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An Empirical Investigation of Cognitive Effort Required to Translate Informative, Expressive, and Operative Text Types

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Abstract

This study aimed at investigating and comparing the expenditure of cognitive effort in translating various text types. The text typology of Reiss (1971, 2014) including informative, expressive, and operative text types was used as the theoretical framework. A mixed-method approach involving the use of screen recording, keystroke logging, think-aloud protocols, and retrospective interviews was adopted for the investigation. To pursue the research aims, 22 senior translation students were recruited to participate in the study and perform three translation tasks: translating informative, expressive, and operative texts. By using think-aloud protocols, the participants were instructed to speak out during the execution of the tasks. The amount of time spent by each participant and the number of pauses taken by them on each translation task were measured and compared as indicators of cognitive effort. Additionally, time and pause analyses were triangulated using technical operation analysis to have a better perception and obtain more reliable results. The findings of this study showed a significant difference in the cognitive effort required to translate informative, expressive, and operative texts. The findings also revealed a higher level of cognitive effort in translating expressive text compared with informative and operative ones.

***Keywords*:** cognitive effort, screen recording, text type, think-aloud protocols

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1. Introduction

One of the important issues when dealing with the notion of translation is understanding what really happens in the translator's mind during the translation process. Since translation is primarily considered as a cognitive task happening in the mind of the translator, understanding what happens in the translator's 'black box' while translating can have huge implications for translators' training and other aspects of translation studies. However, because of some complexities in doing Translation Studies research in general (Salemi et al., 2015) and process-oriented research in particular (Breedveld, 2002; Holmes, 2004), one can notice the paucity of studies addressing the cognitive aspects of Translation Studies (Albl-Mikasa et al., 2020; Breedveld, 2002; Jakobsen, 2014; Muñoz et al., 2018; O'Brien, 2013).

The review of the previous studies indicated that the majority of cognitive translation studies have been done in the context of post-editing machine translation output (Alves et al., 2016; Carl et al., 2015; Herbig et al., 2019; O'Brien 2006, 2017; O'Brien & Ehrensberger-Dow, 2020; Popovic et al., 2014; Vieira, 2017;), raw machine translation output (Doherty & O'Brien, 2014; Nurminen, 2020), translation of texts with different levels of difficulty and complexity (Liu et al., 2019; Shreve et al., 2010;), translation of texts rich in metaphors (Koglin, 2015), direct and inverse translation (Buchweitz & Alves, 2006; Ferreira et al., 2016; Fonseca, 2015; Tomczak & Whyatt, 2022; Whyatt, 2019), interlingual and intralingual translation (Whyatt et al., 2016), audiovisual translation (Fernández-Torné & Matamala, 2016; Kruger et al., 2017), the role of the translators' personality and their behavioral processes (Hubscher-Davidson, 2009) or translation revision (Schaeffer et al., 2019). However, the cognitive aspects of translators' performance when translating various text types with the same level of difficulty and readability have received considerably less attention.

Therefore, a study focusing on the cognitive effort involved in translating different types of texts is needed. Conducting empirically-grounded cognitive studies of the translation process would not only help understand translation activities but also provide a basis for the development of translation tools and enhance interaction between human translators and technology (Carl et al., 2011). Thus, this study seeks

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to investigate how text type affects translators' cognitive processes and efforts when translating. In particular, the following questions are addressed:

1. What are the differences between the temporal effort required in translating informative, expressive, and operative text types?

2. What are the differences between pauses in translating informative, expressive, and operative text types?

3. What are the differences between the technical effort needed in translating informative, expressive, and operative text types?

2. Literature Review

2.1. Review of Theoretical Framework

As a pioneering method to record and study what happens in translators' minds throughout the translation process, the pioneers of translation process research (such as Englund Dimitrova, 2005; Jääskeläinen, 1999; Krings, 1986; Lörscher, 1991) have used think-aloud protocols which have their roots in cognitive psychology. The use of verbal protocols to elicit data on cognitive processes was suggested by Ericsson and Simon (1980) as a "valuable and thoroughly reliable source of information" (p. 247).

In response to the uncertainty about the validity of data elicited from think-aloud protocols, they examined the validity and richness of verbal reports as data and asserted that "the failure of subjects to report some information does not demonstrate the uselessness of verbal protocols. The incompleteness of reports may make some information unavailable, but it does not invalidate the information that is present" (p. 243). In line with this claim, Payne (1994) notes that verbal protocol methods may not offer perfect data but they are good enough to be employed as a tool by psychologists and other behavioral scientists to provide deep insights into mental events. Moreover, Sun (2011) found no strong evidence suggesting that think-aloud protocols significantly change or influence the translation process.

Today, in addition to verbal protocols, the use of advanced and more precise technologies such as screen recording, keystroke logging, and eye-tracking as

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empirical research techniques has enabled researchers to do more in-depth investigations into the cognitive processes involved in translation (Alves et al., 2019). Thanks to these research tools and methodologies, especially keystroke logging for providing precise valid information (Muñoz Martín & Apfelthaler, 2022) and as a major source of behavioral data in cognitive translation studies (Muñoz Martín & Cardona Guerra, 2018), the complexity of cognitive aspects of the translation process has continued to be gradually revealed (Mees et al. 2009) and consequently there has been a rapid growth in cognitive translation and interpreting studies (Xiao & Muñoz, 2020).

2.1.1. Cognitive Effort

Tyler, et al. (1979) define cognitive effort as "the amount of the available processing capacity of the limited-capacity central processor utilized in performing an information-processing task" (p. 608). Krings (1986) undertook the first comprehensive study to describe translators' cognitive processing during translation and classified translation strategies applied by participants to tackle translation problems faced during the translation process.

