Translation in the Digital Age

Translation in the Digital Age:

Translation 4.0

Edited by

Carsten Sinner, Christine Paasch-Kaiser and Johannes Härtel

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INTRODUCTION

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We all know these are difficult times for humanities and the arts, and particularly for translation studies. In some countries, academic institutions dedicated to the training of translators and interpreters and to research in translation studies are asked at regular intervals (or whenever governments have to find new ways of reducing costs) why translators and interpreters have to be trained at a university instead of being taught at technical colleges. Some institutes have had to close, reduce the courses they offer or fuse with other institutions and see their foci in teaching and research reduced to an auxiliary (sub)discipline.

The view that translation, interpreting and translatology face major challenges is something most scholars in the area of translation studies will probably have heard in debates or read in articles on translation. New technologies allow new ways of investigating our profession, analysing the process of performing these acts of linguistic mediation, or the outcome of our work, and even make it possible to take a fresh look at old data, such as the impact of translation on Portuguese society in the 18th century, or the role of interpreters during wars that took place long before it was possible to tape them. But apart from a certain improvement in terms of research possibilities, what else does the future hold for translation and interpreting?

Over the last few years scholars have commented in different fora on translation and interpreting on the need for a (more) future-oriented translatology, or reflected on what the future might bring. The base line of these discussions can be summarised in one sentence: “What the future holds for translation is basically uncertain”. The same holds true for calls for papers for various conferences on digitalisation and translation that have been organised in recent years.

We could perhaps say this is normality for the future. But it is different from slogans such as “the future will be great” or “the future will be difficult”. We simply don’t know, but we can guess, and we have to be prepared.

In a survey undertaken in preparation for the LICTRA congress *Translation 4.0: Translation in the Digital Age* held in Leipzig in March 2017, in 2015 we asked students for their opinion on how translation technologies already permeate our lives and how this might challenge the profession of translators and interpreters. Some respondents mentioned devices such as “wearable translators” that thrilled them—and made them doubt about the future of human translators.

Quite a few of those “wearable translators” are more “interpreters”, working with spoken language, rather than translators, and from the marketing campaigns one can tell that most of the devices we find on the market are for the (basic) needs of people travelling for business or leisure. In the case of some of the devices, the marketing clearly targets these groups, as the explanation for one of them in an advert about using the product “for guests” clearly shows: “[A] service for travel[-]related businesses whose patrons are tourists. Provide unique travel experiences by renting out ili to international guests” (Ili Translators 2017). At the same time, Japanese hotels are experimenting with voice-translating equipment in lifts, breakfast rooms, restaurants, etc. The combination of voice recognition, machine translation, and services attached to that is only one of the many aspects related to the ongoing digitalisation of our lives. In this context, we have to consider the social dimension, and the concern about the possible “superfluity” of human labour in the system. The public discourse reveals a general concern that digitalisation could render “human” jobs obsolete, while experts are debating to what extent this will be comparable with the “restructuring” of work processes during the Industrial Revolution.

The label *Translation 4.0* should actually be understood as programmatic, as expressions such as *Industry 4.0* or *Internet 4.0* are often used to refer to the increasing application of Internet technology to facilitate communication between humans, machines and products. Yet, during the preparation for the 2017 LICTRA congress, some colleagues asked us where we were “right now”, whether we were sure about “4.0”, and similar questions.

In 2016, a book on *Dolmetschen 3.0,* ‘interpreting 3.0’, edited by Ursula Gross-Dinter, was published, its aim to present new technologies and methods and to comment on their impact on interpreting, for example, on interpreting quality. The main issues addressed, explicitly mentioned by the editor as aspects to be dealt with in the volume, were the following:

- How and to what degree will new technologies change the profession of interpreters?
- What development steps has conference technology gone through and which are the most interesting ones right now?
- What trends deriving from the new technologies can be discerned in simultaneous and consecutive interpreting?
- What techniques will accompany the establishment of the emergent "speech-to-text interpreting"?
- How will these changes impact the process and product of interpreting?

While translation studies scholars ponder Interpreting 3.0, as in this example, in other areas we get the impression that we have already arrived at level 4.0. The key-note speech at the 2017 *tekom* conference was held by a futurologist, Erik Händeler, who spoke about "Digitalisierung und Industrie 4.0: Warum es jetzt um den Menschen hinter der Technik geht" (tekom 2017), i.e. 'Digitalisation and Industry 4.0: Why it is now all about the humans behind the technology.' Meanwhile, also in 2017, the German Federal Ministry of Education and Research stated that we find ourselves on the verge of another industrial revolution: Industry 4.0 (BMBF 2017).

Following the development of the World Wide Web to *Web 2.0*, *3.0*, and *4.0*, today—in 2019—, we find, parallel or practically simultaneously, the usage of *Industrialisation 3.0* and *4.0*, *Business 3.0* and *4.0*, *Translation 3.0* and *4.0*, *Interpreting 3.0* and *4.0*, and there are even instances of *Industrialisation 5.0*.

