# Identification and Rewriting of Negative Translatability Indicators in Human Translation:
## Pre-editing Japanese Hybrid Texts for Translation into Chinese

# 人手翻訳における翻訳可能性の負インディケーター（**NTI**）の検出とリライト：
## 中国語への翻訳における日本語ハイブリッドテクストのプリエディット

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**Abstract:** Through an empirical analysis of publicly available Chinese versions of Japanese corporate documents, He (2018) revealed a high incidence of translation errors, demonstrating that almost 16% of revisions can be traced to features of the source texts. Focusing on Japanese Corporate Social Responsibility (CSR) reports which feature technical content with a marketing function, this paper describes the identification of 'negative translatability indicators' (NTIs) and investigates whether substituting alternative expressions can improve translatability. First, the paper proposes NTIs derived from an analysis of errors in the Chinese translations of Japanese CSR reports using the data and results from He (2018). Second, based on a 500,000-character collection of CSR reports, the paper establishes the frequency of each NTI in the corpus. Sample sentences containing NTIs are then rewritten according to pre-editing rules. The impact of eliminating each NTI is evaluated by comparing human translations of the original (with NTIs) and pre-edited (NTIs removed) sentences. The results shows the relative effectiveness of pre-editing rules in terms of accuracy and fluency, with encouraging results.

## 1. Introduction

### 1.1 Problem statement

In Japan, Simplified Chinese (ZH-CN) has become the second biggest (in volume)

target language after English for translation from Japanese. According to the Translation Industry Questionnaire Survey for 2017 conducted by Japan Translation Federation[1] (JTF), 67.8% of translation agencies provide Japanese (JA) to ZH-CN translation service (n=276). However, based on the author's experience as a reviser and QA checker working in the localisation industry, the low quality of the draft ZH-CN translation from JA tends to entail time-consuming and expensive revision in consultation with the client. This is echoed in the JTF report (2012), which attributes the difficulties of quality management in China's translation industry to translators' lack of training, social status, and remuneration, making an impact on Japan's translation industry since translation companies in Japan often work with translation companies or translators based in China. The quality issue becomes even more acute when it comes to hybrid texts[2] which feature technical content with a marketing function, a trending genre in the translation industry. In its April 2018 journal, Amelia, a well-known translator network in Japan, highlighted this genre by featuring interviews on translation as content marketing with language service providers (LSPs) in Japan, such as SDL and Lionbridge. According to Amelia, the need for translating content for promoting product sales has been increasing over the past few years, creating a new and promising domain with, however, insufficient competent translators. Moreover, clients have high expectations towards quality because these documents have a direct influence on sales performance.

He (2018) conducted an analysis of 11 publicly available ZH-CN translations of JA corporate documents — CSR reports, typical hybrid texts — which revealed a high incidence of translation errors, confirming that there is a systemic issue in JA to ZH-CN translation, and showing that up to 16% of revisions can be traced to source text expressions ambiguous or incomprehensible for the translators. Esselink (2000, p. 25) states that "the localization of a product does not begin with the delivery of source material to the localization vendor. Publishers can influence the success of their localization and globalization effort to a large extent by preparing their products for foreign markets during the development phase, in other words, by internationalizing them properly". According to LISA (Localization Industry Standards Association)[3], "[i]ternationalization is the process of generalizing a product so that it can handle multiple languages and cultural conventions without the need for re-design. Internationalization takes place at the level of program design and document development." Esselink (2000, p. 27) stresses that the text for localisation "must be written with translation in mind, so the translator can work quickly and accurately, without the need for clarifications, rewrites, or cultural modifications". Pym (2014) also points out that from a translation-theoretic perspective 'internationalisation' is the key concept that makes localisation more than a synonym for 'adaptation' or a use of new translation technologies. Based on the author's professional experience, although the awareness of the need for internationalising JA source texts is growing, the lack of a systematised methodology for managing JA source issues for human translation (HT) remains a major challenge for the whole translation industry. In response, this paper proposes a set of 'negative translatability indicators' (NTIs —

borrowing O'Brien's term from MT research (2005)) that correlate with translation errors, suggests rewrite/pre-editing rules, and presents the result of a corpus-based experiment conducted to establish the frequency of each NTI and assess the effectiveness of eliminating them.

### 1.2  Background to the present study

As a precursor to the present study, He (2018) presented the analysis of 11 publicly available ZH-CN translations of JA CSR reports (totaling 24,001 characters) with the following two aims: (1) to develop and validate an error typology that accounts for not only TT errors but also problematic features of source texts (STs); (2) to identify the type and frequency of translation errors. 1,087 errors were identified of which 530 concerned accuracy, 517 fluency, 39 cohesion and 1 terminology.

The number of accuracy and fluency errors identified supports the industry observation that ZH-CN translators in general lack competency. The process of identifying and labelling errors revealed that when certain features appear in the ST, the possibility of translators making errors increases. Based on the errors identified in He (2018), this paper establishes an *NTI set* which consists of a list of NTIs and the corresponding rewrite/pre-editing rules.

### 1.3  Research questions

Given the hypothesis that avoiding NTIs in JA can improve the quality of human translation of CSR reports into ZH-CN, the present research questions (RQs) are:

RQ1:  Do translation errors found in JA to ZH-CN translations of CSR reports published by major Japanese companies relate consistently to NTIs in the source texts?

RQ2:  How frequently do these NTIs occur?

RQ3:  To what extent can avoiding NTIs (by rewriting them with alternative expressions) improve the quality of ZH-CN translation of CSR reports?

To answer RQ1, I analysed the errors identified in He (2018), established the connection between the errors and source features, and formulated an NTI set specifically for Japanese CSR reports. I establish how frequent these NTIs are in a much larger corpus (500,000 characters) using the Sketch Engine corpus tool and regular expression in order to answer RQ2. To answer 3, I conducted a corpus-based experiment to gauge the impact of each NTI by assessing the effectiveness of eliminating it via a pre-editing process. Hutchins and Somers (1992, p. 151) define 'pre-editing' as "checking source texts for forseeable problems for the system and trying to eradicate them", "the reformulation of the text using a 'controlled language'" being "its extreme form". This study adopts Hutchins and Somers' definition of 'pre-editing' that covers both 'identification of problems in STs' and 'rewriting of problematic STs with alternative expressions'.

## 2. Related work

According to Nyberg et al. (2003, p. 245), "[b]oth humans and computers may experience difficulties in understanding and translating natural language, due to its inherent ambiguity and complexity. Controlled languages (CLs) address this problem by defining guidelines for and restrictions on the language which is used to author texts", which are then translated into a large number of target languages. Such is the approach adopted here.

This section defines controlled natural languages (CNLs), reviews Japanese-based controlled languages (CLs) and the notion of NTI.

