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Probe into Translation Process Based on Think-aloud Protocols

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***Abstract*—This paper tries to explore the translation process of the students translator while translating. Psycholinguistically-oriented thinking-aloud method is used to collect data from self-reports protocols. It is found that there exist four phrases (preparation, incubation, illumination and evaluation) both in English-Chinese and Chinese-English translation process. The participants do fairly well in E-C translation than in C-E translation. Translation scores vary with the change of the translation tasks (E-C or C-E) and also with the growth of university grades. As far as translation strategies are concerned, they are more likely to employ strategies in the incubation and illumination phrases. Fewer strategies are applied in the preparation phrase and hardly any strategies used in the evaluation phrase. There were significant differences on the strategy use of the participants from two grades in the incubation and the evaluation phases.**

***Index Terms*—translation process, psycholinguistic process, think-aloud protocols**

I. Introduction

A. Background

Since 1980s, translation studies has matured as an independent discipline which bring many other disciplines together, such as linguistics, philosophy, information science, cognitive science, culture studies and the like. The discussion of fidelity versus liberty, pursuit of translation techniques and translation equivalence had always been the hot issues in traditional translation studies. Nowadays, translation studies begin to attach importance to the study of translation process in order to unveil the 'black box' of translators. However, those theoretical models of equivalence are prescriptive rather than descriptive, which concentrate on speculative idealization rather than empirical description based on actually occurring data. Against such background, there appears psycholinguistically-oriented thinking-aloud method, which studies translation process based on self-report protocols.

From Lǒrscher's point of view, there are three important reasons for the empirical investigation of the translation process:

As far as the psycholinguistic investigation of translation is concerned, it can be expected that only on the basis of empirical studies of translation behavior using a process-analytical approach can hypotheses on what goes on in the translator's head be formed. Thus, light could be shed on translation as a psychological process that is still largely unknown and uninvestigated. As far as psycholinguistic investigation in general is concerned, it can be expected that empirical studies of translation behavior will yield general insights into language processing, about aspects of the mental processes of speech reception and speech production and about the mental strategies employed by the language user. As far as the teaching of translation is concerned, it should be possible to make use of knowledge of the translation process for teaching translation. If certain translation strategies turn out to be successful, it might be worth considering teaching these strategies in one way or another (Lǒrscher, 1991).

B. Objective of Research

As the main concern of the present study, the translation process should be clarified beforehand. Most psychologists use a four phase model of the creative process to get a clearer view of the complex activities going on in the human mind. These phases were first distinguished in 1913 by Poincaré who described them as preparation, incubation, illumination and evaluation. They will be referred to later experiment to describe the mental processes which take place in such creative translation of the participants.

An idea should been kept in mind that the phases do not simply follow each other in a sequence. They come in loops and some of them are gone through repeatedly. Therefore, illumination appears to be closely connected with evaluation. While carrying out the experiment on translation process based on think-aloud protocols of twenty translation majors in China, the translation process can be categorized into these four phases and the data then been collected for the sake of analysis. The participants under this study are college-level translation majors from Grade Two and Grade Four. The

data collected from the experiment are then coded according the rules designed before-hand. Combined with questionnaires and interviews, the coded data are analyzed both qualitatively and quantitatively, using the software Statistical Package for the Social Sciences (SPSS15.0), intending to explain the translation process of the student translators. This study will contribute to the training of translators and translation teaching.

C. Research Questions

The present study will answer the following questions:

- How about the phases of translation process while dealing with English-Chinese and Chinese-English tasks?
- How about the distribution of the translation strategies in those phases of translation process?
- What is the difference between different participants with the change of the translation tasks?

II. Literature Review

A. Review of Translation Process Model Abroad

The following parts will go over some major studies of translation process in order to show the importance of translation process investigation.

Eugene Nida (1964) developed a model based on human communication theory. The translator is defined as a communicator who is involved in written communication. James S. Holmes (1978) presented a two-map two-plane text-rank translation model. Holmes' model is a further step forward, yet his model is still based on linguistic schemata, leaving the mental processing untouched. In 1983, four papers, perhaps the pioneer research on the process of translation, appeared in *Transfer and Translation in Language Learning and Teaching* edited by Franz Eppert. Then new forward step was made by Roger. T. Bell (1991) who reported his study on the mental process of translation providing an information model benefited from cognitive science. This is an exact exemplification of the psycholinguistic model, which comprises ten subprocesses of translation.

