Spoiled for choice?
Uncertainty facing options in translation

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Abstract: Uncertainty is inherent to translating. Texts tend to have many valid renditions, and the outcome of a translation can never be fully anticipated. This study investigates the relationship between uncertainty in translation and the range of options available to translation students. To do so, we applied Muñoz & Cardona's (2019) approach to task segmentation and pause analysis to study translation processes in 19 translation trainees working on the same source text with a key-logger. We identified 10 potential hesitation indicator types in the key-logged processes. Target texts were then scrutinized using choice network analysis (Campbell, 2000) in order to identify and quantify the choices made by the participants. The relationship between the quantified hesitation indicators and the number of options for each segment was explored, and no correlation was found between them. Participants did not always hesitate between all available options, their decisions did not always determine further ones in a linear way, and indecision sometimes remained after the end of the process. The results suggest that decision making processes in translation cannot be fruitfully approached as games with complete information, but they could be explained from a broader perspective that accounts for risk taking and incomplete information.

Keywords: Translation process; uncertainty; choice network analysis; hesitation; translation options.

1. Uncertainty in translation

Heisenberg's (1927) uncertainty principle was the first mathematical expression of the idea that there is a limit to what we can know about nature: the position and velocity of quantum particles cannot be simultaneously and accurately measured. Another uncertainty principle in physics is called the *observer effect,* which states that the act of observing produces changes in the observed phenomenon, since the observer becomes part of an observation system. This more general principle went beyond the domain of physics and influenced other sciences (Pym, 2010, p. 93).

What is common to uncertainty in physics—as stated in the observer effect—and communication, including translation and interpreting, is the idea that our knowledge is limited by the fact that it is underdetermined: the observed phenomenon never fully determines its observation. This indeterminacy also

applies to communication and translation because texts never fully determine their interpretation (Pym, 2010, pp. 93–94).

In cognitive translation studies, uncertainty has been recognized as a common feature of translation performance and has been associated with problem-solving tasks (Tirkkonen-Condit, 2000; Wilss, 2007; Angelone, 2010; Angelone & Shreve, 2011). Translation processes have often been understood as sequences of problem-solving activities interspersed with unproblematic task sequences (e.g., Wilss, 1994; Angelone, 2010). An example of this approach is the Monitor Model proposed by Tirkkonen-Condit (2005), according to which translators apply a default rendering procedure if they find no problems in their outcome. When a problem arises, a monitor interrupts the default procedure and activates conscious decision making (see also Tirkkonen-Condit et al., 2008; Carl & Dragsted, 2012; Schaeffer & Carl, 2013, 2014; Carl et al., 2016).

Angelone (2010) describes the translation process as a series of interconnected bundles of problem-solving behavior consisting in sequences of problem recognition, solution proposal and solution evaluation. In his model, uncertainty arises when comprehension, transfer or production processes pose a problem for the translator and activate uncertainty management and problem-solving behaviors. Each of these problem-solving behaviors—and the uncertainty activating them—can be associated with one sequence of comprehension, transfer, or production.

Carl & Dragsted (2012) challenge this stratificational view of the translation process and propose "an extension of the monitor model in which comprehension and production are processed in parallel by the default procedure" (p. 5). They argue that it is difficult to univocally allocate uncertainty to one of the comprehension, transfer, or production sequences, because the borders between such sequences become blurred and "do not normally exist independently in the translator's mind" (Carl & Dragsted, 2012, p. 8). Instead, they propose a literal default procedure with parallel production and comprehension processes, and a conscious, effortful procedure (starting when the monitor interrupts the default procedure), in which the relations between production and comprehension are more disentangled.

However, the separation of translation processes as belonging to two kinds of procedures—unproblematic text sequences and problem-solving activities—tells us little about uncertainty beyond its connection to translation problems. Since uncertainty is a graded concept, different degrees of uncertainty cannot be explained within the two-state framework of problematic/unproblematic translation sequences. Rather, uncertainty—as "a cognitive state of indecision" (Angelone, 2010, p. 18)—may be seen as part of decision-making processes, whether problematic or not.

Translation has been often described as an activity based on decision making (e.g., Levý, 2000 [1967]; Kußmaul, 1986; Wilss, 1994; Angelone, 2010), and the translation process has been compared to a game with complete information—like chess (Levý, 2000 [1967]). In these kinds of games, alternatives are exactly definable, and each decision made at one point influences further decisions: "Once the translator has decided in favor of one of the alternatives, he has predetermined his own choice in a number of subsequent moves" (Levý, 2000 [1967], p. 149). Pym (2010, pp. 106–107) argues that translating is not like playing chess, because translators never have complete information about their game, and not all decisions determine further ones.