### 2.1 Controlled language

According to Kuhn (2014, p. 123), "[a] controlled natural language is a constructed language that is based on a certain natural language, being more restrictive concerning lexicon, syntax, and/or semantics, while preserving most of its natural properties". Schwitter (2002) categorises CNLs into three groups based on different purposes they fulfil. The purposes are: (1) to help to prepare technical manuals so that these documents are both clear and unambiguous for human readers; (2) to make multilingual machine translation of technical documents more effective and efficient; (3) to make it easier for authors to write unambiguous, complete, and consistent specifications and to make it feasible for machine to acquire knowledge, to prove theorems, or to build models. According to Kuhn (2014, p. 125), these purposes emerged at different points in time, Group (1) is the oldest, Group (2) emerging later, while Group (3) is the most recent (and need not further concern us here). O'Brien (2003) divides English-based CLs into two categories: human-oriented controlled language (HOCLs) and machine-oriented controlled languages (MOCLs). The objective of a HOCL is to improve readability and comprehensibility whereas the primary objective of a MOCL is to improve machine translatability.

It is important to note that CLs are primarily intended for use at the point of authoring, that is, with a pre-emptive purpose. Thus, syntactic rules are typically formulated as 'Avoid pattern P', yet with no explicit indication of the preferred substitution. In contrast, lexical rules are typically in the form 'Do not use X, instead use Y', that is, they provide an explicit rewrite alternative.

### 2.2 Japanese-based CLs

Pioneering work on Japanese CNLs dates back to Nagao et al. (1984), who devised a controlled grammar to assist authors in producing syntactically unambiguous Japanese for machine translation. More recently, Ogura et al. (2010) propose their so-called STJ (Simplified Technical Japanese) rule set, which they claim has around 50 rules to flag problematic source issues. These rules were used to customise acrolinx IQ[4] for optimising the quality of source texts. Their efficacy was demonstrated by comparing the machine

translation output of the original source texts with that of the rewritten texts; however only six of the rules were tested. Hartley et al. (2012) formulated two sets of authoring guidelines for technical documents in Japanese: 20 guidelines for consumer user manuals and 10 guidelines for internal company documents. The former were manually identified from a parallel corpus with reference to Ogura et al. (2010), and the latter were based on general technical and business writing guidebooks. Their efficacy was investigated in terms of both the readability of the Japanese source text (which fits group (1) of Schwitter's classification) and the quality of the English MT output (Schwitter's group (2)). To promote "Technical Japanese" – intended to improve the understandability and machine-translatability of technical information – Japan Patent Information Organisation proposed seven categories with 27 rules at the sentence, clause/phrase and word levels (Japio, 2018). To improve machine translatability of Japanese municipal documents, Miyata (2017) formulated 22 CL rewriting rules collected from general and technical writing guidelines, and 38 CL rewriting rules derived from trial-and-error experiments, all of which are MT-oriented.

Kuhn (2014) observed that 22% of English-based CLs have translatability as their goal (p. 142); and in most cases, machine translatability is the focus. Miyata (2017, p. 44) also pointed out that there exists very little precedent in the literature reporting the results of experiments on human translatability. As an exception, Spyridakis et al. (1997) reported the results of a study testing the human translatability of Simplified English (SE) into Spanish, Chinese and Japanese. The results revealed that SE was translated significantly better by native Spanish speakers than by Chinese speakers. One of their assumptions was that the linguistic similarity of Spanish to English is greater than that of Chinese to English, which consequently improves the translation quality of English to Spanish and has some positive effect on the ease of translation. This implies that the effectiveness of a CL also depends on the particular language pair. In other words, CL rules designed to improve Japanese to English translatability may not have the same effect on Japanese to Chinese translation. Furthermore, existing Japanese-based CL rules aim to improve understandability for humans and machine-translatability of industrial, technical or municipal information, while the present research targets the understandability of JA hybrid texts for translators working into ZH-CN.

### 2.3  Negative Translatability Indicator (NTI)

Negative Translatability Indicator (NTI) is a notion coined by O'Brien (2005): It is defined as "a linguistic feature, either stylistic or grammatical, that is known to be problematic for MT" (p. 38). A CL rule can be understood as a guideline to eliminate one or multiple NTI(s). In the MT domain, avoiding NTIs through pre-editing has been shown to improve output quality. (Hartley et al., 2012; Miyata et al., 2016).

This paper formulates NTIs with regard to these previous studies. The purpose of the NTIs proposed in Section 3 fits in group (1) of Schwitter's (2002) classification — to help to prepare clear and unambiguous source documents for human readers. The specificity

of my goal is to target a special class of reader – the translator – as the beneficiary of a pre-editing process. Kuhn (2014, p. 126) summarised nine properties of CNLs as below, any two of which can overlap.

A. The goal is comprehensibility.
B. The goal is translation.
C. The goal is formal representation (including automatic execution).
D. The language is intended to be written.
E. The language is intended to be spoken.
F. The language is designed for a specific narrow domain.
G. The language originated from academia.
H. The language originated from industry.
I. The language originated from a government.

My study targets properties A, B, D, F and H. Equally, it aims to be an HOCL to improve readability and comprehensibility for the benefit of translators.

## 3. NTI identification and rule formulation

While (as noted in Section 2.1) CLs are designed for pre-emptive use at the point of authoring, the present research addresses the issue of existing, problematic (source) texts. In this post-hoc scenario the formulation of explicit rewrite rules for not only lexical but also syntactic patterns is essential. Thus I define an *NTI set* as a list of NTIs and the corresponding rewrite/pre-editing rules. There are basically two approaches to formulating such sets: to re-use existing rules, or to create rules from scratch. In the MT domain, obtaining original rules by analysing MT errors and identifying problematic lexical or syntactic patterns is a well-tried approach. Compared to English-based CLs as reviewed by Kuhn (2014), the varieties of Japanese-based CLs are scarce, and very few make public the full set of their rule, Japio (2013/2018) being an exception. Many books, such as JTCA (2011/2016), suggest rules for authoring Japanese technical documents to reduce their ambiguity and complexity. Section 3.1 presents the method for identifying NTIs, and Section 3.2 describes the process of formulating the HT-oriented rewrite/pre-editing rules.

### 3.1 Method

Although the NTI set this study aims to construct has a different purpose, exploring such MT-oriented CL rules and technical writing guidelines betters the author's understanding of controlled Japanese, and guides the identification of NTIs critical for HT.

Thus, I analysed 1,087 labelled errors identified in He (2018), linking them to their STs to determine whether some recurrent lexical or syntactic pattern caused the

translation errors. If an error is deemed to be incurred by a problematic feature in the ST, 'NTI' is marked as shown in Table 1. The identification is performed by the author of the present paper alone.