In 1991, Wolfgang carried out the project to reconstruct translation strategies that underlying translation behavior, operate within the translation process. Wilss first expounded on the relationship between cognitive psychology and translation and pointed out 'a chain of mental operations in which processes of analysis, interpretation, comparison, analogy, inference, weighing of possibilities, planning, combining, etc. are interactively united' (Wilss, 1996). And such cognitive approach to the translation process includes various operational concepts such as action, behavior, problem-solving, decision-making, creativity, intuition, strategies, methods, techniques, and routines of translation.

B. Review of Translation Process Model in China

There exists no scholar in China who has presented a systematic study on the process of translation to the knowledge of the present researcher. In describing the translation process, Chinese traditional translation theorists would divide the process into two or three stages. Some theorists speaking for two-stage model are Jin Zhang (1987) who conceived the models of literary translation process; Hongyin Wang (1989) proposed holistic model and Zhongying Fan (1994). The representative scholars who divide the translation process into three stages are Peiji Zhang (1980), Suru Shen (1982) and Ping Ke (1998).

Qiuxia Jiang (2000) offered a simplified diagram about the model of literary translation to explore the aesthetic process in the literary translation. Yunxing Li (2001) also provides a model of the translation process seen as a cross-cultural communicative activity. These models provide an overall description of the translation process with respect to its stages carried on by the translator. This description is general, broad, and simple. There could have been subprocesses that are further analyzed under each stage.

C. Review of Translation Process Based on TAPs Abroad

Since the mid-1980s investigations on translation process analysis based on think-aloud protocols to tap and map the translator's mind have flourished (Krings, 1986; Séguinot, 1989; Tirkkonnen-Condit, 1991). They observed the practical performance patterns of novice and expert translators in training programs, attempting to make a detailed psycholinguistic description of translators. As Fraser (1996) concludes that 'translation process studies have, in fact, relatively little in common and present very different pictures of the translation process they all set out to investigate.' More investigations carried out by Fraser (2000), Jääskeläinen (2000), Séguinot (2000) and Tirkkonen-Condit (2000) have paid much attention on the performance of expert translators, methodological issues about TAPs application, cognitive management and decision making during translation process.

In fact, there still exist differences in choosing concurrent or retrospective TAPs. Hansen (1999) preferred the retrospective verbal protocols while Jakobsen (2002) supported the concurrent TAPs. Alves (1997) and Alves & Gonçalves (2003) suggested the retrospective TAPs can be better than concurrent TAPs concerning the empirical data collection so as to tap into the translation process. Olk (2002) studied critical language awareness applying the technique to reveal translators' construction of discourse. Investigations on the translation process continued with using technological tools and observing translators' performance traits online (Hansen, 1999; Jakobsen & Schou, 1999), even the electronic treatment of translation product (Laviosa, 1998; Ghadessy et al., 2001).

With the development of triangulation used in Social Sciences, Alves (2001) proposes a different type of data

elicitation techniques in order to reveal the relationship between translation process and product. This method is also preferred by the TRAP group from the Copenhagen Business School (Hansen, 2002) and particularly by Jakobsen (2002). CORPRAT (Corpus on Process for the Analysis of Translations) suggested the work on the cognitive performance of translators be carried out through the triangulation of data elicitation techniques (TAPs, Translog, Wordsmith Tools, etc.) while using small corpora in an attempt to map the process-product interface in translation.

D. Review of Translation Process Based on TAPs in China

Suhua Jiang (1998) first emphasizes the significance of studying translation process and introduced think-aloud introspective experimental method. Mengzhi Fang (1999) examined how the translator performs in the translation process via self-accomplishment, self-manifestation and self-realization. Jingquan Wu (1999) stated that studies on the translator and his psychological change should be emphasized. Yicheng Wu (2000) has done research on cognitive psychology and translation. In the same year, Hansong Cai stressed the great importance of research into translating process and briefly discussed the origin and classification of verbal protocols. Another scholar Zhiping Song (2006) suggested that TAPs could be applied to search into psychological model of translation studies.