With the numbers *4.0* and especially *5.0*, authors often point at an uncertain future in our relations with technologies, and, as the following example from 2019 shows, this uncertainty is closely related to the worries regarding the future of human translators mentioned before. The International Translation Studies conference hosted by the German Federal Association of Interpreters and Translators (BDÜ) in Bonn in November 2019 addresses the theme "Translation and Interpreting 4.0 – New Ways in the Digital Age", and in their Call for Papers, the organisers explain that

> […] we find ourselves in the midst of fundamental upheaval affecting all sectors, with artificial intelligence, Big Data, the Internet of Things and blockchain applications being just a few examples of the concepts brought about by digitalisation. Not only are these technologies changing the manner in which customers of translators and interpreters work, how they produce and use language content, how they procure language services: they are also altering how translators and interpreters themselves work, and how they interact with their customers. As a consequence, quite a few

> business models pursued by freelance translators and interpreters, language service providers or corporate language services— which have been working reasonably well so far—will turn out to be a thing of the past in the foreseeable future. (BDÜ 2019)

Obviously, the way of counting in this field of translation studies has nothing to do with the way software producers market the different versions of their products. It follows the pattern of Web 1.0, 2.0, etc., echoing the way the numbers refer to certain stages of development, with new forms that can be seen as the result of developments and expansion of existing formats (Fast 2013: 39). Therefore, the descriptors for the different stages of the World Wide Web work well to illustrate what Industry 4.0 or Translation 4.0 might be.

Röher (2016: 49-53) gives a very concise overview of the development of the World Wide Web to become Web 3.0: Web 1.0 more or less corresponds to the years 1990 to 2000, Web 2.0 from 2001 to 2010, and Web 3.0 covers the period since 2010. (ITW: s. v. Web). The early years of the WWW were characterized by static web sites which could be only used in a rather passive way as they could not be actively co-shaped or influenced (Fast 2013: 38). But in Web 1.0, which obviously was not called this at the time, there were already discussion forums, online shops and other applications which allowed users to do more than just "receive" passively. The transition to Web 2.0 was fluid and we cannot accurately date its beginning. The name *Web 2.0* was coined by the editor and software developer Tim O'Reilly, who in 2004 organised a conference called *Web 2.0 Conference* (Schmidt 2009: 11). He sees the bursting of the dot-com bubble as a turning point in the development the WWW (O'Reilly 2005: 1). Web 2.0 is characterised by communality in the sense that every individual person contributes to shaping it, often without even being aware of the fact, for example, through setting links, leaving customer evaluations in online shops, etc. Another important aspect of Web 2.0 is database management (O'Reilly 2005: 3), which is essential as dynamic websites draw their data directly from a database in order to be individualised depending on users' requests. Software becomes more a service than a product (O'Reilly 2005: 4), and begins to function as a secondary interface, as Röher (2016) points out. O'Reilly (2005: 4) calls this the "end of the Software Release Cycle" and "the perpetual beta", referring to constant updating and adjustment in response to user behaviour. O'Reilly (2005: 4) also describes the idea of "Lightweight Programming Models" which allow existing systems and web-services to be loosely linked in order to generate an even more attractive experience for their respective users. User-friendly interfaces are a very important basis for using these websites and the basis of participation in and self-representation on the WWW. In Web 2.0., everyone is potentially both maker and user, and the idea that everyone can participate, especially people without commercial interests (Beck 2007: 5), and the concept of user-generated content (cf. Schmidt 2009: 16) are frequently mentioned whenever Web 2.0 is a topic of discussion. Social networks are therefore seen as the quintessence of Web 2.0. Other applications, such as the integration of real-time communication into websites—for instance chats—(Beck 2007: 9) provide evidence for the tendency towards a quicker and easier exchange of information. The success of Web 2.0 is at least partly explained by the improvement of connectivity and faster data transfer in many parts of the world (Schmidt 2009: 14). Actually, many of the applications seen as typically “2.0” did in fact already exist before the boom but were only intensively used after the turn of the Millennium. Web 3.0, sometimes also called the semantic web, is based on something called a semantic network. The automatic derivation of conceptual links, interpretative connections, is in the centre of this new web generation. *Information* is no longer the key, it is all about *knowledge* composed of semantically linked information. These links are based on ontologies that define clear semantic relations between the individual elements, are automatically produced and are machine readable (Ultes-Nitsche 2010: 7-8). Referring to Berners-Lee, Hendler and Lassila (2001), Ultes-Nitsche (2010: 7) gives the simple equation “Web 2.0 + Semantic Web = Web 3.0”. In other words, the characteristics of Web 2.0 survive, but thanks to the development of ontologies, there are new possibilities for cross-linkages and a better exploitation of the web’s possibilities. A simple example is tagging, allowing individual web contents (Ultes-Nitsche 2010: 10) to be marked by attributing tags, descriptors, to them, thus classifying them according to subject, category or group. Actually, perhaps because the term *Web 3.0* is not as popular as *Web 2.0* was, descriptions and definitions vary quite considerably. While Ultes-Nitsche (2010) believes the core of Web 3.0 is the optimisation of processes in everyday life, from finding recipes or checking availability and comparing prices of hotel rooms online, others, such as Mörike (in 2010), believed that even the semantic search is a vision that has not yet been achieved. In fact, the development was faster than the experts predicted: only a few years later, even popular search engines like Bing and Google are actually called *semantic search engines* (cf. Horch, Kett & Weisbecker 2013: 128-131).

In 2016, Röher still states (2016: 53) that to judge from the vague descriptions of a next “stage of web culture” or expressions such as “what some people call Web 3.0” (Newitz 2008: no page) which are frequently used in relevant publications, it becomes clear that Web 3.0 is not a neatly defined and circumscribed space.

