuitive statements to the effect that stress is intrinsic to interpreting:

> More often than not the interpreter is very highly strung and must in his profession stand a long and continuous strain which is hard to bear. (Herbert 1952: 6)
>
> L'interprète travaille constamment sous tension et doit posséder une endurance hors pair sous peine de devenir tôt ou tard la victime de ses nerfs. (van Hoof 1962: 62)
>
> When he interprets, the interpreter is under pressure. (Seleskovitch 1978: 41)
>
> […] stress is held to be an important factor in interpreting. (Henderson 1987: 39)
>
> Simultaneous interpreting is a highly complex discourse performance […[where language perception, comprehension, translation and production operations are carried out virtually in parallel and under severe time pressure. […] the task […] is likely to create a heavy processing load. (Tommola and Hyönä 1990: 180)

Consequently, it was held that "interpretation requires that one have nerves of steel" (Gravier 1978: iv), that "interpreters must have (…) the ability to work under stress for long periods" (Longley 1989: 106), must posses "a quality perhaps best defined by the modern slang word 'unflappability', or coolness under pressure" (Roland 1982: 13), and should be "programmed to be winners under adverse circumstances" (Coughlin 1988: 359).

This view seems to be shared by those using the services of conference interpreters.

When clients of an interpreting service were asked what they considered particularly difficult about the interpreting profession, the most frequent replies were 'high concentration' and 'stress' (Moser 1995).

It took some time, however, before attempts were made to test the validity of these claims.

> Although the question of individual differences in personality, and the ability to withstand the stress involved in the career of a simultaneous interpreter (e.g. the constant information load during interpretation, the confined environment of the interpreting booth, fatigue, and the effects of environmental noise) is often discussed by professional interpreters,

> virtually no research has been carried out in this area. (Gerver 1976: 188-89)
>
> A great deal has been written about the pressures and strains imposed on interpreters working in international forums […]. Little serious empirical work has been undertaken, however, to identify the sources of stress acting on them. (Cooper, Davies and Tung 1982: 97)
>
> Simultaneous interpreting […] for some unknown reasons […] has never been analysed within the framework of a stress theory. […] the plea for more research in this domain seems more compelling than ever. (Klonowicz 1991: 446/447)

3.2. Empirical stress research

Over the last twenty years, the research community has ceased to take the initial intuitive claims at face value. The formerly tacit assumptions have been put to the test. A number of empirical stress studies have been implemented in an attempt to gauge the environmental, psychological and physiological stress under which interpreters work.

3.2.1. Environmental (physical) stress

Environmental (physical) stressors include such factors as temperature, humidity and air quality.

Some of the earliest stress studies investigated the impact of the work environment or, more precisely, temperature, humidity and air quality in the booth (Kurz 1981, 1983a, 1983b, Kurz and Kolmer 1984).

Even though, over the years, the efforts of the Technical and Health Committee of AIIC (International Association of Conference Interpreters) have led to considerable improvements in the design of booths, these early studies showed that in practice working conditions, particularly in mobile booths, were frequently poor or unacceptable. There were major inadequacies with regard to temperature, relative humidity and CO2 levels. While the applicable ISO standard recommends a temperature comfort zone of 18-22°C, this range was exceeded in 100% of the booths in which measurements were carried out. The average in-booth temperature at the end of a conference was 26.4°C.

3.2.2. Psychological stress

While some working conditions are stressful for most individuals, the perception of stress is highly subjective and is influenced by personality factors, such as an individual's self-confidence or the way he/she judges a situation. To a large extent, it is these factors that determine whether an individual perceives a situation as stressful or not.

Ergopsychometric studies, i.e. psychological testing under stress as compared to neutral conditions, have confirmed the well-known phenomenon that there are individuals who show an unchanged or even improved performance under load ('consistent performers'), while others with an equally good performance in a stress-free atmosphere tend to fail in stressful situations (Guttmann and Etlinger 1991).

Kurz (1997) used the State and Trait Anxiety Inventory (STAI) to investigate conference interpreters' anxiety levels. The findings support the hypothesis that conference interpreters have better situation-dependent control over their feelings of anxiety and manage to label their anxiety in a positive way. This suggests that they are 'consistent' performers', able to maintain an even performance under stress.

Jiménez and Pinazo (2001), who used the STAI to determine whether there is a relation between anxiety and students' interpreting performance, also point out that the capacity to control stress has traditionally been considered one of the prerequisites for interpreting.