Instead, Pym (2010) compares translation with a risk game where translators calculate risks and take decisions with "no certainty that all possible options have been seen, nor that future decisions will be entirely determined by the previous ones" (p. 107). In fact, translation always takes place under uncertainty conditions, i.e., based on incomplete information and with unknown

results (Kochenderfer, 2015), and some amount of uncertainty often remains even after having made a decision: translators tend to assume some degree of risk (Künzli, 2004; Pym, 2015).

In neural machine translation, the translation task is deemed inherently uncertain "due to the existence of multiple valid translations for a single source sentence" (Ott et al., 2018). This is especially evident when a machine translation system offers the translator a number of variants from a translation memory. In cognitive translation studies, Tirkkonen-Condit (2000, p. 123) suggested that the diversity of ways to carry out a translation task may be a cause of uncertainty. Wilss (1994, p. 146) proposed two explanations for the situations of uncertainty in which decision making is delayed: (1) translators are confronted with "a long array of alternatives", and (2) they are collecting information. Carl, Tonge & Lacruz (2019) describe the translation process drawing on systems theory and the notion of entropy, and assume that cognitive effort is greater when there is greater entropy, i.e., a greater number of possible choices with equal probability. Their assumption is supported by the correlations detected between the degree of word translation entropy and some parameters of the translation of sentences in context, such as the first fixation duration and the total fixation duration during the reading of the ST (Schaeffer et al., 2016; Carl & Schaeffer, 2017). In this study, we investigate if the number of available alternatives is related to the degrees of uncertainty identifiable in full-text translation processes.

2. Identifying uncertainty

Researchers have used different indicators to identify uncertainty in translation processes, depending on their research methods and goals. Verbal protocols are the most used method, with researchers identifying uncertainty through verbal indicators such as explicit questions, hedges on quality or quantity, and recognition of lack of knowledge (Tirkkonen-Condit, 2000; Künzli, 2004; Hjort-Pedersen & Faber, 2009; Angelone, 2010; Amirian & Baghiat, 2013; Khorasani & Yousefi, 2014). When combining verbal protocols with screen recording, researchers also identified non-verbal (keyboard and interface) behavior indicators, such as scrolling over the source text, extended pauses, deletions, revisions, cursor repositioning, information retrieval, typing multiple proposals, and delayed deletion or revision (Angelone, 2010; Angelone & Shreve, 2011; Amirian & Baghiat, 2013). Furthermore, Angelone (2010) also proposed the use of physiological indicators such as eye movements, pupil size changes, changes in brain activity and galvanic skin response.

In this study, we propose to distinguish between *indeterminacy* as a characteristic of a situation with incomplete information, *uncertainty* as a feeling of insecurity or indecision related to such lack of information—which could probably be detected through physiological indicators—, and *hesitation* as a behavior related to uncertainty—which can be particularly well operationalized in keylogged translation processes. For example, a situation may be characterized by indeterminacy when there are several possible options for translating a segment and not enough information is available to decide among them. A translator in this situation may feel uncertainty—which in turn may perhaps influence, for instance, her heat rate or electrodermal activity—, and act hesitantly, for example, by typing a word and deleting it or switching options. In our analysis of the keylogged translation processes of 19 students, we identified 10 non-verbal (keyboard and mouse) hesitation indicator types (see 4.5).

3. Identifying options

Campbell (2000) designed choice network analysis (CNA) as a method for inferring models of the mental processes involved in the translation of a text by multiple subjects. CNA compares and classifies the choices made by translators in order to obtain a model of the alternatives available to them. The larger the sample of translators is, the nearer we are to "the complete range of behaviors of translators of that text" (Campbell, 2000, p. 32). The underlying idea of CNA is that by analyzing the choices made by different translators of the same text, the potential forks in their processing pathways can be inferred. Campbell (1999) suggested that the complexity of the choices available to the translators can be a measure of the relative difficulty of segments of source texts. Here, we investigate if the number of options available can also work as an indicator of the potential uncertainty associated with the translation of each segment.

Campbell (2000, p. 39) established three principles for building a choice network:

1. It must gather all the translators' choices that are relevant to the theoretical framework. This means that translations that are not clear renditions of the ST segment should also be accounted for (as in the case of paraphrases, for instance).
2. It must be linguistically plausible (it should not ignore grammatical relations).
3. It must follow the parsimony principle: it should account for all the choices with the least possible number of nodes (alternatives) and branches (options).

Here we follow these principles, as well as the assumption that the choices made by the translators at any point in the process may constrain the subsequent options available to them (Campbell, 2000, p. 40). Section 4.6 explains the procedure followed to build our choice networks.