And yet, at the same time, we could already find people who claimed there was a Web 4.0, such as Tamblé (2014), who explains that—at least from an economic perspective—Web 4.0 was the next evolutionary step of added value in Economy 4.0. She claims that, to her, the "version number" 4.0 means that "new technologies or [artificial?] intelligence and [new ways of?] communication enable us to cooperate even more comprehensively in networks, and that networks can describe the interaction of humans and machines or, for example, the more classical interaction of companies and customers" (translation C. S.).

Some definitions of Web 4.0 (as well as those of Web 3.0) clearly overlap with those of Industry or Economy 4.0. After the first Industrial Revolution around 1800, there was a second Industrial Revolution consisting in automatisation, production lines, etc.; the term Industry 3.0 was coined when computer technology with electronically controlled machines entered factories in the mid-1970s. In modern "smart factories", all the different components are somehow linked, robots "control" themselves, production lines order their own supplies and so on. Some argue that this is Industry 4.0, while other authors believe the current stage is still based on micro-electronics from an earlier phase. The far-reaching intertwining of industry, production, service, consumption, and Web/Internet is seen as the birth of Industry 4.0, or, for some authors, Internet 4.0, or just Economy 4.0.

When we put *Translation 4.0* in the title of the LICTRA congress, we did this not only to reference the role of translation and interpreting in this 4.0-structure of industry, internet, consumption, etc., but also as a provocation and defence regarding the role translation that will play in all our futures.

More and more frequently, we find the terms *Industry 4.0* and *Internet 4.0* used as synonyms in order to refer to the increasing use of Internet technology to facilitate communication between humans, machines and products. The technological building blocks of this world are cyber-physical systems, and the Internet of Things, in the sense of the development whereby the computer as a stand-alone device will lose much of its importance, and we see a movement towards a network of identifiably different "intelligent" physical objects—things—built up in a structure that is similar to or is a development of the Internet.

If we accept that the ongoing digitalisation of production and communication, and of the way we live our lives, goes further than what

Industry 3.0 and Web 3.0 brought us, then we understand the 4.0 in the LICTRA congress title and in the title of this volume.

We believe that despite all possible reservations regarding the accuracy of definitions and the range of the respective innovations, Industry/Web/Internet 4.0 and therefore also Translation 4.0 are clearly at least in a process of formation, if they are not already present. That is why we put the analysis of major current and future problems deriving from the "digital revolution", if we can call it that at all (however, this is not the place to analyse the different points of view regarding what amounts to a revolution in sciences, industries, communication, etc.), at the core of LICTRA 2017. However, we not only wanted to look into developments in translation and interpreting per se, but also to explore the consequences of digitalisation for research. We can now use modern technologies in order to find out more about the effects of translations in the past, for example. So, as well as looking into the future, we also wanted to allow a renewed look, to "revisit" research on classical questions using new technologies, and to take into account the effects this new dynamic and these rapid technical developments will have on translation itself and on the constantly developing avenues of T&I research. And we wanted the conference participants to look at the impact that the ever changing role of translation has on society, be it through growing visibility or through the widely dreaded "globalisation" of content and ways of saying and doing things.

This volume presents a peer-reviewed selection of the contributions in English to LICTRA 2017; the German texts are published elsewhere (Sinner, Paasch-Kaiser & Härtel 2019 and Schmitt 2019).

The volume opens with a section on interpreting, with articles by Ena Hodzik and Mir Saeed Mousavi Razavi dealing with aspects of simultaneous interpreting using state-of-the-art technology and approaches, and a contribution by Chaowei Zhu and Junlan Li on medical interpreting. The section after that deals with the construction and exploitation of corpora and empirical databases and with corpus-aided or corpus based research into translation studies. Contributions from Andy Stauder and Michael Ustaszewski focus on translation research based on corpora and meta-corpora/data bases, while Marcello Giugliano introduces databases as research tools for image analysis in his investigation of the interface between imagology, translation studies and digital humanities. Irina Pasenkova analyses decisions made by translators regarding lexicon—using the example of verbs of speaking in English and Russian—and Shirin Ohadi Esfahani uses parallel corpora to investigate verb-noun collocations in English and Persian. In the next section, on evaluating translation products, Milan Potočár analyses the evaluation of legal translations between so-called smaller languages, Alireza Akbari aims to objectively score students' translation drafts in Persian using the preselected items evaluation (PIE) method, and Yasamin Khosravani presents a simplified model for assessing the quality of subtitles. Subtitles are also the topic of the next contribution, by Andrea Heilke, who compares the inclusion of deaf and hard-of-hearing through subtitling in Germany, the UK and Spain, broadening the view of this volume to the social level of research in the era of globalisation and digit(al)isation. Finally, three articles examine how to deal with aspects that could be subsumed as approaches dealing with problems of cultural and linguistic adaptation: Mengye Han and Laura Santamaria Guinot present their work on pairs of original and translated *microtitles* in animated films translated from English to Chinese with particular focus on their phatic function, Alba Rodríguez-García analyses *blended translation strategies* for Europhone African writing, and María Teresa Sánchez-Nieto studies two cases of translator's agency by analysing a German and an English translation of a Spanish novel using corpus techniques to compare the translation.