Nevertheless, the Cooper Study (Cooper, Davies and Tung 1982), which focused on mental and emotional stress in conference interpreters, found that 45% of the respondents indicated that over 40% of the stress in their lives was work-related.

When asked what they find particularly difficult about the interpreting profession, 26% of the users of interpreting services interviewed in Peter Moser's study (1995) mentioned high concentration and constant stress, and 18% likened the job of the interpreter to that of a pilot or air traffic controller.

Besides, there are situations which even experienced conference interpreters find more stressful because circumstances require additional efforts. Riccardi, Marinuzzi and Zecchin (1998) hypothesized that remote interpreting (with no direct view of the speakers) would impose more strain on interpreters than regular conference interpreting. Their assumptions were confirmed by two remote interpreting experiments conducted by the United Nations.

Interpreters participating in a UN remote interpreting experiment in 1999 emphasized that they were able to maintain performance at acceptable levels only at a higher psychological and physiological cost (Report of the Secretary General 2001a). This was corroborated by the interpreters participating in a

second experiment in 2001, who stated that remote interpretation demanded greater physical effort and led to higher psychological stress than normal on-site work (Report of the Secretary General 2001b). In the Workload Study, too, videoconferencing was perceived as having a negative impact on performance by 73% of the respondents having experienced it (Mertens-Hofmann 2001, see 3.2.4).

Interpreting for live TV broadcasts has also been shown to be more stressful. Being aware that he/she is interpreting for an audience of hundreds of thousands or even millions, the TV interpreter is more keenly afraid of failure than during 'ordinary' conference interpreting (Kurz 2002).

3.2.3. Physiological stress

Researchers have also started looking at physiological stress parameters as objective signs of stress. (For an overview of physiological stress responses see Zeier 1997.)

Tommola and Hyönä (1990) measured the variations in mental load during simultaneous interpreting and two other language processing tasks (listening and shadowing) by means of pupillometry and found that SI was associated with the highest dilation levels.

Klonowicz (1991) examined changes in effort during a day's work in the booth. Blood pressure and heart rate were measured immediately before and immediately after 30-minute shifts, showing more pronounced elevations with the duration of work.

In a pilot study Moser-Mercer, Künzli and Korac (1998) studied the impact of prolonged turns (more than 30 minutes) on the quality of interpreters' output and used a saliva test to determine cortisol and immunoglobulin A concentrations.

Kurz (2002) examined whether interpreters' subjective impression that live TV interpreting is more stressful than 'ordinary' conference interpreting can be confirmed by objective physiological stress measurements.

3.2.4. Workload Study

AIIC commissioned a Study of Workload and Burnout in Simultaneous Interpreting (Mertens-Hoffman 2001), using a combination of various research methods and tools. It is the first comprehensive study to investigate all four sets of parameters: psychological, physiological, physical (environmental) and performance factors. A major focus of the study was on the extent to which these were or were not interrelated (Mackintosh 2001).

The study consisted of a mail survey among a representative sample of AIIC interpreters (607 respondents) and an in-depth study (48 booths). The mail survey investigated levels and components of job satisfaction, causes, feelings and effects of work-related stress and discomfort, and burnout. The in-depth study included:

a) physical measurements in booths (humidity, effective temperature, air quality, etc.
b) questionnaires on interpreters' attitudes
c) recording of interpreters' heart rate and blood pressure over 24 hours and measurement of cortisol levels at different times during the day
d) objective measurement of performance quality in an attempt
   - to map out both positive characteristics and sources of stress in the interpreter's work
   - to characterize physical stress (air quality, effective temperature, etc.) in the interpreter's work environment
   - to test the implications of the work characteristics on the interpreter's quality of life and quality of work
   - to identify recommendations for improvement.

Physical measurements in the booths revealed serious shortcomings with regard to CO2 levels, relative humidity and temperature. A high percentage of all mobile booths measured was either unacceptable or poor by ISO standards.

On the basis of the replies to the questionnaire, levels of mental and physical exhaustion, cognitive fatigue and mental stress are higher for interpreters than for hi-tech workers and similar to those of teachers and senior officers (in the Israeli army). The responses confirmed interpreting as a high-stress occupation performed by competent and motivated professionals.

Although interpreters appear to have developed coping mechanisms for stress, there are indications that there is a physiological cost associated with these levels of expertise. Ambulatory blood pressure and heart rate measurements over 24 hours demonstrated the stressfulness of the interpreters' job. The rates were highest when the interpreters were 'on mike'. Salivary cortisol levels were comparable to those of workers in other high-stress occupations.