4. Research design and methods

4.1 Research aim and question
The aim of this study is to explore the relationship between the number of choices potentially available to a group of translators translating the same source text, as evidenced in the number of variants that actually appear in participants' translations of each text chunk, and the degree of hesitation identifiable in their keyboard and mouse behaviors when typing these text chunks. We tried to answer the following question: *Is the number of choices made by the whole set of participants associated in any way with the degree of hesitation identified in each of the individual processes?* Since our aim is exploratory, no hypotheses were formulated. Although correlations have been found between word translation entropy and cognitive effort as indicated by fixation duration (Schaeffer et al., 2016; Carl & Schaeffer, 2017; Carl, Tonge & Lacruz, 2019), to the best of our knowledge, no studies have been conducted on the relationship between the number of options identified in the translations of a group of translators and the hesitation indicators of their individual translation processes.

4.2 Participants
Among the total number of BA students attending an intermediate translation course at the Universidad de Las Palmas de Gran Canaria, the keylogged data

of 19 participants (13 female and 6 male, see Table 1) were selected as they were the ones who had completed most of the sessions. Participants were trained to translate with Inputlog and they used it on a regular basis as an everyday requirement in their training program, with the dual aim of using the recordings for teaching purposes and facilitating data collection for research purposes. They normally devoted one or two hours per week to translate and record their processes with Inputlog. Participants signed an informed consent. Color names were assigned to them in order to conceal their identity.

Table 1. Participants

participant	sex	age	year	birthplace	dominant hand
white	female	21	3rd	Las Palmas de Gran Canaria	right
silver	male	28	3rd	Las Palmas de Gran Canaria	right
grey	female	20	3rd	Las Palmas de Gran Canaria	right
blue	male	20	3rd	Las Palmas de Gran Canaria	right
turquoise	female	25	4th	México D.F. (México)	right
green	female	21	4th	Las Palmas de Gran Canaria	right
yellow	female	20	3rd	Los Llanos de Aridane (Gran Canaria)	right
gold	female	22	3rd	Santa Cruz de Tenerife	right
orange	female	22	3rd	Las Palmas de Gran Canaria	right
brown	female	20	3rd	Las Palmas de Gran Canaria	left
pink	female	20	3rd	Las Palmas de Gran Canaria	right
coral	male	24	3rd	Las Palmas de Gran Canaria	right
rose	male	23	3rd	Las Palmas de Gran Canaria	right
red	female	20	3rd	Las Palmas de Gran Canaria	right
carmine	female	20	3rd	Santa Cruz de Tenerife	left
magenta	male	27	4th	Caracas (Venezuela)	right
purple	female	20	4th	Las Palmas de Gran Canaria	both
violet	female	23	3rd	Melo (Uruguay)	left
indigo	male	21	3rd	Telde (Gran Canaria)	right

4.3 Source text

BA students were commissioned to translate seven texts with Inputlog throughout the semester. In this study, we decided to focus on the first session because we thought it more likely to yield more interpersonal differences, and we assumed that in this way we could obtain as wide a range of translation options as possible. After a first warm-up session, students were commissioned to translate an 841 word-long text about cultural differences from English into Spanish (see Appendix A).

4.4 Data collection

All participants translated into their mother tongue and were able to use all the resources available on the Internet. In this first session, participants were asked to translate against the clock for two hours, including the time needed to upload the document, with the pedagogical aim of reproducing the time pressure of the professional world. To avoid a possible confounding variable due to fatigue, the subsequent analysis concentrated on the first part of the process. Although in other sessions they were commissioned to work elsewhere, this session was performed in class.

4.5 Pause analysis and hesitation indicators

Following Muñoz & Cardona's (2019) study on pauses and task segmentation, and in order to chunk and analyze the participants' workflow as keylogged, we established a baseline of 0.2 s and set two subject- and session-dependent pause thresholds: A Lower Threshold (LT) at 2 × median pause *within* words, and an Upper Threshold (UT) at 3 × median pause *between* words. Median pause values within and between words were calculated by Inputlog's inbuilt pause analysis.

By establishing these thresholds, pauses are classified into three different kinds: (1) *short pauses*, between the baseline of 0.2 s and the LT; (2) *mid pauses*, between the LT and the UT; and (3) *long pauses*, those above the UT. Regarding the nature of these pauses, Muñoz & Cardona (2019) argue that (1) short pauses mainly hint at physical causes (such as problems with the keyboard) and typing micro strategies; (2) long pauses flag a reallocation of attentional resources (such as, for example, awareness of a problem or the need to check information) that force informants to temporarily cease any keylogged action; and (3) mid pauses are mainly associated with cognitive and metacognitive activities, such as planning, monitoring, and evaluating.