Table 1.　NIT idenfiication process

| JA | ZH-CH | Agreed errors | NTI? |
|---|---|---|---|
| **多様な人材**の活躍支援 | 为多样化人才施展才华提供支持 | 3: TT-Accuracy-Misrepresentation | |
| 多様な人材の活躍**支援** | 为多样化人才施展才华**提供支持** | 19: TT-Fluency-Awkward/Unidiomatic | NTI |
| ※「らしく×らしく」は、ダイバーシティを前提に「自分らしく」「女性らしく」「私らしく」などを**イメージ**して命名 | ※ "RASHIKU × RASHIKU" 以人才多样化为前提，并以"自我本色"、"女性本色"、"真我本色"为**形象**而命名 | 3: TT-Accuracy-Misrepresentation | NTI |
| 「JWEF 女性技術者に贈る奨励賞」**審査員**特別賞を受賞 | 国誉员工荣获名为"赠与 JWEF 女性技术人员的鼓励奖"的**审查员**特别奖 | 8: TT-Accuracy-False friend | |

O'Brien (2003) analysed the function of a HOCL (AECMA SE) and proposed a methodology for classifying CL rules/NTIs based on previous taxonomies (Mitamura & Nyberg, 1995; Adriaens, 1994), which is adopted in this paper (Table 2).

Table 2.　O'Brien (2003)'s CL rule classification framework

| No. | Category | Baseline |
|---|---|---|
| 1 | Lexical | If the primary function of the rule is to influence word selection or to influence meaning by word selection, ten it is classified as a lexical rule. |
| 2 | Syntactic | If the primary function of the rule is to influence syntax, then the rue is classified as a syntactic rule. |
| 3 | Textual | The "Textual" category is subdivided into "Text Structure" and "Pragmatic" rules, depending on the primary function of the rule in question. If the primary function of the rule is to influence the graphic layout of, or information load, in the text, then it is classified as a Text Structure rule. If the primary function of the rule is to inluence text purpose or reader response to the text, then it is classified as a pragmatic rule. |

O'Brien (2003) also provided a more fine-grained classification, seen in examples of categories in Table 3.

### 3.2 Formulation of NTIs and rewrite rules

Through analysis of the 1,087 errors, 180 were found to be associated with NTIs, most of which can be categorised according to O'Brien's typology. However, some features (syntactic patterns and stylistic issue) are specific to Japanese texts. For example, 'Vsahen-

stem を検討する' is a structural NTI but does not fall into any sub-categorisations of the Syntactic or Textual group in O'Brien's typology.

NTIs thought to have triggered the translation errors are grouped into approximately 100 types which in turn are found to instantiate 16 of O'Brien's 61 sub-categories. This paper takes 38 NTIs shown in Table 3 — 20 lexical, 15 syntactic and 3 textual — which are a representative selection of examples from the 16 O'Brien categories. It establishes the frequency of each NTI and tests the effectiveness of eliminating them by conducting the corpus-based experiment described in Section 4. Symbols such as Vpassive (passive form of verb), Vinf (informal form of verb), Vmasu (*masu*-stem of verb) and Vsahen-stem (sahen-stem of verb) are adopted from Makino and Tsutsui (2008/2018) to indicate the forms of the words. Information about frequency of each NTI is added to Table 3 for later reference to answer RQ2 in Section 4.3.

Table 3.   38 NTIs tested in this research

| No. | Category | NTI | Frequency (per million words) |
|-----|----------|-----|-------------------------------|
| 01 | Lexical - Vocabulary Usage | 支援 | 108 (194.55 ) |
| 02 | | 反映 | 58 (104.48 ) |
| 03 | | 発信 | 30 (54.04 ) |
| 04 | | 評価 | 121 (217.96 ) |
| 05 | | 貢献 | 262 (471.96 ) |
| 06 | | 活用 | 156 (281.01 ) |
| 07 | | 追求 | 47 (84.66 ) |
| 08 | | 配信 | 6 (10.81 ) |
| 09 | | 決定 | 44 (79.26 ) |
| 10 | | 独自 | 120 (216.16 ) |
| 11 | | 最適 | 55 (99.07 ) |
| 12 | | 確実 | 50 (90.07 ) |
| 13 | | 現場 | 165 (297.22 ) |
| 14 | | 考え | 27 (48.64 ) |
| 15 | | イメージ | 16 (28.82 ) |
| 16 | | ダイバーシティ | 90 (162.12 ) |
| 17 | | モビリティ | 21 (37.83 ) |
| 18 | | ニーズ | 122 (219.77 ) |
| 19 | | トータル | 16 (28.82 ) |
| 20 | Lexical - Prefix/Suffix Usage | 化 | 1,174 (2,114.80 ) |
| 21 | Syntactic - Structure | A や B、C | 77 (138.70 ) |
| 22 | | A や B などの C | 137 (246.79 ) |
| 23 | | …Vmasu、…Vinf ため | 4 (7.21 ) |
| 24 | | N の Vsahen-stem を行う | 152 (273.80 ) |
| 25 | | N1 に向けた N2 | 159 (286.42 ) |

| No. | Category | NTI | Frequency (per million words) |
|---|---|---|---|
| 26 | | A、B、C の No.+Counter (*No.>3) | 18 (32.42 ) |
| 27 | | Use [Vinf+N] to indicate potential | 4,914 (8,851.90 ) |
| 28 | | Vsahen-stem を実現する | 50 (90.07 ) |
| 29 | | Vsahen-stem が進められる | 4 (7.21 ) |
| 30 | | V1sahen-stem・V2sahen-stem | 813 (1,464.51 ) |
| 31 | | N に向けて | 153 (275.61 ) |
| 32 | | Vsahen-stem を検討する | 11 (19.81 ) |
| 33 | Syntactic - Punctuation | Use of centred dot (・) | 3241 (5837.04 ) |
| 34 | | Use of full-width slash (／) | 149 (268.35 ) |
| 35 | Syntactic - Ellipsis | Use [N+ 『』or「」] to indicate the reference | 10 (18.01 ) |
| 36 | Textual - Information Load | The antecedent before として is too long (more than 30 characters) | 111 (199.91 ) |
| 37 | | The antecedent before 目的とする is too long (more than 20 characters) | 51 (91.85 ) |
| 38 | | The antecedent before において is too long (more than 20 characters) | 94 (169.29 ) |

Rewrite rules for lexical NTIs are formulated by offering a substitute expression to be used in a restricted context. For example, if '考え' (No.14) is used in a sentence with the action subject being a company, replace it with '予定' if it refers a plan, and replace it with '理念' or '方針'if it refers to a concept or policy. Rewrite rules for syntactic NTIs, on the other hand, are formulated with alternative structure. For example, No.24 ('N の Vsahen-stem を行う') is instructed to be replaced with 'N+ を +Vsahen-stem+ する'. For textual NTIs, the rewrite rule is to make long modifier an independent sentence.