To examine the translating of different text types and the effort that goes into the activity, it is necessary to explain the use of the term 'cognitive effort' in the current study and to determine how this effort can be measured. In this study, the cognitive effort is regarded as the number of mental activities participants allocate to the task of translation, and it can be measured by task execution time (Ferreira et al., 2016; Krings, 2001; Popovic et al., 2014; Schaeffer & Carl, 2014; Whyatt et al., 2021), the number of technical operations (Krings, 2001), and also the number of pauses (Buchweitz & Alves, 2006; Cenoz, 2000; Dragsted, 2012; Rosa et al., 2018) made in translation. Any investigation of cognitive effort requires the use of indirect parameters because it cannot be measured directly (Vieira, 2017).

Krings (2001) lists three distinct, but related, categories of post-editing effort including temporal, technical, and cognitive. Krings's classification is believed to be adequate for evaluating translation efforts considering the fact that post-editing and translation are closely related activities and share some objectives and can draw on

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each other's research methods and findings (Sun, 2019). As Lacruz (2017) argues, it provides a good framework to be applied in the translation itself and its related activities. Besides, based on Dam-Jensen and Heine (2013), writing and translation have many characteristics in common and could be studied as types of text production. This is why the same methods can be used to investigate both areas. The three categories of efforts defined by Krings (2001, p. 179) are as follows:

- Temporal Effort:

This concept refers to the amount of time spent on the task; therefore, it is the simplest and easiest effort to measure: spending more time is an indicator of exerting more effort.

- Technical Effort:

The technical effort which is easy to observe refers to the effort involved in the process of inserting or deleting characters, using a mouse to cut and paste or move around the text. In other words, it refers to the actual linguistic changes made to correct translation errors. It can be measured easily by using logging software to investigate the physical actions involved: engaging in more physical actions means exerting more effort.

- Cognitive Effort:

Of the three efforts, the cognitive effort is the most difficult to investigate because it cannot be measured directly, and special tools, namely a keystroke logger, a screen recorder, or an eye tracker are required to represent it. Nevertheless, it is the most interesting effort from the standpoint of translation process research and is directly related to the two discussed efforts (i.e., temporal and technical efforts).

In addition to Krings's suggestion of measuring temporal, technical, and cognitive effort, pauses and hesitation phenomena provide potential evidence of cognitive processing as well (Cenoz, 2000). For example, in 1998, by developing and using the Translog tool that records keyboard activity during translation, Jakobsen investigated pauses in the context of translation process. In addition, it has been claimed by Jakobsen (1998) and other researchers (see, e.g., Buchweitz & Alves, 2006; Cenoz, 2000; Dragsted, 2012; Krings, 2001; Lacruz et al., 2012; Rosa et al., 2018) that pauses

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are indicators of cognitive processing.

2.1.2. Text Types and Their Importance in Translation Studies

In the field of Translation Studies, the importance of recognizing the type of text before translating is highlighted by researchers (Nord, 2018; Puchala, 2011). Puchala (2011) expresses that in the translation process the awareness of text type is of crucial importance and should be taken into account because the correct recognition of the text type and its function allows the translator to adopt appropriate translation strategies in order to successfully produce the target text. In this regard, Nord (2018) argues: "Text-type classifications sharpen the translator's awareness of linguistic markers of communicative function and functional translation units" (p. 37).

Of the text-categorizations proposed by some scholars (de Beaugrande & Dressler, 1981; Hatim & Mason, 1990; Newmark, 1988; Reiss, 1971, 2014), Reiss's (1971, 2014) text typology, a pioneering translation-relevant text typology, was chosen for this study. The text typology Reiss proposes also establishes a relation between the text type and the translation method and may serve as a guideline for novice translators. Reiss's (1971, 2014) text typology includes a fourth text type i.e., audio-medial texts, but these are not considered in the present study because of the added complication of attending to the relationship between the text and the other media. Reiss (1971, 2014, p. 26) divides texts in terms of their communicative function into three types, informative, expressive, and operative, and also discusses corresponding translation strategies for these three text types. Reiss's (1971, 2014) categories are as follows:

- Informative texts: are content-focused and aimed primarily at conveying information
- Expressive texts: are form-focused and perform an aesthetic function
- Operative texts: are appeal-focused and aimed at persuading the text receiver

As Reiss (1971, 2014, pp. 27–43) points out, in content-focused texts the depictive function is emphasized and the dominant interest is in conveying certain matters,

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information or data, where it is essential that the informational content corresponds to that of the original text. In translating these kinds of texts, the translator should take into account that representing certain information accurately in the target language is of primary importance. Considering this, information implicit in the source text must be explicitly stated in the target language.

In form-focused texts, formal elements are used by the author, whether consciously or unconsciously, for a specific aesthetic value. In these kinds of texts, the expressive function is emphasized and the main interest is in creating a corresponding effect. In translating these kinds of texts the translator should try to appreciate the original author's forms, style or artistic structure and be inspired by it to create a corresponding impression.

The persuasive function is emphasized in appeal-focused texts and the dominant interest is in convincing the reader or hearer of the text to undertake an action. As a rule, the same effect is sought in the target language text as in the original text, but Reiss (1971, 2014) believes that when dealing with this text type "the translator has to depart more from the content and the form of the original than in other types of text […] and fidelity means achieving the result intended by the author, preserving the appeal inherent in the text" (p. 41).

2.2. Review of the Related Studies

In a study carried out by Dragsted (2005), the differences between novice and professional translators were compared based on observations of the cognitive segmentation performed by them when translating texts with different levels of difficulty. When translating the easy text, some differences were observed between professionals and novices, while those differences were neutralized in the translation of the difficult text. The speed of production between the two groups was noteworthy in both texts, but more markedly in the translation of the easy text where it was higher for professional translators. However, it was neutralized when translating the difficult text. Regarding the cognitive segments, in translating the easy text there were differences between the two groups but in translating the difficult text these differences were reduced and professionals acted like novices.

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In order to study the learning strategies applied by university students while translating a text, Shirvani (2009) incorporated think-aloud protocols and retrospective interviews. The overall findings indicated that the participants employed both direct (memory strategies, cognitive strategies, and compensation strategies) and indirect strategies (metacognitive strategies, affective strategies, and social strategies) to the same extent while translating; however, notable differences between the use of cognitive and metacognitive strategies were observed.

