The Translation of Interaction in the Genre of Popular Science: The Case of *Scientific American*

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1. Introduction

In recent years, popular science writing has quickly emerged in Taiwan as one of the bestselling publications, the majority of which are translations, especially from English. Although the publications have received a successful response from the Taiwanese readers, many scientific experts have expressed their concerns about the quality of these translations. Their criticisms focus almost solely on the accuracy of the translation—for example, works being translated by translators with limited understanding about the subject. The inaccurate information could mislead and wrongly educate school students, who constitute the majority of the readership. However, beyond the concern about the accuracy of translations, little attention is paid to the activity of translation itself and to examine it from the relevant translation theories: whether the mismatches between the source and target texts are the result of translation strategy rather than inaccuracy (*cf.* skopos theory, Nord 1997); or how these translations are influenced by target readers (*cf.* audience design, Bell 1984, Mason 2000). We would like to argue that the translation of popular science texts into Chinese has many more interesting dimensions worthy of investigation beyond the question of accuracy, and this is the motivation for carrying out the present study. As the writer-reader relationship is the key feature that characterizes the genre of popular science from other types of science writing, the present study aims to explore how the translators may adopt a similar or different writer-reader interaction when facing different audiences and possibly with different communicative purposes.

2. Interaction in Written Texts

This study endeavours to investigate interaction in written texts. It seems needless to emphasize that a written text involves interaction since it is written by a writer and read by readers and therefore the writer, the readers and the text interact. However, when the study of interaction in linguistics began to attract attention, the focus was mostly on spoken texts, in which the interaction of speaker and listener was more obvious and could be investigated more easily. Nevertheless, interaction in written texts has gradually received more attention and different approaches have been proposed. Researchers (Nystrand 1986, Hoey 1983, Thompson and Thetela 1995, Myers 1999, Hyland 2005 and many others) argue that interaction in written texts can be conducted as that in the spoken text, though with different effects as a result of the different medium.

The study of interaction, however, remains a vague concept. The concept of interaction has been touched in different disciplines in linguistics, but they all seem somewhat different in what they mean. The discussion of “interpersonal” (Halliday

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1985), “communicative”(Beaugrande and Dressler 1981), “dialogic”(Hoey 2001), or “metadiscourse” (Crismore 1989, Hyland 2005) aspects of written texts all seem related to the concept of interaction, but these studies are however isolated under different lines of frameworks and approaches. In his search for a way to relate all these relevant studies under an umbrella, Myers (1999) proposes to take interaction as a core, by which different linguistic features and models can actually be related with each other.

> “They [studies of interaction in texts] bring together features that are sometimes isolated under the headings of hedging, representation of speech, speech acts, cohesion or address” (ibid: 55).

The model of interaction in the present is primarily based on that of Thompson and Thetela (1995) and Thompson (2001), who provide a clear picture of the development of studying interaction in written texts. They point out that there are two mainstreams in this field: information-oriented and function-oriented.

(1) Information-oriented: The core concept here is that dialogue should be regarded as the basis of the construction of monologue, so the written text is considered as a dialogue between writer and reader (e.g. Widdowson 1984; Hoey 1983, 2001). This is also called a reader-friendly interaction because the focus of the studies is on how the writers care about their readers.

(2) Function-oriented: This approach concentrates on the side of the writers in interaction, and is also called writer-oriented. The theoretical basis can be traced back to the interpersonal function in systematic functional grammar (Halliday 1985). The studies focus on how the writers use linguistic features to express their attitude and stance overtly in the texts - by use of questions, comments, evaluations *etc.* - and to influence the readers.

Although the studies of interaction are categorized into two approaches, they are, however, “essentially two sides of the same coin” (Thompson 2001:61). In a text a writer generally wants to achieve the two interactive dimensions at the same time, and often a linguistic device is operated to achieve two interactive purposes at the same time. For example, inserting a question can be regarded as a friendly signal, demonstrating the concerns for the questions the reader possibly has in mind, but on the other hand this can be a manipulative strategy to encourage the readers to follow the question and then accept their answers provided. Therefore, the approach of staying on only one side of the interactive dimensions may end up in an incomplete interpretation of writer-reader relationship.

For this reason, Thompson and Thetela (1995:125) raise their concerns about the trend that two aspects of the interaction are often conducted separately: “one area that has not yet been explored is the way in which interactive, reader-friendly choices work together with interactional, reader-managing choices.” This is also the basic principle we intend to follow in examining our data: not only how the writers act but also how the readers are considered. The approach is to bring the two sides of the pictures into consideration and provide a clearer picture of the interaction taking place in our data.