## 4. Rewriting/pre-editing experiment

This Section addresses RQ2 (frequency of NTIs) and RQ3 (effectiveness of eliminating NTIs). To that end, a rewriting/pre-editing experiment was conducted to verify the impact of each NTI formulated in Section 3 in terms of the extent to which its elimination can improve translation quality. Section 4.1 describes the method adopted. Section 4.2 introduces the setup. Section 4.3 discusses the results.

### 4.1 Methods
Zanettin (2012, p. 7) states "[i]n the field of corpus linguistics, a corpus is by default assumed to be a collection of texts in electronic format which are processed and analysed using software specifically created for linguistic research".

The purpose of building such a JA CSR corpus is to establish the frequency of each NTI identified in Section 3.2 in a large corpus which is representative of CSR reports in general, and to extract samples that contain the NTIs in order to conduct an experiment to assess whether eliminating these NTIs can improve translation quality.

The corpus is a collection of 13 JA CSR reports published by 13 different Japanese companies in Fiscal 2016 and earning Year 2017 Environmental Communication Awards hosted by the Japan Ministry of the Environment. Thus, they are representative, all the more because they are the only the award-winning companies that published ZH-CN CSR reports in 2017.

All of the JA CSR reports can be downloaded from each company's website in PDF format. After extraction from PDF files and cleaning, the texts were uploaded to Sketch Engine, a web-based corpus tool which annotates texts using the Japanese MeCab[5] part-of-speech (POS) tagset[6]. It first segments words and then provides annotations with predefined POS categories, inflection type and inflection form, enabling search not only by lemma but also syntactic patterns using POS tags. In addition, Sketch Engine can provide statistical information about the frequency of each search result, to help answer RQ2 (frequency of NTIs). Knowing how frequently each NTI occurs in a large corpus can make clear how far-reaching the influence can be when eliminating a particular NTI.

Another useful function of Sketch Engine is that Corpus Query Language (CQL) can be used to search for complex grammatical or lexical patterns combining with regular expressions and wildcards. "Regular expression are patterns of characters where wildcards are used to allow for further flexibility" (Saldanha & O'Brien, 2014, p. 89). For example, the regular expression ".{20,} において" searches strings that contain "において" (*nioite*) before which there are 20 or more characters as the antecedent. In practical terms, this allows the identification of all instances of infringements of NTI No.38, which says 'The antecedent before において is too long (20+ characters)'. As examples of wildcards, an asterisk (*) stands for zero or more characters and a question mark (?) stands for exactly one character. Figure 1 illustrates the displayed screen when searching for a Japanese word in Sketch Engine.

Table 4 shows the CQL used for searching NTI No.16, 22 and 24 using lemma and Japanese MeCab POS tagset. The result for all 38 NTIs cannot be presented here due to space constraints.

After corpus creation and query formulation, the next step is to extract samples from the corpus for the corpus-based experiment detailed in Section 4.2. Saldanha and O'Brien (2014, p. 207) state that "[a] sample is a small part of a group that is taken to be representative of the whole group, and therefore studying the sample allows the researcher to make inferences about the whole group". This research adopts random sampling "which is considered the 'gold standard' of sampling and refers to the ideal scenario where every member of the population being studied has an equal chance of being selected as a participant in the research project" (Saldanha & O'Brien, 2014, p. 207). For each NTI, if using CQL or a simple query in Sketch Engine can identify the target, 20 random samples
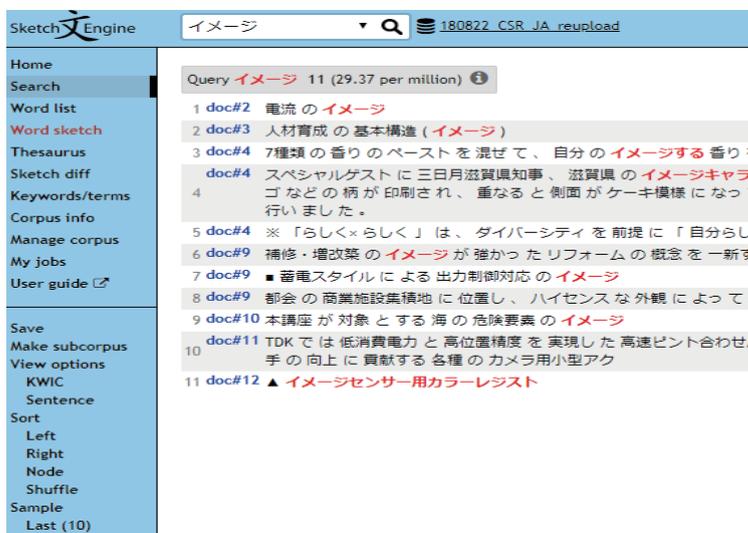
Figure 1.   Search result for the Japanese word "イメージ"

Table 4.   Examples of CQL and frequency of search result

| NTI No. | Category | NTI | CQL | Frequency |
|---|---|---|---|---|
| 16 | Lexical-Vocabulary Usage | ダイバーシティ | "ダイバー" "シティ" | 90 (162.12 per million) |
| 22 | Syntactic-Structure | AやBなどのC | [tag="名詞.*"]{1.}"や"[tag="名詞.*"]{1.}[lemma="など"]"の"[tag="名詞.*"]{1.} | 137(246.79 per million) |
| 24 | Syntactic - Structure | NのV sahen-stemを行う | "の"[tag="名詞-普通名詞-サ変可能"]"を"[lemma="行う"] | 152(273.80 per million) |

were extracted Sketch Engine using an in-built function.

All samples and data were managed in a master Excel file. Translation and error identification/labelling were also performed using Excel.

## 4.2 Experimental setup: task design & implementation

This experiment takes three factors to assess the impact of each NTI: (1) the frequency of the NTI in a large corpus; (2) what type of translation errors are induced by the NTI; (3) whether rewriting the NTI improves the quality of the translation.

Using the methods described in Section 4.1, a corpus of 555,135 tokens / 425,302 words / 29,162 segments was built. Using this corpus, the following steps were taken to establish the frequency of each NTI, what type of translation errors can be induced by the NTI, and whether rewriting the NTI improves translation quality.

**Step 1.** Formulate a CQL or a regular expression to find each NTI, and establish its

frequency.

**Step 2.** Extract 20 random samples for each NTI, and pick the first four valid samples.

**Step 3.** Divide the samples into two sets (Set A and Set B, each containing two different samples of the same NTI), send Set A to Translators A and B, and Set B to Translators C and D for translation into Chinese. This yields the set of target texts derived from the original source texts (with NTIs), henceforth 'TT-original'.

**Step 4.** Analyse the translation results and formulate initial rewrite rules.

**Step 5.** Work with the rewriter (Japanese native speaker who is a professional English to Japanese reviser) to rewrite the samples. The principle of rewriting/pre-editing is to disambiguate the source text by substituting the NTI with an alternative expression while preserving the intended meaning as much as possible. Since only the NTI for testing can be modified, any other NTI(s) contained in the same sample is left as is.