In 2002, Jv Miao adopted a descriptive, comprehensive and systematic methodology to describe the translation process and translator through observations and analysis of phenomena. Eventually, a macroscopic and communicational translation model is proposed by her. Such researches on translation process can be seen in Dechao Li (2005), Jun Wen (2005, 2006) and Yushan Zhao (2010). Binghan Zheng (2006, 2008) introduced the Triangulation Module, which mainly consists of TAPs and Translog technique, is an up-to-date ideal method in the process-oriented translation studies. Junxia Dai (2009) made a review on the tapping translation process by applying the theory and method in psychology.

Sisi Zhou (2010), Xichan Tian (2010) and Juan Shen (2011) also gave the detailed explanation about the application of TAPs, which might push forward the empirical studies in translation field. Lina Deng (2007) made an account of the TAPs and went on to illustrate the operation procedure in detail, offering a comprehensive analysis of the major variables of TAP and raising hypotheses with respect to the TAP. Binghan Zheng (2007), Lina Deng (2007), Rong Yang (2009), Qiulan Zhai (2009), Fangyan Wan (2010) and Xinxin Tan (2011) conducted the empirical studied on translation units during the translating process by the analysis of TAPs.

It is clear that Chinese scholars have done adequate research on the translation process. Yet mapping the process-product interface in translation has been a long-time challenge for researchers in the field.

III. METHODOLOGY

In recent years, the study of the translation has apparently moved from prescriptive attitude to more descriptive, scientific stances among which think-aloud method is often utilized by researcher. Except some shortcomings in terms of the methodology, this method remains valid means of accessing something of the translator's thought process, throwing light on how translators solve problems and make decisions while translating.

A. Experimental Participants

With the aim of presenting the actual process of translation, the translation major students will be selected for the present protocols who has acquired a certain amount of translation competence but who faces nevertheless still a number of problems when training (More details in Table 1).

TABLE 1
BACKGROUND INFORMATION OF THE PARTICIPANTS

No.	Grade	Original Score / Group	First Name	Sex	Age	Code Name	English Study	Translation Study
P1	Four	89/ A	Chen	F	22y	4A1	10.5y	2.5 y
P2	Four	88/ A	Zhou	F	22y	4A2	10.5y	2.5 y
P3	Four	84/ A	Li	F	21y	4A3	9.5y	2.5 y
P4	Four	86/ A	Jing	F	21y	4A4	9.5y	2.5 y
P5	Four	85/ A	Song	F	23y	4A5	11.5y	2.5 y
P6	Four	72/ B	Shi	F	22y	4B1	10.5y	2.5 y
P7	Four	71/ B	Zhang	M	22y	4B2	10.5y	2.5 y
P8	Four	73/ B	Li	M	22y	4B3	10.5y	2.5 y
P9	Four	75/ B	Zhao	F	23y	4B4	11.5y	2.5 y
P10	Four	74/ B	Ying	M	22y	4B5	10.5y	2.5 y
P11	Two	89/ A	Wang	F	21y	2A1	8.5y	0.5y
P12	Two	82/ A	Liu	M	22y	2A2	9.5y	0.5y
P13	Two	80/ A	Wang	M	22y	2A3	9.5y	0.5y
P14	Two	84/ A	Yang	F	21y	2A4	8.5y	0.5y
P15	Two	78/ A	Li	F	21y	2A5	8.5y	0.5y
P16	Two	69/ B	Jiang	F	20y	2B1	7.5y	0.5y
P17	Two	68/ B	Dong	F	20y	2B2	7.5y	0.5y
P18	Two	69/ B	Hu	M	19y	2B3	7.5y	0.5y
P19	Two	68/ B	Wu	M	22y	2B4	9.5y	0.5y
P20	Two	69/ B	Yan	M	22y	2B5	9.5y	0.5y

Note: P ---Participant A---High- Score Group B--- Low- Score Group Y---year
4A1----the first participant in high-score group from Grade Four
2B5--- the last participant in low-score group from Grade Two