Shreve et al. (2010) conducted an eye-tracking study concentrated on sight translation to determine the effect of text complexity on cognitive effort. The researchers found that sight translation is more sensitive to disruption than written translation and in sight translation, more processing effort is needed in translation of texts with syntactic complexity than in translation of syntactically non-complex texts. The findings also revealed that in sight translation continued presence of the source text makes it sensitive to visual interference. It means subjects were more affected by visual interference while performing sight translation tasks.

In a study carried out by Dragsted (2012), eight Danish/English MA translation and interpreting students were recruited in order to investigate the correlation between indicators of difficulty observable in translation product (the texts translated by participants) and translation process data from eye tracking and keystroke logging. The researcher found a clear and strong relationship between target text variability and fixation counts, gaze time, and pause length: words with many alternatives in target text cause longer gaze time, longer pauses, and more fixation counts. The researcher also found that the participants consider target lexical alternatives in their mind while choosing a final target word and the selection process is more effortful when more alternatives are considered by them.

Schaeffer and Carl (2014) introduced a metric that measures the literality of translations and evaluated the effort required for non-literal translation as well. To do so, the researchers measured the translators' gaze behavior and translation time for different language pairs from the CRITT TPR. The findings demonstrated that the literality of the produced translations is in inverse proportion to time and effort. Wording it differently, a literal translation requires less gaze activity, time, and

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cognitive effort.

Koglin (2015), incorporated keystroke logging and eye-tracking analysis to investigate the cognitive effort required to post-edit machine-translated metaphors compared to the translation of metaphors manually. The findings derived from the data analysis confirmed the researcher's hypothesis which was the requirement of less cognitive effort to post-edit metaphors than the manual translation of metaphors.

Ferreira et al. (2016) investigated cognitive effort involved in direct and inverse translation performance by means of eye-tracking technology to analyze the total time spent on each task, fixation time, and average fixation time. In addition to the mentioned technology, translation task was recorded by eye tracking tool and retrospective protocols to validate the data. Ferreira et al., after analyzing the data, found that although traditional methods such as measuring the total time portrayed more effort in the inverse translation task, the number of fixations indicated that more effort was involved in the source text in both tasks of direct and inverse translation.

Whyatt et al. (2016) compared mental operations needed to perform interlingual and intralingual translation. They expected that more processing effort would be allocated to the task of translation than to the task of paraphrasing. They also hypothesized that in the paraphrasing task cognitive rhythm is more fluent than in the translation task. The researchers used keystroke logging, eye tracking, and screen recording methods to collect data. The results of data analysis revealed that switching between languages was the cause of spending more time on text production when translating, while less time was spent on the task of paraphrasing. Additionally, in translation task longer fixation duration on the source text and online resources was an indicator of more intense cognitive effort.

Another study worth mentioning was performed by Schaeffer et al. (2016) which demonstrated some of the new research methods including making the use of Pause-Word Ratio, Translation Difficulty Index, and Activity Units to analyze empirical translation process data. Additionally, using Activity Units for measuring cognitive effort in translation process was proposed by the researchers. These units explain what happens within the pauses and take into account information such as typing and gazing when the translator’s eyes transfer between the source and the target texts.

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Fernández-Torné and Matamala (2016) compared the effort involved in creating an audio description, translating an audio description, and post-editing a machine-translated audio description. Analysis of the data obtained from measuring temporal, technical, and cognitive effort by means of a keystroke logging tool revealed that post-editing was the fastest option and less technical and cognitive effort was involved in it while the effort involved in audio description creation was apparently the most demanding.

In an Indonesian study, Rosa et al. (2018) compared the management of pauses in a translation process by student translators and professional translators. The analysis of the data collected through Translog, think-aloud protocols, and screen recording revealed that the longest pauses were taken by student translators in the drafting phase; meanwhile, professional translators took the longest pauses in the post-drafting phase. Based on the findings, pauses were not only unavoidable activities in translation process, but they were also an indicator of cognitive processing. Furthermore, a positive correlation between cognitive load and pauses was revealed.

Careful analysis of related literature revealed that most cognitive translation studies have addressed the subject from post-editing machine translation output (e.g. Alves et al., 2016; Vieira, 2017), the role of the translators' personality and their behavioral processes (Akbari & Segers, 2017), or translation of texts rich with metaphors (Koglin, 2015) perspectives; whereas, the cognitive aspects of translators' performance in translating different text types have received less attention. Hence, a study in this area focusing on the cognitive effort involved in translating various types of texts with the same level of difficulty is needed.

3. Methodology

A mixed-method approach was adopted for the present study. Given the interdisciplinary nature of research in the social and human sciences, studies using mixed methods, integrating both quantitative and qualitative research elements, have become increasingly popular (Creswell, 2009). Data or in Halverson's (2019) term 'processing' translational data, were collected using both quantitative (i.e., screen recording and keystroke logging) and qualitative (i.e., think-aloud protocols and

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retrospective interview) methods. The data obtained using the qualitative method were used to enrich the findings of the quantitative methods to achieve more reliable results. This design is in accord with the 'concurrent triangulation strategy' of mixed research design described by Creswell (2009), where "the researcher collects both quantitative and qualitative data concurrently and then compares the two databases to determine if there is convergence, differences, or some combination" (p. 213).

3.1. Participants

The participants in the present study were 27 Iranian senior translation students at the University of (NN removed for blind peer review) studying Translation in their Bachelor of Arts Program, who volunteered to participate in the study. They were all native speakers of Persian with English as their second language. To ensure the homogeneity of the participants, the Oxford Placement Test and a typing skill test were administered. Based on the results of these tests, a total number of 22 participants were recruited to take part in the study and translate three types of texts (see section 2.2.). They had an average age of 22 years (range 21–25, SD = 1.90 years), an average of 5 years of English learning, and 4 years of translation training backgrounds. None of them worked as professional translators but had courses in translation theory and practice as part of their regular undergraduate program and during their training, they had practiced translating informative, expressive, and operative texts. Thus, the participants were homogenous with respect to their years of educational background in translation, typing skills, and general language proficiency.