**Step 6.** Send the rewritten samples in Set A to Translators A and B and those in Set B to Translators C and D. This yields the set of target texts derived from the rewritten source texts (without NTIs), henceforth 'TT-rewritten'.

**Step 7.** Perform accuracy evaluation by asking two Chinese native speakers – professional translators previously employed in He (2018) as assessors – to evaluate separately whether the translation of the NTI and the translation of the pre-edited text deliver the intended meaning. Three options were available to the evaluators: 1. The translation is accurate with respect to the highlighted source span, 2. The translation is not accurate with respect to the highlighted source span, and 3. It is not possible to decide if the translation is accurate because the meaning of the source span is not clear. The evaluators were given ST-original or ST-rewritten in the 'Japanese' column, TT-original or TT-rewritten in the 'Chinese translation' column, and evaluation instructions in Chinese in an Excel spreadsheet. The evaluators were requested to enter '1', '2' or '3'. See Table 5 for sample results.

Table 5.   Accuracy evaluation screen

| Japanese | Chinese transtation | 根据上下文判断译文能否传述原文（划线部分）想要表达的意思<br>1.　能传达<br>2.　不能传达<br>3.　无法判断，因为原文的意思不明确或无法理解 |
|---|---|---|
| 教育格差是正を**支援**する教材提供プロジェクト | 支援缩小教育差距的免费提供教材项目 | 2 |
| 当社は、公益財団法人日本経済センターが主催する日経 GSR 研究会のプログラムの一つである「日経 GSR 学生アイデア・コンテスト」を第 1 回から**支援**しています。 | 该公司从第一届开始就一直支援"日经 GSR 学生创意大赛"活动，这是由公益财团法人日本经济研究中心举办的日经 GSR 研究会的项目之一。 | 2 |

**Step 8.** Perform fluency ranking evaluation by asking three Chinese native speakers – majors in Chinese language now working as Chinese teachers in high school – to compare TT-original and TT-rewritten, focusing on NTI related spans. Four options were given to the evaluators: (1) version 1 is more fluent than version 2, (2) version 2 is more fluent than version 1, (3) version 1 and version 2 are equally fluent, (4) version 1 and version 2 are equally disfluent/unnatural. As shown in Table 4.3, the evaluators were given "Version 1", "Version 2" and evaluation instructions in Chinese in an Excel spreadsheet. The evaluators were blind as to whether a given translation was TT-original or TT-rewritten as both "Version 1" and "Version 2" were a mix of TT-original and TT- rewritten, the key being known only to the author. The evaluators were requested to enter '1', '2', '3' or '4' (see Table 6). After the evaluation the key was used to reassign these numbers such that '1' means TT-original is more fluent than TT-rewritten, '2' means TT-rewritten is more fluent than TT-original, '3' means the two are equally fluent, and '4' means the two are equally disfluent/unnatural. See Table 6 for sample results.

Table 6.　Fluency ranking evaluation screen

| 版本 1 | 版本 2 | 请判断划线部分哪个版本作为中文更自然流畅，并从 1 至 4 中进行选择<br>1.　版本 1 比版本 2 更自然流畅<br>2.　版本 2 比版本 1 更自然流畅<br>3.　版本 1 和版本 2 同样自然流畅<br>4.　版本 1 和版本 2 都不自然，无法比较 |
|---|---|---|
| <u>支援缩小教育差距</u>的免费提供教材项目 | <u>改善教育差距</u>的教材免费提供项目 | 4 |
| 该公司从第一届开始就一直<u>支援</u>"日经 GSR 学生创意大赛"活动，这是由公益财团法人日本经济研究中心举办的日经 GSR 研究会的项目之一。 | 本公司自第一届"日经 GSR 学生创意大赛"就开始提供<u>赞助</u>，这是由公益财团法人日本经济研究中心主办的日经 GSR 研究会项目之一。 | 2 |

**Step 9**. Compare the fluency evaluation and accuracy evaluation results to ascertain the impact of each NTI and the effectiveness of the rewrite rules and thus their readiness for adoption as pre-editing rules.

### 4.3 Results and analysis

Following Step 1 described in Section 4.2, Table 3 shows the frequency of each NTI. The degree of 'noise' in the search result differs among NTIs. For example, NTI No. 20 (use of suffix '化'), the CQL for which is [word=".*[^進变強文酸美深绿液净悪]"]"化". Although patterns to be ruled out have been added to the CQL in order to reduce invalid

search results, it is not possible to cover all patterns. Another example is NTI No. 27 (Use [Vinf+N] to indicate potential), the CQL for which is [tag="動詞.*" & infl_form="連体形-一般"] [!word="(ため|こと|もの|な)" & tag="名詞.*"]. Since '[Vinf+N]' can indicate more than potential, the search result inevitably contains noise.

Tables 7 and 8 show partial results of the accuracy evaluation. The complete table cannot be presented due to space constraints. In Table 8, a change from '2' to '1' or from '3' to '1' or '2' is regarded as a *positive* result. That is because a change from '2' to '1' indicates that TT-original was judged to have failed to deliver the intended meaning of the marked source span (NTI) while TT-rewritten was judged to have accurately delivered the meaning of the marked source span (substitution of NTI); that is, eliminating the NTI had a good impact on translation quality. In addition, a change from '3' to '1' or '2' is also deemed to indicate a positive impact in eliminating an NTI, because it means that the evaluator who cannot understand the meaning of ST-original (because of the NTI) can understand that of ST-rewritten and is able to make a sensible judgement. On the other hand, a change from '1' to '2' is regarded as a *negative* result, since TT-original is judged to deliver the intended meaning of the marked source span whereas TT-rewritten is not; that is, the rewriting had a bad impact on translation quality. There are instances where '1' remains '1' and '2' remains '2', meaning eliminating an NTI had no impact on the translation quality. Such instances are regarded as *neutral* results.

Table 7.   Partial accuracy evaluation result (NTIs No. 1 to 3 with four samples each)

| NTI No. | Translator A | | | | Translator B | | | | Translator C | | | | Translator D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TT-o Eva1 | TT-r Eva1 | TT-o Eva2 | TT-r Eva2 | TT-o Eva1 | TT-r Eva1 | TT-o Eva2 | TT-r Eva2 | TT-o Eva1 | TT-r Eva1 | TT-o Eva2 | TT-r Eva2 | TT-o Eva1 | TT-r Eva1 | TT-o Eva2 | TT-r Eva2 |
| 1.1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | | | | | | | | |
| 1.2 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | | | | | | | | |
| 1.3 | | | | | | | | | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 1 |
| 1.4 | | | | | | | | | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 1 |
| 2.1 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | | | | | | | | |
| 2.2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | | | | | | | | |
| 2.3 | | | | | | | | | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 |
| 2.4 | | | | | | | | | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 |
| 3.1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | | | | | | | | |
| 3.2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | | | | | | | | |
| 3.3 | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 |
| 3.4 | | | | | | | | | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 |

Table 8 summarises the number of positive, negative and neutral results of the accuracy evaluation results for all 38 NTIs by translator. The evaluation was done by two evaluators (Eva1 and Eva2) separately. For 'Neutral result', the table also shows the breakdown of the number of judgements where '1' (translation is accurate) remains as '1', and '2' (translation is inaccurate) remains as '2'. A discrepancy between the two evaluators can be observed regarding the number of positive results, but the number of negative results is relatively low and the number of neutral results is very high.