B. Experimental Materials

TABLE 2
BACKGROUND INFORMATION OF THE EXPERIMENTAL MATERIALS

Code Name	Degree of Difficulty	Title of ST	SL	Author	TL	Title of TT	Translator
Text One (T1)	Easy	My Mother's Gift	English	Suzanne Chazin	Chinese	母亲的礼物	Jianhua Jiang
Text Two (T2)	Difficult	Slavery gave me nothing to lose	English	Zora Neale urston	Chinese	黑奴的历史对我有什么损失	Degao Ma
Text Three (T3)	Easy	普通人的新年	Chinese	Weiwei Zhu	English	Spring Festival for Ordinary People	Zuchun Ju
Text Four (T4)	Difficult	寂寞	Chinese	Qiuning Chen	English	Solitude	Zuchun Ju

Note: T1---Easy E-C Translation T2--- Difficult E-C Translation T3--- Easy C-E Translation T4---- Difficult C-E Translation
ST---Source Text SL---Source Language TL--- Target Language TT---Target Text

These texts have been evaluated by both students and teachers to make sure that they must contain a sufficient number of translation problems so that a sufficient number of problem-solving strategies may be revealed. Therefore, from the foregoing discussion, it follows that selection of the texts is not an easy job which based on the subjective impression of the students or exactly the teachers' judgment about the degree of difficulty of the texts selected. In addition, ten English majors were randomly selected for the think-aloud translating task of all these texts. Thus, the enough time restriction was found: one hour for each text.

C. Experimental Tools

An audio-record device was employed to record the words either in English or Chinese uttered by the subjects. Furthermore, two cameramen carried their video cameras to give a shot of the whole experiment process, which facilitate a more detailed analysis for these various processing activities. Five assistants of the researcher paid close attention to each subject and took observation notes carefully and clear some doubts with the participants after the translating tasks. The rating scale of translation product is adopted from *Practice Tests and Lectures for English Majors (Grade Eight)* edited by Yanhua Zhu, which is supposed to show the quality of the translation in detail. There are two types of post-translating questionnaires, one for English-Chinese translation; the other for Chinese-English translation, each of them consists of two parts. The interview was designed to explore the translating habits of the participants. The Tapes of the interview were also transcribed to be the aid methods to the present study.

D. Experimental Procedures

Due to the limits of devices, place and manpower, the experiment was carried out in eight different times. After the think-aloud protocols training, the subjects are instructed to verbalize all the thoughts that occurred to them while translating.

TABLE 3
INFORMATION ABOUT EXPERIMENT

time	1	2	3	4	5	6	7	8
Participants	4A1-4A5	4B1-4B5	2A1-2A5	2B1-2B5	4A1-4A5	4B1-4B5	2A1-2A5	2B1-2B5
Texts	T1, T2	T1 ,T2	T1, T2	T1, T2	T3 , T4	T3, T4	T3, T4	T3, T4

After translating, the questionnaires and interview were carried out by researchers so as to attain in-depth discussion of the findings. The data collected from the experiment fall into two main categories, namely the translation products and the think-aloud protocols. Each of the translation products was rated by two teachers, and the final score was the average of the two scores given by the experienced teachers. The intersubjective validity of the score is 0.8964. Then, the scores were kept for the consequent data analysis. The researcher transcribed the exact words of the think-aloud protocol, marked the time span of the pauses and the phrases of translation processes. The quantitative analysis of the data in this research was implemented by SPSS (15.0). Software of Word 2007 and Excel 2007 were applied to calculate some minor problems in data analysis.

IV. DATA ANALYSIS

A. The Reliability and Validity of the Data

The present study is based on think-aloud protocol, so the reliability and validity of this method should be conformed first. The information gotten from the twenty participants showed that the think-aloud method did not interfere them very much. Most of them finished the translation tasks within the limited time (one hour for each text). As for the noticeable pause, all these subjects kept silent less than 20% of the whole translating time, and the average percentage of their pause is 9.5% of their translating task (just for one text). This meant each subject's thought elicited was sufficient for the think-aloud protocol and available for analysis, and on average, more than 90% of the subjects' thought could be captured and analyzed for the study. Table 4 showed the time consumed and pause periods and their percentage of the whole translating time of each participant. In view of the space consideration and the large scale of experiment data, only the task fulfillment of text one of the twenty subjects was revealed here.