3.2. Selection of Source Texts

Different types of source texts, i.e., informative, expressive, and operative were chosen to be translated by the participants. The texts were extracted from the following resources:

- The informative text was a cooking instruction downloaded from http://www.mamamiarecipes.com/greek-lemon-chicken-and-potatoes/.

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- The expressive text was chosen from *The Sisters*, a short story by James Joyce (1914).

- The operative text was an advertisement for sports shoes retrieved from http://angrybirdsriogame.info website containing all information about Advert examples persuasive language presentation by/.

The selected texts did not require specific background knowledge and had almost the same length. To ensure that the source texts were of the same levels of difficulty and readability, the Flesch Reading Ease formula was used to measure the difficulty of selected texts (for more details see Flesch, 1948). This test is based on the number of sentences, the average sentence length, the average number of words per sentence, the average number of syllables per word, and the percentage of hard words. The readability index is claimed to be an indicator of text comprehensibility, and some researchers including Acar and Işisağ (2017) highlight the importance of measuring the readability and comprehensibility of the text in translation. Based on the results of the readability formula index, the source texts were similar in average difficulty and readability.

3.3. Typing Skill Test

A typing skill test was administrated to ensure that the participants possessed average typing speed and typing skills. A study performed by Sharmin et al. (2008) confirms the impact of typing skills on the translation process. Hence, conducting a typing skill test was necessary to avoid the risk of participants' lack of typing skills affecting the final findings. A 170-word text was given to the participants to type in three minutes and then their typing speed and accuracy were measured. According to the test results, as shown in Table 1, all selected participants possessed advanced typing skills.

Table 1

Typing speed of the participants

Number of participants	Mean of gross speed	Mean of accuracy	Mean of net speed
22	81	96	80

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In Table 1, gross speed represents the total number of words participants typed in three minutes. By accuracy, we mean the percentage of the correctness of the typing performance, and net speed refers to the number of correct words participants could type in three minutes.

3.4. Apparatus

The screen recording software BB Flashback Pro 5 Recorder was utilized in this study. This software records the processes and activities in progress on the screen of a computer and registers them as a digital video. In addition to screen recording, it is equipped with several other capabilities such as sound recording and webcam recording. It is also designed to enable the researcher to access information about time, keystrokes, pauses, and mouse movements. Angelone (2016) states that screen recording "provides insightful data in the form of extended pauses in screen activity (signaling potential problem areas), subsequent information retrieval patterns, the textual level of target text generation, and revision tendencies" (p. 309).

3.5. Measures

3.5.1. Time

The temporal effort was measured by the total time spent by each participant to complete the task from start to end. The total production time was also broken into three phases as defined by Jakobsen (2002, pp. 192–193): (1) the *orientation* or reading phase which is the time delay between the moment the source text is received to the moment when the first letter of translation is typed; (2) the *drafting* or writing phase which is the duration of time from the first letter to the moment the final punctuation mark is produced; and (3) the *revision* phase which lasts from the end of the drafting until the task doer considers the task to be completed.

3.5.2. Pause

To answer the second research question, the number of pauses taken by each

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participant on the three translation tasks was compared. Following the approach presented in Buchweitz and Alves (2006) and Wang and Hemchua (2022), a five-second pause criterion was applied to ensure that they are long enough to reflect an effortful problem-solving behavior rather than simply slow typing, distractions, or automatic lexical choices. O'Brien (2006) warns that because pauses depend on individual differences, they are not reliable indicators and need to be used in combination with other data elicitation techniques. However, in the study undertaken by Lacruz et al. (2012) pauses were found to be reliable indicators of cognitive effort in both writing and translation. Drawing on assumptions made by other researchers (see, e.g., Buchweitz & Alves, 2006; Cenoz, 2000; Dragsted, 2012; Rosa et al., 2018), pauses were considered as indicators of cognitive effort in the current study. At the suggestion of O'Brien (2006), to have a deeper understanding and obtain more reliable results, pause analysis was combined with technical effort analysis.

3.5.3. Technical Operation

The technical effort was gauged by measuring the number of technical operations including insertions, deletions, substitutions, movements, and compromising strategies made by each participant in translation tasks. These measures were manually extracted and counted by the authors according to the information provided in the video files. When a word was added to the already typed sentence, it was counted as one insertion and when a word was permanently omitted from the translated text it was counted as one deletion. Furthermore, when the participants decided to change the location of a word or phrase to be in accordance with Persian word order (subject, object, verb) or rules, it was counted as one movement. Substitution happened when a certain word or phrase was replaced by another to modify the translation. Finally, it was considered as a compromising strategy when participants decided to borrow, transcribe, omit, or write a wrong equivalent after searching in bilingual or monolingual dictionaries to find a proper equivalent.

3.6. Procedure

In order to avoid any distractions, the experiment was conducted in a controlled

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environment (laboratory setting) where the participants were asked to translate three different text types and carry out a think-aloud task (articulate their thought processes) at the same time. The laboratory was well equipped having separated cabins and computers for the participants.

The data collection procedure involved three phases: (1) informing the participants, (2) conducting the translation tasks combined with think-aloud and audio recording, and (3) holding immediate retrospective interviews without audio playback of the translation process.

In the first phase before starting the experiment, the participants were informed about the test procedures, directions, and study purposes. After ensuring that the participants understood what to do, they were told to fill in a profile questionnaire designed to gather personal information on participants, containing their age, sex, and years of English language learning experience.