In this study, mid pauses within words and long pauses interrupting the typing of a word (*broken words*) are hypothesized to hint at hesitation, perhaps about the choice just made. We also counted as indicators of hesitation the cases in which participants typed different options; marked, deleted and retyped, or changed a part of the text. Mid pauses before punctuation marks and before the space bar may also be related to hesitation, since they are delaying *micro-decisions* such as ending a word, phrase, or sentence, but they may also point to other processes, such as evaluation, perhaps depending on their length. They were also taken into consideration as potential indicators of hesitation, and the same happened to web searches and typing in the search engine. In brief, we identified 10 hesitation indicator types (see Table 2).

Table 2. Indicators of hesitation

Multiple options	translators type more than one option separated with forward slashes or parentheses.
Marks	they write an asterisk, parentheses, or some other mark to indicate that they are going to go back to that part of the text.
Retypes	translators delete and write again the same part of the text.
Median pauses within words	typing a word is interrupted by a median pause.
Changes	translators delete a part of the text and write a new option.
Broken words	typing a word is interrupted by a long pause.
Median pauses before punctuation mark	translators make a median pause before writing a punctuation mark.
Median pauses before space bar	translators make a median pause before pressing the space bar.
Searches	translators make a search on the Internet.
Typing in the search engine	translators write something in the search engine but do not press the enter key or press it after a long pause.

4.6 Choice network analysis

Choice networks were built following Campbell's (2000) principles in order to gather all the choices made by the group of translators, and thus potentially available to each of them at the time of completing the task. Our networks account for all the choices, with the exception of illegible or highly agrammatical text segments that could not be understood. For example, the

networks include omissions, paraphrases and changes in the order of the text segments, but also segments with typos, misspellings, or local mistakes such as lack of grammatical agreement. We did not find completely irrelevant or inappropriate choices, although in that case we would have had to discard them in order not to distort the results of the analysis.

Also following Campbell (2000), we assume that every choice made by the translators may constrain subsequent choices. So, for instance, our networks account just once for the choices that are made at the beginning of the process (e.g., choice between past and present) or at the beginning of a sentence (e.g., the use of interrogation marks in Spanish) and affect the whole text or sentence.

4.7 Aligning text segments with task segments

Our data analysis produced two kinds of segmentation:

1. In order to elaborate the choice networks, we divided the source text into short segments, most of which were phrases. This segmentation resulted in instances where variation in choices occurred at multiple textual levels within the same segment (such as word choice variation coupled with syntactic variation). Although this complicated our analysis, we believe that this segmentation captures as many choices as possible.
2. The analysis of the processes produced task segments, which correspond to keyboard and mouse activity between two long pauses.

In order to puzzle out the differences between text and task segmentation, we adapted the text segments initially studied with CNA to the individual task segmentation. The process of alignment is complicated because in most cases these two kinds of segments do not overlap. In example (1) (Table 3), taken from the process of Red, the text segment *but have to wash it* was translated in the task segment 144 as 'but have to choose' (our back translations henceforth), which also translates *either* from the next text segment. In all cases, we counted the hesitation indicators that were most likely to correspond to each text segment, combining the original text segments when necessary.

Example (1): Red[1]

Table 3: Lack of overlap between text and task segments.

TS	ST	LP	events
144	but have to wash it either with freezing cold or boiling hot water	4024	,_sino_que_•m·•hemos_de_elegir_·m·¤{ST}
145		1482	·m·
146		1560	·m·¤{TT}
147		3123	entre_
148		3096	congwel[‹3]••el••arnos_las_manos_•••o_

*ST (Source Text), TS (number of Task Segment), LP (Long Pauses), events (within a task segment)

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[1] In Appendix B we include the notation code for representing the process.

5. Results and discussion

Table 4 presents the hesitation indicators found in each participant's process. The most frequent indicators were *changes,* with an arithmetic mean of 69, followed by *mid pauses within words* (53.3) and *searches* (40). The first two columns show that only three participants typed more than one option, delaying the decision in the process, and two of them also used marks to indicate that they had not made a choice yet (in total, three participants used marks). Since both activities consist of signaling the text for further revision, there could be a tendency for both indicators to be used by the same translators. The two participants who typed multiple options and used marks also made more searches and typed more in the search engine than the average. The co-occurrence of these phenomena could indicate that the subjects in question tended to suspend their choice until they had reached an acceptable degree of certainty. The fact that participants were translating against the clock may have prevented more subjects from suspending their choice in this way. In turn, participants with more retypes also made more changes than the average—which makes sense, since retypes reflect indecision between the choice just made and a new one.