TABLE 4
A GENERAL DESCRIPTION OF THE TWENTY SUBJECTS' TASK FULFILLMENT OF TEXT ONE

Participant	Time (min)	Pause (min)	Percentage
4A1	50	3.2	6.4%
4A2	37	2.13	5.8%
4A3	23	2.15	9.3%
4A4	49	5.1	10.4%
4A5	33	3.9	11.9%
4B1	30	5.45	18.2%
4B2	26	2.1	8.1%
4B3	38	2.48	6.5%
4B4	50	7.47	14.9%
4B5	30	3.8	12.67%
2A1	26	1.37	5.3%
2A2	48	5.7	11.9%
2A3	34	6.07	17.8%
2A4	28	2.7	9.6%
2A5	41	1.88	4.6%
2B1	36	2.18	6.1%
2B2	29	2.65	9.1%
2B3	38	1.05	2.8%
2B4	33	3.43	10.4%
2B5	50	4.9	9.8%
Average	36	3.49	9.5%

In responding to question one about the percentage of thought they uttered, 50% of the subjects chose "B" (above 70%) in questionnaire one (English-Chinese translation); 40% of the subjects chose "B" (above 70%) in questionnaire two (Chinese---English translation). It could be argued that the majority of the subjects' self-estimated percentage of thought uttered is above 70%, which is consistent to the previous discussion.

As for question two about the degree of the influence of the translating aloud method, 40% of the subjects chose "B" (much) in questionnaire one (English-Chinese translation); 30% of the subjects chose "B" (much) and 25% of the subjects chose "D" (a slight) in questionnaire two (Chinese---English translation). It is interesting to say that the majority of the subjects feel the translating aloud method has some, but not great, influence on their translating especially in English-Chinese translation. Meanwhile, some subjects felt that thinking-aloud has a slight influence on their translating process in Chinese-English translation.

The reason for such results is obvious: most subjects usually translate with silent thinking, when being asked to translating aloud, they would make overt verbalization, which was fresh and different from their previous practice, therefore, they could sense the influence. When it comes to Chinese---English translation, five subjects were

interviewed after the experiment. Three of them considered C-E translation more difficult than E-C translation. They had to ponder over it again and again, thus there exists no great difference between silent translating and translating aloud. Two were found to have the habit of talking while learning, both in writing, reading and translating. Ericsson and Simon's (1979) study showed that think-aloud method interferes very little with task performance if the probe requires reporting on normally available verbal information. However, overt verbalization may slow down task performance and may facilitate memory retrieval and storage.

With respect to the third question concerning whether or not could they be able to finish the translating task within the fixed time, 45% of the subjects chose "B" (often) in first questionnaire (English-Chinese translation). And 40% of the subjects also chose "B" (often) in second questionnaire (Chinese-English translation). It can be concluded that the majority of the subjects self-estimated that they had a good control over time consuming while translating, which is consistent to the previous discussion.

TABLE 5
TWENTY PARTICIPANTS' RESPONSES TO THE QUESTIONNAIRE (NUMBER OF PARTICIPANTS / PERCENTAGE)

	A--Ⅱ-Q1	B--Ⅱ--Q1	A--Ⅱ--Q2	B---Ⅱ--Q2	A--Ⅱ--Q3	B---Ⅱ--Q3
A	1 (5%)	0 (0%)	1 (5%)	4 (20%)	4 (20%)	6 (30%)
B	10 (50%)	8 (40%)	8 (40%)	6 (30%)	9 (45%)	8 (40%)
C	4 (20%)	6 (30%)	5 (25%)	4 (20%)	5 (25%)	6 (30%)
D	4 (20%)	4 (20%)	4 (20%)	5 (25%)	2 (10%)	0 (0%)
E	1 (5%)	2 (10%)	2 (10%)	1 (5%)	0 (0%)	0 (0%)

Note: A-E refers to the five choices of each question. A---Questionnaire A B--- Questionnaire B
Ⅱ---the second part of each questionnaire Q1---the first question Q2---the second question Q3---the third question
a--Ⅱ-Q1 refers to the answer of the first question in the second part of Questionnaire a.