In the second phase of the experiment, the participants were requested to translate three types of source texts (informative, expressive, and operative) from English (L2) into Persian (L1) with a break in between and also verbalize their thoughts, speaking clearly into the microphone. The think-aloud protocols data were collected in the participants' native language so that they could reflect their thoughts easily and were subsequently translated into English by the authors. The think-aloud protocols data were recorded by the screen recording tool BB Flashback. Pauses and temporal and technical effort were also automatically recorded by BB Flashback and subsequently manually measured and analyzed. The participants were free to consult both bilingual and monolingual paper dictionaries and their mobile phone dictionaries.

Considering the benefits (Saldanha & O'Brien, 2014) and limitations (Hansen, 2005; Vik-Tuovinen, 2002) of the immediate retrospective interview, it was conducted on an individual basis for the third phase of the experiment as one of the major techniques of retrospective verbalization (Cohen & Hosenfeld, 2006). In this method, participants were requested to answer predetermined questions regarding their thought and actions while performing the already completed tasks to find out the translation difficulties and problematic aspects in source text comprehension.

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3.7. Data Analysis

The data were collected from a group of 22 participants. The main body of data consisted of a total of 66 video and audio files recorded by BB Flashback from three translation tasks. To meet the objectives of this study, the analysis of cognitive effort focused on the time spent by each participant and also on the number of pauses and technical operations (insertion, deletion, substitution, movement, and compromising) found in translation tasks. Both descriptive and inferential analyses were performed for each variable and all data were analyzed using the SPSS software 22.

To analyze think-aloud data, the protocols were transcribed from audio files and broken into short phrases by following the traditional steps of transcribing, annotating (or encoding), and analyzing proposed by Sun (2011). Based on Matthews and Ross (2010), there are several techniques for analyzing qualitative data, such as thematic analysis, discourse analysis, content analysis, and analyzing narrative or grounded theory. In this study, the collected data were analyzed thematically which enabled the authors to check their interpretations, look for links within the data, and put each participant's words alongside the words of other participants to look for similarities and differences within and between each set of data. Thematic analysis is defined as "a process, a way of working with data which works from the raw data – the raw verbal or visual data we have gathered – and remains in touch with that raw data throughout" (Matthews & Ross, 2010, p. 374).

4. Results and Discussion

The following subsections provide analyses of the findings of the study along with discussions of the findings in the context of research questions and aims.

4.1. Findings for Research Question 1

To answer research question one concerning task time, a comparison was made between the time spent on the three translation tasks since as discussed in the literature, spending more time is an indicator of exerting more effort.

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4.1.1. Descriptive Statistics

The mean task execution time, measured in seconds, indicates that on average participants took 15% longer to translate expressive text (2173.6818) than informative text (1605.3636) and 24% longer than operative (1334.0455) text, as Table 2 shows. Thus, translating the expressive text was the most time-consuming one.

Table 2

Descriptive Statistics of the Spent Time While Translating the Three Text Types

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Informative	22	1605.3636	534.00540	113.85033	1368.5989	1842.1284	918.00	2695.00
Expressive	22	2173.6818	519.82730	110.82755	1943.2033	2404.1603	1478.00	3280.00
Operative	22	1334.0455	599.84684	127.88778	1068.0883	1600.0026	680.00	3310.00
Total	66	1704.3636	648.04417	79.76872	1545.0545	1863.6728	680.00	3310.00

Figure 1 also depicts the task duration rounded to seconds for all participants. The data in this figure provide evidence that in most cases there was a considerable variation between the translations of three types of texts in terms of task time. Careful inspection reveals that almost all participants took longer to translate the expressive text than the informative and operative texts.

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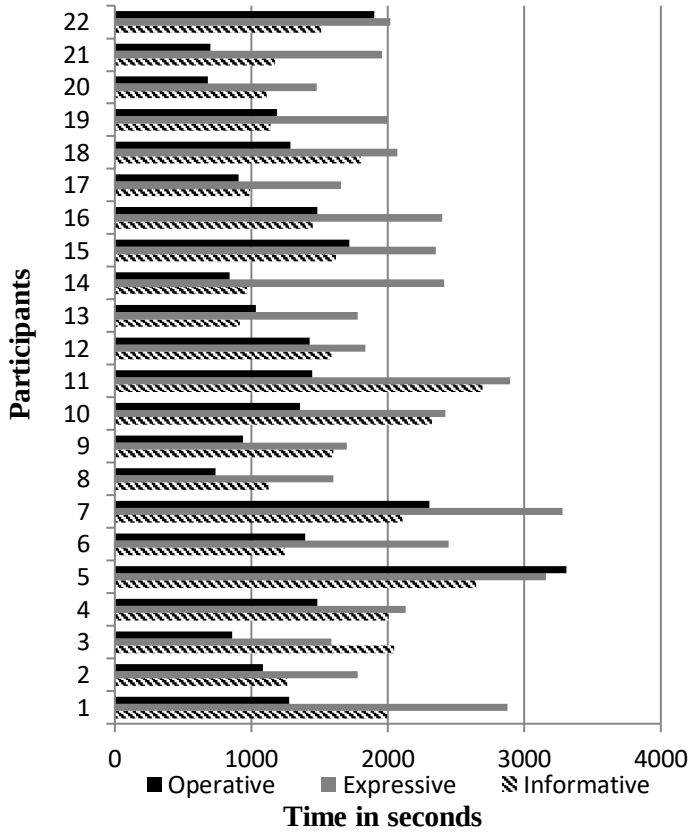
Figure 1

Individual Distribution of Translation Time Spent by Each Participant on Each Text



4.1.2. Inferential Statistics

ANOVA was used to examine the differences between the times spent on translating the three types of texts. As Table 3 shows, there was a significant difference between the time spent on translating the three text types (F=13.240; Sig. < .05).

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Table 3

ANOVA of the Time Differences While Translating the Three Text Types

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	8078314.455	2	4039157.227	13.240	.000
Within Groups	19219166.818	63	305066.140		
Total	27297481.273	65			

Additionally, a follow-up Tukey test was run to determine the exact differences. As shown in Table 4, there were significant differences between the time spent on translating informative and expressive texts compared with operative and expressive ones (Sig. < .05).