3. Corpus

The study is based on the popular science magazine *Scientific American* (*SA*). The corpora constructed for this paper include: *Scientific American* English (SA-E) contains English source texts with 103,004 words. *Scientific American* translated Chinese (SA-TC) contains target translations with 109,985 words. In order to provide a reference to the Chinese norm while comparing SA-TC with SA-E, a Chinese reference corpus is included: a written science sub-corpus from Academia Sinica Balanced Corpus of Modern Chinese (SC-S), containing 566,717 words. The English texts are collected from the English *SA* website based on the paper publications in the US, and the Chinese texts are from the Chinese website based on the paper edition published in Taiwan. Some texts are given in full and others are selective reductions. For example, if an article is too long, the first two thousand words at most are usually available online. Given that the aim is to look for recurrent patterns throughout the corpus, reductions are considered not to influence the results of the analysis. The publication period is restricted from February 2002 (the first Chinese issue) until February 2005 when the corpus was constructed.

4. Using Corpus to Investigate Interactive Features

A set of linguistic features has been investigated in the schools of systematic functional grammar, pragmatics, critical discourse analysis, *etc.* These three representative models about the use of language and its explanations give us a list of toolkits for investigation, such as transitivity, mood, modality, theme-rheme pattern, personal reference, cohesion, speech act, lexicalization, presupposition, and implicature. For the features to be investigated in the first step, the quantitative analysis, we have decided that the selective features should meet two requirements: (1) they should generate fruitful implications to the writer-reader interaction in our data in the pilot study, based on a sample of parallel text from the corpus; (2) and they should be able to be investigated in a large-scale machine-readable corpus for recurrent patterns. Based on these criteria of selections, the features finally selected are deixis, junction, first and second personal reference, and hedges. In the quantitative analysis, the patterns of interaction in each corpus are examined under the four selective interactive features. The results of the figures offer a potential indication to different patterns between source texts and target texts and the trends of shifts taking place in the process of translation. Based on the results obtained from the quantitative analysis, qualitative analysis is then carried out to examine the interactive features located in the texts, and at this stage those features having difficulty (such as transitivity and presupposition) to be analysed quantitatively are brought into discussion wherever relevant to the analysis.

The electronic files of the texts were saved as plain text in order to be processed by the parallel corpus programme *ParaConc*. The Chinese texts were segmented by a programme developed by the Natural Language Processing Laboratory of National Tsing Hua University in Taiwan, following the standard of segmentation of Academic Sinica Corpus. The segmentations processed by the machine were then checked manually in order to ensure accuracy. The English and Chinese texts were aligned manually by sentences and then imported into *ParaConc*.

In the quantitative analysis, the raw numbers were generated by the software and the number of shifts was calculated, first by the software and then checked

manually. In the qualitative analysis, the first step is to generate concordances of key words (based on the results of quantitative findings); then generalizations of the trends in these concordances were identified with the assistance with co-textual elements (such as collocations), and finally contextual factors (pragmatic effects and socio-cultural significance) were drawn into the interpretation for the reasons or effects of the interactive phenomenon.

In this paper, we will present a sample analysis of deixis, one of the interactive features investigated in the project. The deixis in English and in Chinese that are calculated in the corpus are shown in table 1.

Deixis	English	Chinese
Demonstratives (pronouns and adjectives)	this/that these/those	這 *zhe*/那 *na*
Spatial adverbs	here/there	這裡 *zheli*/那裡 *nali*
Temporal adverbs	now/then	這時 *zheshi*/那時 *nashi*

Table 1: Deixis investigated in the study.

5. Quantitative findings

First, the total numbers of occurrences of demonstratives, time and place adverbs in SA-E, SA-TC and SC-S are presented in table 2 below.

		SA-E	SA-TC	SC-S
Proximal	Demonstratives	447	1167	1512
	Place adverbs	88	36	16
	Time adverbs	22	14	14
	Total (percentage of corpus words)	557 (0.54%)	1217 (1.10%)	1542 (0.27%)
Distal	Demonstratives	199	227	337
	Place adverbs	28	5	9
	Time adverbs	28	60	48
	Total (percentage of corpus words)	255 (0.25%)	293 (0.27%)	394 (0.07%)
Total (percentage of corpus words)		812 (0.79%)	1510 (1.38%)	1936 (0.34)

Table 2: Total number of deictics in SA-E and SA-TC.