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Transitional Probability Effects on Prediction during Simultaneous Interpreting from German into English

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Abstract

The effect of transitional probability on predictive processes during simultaneous interpreting as online spoken language processing was investigated during a shadowing task in German and two simultaneous interpreting tasks from German into English performed by English-German bilinguals. As revealed by speech latency measurements, transitional probability only had an effect on prediction during shadowing but not during SI when asymmetrical sentence structures were used in the source and target languages, i.e. head-final German sentences and head-initial English sentences. However, when the source and target languages employed symmetrical structures, i.e. head-initial sentences, an effect of transitional probability on prediction was observed during SI. These results highlight the importance of language specificity, as reflected in sentence structure, during SI from German into English. At the same time, this study shows how applying psycholinguistic methodology to an investigation of simultaneous interpreting as an online language processing task can reveal something about the mechanisms underlying sentence processing during SI.

Keywords: *simultaneous interpreting, predictive processes, syntactic asymmetry, contextual constraint, transitional probability*

1 Introduction: Predictive Processes during Simultaneous Interpreting

This study investigates the effect of transitional probability (TP), i.e. the statistical likelihood with which words appear together in a language, on predictive processes during simultaneous interpreting from German into English. Simultaneous interpreting (SI) constitutes the oral translation of speech from one language, i.e. the source language, into another, i.e. the target language. Interpreters have to perform a multiplicity of tasks during SI, such as listening to and analysing the source language and producing the translation into the target language, all the while engaging their working memory and switching their attention from one task to another, which imposes a heavy cognitive load (Seeber 2011). One way of attempting to circumvent this load is by anticipating or predicting upcoming words, ideas and messages during SI.

An important factor that has been thought to influence prediction, or anticipation as it is often termed in the SI literature, is the difference in sentence structure or word order between the source language and the target language (Wilss 1978, Jörg 1995, Gile 2009). For example, when interpreting from German head-final sentence structures, where the main verb is placed at the end of the sentence, into English head-initial sentence structures, where the main verb is always placed in second position in the sentence, interpreters often predict the verb, and sometimes even produce it in the English output before it becomes available in the German input.

Earlier SI studies make a distinction between two types of anticipation: linguistic and extralinguistic (Lederer 1981). The first is assumed to rely more on the TP between words in a language (Gile 2009). For example, words that form an idiomatic expression or a collocation have a high probability of appearing together. Therefore, when interpreting "to reach a decision", "decision" could be anticipated upon hearing "to reach" due to the high TP between the two words, which comprise a collocation in the English language. Extralinguistic anticipation is based on semantic cues or meaning paired with background knowledge about the world. In the case of SI in conferences where it is carried out, background knowledge constitutes knowledge about the place of the conference, the topic of discussion, the speaker, the audience, etc. (Gile 2009).

According to Van Besien (1999), anticipation occurs based on semantic associations created between the to-be-anticipated word and words in the preceding context. Other studies provide evidence in support of linguistic anticipation. For instance, Wilss (1978: 348) found that upon hearing *namens* ("on behalf of"), which is part of a frequently used German expression when thanking somebody for something: *Namens… darf ich …danken* ("on behalf of…I would like to thank…"), the interpreter anticipates *danken* based on the high probability that it will follow *namens* in German. Setton (2005) characterises such connecting devices as primary pragmatic factors that lead to anticipation during SI.

Such devices, along with extralinguistic cues like world or background knowledge on the respective topic of discussion, are used incrementally to draw inferences and anticipate what will follow in the unfolding speech (Setton 1999, 2005). This suggests that SI is much more than a transcoding of highly probable lexical items and that some degree of deverbalisation is always necessary.

However, it is precisely this incremental or piecemeal nature of language processing that leads to TP effects on prediction during SI, as the present study will show. Studies that look at the ability to predict words during reading show that TP effects rely on a lower level of input processing than semantic effects in the context as a whole (McDonald and Shillcock 2003a, 2003b). In line with such studies, the general ability to draw inferences based on the preceding context and statistical information (i.e. TP) was taken into account in the present study by measuring the latency (Marslen-Wilson 1992) between the source language input and the target language output during SI (i.e. SI latency), rather than the ability to anticipate words and actually produce them in the output before they become available in the input. Consequently, the terms prediction and predictive processes will be used rather than anticipation.

Because SI is essentially a bilingual language processing task and the main goal of the interpreter is to transfer the meaning or sense from one language into another, although to a varying degree according to the interpretation of opposing theories, it is not very surprising that semantic cues would have an effect on the analysis of the input that leads to prediction during SI. Nonetheless, one effect of TP on the prediction of words during SI is much less obvious. In a previous study (Hodzik & Williams 2017) investigating the types of cues that trigger predictive processes during shadowing, i.e. within language repetition, in German and during SI from German into English, it was found that contextual constraint or the semantic and syntactic cues in the context as a whole have an effect on the prediction of the sentence-final verb during shadowing in German and during SI from head-final German sentences into head-initial English sentences. By contrast, TP only had an effect on prediction during shadowing but not during SI.

The asymmetry in word order between the source (German) and target (English) sentences in the SI task was posited as a possible account of the findings in Hodzik and Williams (2017). The conversion of word order from head-final in the source language into head-initial in the target language may have caused a delay in interpreting, which in turn may have led to a lack of TP effect on SI latency.