Table 4

Tukey Test of the Time Differences among the Three Text Types

		Mean			95% Confidence Interval	
(I) text types	(J) text types	Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Informative	Expressive	-568.31818*	166.53314	.003	-968.0519	-168.5844
	Operative	271.31818	166.53314	.241	-128.4156	671.0519
Expressive	Informative	568.31818*	166.53314	.003	168.5844	968.0519
	Operative	839.63636*	166.53314	.000	439.9026	1239.3701
Operative	Informative	-271.31818	166.53314	.241	-671.0519	128.4156
	Expressive	-839.63636*	166.53314	.000	-1239.3701	-439.9026

*. The mean difference is significant at the 0.05 level.

Considering the problems caused by idioms (Marsheva et al., 2019) and cultural items (Alipour & Hadian, 2017; Zandrahimi & Marzban, 2017; Lei & Zhao, 2022) in the translation process, it seems connotative words, idioms, cultural references, and the author's tone and original style are the most important factors in slowing down the participants' translation rhythm of the expressive text even though the selected texts had the same level of difficulty and readability based on the results of the Flesch Reading Ease formula. This can be understood more easily by considering the participant's (P) 06 comment on her retrospective interview while facing the challenge of words' connotation in translating the expressive text:

P06 retrospective interview

"In the expressive text, some words were not used for their literal or primary meaning;

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they included a secondary or contextual meaning that led to my confusion".

Participant 10 also mentioned the challenge of preserving the author's tone and original style in his retrospective interview:

P10 retrospective interview

"I think the expressive text was the most difficult text type to translate since you must be able to reserve the original style and convey the idea of the author. This becomes especially challenging when working with various authors because each author has their own voice".

4.2. Findings for Research Question 2

Research question two aimed at identifying the differences between the participants' pause behavior in informative, expressive, and operative text types. Underlying the pause analysis was the assumption that the mind is processing when pauses are taken and that an increased number of pauses can be an indication of more cognitive effort.

4.2.1. Descriptive Statistics

Descriptive statistics related to the pauses while translating the three text types are indicated in Table 5. The means for this indicator were 51.0000 in expressive text, 35.6364 in informative text, and 27.5909 in operative text. Thus, the number of pauses was more in the expressive text than that in the informative and operative texts.

Table 5

Descriptive Statistics of Pausing While Translating the Three Text Types

					95% Confidence Interval for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
Informative	22	35.6364	8.73714	1.86277	31.7625	39.5102	22.00	62.00
Expressive	22	51.0000	9.13914	1.94847	46.9479	55.0521	27.00	69.00
Operative	22	27.5909	6.36702	1.35745	24.7679	30.4139	17.00	38.00
Total	66	38.0758	12.66893	1.55944	34.9613	41.1902	17.00	69.00

Figure 2 provides information about the participants' pause behavior. It shows that

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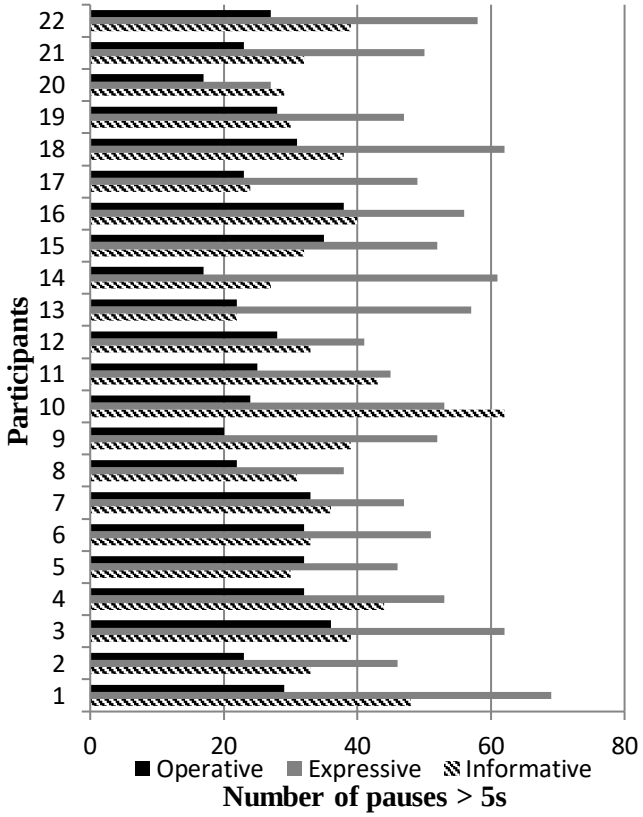
the distribution of pauses is similar for almost all participants, with the expressive text showing the greatest number of pauses followed by the informative and operative texts.

Figure 2

Individual Variation in the Number of Pauses > 5s Made by Each Participant for Each Text



4.2.2 Inferential Statistics

Table 6

ANOVA of the Pause Differences While Translating the Three Text Types

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	6224.212	2	3112.106	46.588	.000
Within Groups	4208.409	63	66.800		
Total	10432.621	65			

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The differences between the number of pauses made while translating the three types of texts were examined by the use of ANOVA. There was a significant difference in the frequency of pauses when translating the three text types (F=13.240; Sig. < .05) as shown in Table 6.

In order to explore the differences further, a Tukey test was run. As shown in Table 6, there were significant differences (Sig. < .05) between the pauses in the three text types.

Table 7

Tukey Test of the Pause Differences among the Three Text Types

		Mean Difference			95% Confidence Interval	
(I) text types	(J) text types	(I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Informative	Expressive	-15.36364*	2.46429	.000	-21.2787	-9.4485
	Operative	8.04545*	2.46429	.005	2.1303	13.9606
Expressive	Informative	15.36364*	2.46429	.000	9.4485	21.2787
	Operative	23.40909*	2.46429	.000	17.4940	29.3242
Operative	Informative	-8.04545*	2.46429	.005	-13.9606	-2.1303
	Expressive	-23.40909*	2.46429	.000	-29.3242	-17.4940

*. The mean difference is significant at the 0.05 level.