To sum up, the participants fulfilled the translating tasks within the required time and produced the appropriate product. The pause periods were less than 20% of the total translating time and each pause lasted no more than twenty seconds. The majority of the subjects felt the think-aloud method did not great influence their translating process. Consequently, the think-aloud protocol is reliable and can be employed as the base of the data analysis.

B. The Coding of the Think-aloud Protocols

1. Strategy Indicators

The think-aloud protocols originated from the experiment are surprisingly large. The transcripts of all subjects concerning four texts cover about almost 250 fully written pages. It took the researcher approximately two months to code all of them. It is evident that the more transcripts are there, the more successes lie in the present study.

All recording were later transcribed verbatim into protocols. But before the TAPs could be processed, the strategy indicators proposed by Kiraly (1997) should first be clarified. It is expected that to what extent Chinese student translators are different from German student translators. Some different strategies employed by Chinese non-professional translators (the translation major students) are added into Kiraly's translation strategy list, ie. interim selection, postpone attempt, tentative solution, read ST segment, self-correction and whole ST reading.

2. Protocols Analyses

First of all, for the sake of the standardization of TAPs analysis, the analysis rules of the protocols are displayed in Table 6:

TABLE 6
THE ANALYSIS RULES OF THE THINK-ALOUD PROTOCOL

Token	denotes	Example
S1---S26	strategy indicators (symbols)	premeasured……查字典, S8
S10	invalid strategy indicators	好像是逗号的意思，对，是逗号 *S10*
（1-10 s）	the amount of seconds used for pause	casually share with……（3s）
{ }	a translation segment on the basis of problem-solving	{ Look back on 什么意思? ……(5s) S7 L2 查一下字典 S8 ……（8s） look back on 回顾 S1 …(4s) 自己的过去 S19 S1，}
……	pauses	要品味生活……品味生活并不是在预先
???	Inaudible utterance	Over peanut-butter ??? ……

The strategies being categorized into the first phase (preparation), which has been mentioned in Kiraly's strategies and new strategies identified in the present study, were S7, S17, S24, and S26. Consequently, S2, S6, S8, S12, S14, S19, S20, and S22 were classified into the second phase of translating process---the incubation phase. And the third one---illumination phase consists of S1, S4, S5, S10, S13, S15, S21, and S23. It is obvious that the preparatory phase involves conscious mental activities, that an awareness of purpose is important here. It will be seen that cognition not only plays an important part in the preparatory phase but also in the evaluative phase, which includes the above-mentioned strategies: S3, S9, S11, S16, S18 and S25. We shall see that the four phases are, in fact, only a construct, and that these phases are actually often simultaneous. For the sake of the following quantitative analysis to do further exploration of those strategies, the number of the four phases of each participants while translating the four different texts were clarified and kept in order.

3. The Basic Statistics

And the total number of the strategies as well as their distribution in the four phases of translating process should also been counted. Table 7 shows the basic statistics obtained from the first translation text (T1) protocols produced by the participant (4A1). Such statistics of the rest participants with all the other texts are kept carefully for further quantitative analysis in the next section (the similar eighty tables like table 7). As was pointed out at the beginning of this part, translation strategies are the first category of analysis in this study. It goes without saying that noting them is only important for what they reveal of the translation processes of the translators, whether professional or non-professional.

TABLE 7
EXAMPLE OF THE BASIC STATISTICS OBTAINED FROM THE PROTOCOLS

Strategy	Frequency	Ph Ⅰ	Ph Ⅱ	PhⅢ	PhⅣ
S1	19			√	
S2	3		√		
S3	0				√
S4	2			√	
S5	0			√	
S6	5		√		
S7	22	√			
S8	8		√		
S9	1				√
S10	8			√	
S11	9				√
S12	1		√		
S13	3			√	
S14	0		√		
S15	0			√	
S16	0				√
S17	1	√			
S18	3				√
S19	15		√		
S20	3		√		
S21	4			√	
S22	2		√		
S23	1			√	
S24	12	√			
S25	4				√
S26	1	√			
Total	127	36	37	37	17