Correlations between measures of (subjective and objective) stress and performance were found to be weak. This is in keeping with findings in the literature, however, which indicate that highly competent and motivated workers maintain a high level of performance in the presence of a variety of stressors.

Now that the link between environmental, psychological and physiological factors has been established in several empirical studies during SI (both in natural settings and in the laboratory), researchers' interest is beginning to focus on more subtle aspects, such as situation-dependent intra-individual differences

in psychological and physiological stress (Kurz 2002) and differences between experts and novices.

4. How experts differ from novices

> An expert is generally considered to be someone who has attained a high level of performance in a given domain as a result of years of experience, whereas a novice is usually defined as someone with little or no experience. (Moser-Mercer 2000: 339)

Anderson (1990) describes three stages of skill acquisition: the cognitive, the associative and the autonomous stage.

In the cognitive stage, subjects or learners develop a declarative encoding, i.e. they commit to memory a set of facts relevant to the skill. The knowledge acquired in the cognitive stage is inadequate for skilled performance. The second stage is the associative stage, during which two important things happen: first, errors in the initial understanding are gradually detected and eliminated; second, the connections among the various elements required for successful performance are strengthened. The third stage of skill acquisition is the autonomous stage. In this stage, the procedure becomes more and more automated and rapid. There is no sharp distinction between the associative and the autonomous stage. Two of the dimensions of improvement with practice are speed and accuracy. The procedures come to apply more rapidly and more appropriately.

People who have acquired expertise in particular areas are, by definition, able to think effectively about problems in those areas. Research shows that it is not merely general abilities nor the use of general strategies that distinguishes experts from novices. Rather, experts have acquired extensive knowledge that impacts what they notice and how they organize, represent and interpret information in their environment, which, in turn, impacts their abilities to remember, reason, and solve problems (Bransford, Brown and Cocking 2003). Experts and novices have been found to differ in terms of:

a) Meaningful patterns of information

   The fact that identical stimuli are perceived and understood differently, depending on the knowledge a person brings to the situation, was demonstrated by de Groot (1965), who tried to determine what distinguished master chess players from weaker chess players. (For a detailed description see Kurz 1996.) He concluded that, on the basis of knowledge acquired over tens of thousands of hours of chess playing, chess masters were able to 'chunk' various elements of a configuration into familiar patterns and realize

their strategic implications. Experts across all domains recognize features and meaningful patterns of information that remain unnoticed by novices.

b) Organization of knowledge
   Experts have acquired a great deal of content knowledge that is organized in ways that reflect a deep understanding of their subject matter. Their knowledge cannot simply be reduced to sets of isolated facts or formulas that are related to their domain, but is organized around core concepts. They possess an efficient organization of knowledge with meaningful relations among related elements clustered into related units that are governed by underlying concepts and principles.
c) Context and access to knowledge
   Experts have not only acquired knowledge, but are also good at accessing the knowledge relevant to a particular task. They do not have to search through everything they know in order to find what is relevant. In the language of cognitive science, experts' knowledge is 'conditionalized'. It includes a specification of the context in which it is useful.
d) Fluent retrieval
   Experts are able to flexibly retrieve important aspects of their knowledge with little attentional effort. Automatic and fluent retrieval are a part of expertise. Fluency is important because effortless processing places fewer demands on conscious attention.

4.1. Stress experienced by conference interpreters and student interpreters

Stress consists of the psychophysiological processes caused by a perceived threat or danger. From a psychological point of view the phenomenon involves two components: (1) the experience of a threatening and strenuous situation and (2) the uncertainty whether one will be able to cope with this situation.

> Stress is what occurs when an individual feels that environmental requirements clearly exceed the resources available to him for coping with them. (Riccardi, Marinuzzi and Zecchin 1998: 96)

Previous research on occupational stress has shown that individuals' perception of stress, rather than 'objective' stress per se, has an overriding impact on the person's physical well-being and performance on the job (Cooper, Davies and Tung 1982).

Stress depends on the complex relation between the individual and the environment. Furthermore, it depends on the subjective evaluation of the event, which is also linked with past experience. Uncontrollable or unpredictable events are more stressful than controllable or predictable ones.

The reason why conference interpreters manage to cope with the high demands of their profession is that they are experts in their domain. Through their training and experience they have acquired sufficient expertise, i.e. a combination of greater knowledge and better strategies. Expertise manifests itself, among other things, in the ability to process larger segments and allows the interpreter to adopt the right strategy quickly, sometimes automatically.