The duration of pauses was also calculated by counting the number of seconds when no keyboarding or mouse activity happened; pauses had an overall longer duration in the expressive text than in informative and operative texts. Besides, among the three phases (i.e., orientation, drafting, and revision), the one in which the pauses of the longest duration were made by the participants was drafting. For example, P05 made pauses as long as 5 minutes and 30 seconds in the drafting phase. This supports Rosa et al.'s (2018) findings which revealed that the longest pauses are taken by student translators in the drafting phase.

4.3. Findings for Research Question 3

The question about the differences between technical effort in the translation of informative, expressive, and operative text types was addressed by counting the number of technical operations including insertions, deletions, substitutions,

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movements, and compromising strategies made by each participant during the three translation tasks. Technical effort analysis was a means of enriching the results of time and pause analysis.

4.3.1. Descriptive Statistics

Descriptive statistics related to the technical effort made while translating the three text types is indicated in Table 8. The means demonstrate that on average participants made more technical operations in the expressive text (29.9545) than in the informative (20.4091) and operative (17.5909) texts.

Table 8

Descriptive Statistics of the Technical Effort While Translating the Three Text Types

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Informative	22	20.4091	7.53821	1.60715	17.0668	23.7513	9.00	48.00
Expressive	22	29.9545	11.13757	2.37454	25.0164	34.8927	16.00	52.00
Operative	22	17.5909	8.85685	1.88829	13.6640	21.5178	9.00	51.00
Total	66	22.6515	10.59244	1.30384	20.0476	25.2555	9.00	52.00

Figure 3 shows the individual variation in the number of technical operations made by each participant. While in the majority of cases only minor differences can be seen among the technical efforts made during the three translation tasks, this difference is found to be more for participants P01, P02, P03, and P14.

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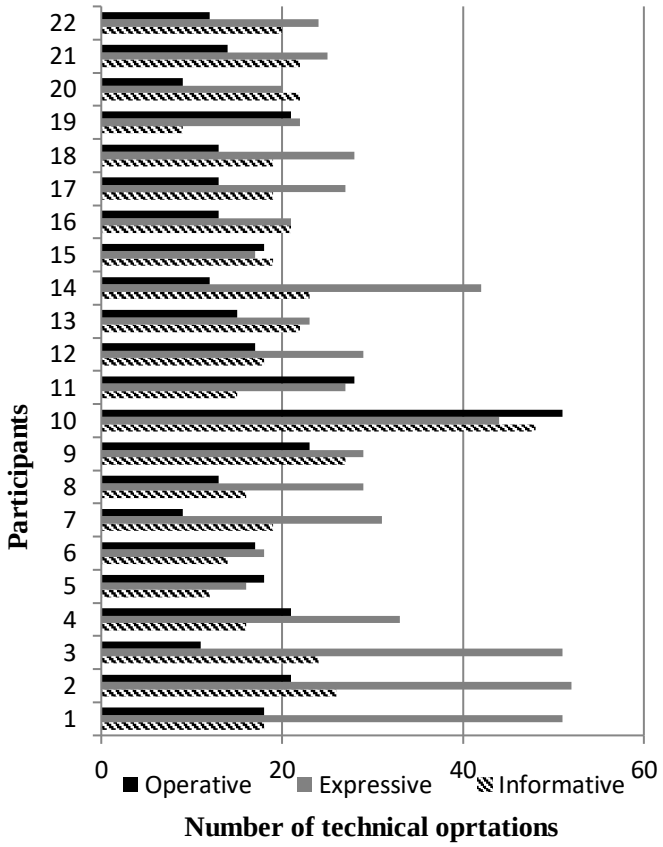
Figure 3

Individual Variation in the Number of Technical Operations Made by Each Participant on Each Text



Compromising (32%) was the most frequent technical operation among the participants. This means that after searching in several bilingual or monolingual dictionaries to find a proper equivalent they finally decided to borrow, transcribe, omit, or write a wrong equivalent. For example, P05 had trouble choosing an appropriate equivalent for the word 'gnomon' in the expressive text. After 3 minutes and 27 seconds of searching both bilingual and monolingual dictionaries, she simply borrowed this word. In translating the informative text, most participants could not find the Persian equivalent of the 'instant-read thermometer' so they decided to omit it.

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The second most frequent technical operation is substitution (25%) in which the participants replaced a certain word or phrase with another to modify their translation, followed by insertion (23%) and deletion (15%); movement only accounted for 5% of the technical operations. An example of movement is shown below based on P21's think-aloud protocols:

P21 think-aloud protocols

"As if returning to some former remark of his… ok 'former remark' means 'previous statement' […] is 'returning' a verb?! I should write it at the end of my sentence to be in accordance with Persian word order (subject, object, verb)".

4.3.2. Inferential Statistics

ANOVA was also utilized to examine the differences between the numbers of technical operations while translating the three types of texts. The difference between the number of technical operations undertaken when translating the three text types was significant (F=13.240; Sig. < .05) as shown in Table 9.

Table 9

ANOVA of Technical Effort Differences While Translating the Three Text Types

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1847.394	2	923.697	10.686	.000
Within Groups	5445.591	63	86.438		
Total	7292.985	65			

A Tukey test was run to further examine the differences. As seen in Table 10, there were notable differences between the technical efforts expended when translating informative and expressive texts compared with operative and expressive texts (Sig. < .05).

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Table 10

Tukey Test of the Technical Effort Differences among the Three Text Types

(I) text types	(J) text types	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Informative	Expressive	-9.54545*	2.80321	.003	-16.2741	-2.8168
	Operative	2.81818	2.80321	.576	-3.9104	9.5468
Expressive	Informative	9.54545*	2.80321	.003	2.8168	16.2741
	Operative	12.36364*	2.80321	.000	5.6350	19.0923
Operative	Informative	-2.81818	2.80321	.576	-9.5468	3.9104
	Expressive	-12.36364*	2.80321	.000	-19.0923	-5.6350

*. The mean difference is significant at the 0.05 level.