A comparison of SA-E and SA-TC shows that the latter has a higher frequency of deictics than the former. The difference lies especially in the frequencies of proximal deictics while the frequencies of distal deictics are very close. This suggests that SA-TC adds a large amount of proximals that do not exist in the source texts. In the next step we compare SA-TC and SC-S to determine whether the increase of proximals in SA-TC is an accommodation to the Chinese norm, in which case the translators' choices and motivations may be less worthy of discussion because the

shifts are either obligatory or preferred in the process of translation. However, the figures suggest that SC-S actually has the lowest frequency of deictics among the three corpora in table 2. The translations not only use a higher frequency of deictics than the source texts but also than the Chinese norms, so we cannot just explain the use of deictics in SA-TC as being under the influence of source texts or constrained by the target norms. Rather, the translators' choices may be involved and their motivation and effects are worth further examination.

We further calculate the translational shifts taking place in SA-TC. Table 3 below summarizes the total number of translational shifts involving deictic demonstratives, and time and place adverbs in SA-TC. In the table ST stands for source text and TT stands for target text.

Distancing Shifts			Proximitizing shifts		
ST proximal→ TT distal	ST proximal→ not translated in TT	Add TT distal	ST distal→ TT proximal	ST distal→ not translated in TT	Add TT proximal
10	110	228	72	118	780
348 (26.5% of all deixis shifts)			970 (73.5% of all deixis shifts)		
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Table 3: Deixis shifts in SA-TC.

A comparison of the two trends of shifts shows that shifts towards proximity (970 instances) occur much more often than shifts toward distance (348 instances). This trend is found to be consistent in the three strategies employed in translational shifts. The number of shifts from ST distal to proximal (72 instances) is higher than the number from ST proximal to TT distal (10 instances). The omission of distals (118 instances) is higher, though with less significant margin, than that of proximals (110 instances). Also, the number of addition of proximals (780 instances) is higher than the addition of distals (228 instances). This consistency shows a significant predominance of proximitizing shifts rather than distancing shifts.

To conclude the quantitative findings, the numerical statistics suggest that, compared with the source text, the use of proximal deictics in the translation is a salient feature and the translators' choices may be involved.

6. Qualitative analysis

Following the direction pointed out by the statistics, in this section we will discuss more fully the use of proximals and the shifts towards proximity, and will also bring a counter-example into discussion.

Examining the text, we find the deictic shifts towards proximity are broadly related to the two aspects of interaction as stated in the review (section 2): to show the writer's consideration for the readers and to express the writer's attitude.

First, proximal demonstratives are often used as an anaphoric to link propositions to the referents mentioned before. The writer's intention to make cohesion explicit can also be demonstrated by the fact that the addition of *zhe* often co-occurs with a strategy of adding extra transition clauses, as in example 1.

Example 1
(Source Text) …annual outlays for maintenance, repairs and operations far exceed total hardware and software costs, for both individuals and corporations.
Our group of research collaborators at Stanford University and the University of California at Berkeley has taken a new tack, by accepting that computer failure and human operator error are facts of life… (Fox and Patterson, June 2003)
(Target Text)…不論是個人還是公司，每年花費在電腦維修與運作上的支出，都遠高於軟體與硬體的總成本。對於這個問題，如今有了新的解決方法。
我們研究小組的成員，分別來自美國史丹佛大學與加州大學柏克萊分校。我們採取一種新的方針，把電腦故障與操作者的疏失，全都視為生命中必然會發生的事實。(Zhong, July 2003)
(Back Translation) …whether individuals or companies, the spending on computer repair and operation are far higher than the total software and hardware cost. Regarding this problem, a new resolution is now available.
Our members of research team are, respectively from Stanford University and the University of California at Berkley in USA. We adopt a new approach, by regarding computer failure and operator failure, as facts that are inevitable in life.

In this example a transition sentence is inserted at the end of the preceding segment. The translator provides a clear link between the two paragraphs for the target readers. The transition sentence points out the macro-structure of the textual organization, a problem-solution structure (*cf.* Hoey 1983), and makes the readers anticipate that a response to the problem will be given in the next paragraph. The proximal demonstrative in the transition sentence refers back to the extended description of the problem in the previous paragraph.