Table 8. Accuracy evaluation results summary (all 38 NTIs)

| Evaluator | Impact of NTI | Translator A | Translator B | Translator C | Translator D |
|---|---|---|---|---|---|
| Eva1 | Positive result | 25 | 12 | 18 | 24 |
| | Negative result | 7 | 17 | 7 | 7 |
| | Neutral result | 44 | 47 | 51 | 45 |
| | | *1-1 22 | *1-1 15 | *1-1 17 | *1-1 16 |
| | | 2-2 22 | 2-2 32 | 2-2 34 | 2-2 29 |
| | | | | | |
| Eva2 | Positive result | 32 | 41 | 42 | 47 |
| | Negative result | 11 | 2 | 4 | 4 |
| | Neutral result | 33 | 33 | 30 | 25 |
| | | *1-1 8 | *1-1 17 | *1-1 20 | *1-1 17 |
| | | 2-2 25 | 2-2 25 | 2-2 105 | 2-2 8 |

Table 9 shows partial (due to space constraints) fluency evaluation results. Since '1' indicates TT-original is more fluent than TT-rewritten, it is regarded as a negative result; '2' indicating that TT-rewritten is more fluent than TT-original is regarded as a positive result; '3' (TT-original and TT-rewritten are equally fluent) and '4' (Cannot compare because both TT- original and TT- rewritten are not fluent) are regarded as neutral results.

Table 9. Partial fluency evaluation result (NTIs No.1 to 3 with four samples each)

| NTI No. | Translator A | | | Translator B | | | Translator C | | | Translator D | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Eva1 | Eva2 | Eva3 | Eva1 | Eva2 | Eva3 | Eva1 | Eva2 | Eva3 | Eva1 | Eva2 | Eva3 |
| 1.1 | 2 | 4 | 1 | 2 | 2 | 4 | | | | | | |
| 1.2 | 2 | 2 | 2 | 3 | 1 | 2 | | | | | | |
| 1.3 | | | | | | | 2 | 2 | 2 | 2 | 3 | 3 |
| 1.4 | | | | | | | 1 | 1 | 1 | 2 | 2 | 4 |
| 2.1 | 4 | 2 | 2 | 1 | 2 | 4 | | | | | | |
| 2.2 | 1 | 2 | 2 | 1 | 3 | 2 | | | | | | |
| 2.3 | | | | | | | 2 | 2 | 2 | 2 | 1 | 2 |
| | | | | | | | 2 | 2 | 2 | 2 | 2 | 2 |
| 3.1 | 1 | 2 | 2 | 2 | 1 | 4 | | | | | | |
| 3.2 | 1 | 1 | 2 | 3 | 3 | 3 | | | | | | |
| 3.3 | | | | | | | 2 | 2 | 2 | 1 | 3 | 3 |
| 3.4 | | | | | | | 1 | 1 | 1 | 3 | 2 | 3 |

In an attempt to identify any correlation between the accuracy results and the fluency results and thereby any relationship between the impact of each NTI on accuracy and on fluency, positive results from both accuracy and fluency evaluations are labelled as 'a', neutral results 'b' and negative results 'c'. As shown in Table 10, all 38 NTIs are ranked based on the number of c and a in terms of accuracy and fluency respectively, '38' being the best and '1' the worst. The ranking prioritises the positives over negatives while disregarding neutral results. The lower the number of 'c' and the higher the number of

'a' an NTI has, the more positive the impact on accuracy or fluency that NTI is deemed to have. The accuracy and fluency results are presented alongside sorted by rank respectively. What can be observed from Table 10 is that lexical NTIs appear at the top of the rankings in terms of both accuracy and fluency, even if they are not the same NTI.

Table 10.   Positive, negative and neutral impact of each NTI on accuracy and fluency