Table 4: Indicators of hesitation by participant.

participant	MO	Marks	Retypes	BW	W•ord	•,;.:	•_	CH	SE¶	SE typ	Tot
white	0	0	6	14	60	28	77	62	54	9	310
silver	0	0	11	2	55	46	15	61	27	0	217
grey	0	0	7	4	95	25	34	57	27	1	250
blue	0	8	9	5	30	9	33	31	54	11	190
turquoise	0	0	3	12	101	19	16	54	17	7	229
green	0	0	3	15	36	12	46	68	86	16	282
yellow	0	0	2	8	25	6	17	42	40	20	160
gold	0	0	11	4	17	6	15	71	7	1	132
orange	0	0	15	6	69	27	18	83	51	7	276
brown	5	6	3	8	73	14	35	28	76	19	267
pink	1	0	13	9	20	14	7	85	45	26	220
coral	0	0	10	10	82	39	10	59	61	10	281
rose	0	0	6	9	19	2	8	59	58	5	166
red	0	0	18	25	67	10	13	86	17	2	238
carmine	1	1	20	7	13	4	14	82	48	13	203
magenta	0	0	20	6	47	14	11	130	27	3	258
purple	0	0	12	30	50	4	23	116	7	5	247
violet	0	0	17	38	72	13	8	54	11	9	222
indigo	0	0	22	12	83	18	32	81	43	8	299
mean	0.3	0.7	10.9	12	53.3	16	23	69	40	9	234
median	0	0	11	9	55	14	16	62	42	8	238
s. d.	1.1	2.2	6.3	9.5	27.7	12	17	26	23	7.13	49

* MO (multiple options), BW (broken word: long pauses within words), W•ord (mid pauses within words), •,;.: (mid pauses before punctuation marks), •_ (mid pauses before space bar), CH (changes), SE¶ (searches), SE typ (typing in the search engine), Tot (total).

5.1 Correlations between hesitation indicators and number of options
We aligned 50% of the text and task segments in the 19 processes, and calculated Kendall's tau between the total number of hesitation indicators and options for each segment. As can be seen in Table 5, there is no association

between the two rankings, since all correlations are extremely weak. Most are near 0, and four are negative.

Table 5: Kendall rank correlation coefficient (τ) between hesitation indicators and options per segment for each participant

Participant	white	silver	grey	blue	turquoise	green	yellow	gold	orange
tau	0	0.11	0.13	0.09	0.22	0.08	0.25	0.17	0.07
brown	pink	coral	rose	red	carmine	magenta	purple	violet	indigo
0.43	-0.09	0.04	0.01	0	-0.01	0.06	0.04	-0.09	-0.06

One possible explanation for this lack of association between the choices identified in the final texts and the hesitation indicators could lie in the selection of indicators or in the way the options were analyzed, although the extremely weak correlations suggest that there could be no association at all between both variables. Another possible explanation could be that translators do not always proceed with calculating each available option before making a decision—or that in many cases they do it without leaving any trace of hesitation in the process. It may be that just one part of the options is considered by each translator, so that indecision is only perceptible in some of the segments for each participant.

Let us consider two examples of hesitation between options that had been accounted for in the choice network analysis (that is, that had been found in some of the final versions of the participants). In the following examples (2) and (3), hesitation between two of the identified options is recognizable in the form of changes and options, respectively.

Example (2): Coral

Table 6: Changes between identified options

ST	TS	LP	Events
to fill our empty stomach.	147	1888	a_llenar_nnues[‹3]•[‹]uestro_•vaci[‹]io_[‹3]•|'|io_e st|'|oma•go._
	148	1358	·m··•[‹31]sacir_[‹2]ar_el_hambre.

In example (2) (Table 6), for the text segment *to fill our empty stomach,* Coral first typed a similarly concrete rendition ('to fill our empty stomach'). After a LP, the participant deleted this option and typed a more abstract translation ('to satisfy hunger'). Both options had been accounted for in the analysis of the corresponding choice network.

Example (3): Brown

Table 7: Hesitation between identified options

ST	TS	LP	Events
that turns on	45	2218	ruido_que_produce_la_pe•••••[‹]•uerta_
the moment we open the door	46	6408	al_abris•[‹]rse••••·m·
	47	4024	·m·
	48	5694	·m·_•(••cuando•••••_la_abrimos)

In example (3) (Table 7), Brown typed a first option for *the moment we open the door,* where the subject is *the door* ('when it opens'). After two LPs and an empty task segment in between, Brown added a second option in brackets where the subject is *we* ('when we open it'). Both options had been identified in our CNA.

However, such correspondence between the options resulting from the CNA and the hesitation reflected in the processes occurs just in some processes and for some options, which suggests that although the options identified have some psychological reality, uncertainty did not emerge in all participants' behavior for each potential alternative.