Myers (1991:16) describes this "knowledge of discourse segments", the ability to anticipate the macro-structure of textual organization, as a distinction between lay readers of science texts and those with expertise. He argues that (ibid: 17) the lay readers "lack the sense of social actions going on behind the text, so they have no schema into which to slot the parts of the introduction", and this argument can also apply to other parts of the texts. Here, we can compare the Chinese readers as laypeople and English readers as experienced readers of this magazine. In other words, the *Scientific American* has been published in US for long enough to assume that most of the readers are accustomed to the conventional narrative and argumentative structures in the magazine, whereas the Chinese translators and writers do not have confidence to make such an assumption about their target readers. Because of the long history of the publication of *SA* in USA, it has become a well-recognized genre and we may suggest that its readers have gradually developed the ability to identify "intertextuality" in the text—they can "make utilization of one text dependent upon knowledge of one or more previous encountered texts" (Beaugrande and Dressler, 1981:10). Gerard Piel, ex-publisher of SA, explains that the presentation of a popular science story usually follows a conventional sequence:

> "The scientist is confronted with a problem or question. He defines the problem. He frames a hypothesis, and designs experiments to test his hypothesis. He tells how he designed his experiment, how it worked, what evidence he got, and how that evidence changed the understanding of what he was working on" (as cited in Bauman 2001).

A reader familiar with this plot will instinctively anticipate that the researcher will propose a solution and explain how the experiment is conducted. If this is an article written by a popular science journalist, the plot may be different and an experienced reader of the magazine would form a different anticipation.

Now, the target readers may still process the text without this supplementary interpretation from the translator, since they can infer coherence from the lexical meaning, and problem-solution is a very common textual structure universally. But the addition of this transition phrase provides evidence of the translator's consideration of the readers; regardless of the actual ability of the readers to infer discourse structure, the translator or perhaps the editor feels that extra cohesive devices may be helpful for the target readers.

Except for the reason that lay audiences perhaps lack background of knowledge, shifts towards proximity show another aspect of consideration for the readers. In example 2, the author is not a researcher who conducts scientific activity. Rather, he reports his first-hand experience as a journalist in attending the lift-off of an exploration rover. Most of the deictic demonstratives here refer exophorically to the scene.

Example 2

	Source Text	Back translation of the Target Text
1	…and a space junkie keeps blocking my view as he bobs up to check the tripod on <u>his</u> huge telephoto camera.	…and a space junkie <u>in the front</u> keeps checking tripod on his <u>that</u> huge telephoto camera, and blocks my view.
2	And even if the payload includes no astronauts, just a large robotic rover.	…or, even <u>this time</u> payload does not carry astronauts, just a large robotic rover.
3	Under the moonless, cloud-covered sky, the star shines from the crowd…	<u>In this night</u> without moon and covered with cloud, dots of star shine from the crowd…
4	…because this rover is going all the way to Mars, where it will join an identical twin launched earlier in June.	…because the destination of Mars Exploration Rovers is Mars far away, and <u>there</u> it will join an identical exploration rovers launched in June.
5	…the robot will search for clues about the watery past of <u>that</u> desert world.	…Mars Exploration Rover will search for whether <u>this</u> desert world has any clues of water existing in past.
6	The controller abort and try for a second shot, at 12:37 A.M.	…controller announces to abort <u>this instance of liftoff</u>, and changes to 12:37 midnight to try a second shot.
7	Departure is set back another week—a week I don't happen to have time.	…date of departure is delayed for a week, <u>but at that time</u> I don't happen to have time.
8	<u>The</u> space junkie is back, this time with a telescope.	<u>That</u> space junkie is back, this time with a telescope.

(ST: Gibbs, Nov 2003; TT: Guo, Dec 2003)

We find in the translation the deictic expressions occur more often than in the source text. A high frequency of deictics in a text is generally regarded as "a symptom of a much more intense engagement with the action and visualization of it" (Furrow, 1988:368). The translator uses *this time*, *this night*, *this instance of liftoff*, which relates the time he wrote this article to the time the lift-off actually happened. The proximal deictics increase "immediacy and cyclicity" (Toolan, 1990:179) in the text and also invite the readers to use their imagination and join the writer at the scene. The translation adds a few distal demonstratives as well, helping to sharpen a vivid spatial-temporal configuration, so that the readers can imagine that the writer sees *that space junkie, that telescope, that time*, etc., some distance away from the writer from his point of view. Through the specification of what are near and what are far from the utterance of context, the writer provides a "window" or "vantage point" (Simpson,

1993:15) for the readers, and the narration becomes more vivid as if the readers are watching a live broadcast of the lift-off.

In row 5 there is a shift from distal to proximal; the referent involved is Mars, a deserted planet far away in space. The source writer uses *that desert world,* which seems to be the unmarked choice on this occasion because *desert* and *past* in this clause both suggest a distance from the context of utterance. By contrast, the translation shifts towards proximity by using *this desert world*. In this instance the translator can follow the source text for the distal demonstrative, which is the unmarked choice in this context, but the translator opts for the marked form. It may seem surprising that the translator should refer to *that space junkie* or *that telescope* which may only be a stone's throw away from him, but *this desert world* which is indeed unseen from the position where he is located. The motivation may again lie in that the translator wishes to produce a more vivid picture of this narration. Here the translator has moved his deictic centre to Mars, and imagines himself standing on Mars and observing how the rover works on Mars. The readers are invited to use their imagination and bring this scene to their present. The motivation of choosing the proximal demonstrative here is not because of actual physical distance but how the translator wants the readers to see the picture and engage with the text.