These results suggest that type of text led participants to make different amounts of technical effort when translating informative, expressive, and operative texts. Additionally, they validate the previous results obtained in terms of task time and the number of pauses in the three translation tasks. More technical effort was invested in translating the expressive text compared with the informative and operative texts.

The current findings show that cognitive effort is significantly influenced by text type, taking task execution time, the number of pauses, and the number of technical operations as indicators of effort.

5. Conclusion

The present investigation compared the cognitive effort required to translate three types of texts i.e., informative, expressive, and operative classified by Reiss (1971, 2014). The findings of this study suggest that there is a difference in cognitive effort spent on translating informative, expressive, and operative texts. Besides, translating expressive texts is found to be more effortful than informative and operative texts when the following variables: task duration, pauses, and technical operations (insertions, deletions, substitutions, movements, and compromising strategies) are taken into account. Coping with content, culture, and stylistic features in expressive texts makes the challenges of this type of text quite different from those posed by the other two types of texts. Therefore, the findings are in line with Hatim and Munday (2004), Puchala (2011), and also with Nord (2018) who overtly emphasize the need to recognize and consider the type of text before translating.

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In addition to the implications of specific findings of the study mentioned in the previous sections, from a more general point of view, these findings have implications for the design of practical translation courses. That is, curriculum designers can include new courses in Translating Literary Texts and English Literature which can provide a motivating drive for language learning (Khatib et al., 2011) and enable students to develop their cultural awareness and critical thinking skills through communication with literary texts (Engku Atek et al., 2020; Khatib et al., 2011). Translation researchers can also use the present study as a starting point to conduct their own study on the importance of the role of text type on translators' performance and translation quality. Furthermore, the results are worth considering by university professors to apply the required changes in their syllabi. On the other hand, they can acquaint students with the principles required to preserve literary features and assure them that recognizing the type of text would help them adopt the most appropriate translation strategy.

It is important to note that in the present study the selected sample was representative of a specific context. Accordingly, it is unclear whether the findings can be generalized to translation students in different settings. Moreover, this study concentrated solely on the language combination of English-Persian and the participants translated from English (i.e., their L2) into Persian (i.e., their L1). It is unclear whether translating from L1 into L2 or translating from another language (for example French or Spanish) into Persian would have led to similar results. Therefore, it is suggested that future researchers try to replicate this study in other contexts. Furthermore, considering the importance of the psychological aspects of translators (Navidinia et al., 2021), examining the potential effects of other personal and contextual factors on their performance are other areas that future studies can address.

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Appendix A

Informative source text (Greek Lemon Chicken and Potatoes)

1. Preheat oven to 425 degrees F (220 degrees C). Lightly oil a large roasting pan.

2. Place chicken pieces in large bowl. Season with salt, oregano, pepper, rosemary, and cayenne pepper. Add fresh lemon juice, olive oil, and garlic. Place potatoes in bowl with the chicken; stir together until chicken and potatoes are evenly coated with marinade.

3. Transfer chicken pieces, skin side up, to prepared roasting pan, reserving marinade. Distribute potato pieces among chicken thighs. Drizzle with 2/3 cup chicken broth. Spoon remainder of marinade over chicken and potatoes.

4. Place in preheated oven. Bake in the preheated oven for 20 minutes. Toss chicken and potatoes, keeping chicken skin side up; continue baking until chicken is browned and cooked through, about 25 minutes more. An instant-read thermometer inserted near the bone should read 165 degrees F (74 degrees C). Transfer chicken to serving platter and keep warm.

5. Set oven to broil or highest heat setting. Toss potatoes once again in pan juices. Place pan under broiler and broil until potatoes are caramelized, about 3 minutes. Transfer potatoes to serving platter with chicken.

6. Place roasting pan on stove over medium heat. Add a splash of broth and stir up browned bits from the bottom of the pan. Strain; spoon juices over chicken and potatoes. Top with chopped oregano.

Appendix B

Expressive source text (The Sisters by James Joyce)

THERE was no hope for him this time: it was the third stroke. Night after night I had passed the house (it was vacation time) and studied the lighted square of window: and night after night I had found it lighted in the same way, faintly and evenly. If he was dead, I thought, I would see the reflection of candles on the darkened blind for I knew that two candles must be set at the head of a corpse. He had often said to me: “I am not long for this world,” and I had thought his words idle. Now I knew they were true. Every night as I gazed up at the window I said softly to myself the word paralysis. It had always sounded strangely in my ears, like the word gnomon in the

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Euclid and the word simony in the Catechism. But now it sounded to me like the name of some maleficent and sinful being. It filled me with fear, and yet I longed to be nearer to it and to look upon its deadly work.

Old Cotter was sitting at the fire, smoking, when I came downstairs to supper. While my aunt was ladling out my stir about he said, as if returning to some former remark of his:

"No, I wouldn't say he was exactly . . . but there was something queer . . . there was something uncanny about him. I'll tell you my opinion. . . . "

Appendix C

Operative source text (Total Trainers)

If your trainers are giving you poor supports in sports, if they are looking unfashionable so you are ashamed to be in the gym, if your trainers are so smelly even pigs would not wear them, then to need Total Trainers.

Total Trainers are designed to get the most out of your body through the latest technology: responsive rubber! Responsive rubber adapts to your needs as you run or play sports. It takes into account your particular weight and height. It gives you 100% support in your sports.

On top of this, Total Trainers come in white with their own set of fabric paints. So you can add your own designs and color schemes. It means no one else in the locker room will have the same looking shoes as you.

With Total Trainer's unique odor elimination system stinky feet will be a thing of the past. Do not believe us? Well this is what one leading sports person had to say about them:

"I put all my success down to Total Trainers. If it was not for them I would never be the footballer I am today". David Beckham

So remember:

Total Trainers!

Nothing else gives you 100%!

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