Note: S1-S26 translation strategies √ ---the strategy distribution in the four phases
Ph Ⅰ ---the preparation stage of translation process Ph Ⅱ ---the incubation stage of translation process
PhⅢ---the illumination stage of translation process PhⅣ---the evaluation stage of translation process

So far, the data collected from the experiment has been described and primarily processed with regard to the mental activities which the first clues to the analysis of the translation process. Although the above mentioned description is just a typical examples for one subject, one text, the whole data about twenty subjects of four texts have been carefully dealt with by the researcher. Of course, the observation notes supplied by the experiment assistants also played an important role in this qualitative analysis.

As the above data show, the translation process is characterized by phases in which the participants transfer SL text into TL text without any problems, and by phases in which the participants are faced with problems and which thus call for strategies, i.e. problem-solving procedures. As the data shows, these strategies are obviously not isolated from each other. Instead, they could be combined into four phase according to the translating process. The qualitative analyses alone have yielded the data of the distribution of these strategies in the four phases. As to the first phase, the most occurred strategies were S24, that is, the participants receive the ST by reading it. Regarding the second phase, S8 was applied again and again for the participants to consult a dictionary, searching a equivalence of a word, phrase, structure etc. As for the third phase, S1 and S10 were employed more frequently because the participants often produce the TT guarded by interim solution or judgment. When it comes to the last phase, few participants use the evaluating or monitoring strategies. When someone felt uncertain about the acceptability of the translation product, (S18 being applied), maybe he/she corrected it (S25), otherwise they just let it to be.

C. Data Analysis

Chi-Square Tests on strategies in four phases employed by participants of different grades and groups revealed the following results.

TABLE 8
CHI-SQUARE TESTS OF THE STRATEGIES IN FOUR PHASES.

		Value (χ^2)	df	Asymp. Sig. (2-sided)
Ph Ⅰ	Grade Two	1.604	1	.205
	Grade Four	17.377	1	.000*
Ph Ⅱ	Grade Two	17.605	1	.000*
	Grade Four	5.471	1	.019*
PhⅢ	Grade Two	43.831	1	.000*
	Grade Four	1.084	1	.298
PhⅣ	Grade Two	7.302	1	.007*
	Grade Four	8.274	1	.004*

* $p < 0.05$

In the first phase (preparation), strategies use on the high-score and low-score groups of second-year students reached no significance and strategies use on the high-score and low-score groups of fourth-year students reached significance. That was to say, the participant of grade two all had no particular strategies so as to receive the ST. Yet, the participants in grade four had a good of receiving ST with some special strategies, such as reading the whole passage or segment of the ST. The high-score of grade four understand the ST intuitively by their cognitive frame. In phase two (incubation), strategies use on the high-score and low-score groups of second-year students reached significance and so did fourth-year students. Both high-score groups of grade two and grade four made full preparation for the production of ST since they knew that translation task was problem-guarded while low-score groups made little even no preparation for it, not knowing what to do next. In phase three (illumination), strategies use on the high-score and low-score groups of second-year students reached significance and strategies use on the high-score and low-score groups of fourth-year students reached no significance. Because the more knowledge they learned about the compare with two languages, the less determined they would be in the illumination part. In phase four (evaluation), strategies use on the high-low score groups of second-year students reached significance and so did fourth-year students. Only the high-score group of both grades had the awareness of evaluating their translation products. The low-score participants just finished the translating stage, then hand the products in without any delay. They have not any habit to make the product evaluated.

Table 9 was a descriptive frequency analysis of the strategy distribution in the four phases during the whole translating process.