Another factor that was considered to account for the obtained results was the degree of literalness in the translation of the TP pairs (collocations and non-collocates) used in the study. While some of the pairs (e.g. *das Versprechen halten*) had more literal translations based on the literal meaning of the words they were comprised of, i.e. *das Versprechen* ("the promise") + *halten* ("to keep") = *das Versprechen halten* ("to keep the promise"), others like *eine Entschediung treffen* ("to reach a decision") had non-literal translations, i.e. *eine Entscheidung* ("a decision") + *treffen* ("to meet") = *eine Entscheidung treffen* ("to reach a decision").

According to Paradis (1994), frequently co-occurring words or phrases, such as collocations and idioms, can be transcoded, rather than translated via conceptual mediation, through direct connections between the collocations in the source language and their translations in the target language. On the other hand, non-collocates or words that do not appear together frequently in a language are more likely to be translated through a language-independent concept.

Direct connections between words in the two languages are said to result in faster word translation times than conceptually mediated word translation (Kroll & Stewart 1994). Speed of translation is also affected by semantic factors like concreteness of meaning, among others, which is very much related to the abovementioned literalness of translation. Concrete words have been found to be translated faster than abstract ones (De Groot et al. 1994). If transcoding is posited for frequently co-occurring words or phrases, then these should be translated faster than non-collocates, provided that their translation is mediated by a language-independent concept. In addition, the speed of translation should also depend on the literalness of translation.

Some SI authors—in-line with the so-called *interpretive theory* of SI—believe that transcoding is a signature of unskilled interpreting (Lederer 1981, Seleskovitch 1984) because the task of the professional interpreter is to *deverbalise* the source speech for the purpose of accessing the language-independent message or sense and transferring this message into the target speech. Others believe that during SI, due to the time constraints imposed on them, interpreters cannot always afford to analyse each segment in the source language up to the conceptual level before producing its translation in the target language (Gile 2009). The debate concerning transcoding and its application to SI will be addressed in the present study in light of the findings obtained.

The aim of this study was to investigate the effect of TP on prediction during SI from German into English as reflected in latency measurements between the source and target languages. Effects of TP on prediction have previously been established in monolingual language processing tasks, during reading in English (McDonald and Shillcock 2003a, 2003b; Frisson et al. 2005) and during shadowing or within-language repetition of speech in German (Hodzik and Williams 2017). The present study aimed to investigate the effect of TP and its relation to sentence structure. Consequently, two SI tasks were carried out, the first involving asymmetrical sentence structures between the source and target languages and the second involving symmetrical sentence structures between the source and target languages.

2. Experiment I: Simultaneous Interpreting from German Head-Final Sentences into English Head-Initial Sentences

2.1 Method

Participants. Twenty-seven native speakers of English who speak German at an advanced level participated in the SI task in Experiment I. The participants' level of German was determined with a language background questionnaire including the length of study and degrees obtained in the L2. These participants were also students at the Faculty of Modern and Medieval Languages at the University of Cambridge. They had studied German for eight years on average prior to the experiment and had taken A-level or university exams in German.

Materials. Sixty-four noun-verb pairs, half (32) with high TP e.g. *das Versprechen halten* ("to keep the promise") and half (32) with low TP, e.g. *die Kontrolle halten* ("to keep/maintain control"), were used in this experiment. Between high and low TP pairs the verb was kept the same and the noun changed, so that factors such as frequency, length, etc. of the target word (i.e. the verb in the TP pair) would not affect data within an experimental item.

TP in German was computed based on co-occurrence frequency information obtained from the DWDS (*digitales Wörterbuch der deutschen Sprache*). Because both forward and backward TP have been found to affect predictability (McDonald & Shillcock 2003b), the two parameters were computed for each TP pair. This confirmed consistently high or low mean forward and backward TP values for each noun-verb pair, depending on which group it was in. The rationale for ensuring consistency between the forward and backward TP values of any given pair was that both values contribute to TP as a cue for prediction.

Forward and backward transitional probabilities were computed for each TP pair using the equation p[verb|noun] = frequency[verb, noun]/frequency[noun][1] for forward TP values and p[noun|verb] = frequency[verb, noun]/frequency[verb][2] for backward TP values (McDonald & Shillcock 2003b, Perruchet & Peereman 2004). The co-occurrences of the English translations of the German noun-verb pairs were computed as well with the equation p[noun|verb] = frequency[verb, noun]/frequency[verb] for forward TP values and p[verb|noun] = frequency[verb, noun]/frequency[noun] for backward TP values (McDonald & Shillcock 2003b; Perruchet & Peereman 2004).

The mean number of occurrences of the noun-verb combinations in the DWDS corpus was 560.7 (range: 43-4300) for the high TP pairs and 164.1 (range 13-1008) for the low TP pairs, $t(31) = 3.665$, $p < 0.001$. The mean forward TP values were 0.05375 for high TP pairs and 0.03583 for low TP pairs. The mean backward TP values were 0.02544 and 0.00699 for high TP pairs and low TP pairs respectively.

Forward and backward transitional probabilities were also computed for the English translations of the high and low TP pairs based on frequency information obtained from the BNC (British National Corpus). The mean number of occurrences for the translations of high TP pairs was 204.3 (range 7-1318) and 37.5 (range 2-60) for translations of low TP pairs, $t(31) = 3.132$, $p < 0.01$. Forward TP values were 0.01268 and 0.00578 for translations of high and low TP pairs respectively. Backward TP values were 0.02923 for translations of high TP pairs and 0.00484 for translations of low TP pairs.