| NTI No. | Category | Accuracy (#of) | | | | NTI No. | Category | Fluency (#of) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a | b | c | rank | | | a | b | c | rank |
| 8 | Lexical - Vocabulary Usage | 8 | 8 | 0 | 38 | 27 | Syntactic - Structure | 11 | 10 | 3 | 38 |
| 6 | Lexical - Vocabulary Usage | 6 | 10 | 0 | 37 | 2 | Lexical - Vocabulary Usage | 17 | 3 | 4 | 37 |
| 4 | Lexical - Vocabulary Usage | 4 | 12 | 0 | 36 | 6 | Lexical - Vocabulary Usage | 13 | 7 | 4 | 36 |
| 13 | Lexical - Vocabulary Usage | 4 | 12 | 0 | 36 | 14 | Lexical - Vocabulary Usage | 12 | 8 | 4 | 35 |
| 18 | Lexical - Vocabulary Usage | 4 | 12 | 0 | 36 | 19 | Lexical - Vocabulary Usage | 12 | 8 | 4 | 35 |
| 11 | Lexical - Vocabulary Usage | 12 | 3 | 1 | 33 | 8 | Lexical - Vocabulary Usage | 11 | 9 | 4 | 33 |
| 17 | Lexical - Vocabulary Usage | 12 | 3 | 1 | 33 | 9 | Lexical - Vocabulary Usage | 6 | 14 | 4 | 32 |
| 27 | Syntactic - Structure | 10 | 5 | 1 | 31 | 1 | Lexical - Vocabulary Usage | 13 | 6 | 5 | 31 |
| 2 | Lexical - Vocabulary Usage | 9 | 6 | 1 | 30 | 38 | Textual - Information Load | 13 | 6 | 5 | 31 |
| 1 | Lexical - Vocabulary Usage | 8 | 7 | 1 | 29 | 33 | Syntactic - Punctuation | 9 | 10 | 5 | 29 |
| 25 | Syntactic - Structure | 8 | 7 | 1 | 29 | 18 | Lexical - Vocabulary Usage | 8 | 11 | 5 | 28 |
| 31 | Syntactic - Structure | 8 | 7 | 1 | 29 | 30 | Syntactic - Structure | 7 | 12 | 5 | 27 |
| 35 | Syntactic - Ellipsis | 8 | 7 | 1 | 29 | 34 | Syntactic - Punctuation | 7 | 12 | 5 | 27 |
| 15 | Lexical - Vocabulary Usage | 7 | 8 | 1 | 25 | 21 | Syntactic - Structure | 6 | 13 | 5 | 25 |
| 20 | Lexical - Prefix/Suffix Usage | 7 | 8 | 1 | 25 | 13 | Lexical - Vocabulary Usage | 10 | 8 | 6 | 24 |
| 21 | Syntactic - Structure | 7 | 8 | 1 | 25 | 25 | Syntactic - Structure | 10 | 8 | 6 | 24 |
| 10 | Lexical - Vocabulary Usage | 5 | 10 | 1 | 22 | 7 | Lexical - Vocabulary Usage | 9 | 9 | 6 | 22 |
| 24 | Syntactic - Structure | 5 | 10 | 1 | 22 | 4 | Lexical - Vocabulary Usage | 8 | 10 | 6 | 21 |
| 36 | Textual - Information Load | 5 | 10 | 1 | 22 | 26 | Syntactic - Structure | 7 | 11 | 6 | 20 |
| 5 | Lexical - Vocabulary Usage | 4 | 11 | 1 | 19 | 16 | Lexical - Vocabulary Usage | 5 | 13 | 6 | 19 |
| 30 | Syntactic - Structure | 1 | 14 | 1 | 18 | 22 | Syntactic - Structure | 12 | 5 | 7 | 18 |
| 34 | Syntactic - Punctuation | 10 | 4 | 2 | 17 | 5 | Lexical - Vocabulary Usage | 10 | 7 | 7 | 17 |
| 14 | Lexical - Vocabulary Usage | 8 | 6 | 2 | 16 | 32 | Syntactic - Structure | 9 | 8 | 7 | 16 |
| 26 | Syntactic - Structure | 8 | 6 | 2 | 16 | 20 | Lexical - Prefix/Suffix Usage | 8 | 9 | 7 | 15 |
| 22 | Syntactic - Structure | 7 | 7 | 2 | 14 | 10 | Lexical - Vocabulary Usage | 6 | 11 | 7 | 14 |
| 37 | Textual - Information Load | 7 | 7 | 2 | 14 | 24 | Syntactic - Structure | 6 | 11 | 7 | 14 |
| 38 | Textual - Information Load | 6 | 8 | 2 | 12 | 37 | Textual - Information Load | 6 | 11 | 7 | 14 |
| 7 | Lexical - Vocabulary Usage | 5 | 9 | 2 | 11 | 35 | Syntactic - Ellipsis | 8 | 8 | 8 | 11 |
| 23 | Syntactic - Structure | 5 | 9 | 2 | 11 | 3 | Lexical - Vocabulary Usage | 8 | 8 | 8 | 11 |
| 28 | Syntactic - Structure | 5 | 9 | 2 | 11 | 31 | Syntactic - Structure | 7 | 9 | 8 | 9 |
| 9 | Lexical - Vocabulary Usage | 3 | 11 | 2 | 8 | 17 | Lexical - Vocabulary Usage | 6 | 10 | 8 | 8 |
| 16 | Lexical - Vocabulary Usage | 3 | 11 | 2 | 8 | 23 | Syntactic - Structure | 6 | 10 | 8 | 8 |
| 12 | Lexical - Vocabulary Usage | 7 | 6 | 3 | 6 | 15 | Lexical - Vocabulary Usage | 6 | 9 | 9 | 6 |
| 3 | Lexical - Vocabulary Usage | 2 | 11 | 3 | 5 | 12 | Lexical - Vocabulary Usage | 8 | 6 | 10 | 5 |
| 32 | Syntactic - Structure | 8 | 4 | 4 | 4 | 36 | Textual - Information Load | 5 | 9 | 10 | 4 |
| 19 | Lexical - Vocabulary Usage | 6 | 6 | 4 | 3 | 28 | Syntactic - Structure | 2 | 12 | 10 | 3 |
| 33 | Syntactic - Punctuation | 6 | 6 | 4 | 3 | 11 | Lexical - Vocabulary Usage | 6 | 6 | 12 | 2 |
| 29 | Syntactic - Structure | 3 | 9 | 4 | 1 | 29 | Syntactic - Structure | 5 | 7 | 12 | 1 |

To investigate any relationship between the effectiveness of removing an NTI on accuracy and that on fluency, the scatter chart shown in Figure 2 was created where the horizontal axis shows the accuracy rank and the vertical axis the fluency rank. In Table 10 additional lines are drawn below rank 16 in accuracy and rank 31 in fluency, indicating the boundaries where the number of 'a' far outweighs that of 'c' but is not greater than the number of 'b'. These boundaries serve to delimit four groups in Figure 2: (1) NTIs in the upper-right quadrant are effective on both accuracy and fluency; (2) NTIs in the bottom-right quadrant are effective on accuracy but cause degradation in fluency; (3) NTIs in the upper-right quadrant are effective on fluency but cause degradation in accuracy; (4) NTIs in the bottom-left quadrant are less effective in terms of both accuracy and fluency. The chart illustrates the relative effectiveness of each NTI on both accuracy and fluency. What is observable from Figure 2 is that (1) there is a limited number of NTIs eliminating which improves both accuracy and fluency; (2) accuracy is improved more than fluency.



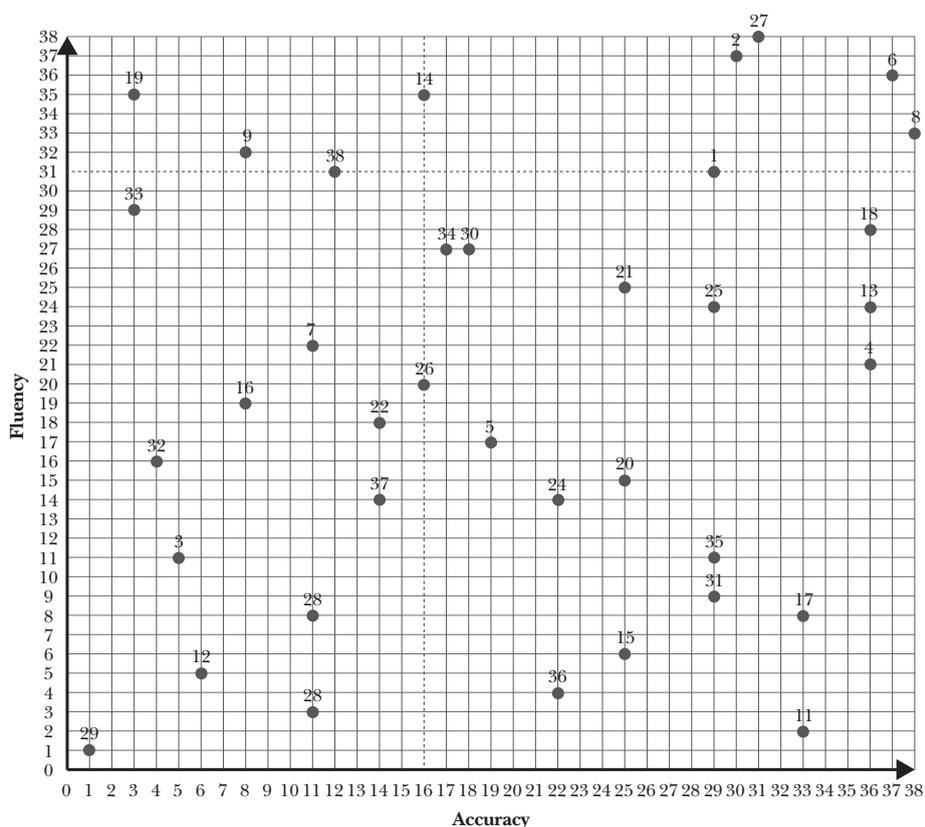Figure 2.   Effectiveness of each NTI on both accuracy and fluency