The two examples of contextual analyses show that the translational shifts towards proximity are largely related to the generic feature of science texts and audience design for the TL readers. Anaphoric discourse references play an important role in the text in maintaining coherence for the target readers, who are assumed to be less familiar with the "*SA* genre". In a more conversational and journalistic style narrative, more exophoric uses of proximal deictics are found, which serve to visualize the textual world for the readers and construct solidarity with the readers. Overall, shifts towards proximity indicate a strong tendency of intervention and engagement in the translations, suggesting an orientation towards the target readers.

On the other hand, we find the uses of distals are often related to the negative attitude that the writers intend to present, whether a physical distance, or more often a psychological distance. In the following example, the writer describes the reactions of the onlookers when they saw him wearing the newest and strange high-tech PDA on his forehead on the streets of Manhattan.

Example 3
(Source Text) But many others didn't even notice <u>the thing</u>, and quite a few jaded individuals took one look and turned away, unimpressed. (Alpert, Aug 2002)
(Target Text) 但有更多人根本沒注意到那東西；幾個滿臉倦容的人看了我一眼就把頭轉開，沒什麼感覺。(Wu, Oct 2002)
(Back Translation) But many more people didn't even notice <u>that thing</u>; several jaded people take one look at me and turn head away, unimpressed.

To translate the definite article *the*, which does not have an equivalent in Chinese, the translator at least has choices from zero article, distal and proximal demonstratives, or pronouns. Here the translator chooses to use a distal demonstrative. The use of a distal demonstrative indicates a detachment from the writer and also from the readers, and emphasizes the strangeness of the situation. In this example, the referent is something that is hardly noticed in the narrative event, and the use of a distal can emphasize the detached attitude from the writers. In terms of the interactivity in the translation, we find that the use of a distal in such cases does not go against the trend of active intervention and engagement from the translator. Actually, the translational shifts from neutral to distance can be regarded as a strong

involvement of the translator in the construction of the text, from the emotionless *the* to a negative emotional *na*.

The contextual analysis finds that one distinctive feature of the distal demonstrative in this corpus is its relatively restricted function. They are most often associated with a negative connotation—an undesirable event, an ignored item, a failed hypothesis in the past, or a referent that does not exist in reality, etc. The distal deictics are often used in contrast with a focalised referent or a main story line, to which the translator tends to guide the readers' attention. It is worth noticing that to associate the distal demonstrative *na* with only negative and detached contexts is a trend identified only in this corpus, and seems largely related to the translators' strategy. In SC-S, the reference corpus, we identify many instances of *na* that are not particularly associated with any negative connotations. Therefore, the restricted function of *na* should be regarded as characteristic of this corpus, and this restriction sharpens a contrast between the more involved *zhe* and more detached *na*.

An analysis of deixis here shows that the translators of Chinese *Scientific American* present a very different pattern of deixis in the texts, consciously or unconsciously. An individual shift at the micro-level may not be significant, but a systematic trend of shifts towards proximity taking place in the translations can generate a very different rhetorical effect in the translation from the source texts. From an interactive perspective, we suggest that an increasing number of proximals in the translation bring the texts closer to the target readers, and even the use of distals can be regarded as an engagement from the writers—to share their feelings and attitude more directly with the readers.

8. Conclusions

This paper presents a theoretical framework and methodology to analyze writer-reader interaction in the genre of popular science. A sample analysis based on selective deixis seems to offer potential evidence of the translator's consideration for the target-readers' needs, and to operate more reader-oriented deictic strategies than do the source text writers. Needless to say, the conclusions drawn from this paper can only be applied to the selective features of deixis and are based on the data of the corpus. In order to make a more generalized conclusion, the project will continue with other parameters of interactive features and to observe whether a consistent patter can be identified across the corpus.

To make a more reliable interpretation of the quantitative observations, it is also necessary to recover the context in which the translations are produced. Although the present study focuses mainly on evidence from text analysis, evidence from other background documentation, such as translation briefs, in-depth interviews with translators and editors, or questionnaires to readers, may also add credibility to the findings of the text analysis. The ultimate aim of this research will be to relate the findings of individual linguistic features at a micro-level to the interactive strategy operated by the writers and translators, whose choices can in turn be explained by the social and institutional norms in which they are situated.

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