As illustrated in 3.2.2, however, there are situations in which even experienced interpreters report greater stress because they are confronted with unknown factors and might need strategies that go beyond their standard repertoire: live TV interpreting (Kurz 2002) and videoconferencing/remote interpreting (Riccardi, Marinuzzi and Zecchin 1998). The interpreters participating in two United Nations remote interpreting experiments confirmed that remote interpretation demanded greater physical effort and led to higher psychological stress than normal on-site work (Report of the Secretary General 2001a, 2001b).

Unlike conference interpreters, novices/student interpreters cannot rely on extensive experience. They still grapple with numerous difficulties (background knowledge, comprehension, concentration, décalage, finding equivalents, keeping up with the speaker, etc.) (cf. Moser-Mercer 2000).Therefore, what has become a routine situation for experienced interpreters is likely to constitute a highly stressful event for student interpreters.

Riccardi, Marinuzzi and Zecchin (1998) administered the ASQ – IPAT Anxiety Scale, the CDQ – IPAT Depression Scale and the MMPI-2 (Minnesota Multiphasic Personality Inventory) to interpretation students and experienced conference interpreters before and after a conference. (Interpretation students were monitored during a mock conference, while interpreters were monitored in real working conditions.) The results showed lower anxiety and depression values for students and interpreters than for the normal population, with students showing greater score variations. This is most likely due to the fact that students do not have a real work experience and were affected more by the conference setting, even though it was only a mock conference, resulting in higher stress levels.

It stands to reason that the higher psychological stress experienced by student interpreters will be reflected in elevated physiological parameters. In order to test this hypothesis, the following pilot study was carried out.

4.2. Pilot study

4.2.1. Method

The pilot study, which was part of a research project conducted under the author's supervision, set out to examine the stressfulness of SI for conference interpreters and students by using objective physiological parameters. The subjective stress a person associates with a particular situation is also reflected in the individual's physiological responses. Consequently, changes of physiological functions can be used as an indicator of emotional and mental processes. A wide variety of physiological parameters, e.g. heart rate, blood pressure, cortisol level and skin conductance level, can be used for this purpose, some of them being easier to record than others (Zeier 1997).

The saliva test used by Moser-Mercer, Künzli and Korac (1998) to determine cortisol and immunoglobulin A concentrations was deemed to be too complicated and unsuited for our purposes. (Subjects have to chew cotton rolls for exactly two minutes and are instructed to rinse their mouths with water ten minutes before the first saliva collection.) It was decided to use a method that (a) can be applied in live interpreting situations and (b) permits the continuous recording of physiological parameters.

The following parameters were chosen: (1) pulse rate and (2) skin conductance level (SCL). (When we are alarmed or stressed we sweat slightly more than usual, which leads to an increase of skin conductance.)

Present-day equipment, such as the Insight Instruments biofeedback system used in the present study, permits the continuous recording of pulse rate and skin conductance level with minimum inconvenience to subjects. Two electrodes are placed on the ventral surface of one of the digits of the left hand (in right-handed persons) and secured with a Velcro snap. This method can, therefore, be applied in live interpreting situations, allowing us to conduct psychophysiological stress research under natural conditions.

4.2.2. Subjects

The pilot study involved two groups of subjects:

1. As part of a more comprehensive research project, pulse rate and SCL of two interpreters were continuously recorded during SI at a medical conference (English/German). The total number of measurements was 14 for interpreter 1, and 12 for interpreter 2.
2. Three students in an English/German SI class taught by the author volunteered to have their pulse rate and SCL recorded while interpreting in

class. They were working with a text which they had received a week in advance.

4.2.3. Results and discussion

Even though in a previous study (Kurz 2002) an individual interpreter's skin conductance level (SCL) showed significant differences in a moderately stressful situation (conference interpreting) as compared with a highly stressful situation (live TV interpreting), it failed to discriminate between experts and novices. From the data available so far, it seems that SCL is better suited to measure intra-individual differences.

There were, however, significant differences in subjects' pulse rate, as can be seen from Table 1.