The results suggest that translating may not be comparable to a game with complete information, such as chess, but could perhaps more accurately be compared to a risk game with incomplete information, as proposed by Pym (2010). Games with incomplete information are like ill-defined problems as in both cases some relevant information is not available, but there is also an important difference between both constructs. In ill-defined problems, the problem solver has incomplete information about the start-state, the goal-state, the available methods, and the constraints on their selection (Ormerod, 2005). In games with incomplete information, also known as Bayesian games, the decision makers have only partial information about the game, but also about the other players' strategies. Bayesian games are models of interactive decision making (Zamir, 2013).

Moreover, in games with incomplete information, decisions do not always determine further ones. The analysis of participant decision processes suggests that decisions are not always taken once and for the rest of the process, but sometimes hesitations occur after having made a decision, as in example (4).

Example (4): Gold

Table 8: Hesitations after having decided verbal tense

ST	TS	LP	Events
We have finally arrived to Ireland	78	**1433**	|cl|P[‹]P|cl|or_gin[‹2]•[‹]fin_hemos_llegado_a_|cl3|I|cl|rlando
and there it is, in front of us,	79	**2208**	_y[‹3]a_y_all•|'|i_est|'|a,
	80	**1360**	_•[‹3]a••ba,_en_frente•[‹9]••d[‹]frente_a_nosot
after 4' 44"			
	111	**1120**	ab|'|iamos_
	112	**2704**	llegado

In example (4) (Table 8), the first choice of verbal tense in task segment 78 was present perfect ('we have arrived'). In the next task segment, in accordance with this first decision, the choice of tense was present ('and there it is'). However, after a long pause, Gold deleted and typed the verb in past simple ('it was'), which was inconsistent with the first option. After 11 task segments of further translation with past tenses, 11 task segments without activity, a segment where she made a change in the title, and 6 further segments without activity (in total, 4' 44"), Gold went back and substituted the first option ('we have arrived') with a new one using past perfect ('we had arrived'). This

example suggests that translation decisions do not always determine further ones, at least not in a linear way, since coherence between choices can be also achieved later in the process.

5.2 Crystallized indecision

Besides the hesitation indicators identified in the translation processes, we also found some evidence of hesitation in the target texts. Sometimes, a situation of indecision crystallizes in the final version, e.g., in the shape of multiple options with no choice, or in blended forms combining two different, even incompatible choices. We labeled these text segments *crystallized indecision,* since here hesitation left its trace in the final version.

For example, we found five instances of crystallized indecision in the choice networks for the source text segments *Here is where we find* and *It is here that we find* (Figures 1 and 2). In both networks, the main options were to introduce the sentence with a reference to space ('here is where we find') or time ('now is when we find'). There were also some instances (2 in the first network, 3 in the second: see Tables 9 and 10) that combined time and space (e.g., 'It is here when we find'), a combination that could indicate indecision.
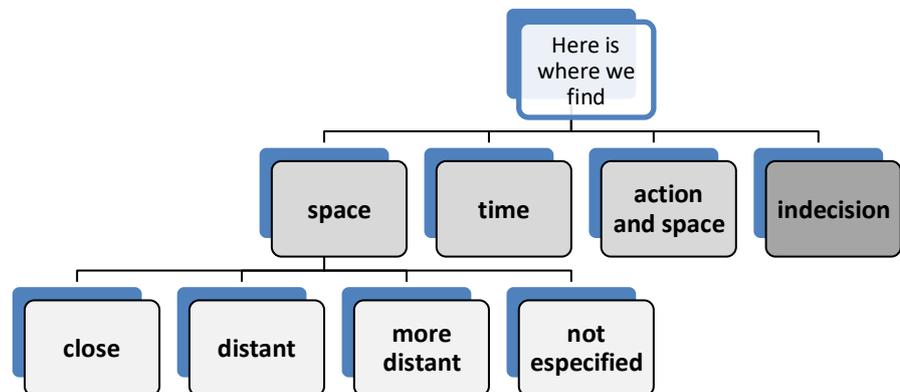

Figure 1. Choice network for "Here is where we find" with instances of indecision

Table 9. Examples for each category of the choice network for "Here is where we find"