In addition to TP, literalness of translation was incorporated in the experimental design. This was determined based on translations of the TP pairs in German-English dictionaries, such as the *Oxford Essential German Dictionary*, the *Collins Concise German-English Dictionary*, the *Langenscheidt Standard German Dictionary: German-English,* and the *Oxford Collocations Dictionary*. The purpose of using multiple dictionaries as sources was to make sure that the same translation was provided in different dictionaries for the same TP pair. Literal translations constituted the first meanings (Davidson 1986) or translations provided in the dictionaries. All translations that followed the first were categorised as non-literal translations.

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[1] In descriptive terms, the probability that the verb will follow the noun is equal to the frequency of co-occurrence of the noun and the verb in the corpus divided by the frequency of occurrence of the noun in the corpus.

[2] In descriptive terms, the probability that the noun will precede the verb is equal to the frequency of co-occurrence of the noun and the verb in the corpus divided by the frequency of occurrence of the verb in the corpus.

The high and low TP pairs with literal and non-literal translations were used to create four experimental conditions: sentences containing a high TP pair with a literal translation (1 or H-l); sentences containing a low TP pair with a literal translation (2 or L-l); sentences containing a high TP pair with a non-literal translation (3 or H-n); and sentences containing a low TP pair with a non-literal translation (4 or L-n). Each sentence employed the German *Perfekt* tense, following a V2 or head-final structure, so that the main verb or the carrier of the meaning, which was also the target word, would be placed in sentence-final position in German.

(1) Er hat das Versprechen gehalten. (H-l)
He has the promise kept
"He kept the promise."

(2) Er hat die Kontrolle gehalten. (L-l)
He has the control kept
"He kept control."

(3) Sie haben eine Entscheidung getroffen. (H-n)
They have a decision reached
"They reached a decision."

(4) Sie haben eine Vereinbarung getroffen. (L-n)
They have an understanding reached
"They reached an understanding."

The frequency of the nouns preceding the verbs, which was also taken from the DWDS corpus, was controlled so that in half of the sentences the noun was more frequent in the high TP condition than in the low TP condition and in the other half the noun was more frequent in the low TP condition than in the high TP condition. Moreover, in half of the sentences the noun was more frequent in the TP pairs with literal translations than in the ones with non-literal translations and in the other half the noun was more frequent in the TP pairs with non-literal translations than in TP pairs with literal translations. Furthermore, the nouns in the noun-verb TP pairs appeared with an indefinite (3 and 4), a definite (1 and 2) or zero article and the number of each was controlled for between experimental conditions, so that the number of nouns with definite, indefinite and zero article was the same between sentences with high TP pairs and sentences with low TP pairs and between sentences containing TP pairs with literal translations and sentences containing TP pairs with non-literal translations.

The 64 target sentences were recorded with a native speaker of German using a recording device (TASCAM HD-P2 portable stereo audio recorder) and saved as separate sound files. These sound files were then divided into two sets so that each participant heard 32 target sentences in each experimental condition and one version of each experimental item. Within each set, sentences were presented in a fixed random order. Filler sentences like (5) were introduced after each target sentence.

(5) Sie schrieb den Brief.
She wrote the letter
"She wrote the letter."

Procedure. The experimental items were presented auditorily on a computer with Superlab 4.5. Participants were instructed to simultaneously interpret each sequence as they heard it and as close as possible to the original. The participants' interpreting output was recorded using a recording device (TASCAM HD-P2 portable stereo audio recorder) connected to the computer through two channels, so that the original input was recorded on one channel and the participants' output on the other channel.

Analysis. The data analysis was carried out in Audacity 2.0.2. Latency was measured between the onset of the sentence-final verb in the input and its translation (in sentence-second position) in the interpreted output, i.e. SI latency. SI latency was expected to be significantly shorter for items with literal translations than for items with non-literal translations. Furthermore, significantly shorter SI latency was also expected for high TP items than for low TP items.

2.2 Results

Figure 1 shows the mean SI latency between the target word in the original input and its translation in the interpreted output.

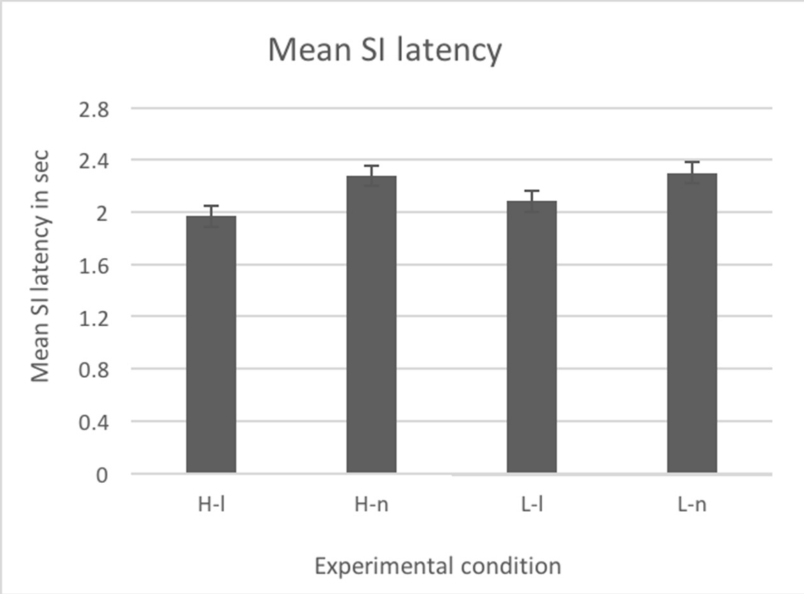

Figure 1. Mean SI latency across participants (n=27) per experimental condition. H-l: high TP, literal translation; H-n: high TP, non-literal translation; L-l: low TP, literal translation; L-n: low TP, non-literal translation.