Interpreter 1	75.00	(14 measurements)
Interpreter 2	73.75	(12 measurements)
Student 1	105.18	(68 - 123)
Student 2	86.90	(63 - 102)
Student 3	100.76	(67 - 116)

Table 1. Average pulse rate values during SI

Even though the medical conference can be described as highly technical and fairly difficult, the interpreters' pulse rate values remained within the normal range. No marked signs of elevated stress were observed. Experienced conference interpreters can be expected to cope with the high demands of a technical conference. Training and experience help them adopt the right strategies.

The pulse rate for all three student interpreters was clearly higher than that of the two interpreters, indicating that for novices even an 'ordinary' classroom situation (working with a text that had been available in advance) involves measurably higher physiological stress.

Figures 2 and 3 show typical pulse rate recordings for an interpreter and a student. The sample recording obtained for the interpreter has a total length of approx. 26 minutes (1563 seconds). Measurements were taken at 27-second intervals. The total recording time for the student was approx. 25.5 minutes (1535 seconds), with measurements being taken at 26-second intervals.

From Figure 2 it is obvious that, with the exception of a slightly higher value at the very beginning, the interpreter's pulse rate remained in the 70s throughout the 26-minute period (average = 69.21, range = 65.72 - 82.59).

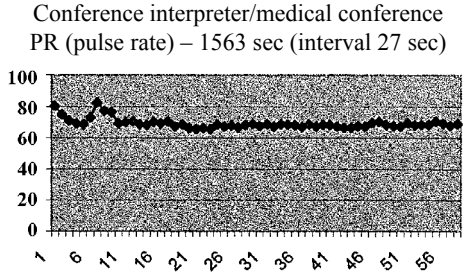

Figure 2. A conference interpreter's pulse rate recordings during a medical conference

By way of contrast, the student's pulse rate was around 100 most of the time and showed much stronger fluctuations (average = 105.18, range = 68.88 – 123.72), a clear indication that the SI situation in the classroom was experienced as highly stressful by the student.

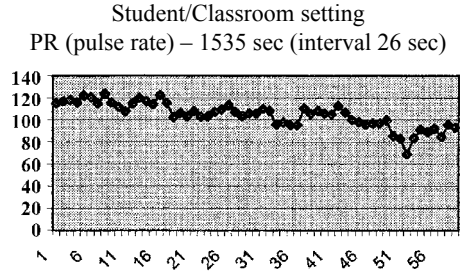

Figure 3. A student's pulse rate recordings in a classroom setting

5. Conclusions

This paper has tried to show the treatment of a topic that has always captured the interest of interpreters, clients and researchers – the stressfulness of the profession.

Since the early 1980s, formerly unsubstantiated claims have come under scrutiny. Several researchers have investigated environmental, psychological and physiological stress parameters and have collected objective data. Most recently, studies have focused

a. on showing the 'connectivity' of different sets of data (work environment, mental, emotional, physiological stress, performance)
b. on comparing intra-individual and inter-individual differences in physiological stress responses, i.e. showing that certain situations (TV interpreting, remote interpreting) are measurably more stressful for an

individual interpreter than others and that novices experience more psychological and physiological stress during SI than experts.

While conference interpreters have learned to overcome their 'stage fright' with experience and have developed more tolerance for the stress involved in SI, student interpreters still grapple with numerous problems.

In order to gain insight into the skill acquisition process and novices' progression towards expert performance, Moser Mercer (2000) asked students to record the difficulties they had with the exercises in class ('Introduction to simultaneous interpreting'). Among the many difficulties reported by them, concentration, i.e. the ability adequately to juggle all the subskills of the task without detriment to any one of them, was the most crucial one. The problems facing novices are likely to give rise to feelings of insecurity, fear of failure and heightened stress.

Unless teachers recognize that the achievement of expertise is a developmental process (Hoffman 1997), they

> […] are evaluating and diagnosing students' difficulties from the vantage point of their own interpreting practice. This is equivalent to an expert judging a novice on a scale developed for experts – it is akin to comparing apples and oranges. (Moser-Mercer 2000: 339)

Interpretation courses, therefore, should be designed in such a way as to facilitate the acquisition of productive interpreting strategies. As coping tactics are a fundamental skill in interpreting, they should be taught within the framework of practical exercises (Gile 1995).

Considering the elevated physiological stress values observed in student interpreters during SI in the classroom, it is suggested that

> […] students should be encouraged to pay more attention to their coping strategies (interpreting resources, feelings of self-efficacy, sense of challenge, will to show competence, responsibility and maturity) and less to their feelings of fear and anxiety in order […] to increase self-confidence, if only for reasons related to personal well-being. (Jiménez and Pinazo 2001: 115)

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