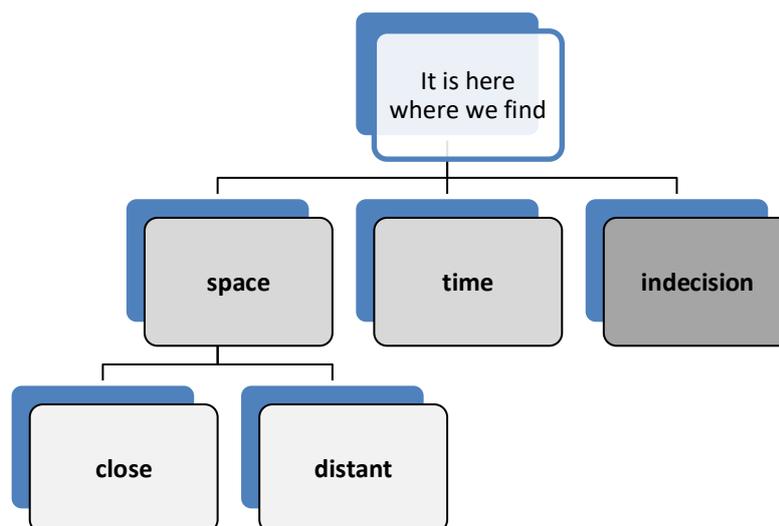| category	example
close	*Aquí es donde nos encontramos* Here is where we find
distant	*Ahí es donde nos encontramos* There is where we find
more distant	*Y allí encontramos* And there we find
not specified	*donde encontramos* where we find
action and space	*Al llegar al cuarto de baño, nos encontramos* Arriving to the bathroom, we find
time	*Ahora es cuando encontramos* Now is when we find
indecision	*Aquí es cuando encontramos* Here is when we find *En ese momento, fue donde pudimos observar* In that moment was where we could observe

Figure 2. Choice network for "It is here where we find" with instances of indecision

Table 10. Examples for each category of the choice network for "Here is where we find"

category	example
close	*Aquí encontramos*
	Here we find
distant	*Ahí es donde encontramos*
	It is there where we find
time	*Entonces nos topamos*
	Then we encounter
indecision	*Y es aquí cuando encontramos*
	And it is here when we find
	Es aquí cuando encontramos
	It is here when we find
	Y aquí es cuando nos encontramos
	And here is when we find

Four of the processes that gave rise to these instances of crystallized indecision are quite simple. In examples (5a), (6), (7) and (8) below (see Tables 11, 13, 14 and 15), the ST segment was translated in one or two task segments, with just few *mid pauses* that could indicate hesitation in some cases—while in others, as in example 8, *mid pauses* are clearly related to the insertion of accent marks. The process was quite different in example (9) (see Table 16), where the translation of the text segment *Here is where we find* was produced along three task segments that, besides *mid pauses,* exhibit two indicators of hesitation: a *retype* and a *change*. Gold started typing a first version of the phrase ('Here is'), deleted it after a median pause, typed it again and completed it after a long pause ('Here is where we could observe'). She kept on translating the next two paragraphs and then started a new cycle of revision that took 181 task segments. About 30 minutes after having typed the first option, she went back to the phrase, deleted 'Here is' and typed the final version, 'In that moment was', which was incoherent with the former option and produced a blended form ('In that moment was where').

In examples (5a) and (5b) (Tables 11 and 12), indecision between reference to space or time appears in two forms. In example (5a), hesitation crystallized in a mixed form that combined space and time in the final version; in example

(5b), hesitation is indicated by a change from a first option referring to space ('Here') to a new option focused on time ('It is then when we find').

Example (5a): Orange

Table 11: Crystallized indecision by Orange

ST	TS	LP	Events
Here is where we find	92	2768	Aqui[‹]••|'|í_••es_cunado_[‹5]ando_la••[‹]
the next weird thing:	93	6152	[‹]••encontramos•_•los_si[‹3]_[‹2]_siguiente_ec[‹]xtra•ño_

Example (5b): Orange

Table 12: Change by Orange

ST	TS	LP	Events
It is here were we find the third peculiarity	141	4792	Aq•u•••••|'|í_[‹5]••Es_enc[‹]tonces_cuando_nos_encontramos_•con_la_••tercera_peculiare[‹]idad

Example (6): Brown

Table 13: Crystallized indecision by Brown

ST	TS	LP	Events
It is here where we find	185	5856	|rs|y_aq••••u•••|'|í••_es_cuadno_nos_•topamos_
the third peculiarity	186	3376	con_la_tercera

Example (7): Coral

Table 14: Crystallized indecision by Coral

ST	TS	LP	Events
It is here where we find the third peculiarity	159	6287	•m·Y•_ez[‹]s_aq•u|'|i_cuando_encontramos_la_terc•era_
that catches our attention:	160	1950	peculiaridad_•que_atrae_nuestrr

Example (8): Rose

Table 15: Crystallized indecision by Rose

ST	TS	LP	Events
It is here where we find the third peculiarity	110	1123	•m·Es_aqu•|'|i_cuando_encontramos_la_tercera_peculiaridad_que_llama_nuestra_atenci•|'|on:_•·m·¦tb¦¤{ST}·m·¦tb¦¤{S12b}soy[‹]upspoon¶{S13a}·m·¦tb¦¤·m·¤{ST}·m·¦tb¦¤·m·¤{TT}·m·

Example (9): Gold

Table 16: Crystallized indecision by Gold

ST	TS	LP	Events
Here is where we find	143	**1952**	|cl|A|cl|•qu|'|i_es••[‹2]•[‹5]
	144	**6543**	|cl|A|cl|qu|'|i_es_donde_pudimos_observar_la_sen
29' 43" later			
	336	**6864**	·¤··m·••·l·[‹4]•|cl|E|cl|n_ese_momento•,_••fue••·¤··m·[‹2]•[‹]•·m·_·•·m·

This example of crystallized indecision is interesting because the conceptual metaphor TIME IS SPACE—which is pervasive across languages (Radden, 2003)—provides a cognitive pathway between both options. In fact, the most frequent blending is 'here is when', which could reflect a conceptualization of time in terms of space (*here* instead of *now*).