A subject analysis, with TP and literalness as within-subject factors, revealed a main effect of literalness on SI latency, F_1 (1, 26) = 17.864, p = 0.000. However, the effect of TP on SI latency was not found to be significant, F_1 (1, 26) = 1.458, p = 0.238. Moreover, no interaction was observed between TP and literalness, F_1 (1, 26) = 0.993, p = 0.328. An item analysis of variance was also carried out with TP as a within-item factor and literalness as a between-item factor. The item analysis did not show a significant effect of TP, F_2 (1, 30) = 0.152, p = 0.700. Moreover, the interaction between TP and literalness was not significant, F_2 (1, 30) = 1.075, p = 0.308.

An SI task was then conducted with symmetrical sentence structures in the source (German) input and target (English) output. For this purpose, the same German head-final sentences that were used as experimental materials in Experiment I were converted into SVO sentences in Experiment II. This allowed for a comparison between the results obtained in the two experiments.

3 Experiment II: Simultaneous Interpreting from German Head-Initial Sentences into English Head-Initial Sentences

3.1 Method

Participants. Nineteen native speakers of English who speak German at an advanced level participated in Experiment II. These participants had the exact same profile as the participants in Experiment I, but they had not previously taken part in Experiment I.

Materials. The same experimental materials were used as in Experiment I, only for this experiment they were converted from head-final into SVO sentences. For this purpose, the tense was changed from *Perfekt* to *Präteritum* (equivalent to Past Simple) in German. In *Präteritum* the main verb is used in its finite form in simple declarative sentences (such as the ones used in this experiment) and placed in second position in the sentence, just like in English.

This resulted in the same four experimental conditions: (1) from above was converted into (1') - sentence containing a high TP pair with a literal translation (H-l); (2) became (2') - sentence containing a low TP pair with a literal translation (L-l); (3) became (3') - sentence containing a high TP pair with a non-literal translation (H-n), and (4) was changed into (4') - sentence containing a low TP pair with a non-literal translation (L-n).

(1') Der Mann hielt das Versprechen. (H-l)
The man kept the promise
"The man kept the promise."

(2') Die Frau hielt die Kontrolle. (L-l)
The woman kept the control
"The woman kept control."

(3') Die Frau traf eine Entscheidung. (H-n)
The woman reached a decision
"The woman reached a decision."

(4') Die Leute trafen eine Vereinbarung. (L-n)
The people reached an understanding
"The people reached an understanding."

The pronouns ("er"= "he"; "sie" = "she/they"; see (1) – (4)) used in Experiment I were substituted with noun phrases ("der Mann" = "the man"; "die Frau" = "the woman"; "die Leute" = "the people"; see (1') – (4')) for the purpose of maintaining the number of words in the sentences, and consequently the processing load, the same between experiments.

The co-occurrence frequency information of the verb-noun pairs was the same as in Experiment I, since the same pairs were used. Forward TP constituted the statistical likelihood that the noun will follow the verb, since the noun followed the verb in this experiment, and it was computed using this equation: p[noun|verb] = frequency[verb, noun]/frequency[verb]. Backward TP represented the statistical likelihood that the verb will precede the noun and it was computed with the equation p[verb|noun] = frequency[verb, noun]/frequency[noun] (McDonald & Shillcock 2003b, Perruchet & Peereman 2004). The mean forward TP values were 0.02544 for high TP pairs and 0.00699 for low TP pairs. The mean backward TP values were 0.05375 and 0.03583 for high TP pairs and low TP pairs respectively. Since the word order remained the same for the English translations, the same co-occurrence frequency and forward and backward TP information applied as in Experiment I.

The total of 64 sentences were recorded with a native speaker of German and saved as separate sound files. These sound files were then divided into the same item sets as in Experiment I and the same filler sentences were reused as well.

A very important difference between Experiment I and Experiment II was in the target word. In Experiment II this was the sentence-final noun, which followed the verb rather than preceding it as it did in Experiment I. Consequently, SI latency was measured between parallel words, i.e. the noun in the source input and the noun in the target output. This meant that, unlike Experiment I, where the target word (i.e. the verb) was maintained the same and the noun preceding it varied between high and low TP pairs, in Experiment II the target word (i.e. the noun) varied and the verb was the same for high and low TP pairs. As previously mentioned, the frequency of the nouns was controlled, so that this factor would not influence the results obtained in Experiment II.

Procedure. The same procedure was used as in the SI task in Experiment I.

Analysis. The same software (Audacity 2.0.2) was used to analyse the data. SI latency was measured between the onset of the target word (the sentence-final noun) in the input and the onset of its translation in the output. An effect of literalness on SI latency was expected, where latency would be significantly shorter for items with literal translations than for items with non-literal translations. SI latency was expected to be significantly shorter in items with high TP than in items with low TP.

3.2 Results

Figure 2 shows the mean SI latency between the target word in the original input and its translation in the interpreted output for each experimental condition.