Consider NTI No.8 ('配信') as an example of Group (1). It has a high rank for both accuracy (a*8, b*8, c*0) and fluency (a*11, b*9, c*4). The Japanese verb '配信' has multiple meanings such as 'make public', 'distribute', 'broadcast', 'deliver', 'feed' and 'publish'. When the verb is identified as an NTI because it often causes mistranslation. The rewrite

rule replaces it with a more explicit expression such as '公開' ('make public') or '発行' ('publish') whichever fits the context. As seen from the result, this NTI rewrite rule has a positive impact on both accuracy and fluency.

Consider NTI No.11 ('最適') as an example of Group (2). It has a high rank for accuracy (a*12, b*3, c*1) but a relatively low rank for fluency (a*6, b*6, c*12). '最適' is a widely used *na*-type adjective which means 'optimum', 'best', 'appropriate ', 'suitable', 'favourable', etc. In the extracted samples, it is used to modify 'business partner' ('最適なお取引先'), 'electricity'('最適な電力'), 'price' ('最適価格') and 'supply' ('最適な供給'), which makes the collocation awkward and the meaning of the STs difficult to understand. Moreover, it is very difficult to find a single substitute adjective that can modify both 'business partner' and 'electricity'. Still, the rewrite rule replaces it with a more explicit expression such as '適した' ('suitable') or 'ちょうど良い' ('optimum'), whichever fits the context. While it improved accuracy, it impaired fluency, the fluency assessor preferring the translation to be as vague as the original source text.

Consider NTI No.19 ('トータル') as an example of Group (3). It has a low rank for accuracy (a*6, b*6, c*4) but a high rank for fluency (a*12, b*8, c*4). As a loan word from the English 'total', it has multiple meanings such as 'overall', 'systemwide', 'general', 'comprehensive' and 'integrated'. In the extracted samples, it is used as an adverb to modify 'transform' and the overall process, and as an adjective to modify 'capability of making proposals'. The interpretation of the word is highly dependent on the context. The rewrite rule replaces the loan word with a Japanese expression such as '総合的' ('comprehensive') or '全体的に' ('fully'), whichever fits the context. However, it is evident that this rewrite rule can improve fluency, but substituting the modifier without making the entire meaning explicit seems to have little impact on accuracy.

Consider NTI No.29 ('Vsahen-stemが進められる') as an example of Group (4). It has a low rank for both accuracy (a*3, b*9, c*4) and fluency (a*5, b*7, c*12). Out of nine 'b's, there are six '2's that remain as '2', which indicates that it is an appropriate candidate but that the rewrite rule needs to be improved.


## 5. Conclusions

Through an analysis of 1,087 errors, the author found 180 errors (approximately 16%) associated with NTIs, which provides answers to research question RQ1 concerning the relationship between translation errors and NTIs.

The answer to question RQ2—which asks if the frequency of each NTI in JA CSR reports can be established—is positive, although some search patterns result in significant noise (i.e., false positives). The normalised frequencies (per million words) provide a basis for prioritising the most widespread NTIs. The CQL expressions used to search lexical or syntactic patterns within the Sketch Engine corpus tool are available for further research.

The answer to question RQ3—the effectiveness of avoiding NTIs in improving translation quality—is presented in Section 4.2. As illustrated in Figure 2, eliminating

6 of the 38 NTIs is considered to have a positive impact on both accuracy and fluency of translation; eliminating 21 NTIs in Group (2) and Group (3) has a positive impact on either fluency or accuracy; eliminating a further 11 NTIs has no positive impact on either fluency or accuracy. Overall, accuracy improves more than fluency.

Inconsistent judgements of both accuracy and fluency can be observed among evaluators. However, as Lommel et al. (2015) have pointed out, in translation evaluation, "it is well known that human judgements of translation show a high degree of variance". Nonetheless, the collection of multiple judgements is a valuable foundation for further research.

An analysis of the results reveals that excessively long sentences have a negative impact on both accuracy and fluency of translation. As seen in Tables 8 and 10, the number of neutral results is very high. One speculation is that a minor change to a small span of text is not effective if the sentence structure is too complex. The length of the random samples extracted from the corpus is long in general. Out of 152 samples for 38 NTIs, 50 contain more than 90 characters, and 27 samples more than 110. As pointed out by Nyberg et al. (2003, p. 245), inherent ambiguity and complexity in STs can make human translation difficult. What was learnt from the initial experiment on the 38 NTIs is that complexity needs to be dealt with first before applying specific rewriting rules for disambiguation.

Compared to pre-emptive CL rules ('Avoid pattern P'), the much more demanding requirement to formulate an explicit rewrite rule for each NTI ('Replace P with Q') emerges as the biggest challenge in pre-editing for HT. Moreover, in the MT arena where the notion of NTI originated, source sentences are selected to test a single NTI pattern and rewrite rule at a time (Miyata 2017). However, in the present HT-oriented research, all sample sentences are extracted from natural data, so that a given sample sentence may include multiple NTIs, which may impair the effectiveness of the target rewrite rule.

A next step is to adopt a new approach to formulating rewrite rules by first segmenting long sentences with a structured method before eliminating NTIs that are related to specific expressions or syntactic patterns. For those NTIs for which the evaluation result remains unconvincing, a cycle of formulating a new rewrite rule, re-translating the sample and re- evaluating the product is envisaged.

**Notes**

1  https://www.jtf.jp/english/
2  Texts that have more than one function are referred to as ʻhybridʼ in both translation studies (Munday, 2016, pp. 114-117) and the industry.
3  Existing from 1990 to February 2011, LISA was a trade body for hardware and software publishers and companies involved in the translation of computer software and other documentation into multiple natural languages. Among its activities, it proposed methodologies and standards that would enable its members to achieve high quality as well as interoperability for tools developed according to these standards.
4  acrolinx IQ is a content optimisation software. https://www.acrolinx.com/
5  http://taku910.github.io/mecab/
6  https://www.sketchengine.eu/tagset-jp-mecab/

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