TABLE 9
FREQUENCY ANALYSIS OF THE STRATEGIES IN FOUR PHASES

Phase Ⅰ	Frequency	Percent	Phase Ⅱ	Frequency	Percent
Valid .00	670	43.7	Valid .00	60	3.9
1.00	864	56.3	1.00	1474	96.1
Total	1534	100.0	Total	1534	100.0
Phase Ⅲ	Frequency	Percent	Phase Ⅳ	Frequency	Percent
Valid .00	195	12.7	Valid .00	1199	78.2
1.00	1339	87.3	1.00	335	21.8
Total	1534	100.0	Total	1534	100.0

In the first phase (preparation), the participants employed strategies for 1534 times, among which 56.3% (864) was valid. In phase two (incubation), the participants employed strategies for 1534 times, among which 96.1% (1474) was valid. In phase three (illumination), the participants employed strategies for 1534 times, among which 87.3% (1339) was valid. In phase four (evaluation), the participants employed strategies for 1534 times, among which 21.8% (335) was valid. Judged by these data, it can be concluded that the participants were more likely to employ strategies in the second and third phases. They had little trouble in comprehending the ST and no awareness to evaluate their translation products. Thus, more attention was attracted to the incubation and illumination stages. The translation task was a kind of purposed problem-solving activities. Therefore, they made many efforts to the second and third phases. Neglecting the first phase might cause the omission of the original information of the ST. And the ignoring of the last phase meant there was no monitoring to the TT production. Their translation competence had not reached the highest peak.

V. CONCLUSIONS

A. Major Findings

Findings below are based on the analysis of the think-aloud protocols and the answers to post-translating questionnaires of the twenty Chinese college level translation majors under the present study.

There exist four phases: preparation, incubation, illumination and evaluation both in English-Chinese and Chinese-English translation processes. The participants were more likely to employ strategies in the second (incubation) and the third phases (illumination). They had little trouble in comprehending the ST in the first phase (preparation) and no awareness to evaluate their translation products in the last phase (evaluation). There were significant differences on the strategy use of the high-level and low-level participants in the second phase (incubation) and the fourth phase (evaluation).

In the first phase (preparation), strategies use on the L_h and L_l groups of participants reached no significance, while strategies use on the H_h and H_l groups reached significance. In phase three (illumination), strategies use on the L_h and L_l groups of participants reached significance and strategies use on the H_h and H_l groups reached no significance. In phase two (incubation) and phase four (evaluation), strategies use on the H_h and H_l; L_h and L_l groups reached significance.

The participant employed the strategy of "Monitor for TL accuracy"; "Self-correction" more in E-C translation tasks than in C-E translation tasks. On the other hand, the participant employed the strategy "Accept interim solution"; "Identify problem"; "SL-TL dictionary search"; "Make intuitive acceptability judgment"; and "Rephrase ST Segment" more frequent in C-E translation tasks than in E-C translation tasks. "Employ mnemonic aid"; "Identify problem"; "SL-TL dictionary search"; "Make intuitive acceptability judgment" and "Self-correction" more frequent in easy translation tasks than in difficult translation tasks. On the other hand, the strategy of "Accept interim solution" and "Uncontrolled interim unit production" was employed more frequent in the difficult translation tasks than in the easy translation tasks.

Concerning the testing materials of T1 and T2, there was reliably significance on the two grades of participants and fourth-year students were significantly better than the second-year students. As to the testing materials of T3 and T4, there was no significant difference. Though the fourth-year students were better than the second-year students, there existed no significance in statistical sense. The entire participants felt more painstaking in C-E translating process than in E-C translating process. They did fairly well in E-C translation than in C-E translation. The number of the strategies employed by participants increased by the development of the participants' bilingual proficiency and the experiences gained in translation training.

B. Further Suggestions

It goes without doubt that translation study is a particularly vast field, being placed at the intersection between many different disciplines. In this sense, interdisciplinary research has been presented here which tries to bring together developments and achievement both in the field of cognitive psychology and translation.

Certainly, the present study does not provide all we want to know about translation process. But, it does suggest a need for a larger and more systematic investigation of the mental activities of Chinese translators. Future studies should also involve (a) more language pairs, such as Japanese and Chinese, French and Chinese, German and Chinese, etc. with TAPs data collected from experiments. (b) more source language texts which represent a variety of text genres, such as popular science, law, speeches, history, economic review, besides literary texts. (c) more participants, not only language learners and translation majors, but also professional translators. Of course, more compare could be made between (d) translation majors and English majors; English majors and non-English majors; language learners of Han nationality and those of other minority nationalities. Keep these above-mentioned features in mind, can we then expand the objects of investigation to include more aspects of the translation process.

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