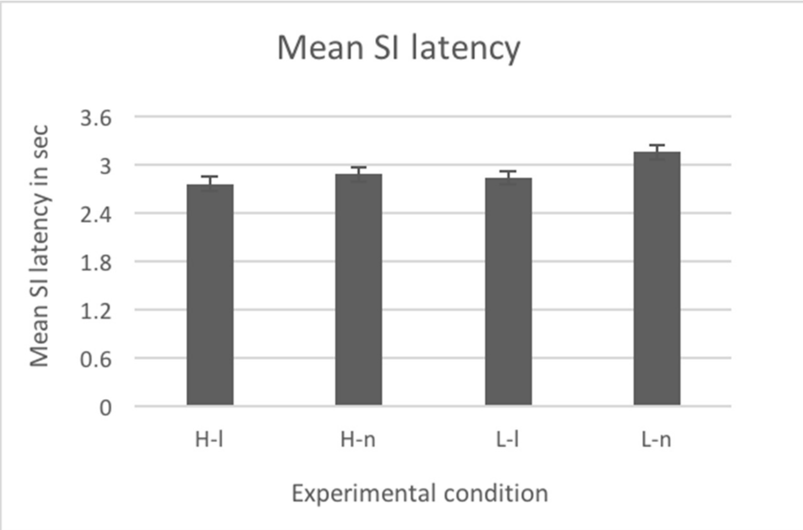

Figure. 2. Mean SI latency across participants (n=19) per experimental condition. H-l: high TP, literal translation; H-n: high TP, non-literal translation; L-l: low TP, literal translation; L-n: low TP, non-literal translation.

A subject ANOVA, with TP and literalness as within-subject factors, revealed a main effect of TP, F_1 (1, 18) 5.110, $p < 0.05$. A main effect of literalness was also found in the subject analysis, F_1 (1, 18) = 9.383, $p < 0.01$. The interaction between TP and literalness was not significant, F_1 (1, 18) = 2.296, p = 0.147. By contrast, the item analysis did not show a significant effect of TP, F_2 (1, 29) = 2.893, p = 0.100. Finally, the interaction between TP and literalness was not found to be significant, F_2 (1, 29) = 0.005, p = 0.943.

The following discussion will attempt to provide an account for the results obtained in Experiments I and II.

4 Discussion

As in Hodzik and Williams (2017), in the present study TP was not found to affect latency during SI involving asymmetrical sentences in the source and target languages. However, a TP effect was observed in a subject analysis of the data obtained during SI involving symmetrical sentences in the source and target languages. The effect of TP on SI latency seems to be somewhat tied to the sentence structure of the language pair involved in the SI task. This finding lends support to language-specific processing of the input during SI, which may have caused a delay in interpreting or a cost in processing, overriding any effect of TP on interpreting latency during SI between asymmetrical sentence structures.

As previously mentioned, studies looking at translation in bilinguals and interpreters distinguish between *transcoding* and conceptually mediated *translation* (Paradis 1994, de Groot & Christoffels 2006). The translation of frequently co-occurring words or phrases, such as high TP pairs or collocations, could employ transcoding, rather than translation via language independent concepts, due to direct memory connections between the word or phrase in the source language and its translation into the target language (Paradis 1994). When highly frequent words or expressions, such as high TP pairs, are transcoded, they are said to be processed in the source language and produced in the target language as language-specific multiword units or chunks, rather than as multiple words, without accessing the language-independent concepts behind those chunks (Kroll and Stewart 1994, Paradis 1994). By contrast, low TP pairs are more likely to be translated as multiple words by accessing the language-independent concepts behind them.

It is possible that the effect of TP on latency during SI involving asymmetrical sentence structures was cancelled out or overridden by a delay in SI caused by the breakdown of the high TP pair, which constitutes a chunk in the input, into two separate words before its production in the output. From this, it follows that there is a delay in the SI of high TP pairs in the experiment with asymmetrical syntactic structures caused by the conversion of word order. The delay does not occur for high TP pairs during SI involving symmetrical syntactic structures, because the word order does not have to be converted between the input and output. Moreover, there is no delay in SI of low TP pairs because they are translated differently from high TP pairs.

It is important to note that during both SI between asymmetrical sentence structures and SI between symmetrical sentence structures, high TP pairs are processed and produced as chunks. Nonetheless, where the two SI tasks differ is in the translation, or rather interpreting, route which is direct between high TP pairs during SI between symmetrical sentence structures, and mediated by the conceptual level during SI between asymmetrical sentence structures. It has to be underlined that even though the translation of high TP pairs is direct, their meaning is still accessed during processing. The translation of low TP pairs, on the other hand, takes the conceptual route both during SI between symmetrical sentence structures and SI between asymmetrical sentence structures.

The present findings indicate that syntactic structure, and in particular the difference between the syntactic structure of the source language and that of the target language, determine whether TP will affect interpreting latency or not. However, the syntactic differences between languages alone could not provide an account for the results on TP obtained in the present study. Within-language lexical patterns and how these reflect on translation had to be considered as well.

Based on the results obtained during SI between German and English involving syntactically asymmetrical sentence structures and during SI between syntactically symmetrical German and English sentence structures, language-specific sentence structure or word order does affect interpreting latency. This study provides findings in support of language-specific processing or analysis of the input during SI as well as language-specific interpreting of commonly used phrases, such as high TP pairs or collocations, which is in contradiction with the notion that the analysis of the input during SI is largely language-independent and therefore does not take into account the specificities of the source and target languages.

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