6. Conclusions and limitations

The results of our analysis suggest that there is no association between the options potentially available to translators and the degree of hesitation that can be detected in their processes. Moreover, we found that decisions made at one point in the process do not always determine further ones, and that indecision can remain beyond the end of the process. A possible explanation for these findings could be that the potential choices available for a translation task do not constitute a closed, definite, and homogeneous class, and therefore translators cannot have complete information about them, which would mean that translation processes cannot be fruitfully approached from the perspective of theory of games and logical models of rational decision-making, since these assume that information about all possible alternatives is available. Instead, we would need a broader perspective that accounts for the relative risks associated with each decision. This would allow us to approach hesitation in translation in a more realistic and contextualized way, considering the differences in perceived risk arising from context, situation, type of text, translation brief, and other factors. The metaphor of games with incomplete information proposed by Pym (2010, 2015) introduces a social dimension to decision-making processes in translation that may be worth exploring, as interaction and collaboration with others can influence the perceived risk and indeterminacy associated with a given choice.

Our research has some limitations related to the type of data collected and the tools used to collect it. Our hesitation indicators are derived from the behavior reflected in the keylogged translation process. It is possible that other indicators, such as gaze fixations, would yield more precise information on the cognitive effort related to translators' hesitation (Carl, Tonge & Lacruz, 2019). Furthermore, our study has focused on hesitation (the behavior related to indeterminacy), but has not addressed uncertainty (the feeling of indecision), which could be investigated using physiological indicators. Translators' emotions could indicate the points at which the indeterminacy of the situation burdens them, and this could be key to investigating the relative risks perceived by translators in relation to each decision. Finally, with regard to the use of choice network analysis to calculate the number of options available to translators, it should be noted that the elaboration of choice networks is very

time consuming when it comes to studying the translation of a complete text. Furthermore, it might be more fruitful to consider the quantitative differences in the use of each option, rather than simply counting the total number of options for each segment. In this way, information could be obtained on the degree of "dispersion" of options in each segment, which would shed light on the risks associated with each decision.

In summary, the results obtained in this study suggest that future empirical research on indeterminacy in translation may benefit from addressing the risks associated with translation decisions, and that this could be done by investigating, for example, translators' feelings of uncertainty and the degree of dispersion of possible options for each segment.

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Appendix A

A Tour Through an Irish House -Cultural Differences between Islands-
Andjelina Schmidt

We have finally arrived in Ireland and there it is, in front of us, the house that is going to be our home for the next few months. We go inside and the first thing we notice is the very piercing and continuous sound that turns on the moment we open the door. It belongs to the first alarm we will find in an Irish house: the burglary alarm. This device is installed in most of the Irish homes. In fact, we can find one in 53% of Irish houses. This is not just the case for rich families, with expensive houses, but for almost everyone who owns a house.

After four hours of flight, and many more in buses from and to the airport, we are quite hungry. So, we go to the bathroom to wash our hands before having something to eat. Here is where we find the next weird thing: the water taps of hot and cold water are separated. In other words, there is one tap for cold water, and one tap for hot water. Which means that we cannot wash our hands with mixed water but have to wash it either with freezing cold or boiling hot water. This is a very common subject when talking about cultural differences between Britain and the rest of Europe. And we always ask ourselves, how it can be that in a modern world, where almost everything is possible, the Irish and British still have not found out the advantages of having mixed water taps.

Once our hands are washed and we are ready to eat, we go to the kitchen to fill our empty stomach. As usual in Ireland, it is cold outside, so a nice warm soup seems just the perfect meal. It is here where we find the third peculiarity that catches our attention: the soupspoon. The Irish do not just have two different taps in their bathrooms, but they also have two big spoons in their drawer. One of them is oval, the tablespoon – the type of spoon we all know and use to eat everything liquid – and a round spoon, which is the one the Irish use to eat their soup.

I have to say that I immediately fell in love with this spoon, because it is so perfectly round and just utterly cute. Nevertheless, I never quite understood the reason of its existence, that for sure had to be another than its simple cuteness. And indeed, it has. It is related to table manners. As it seems, while in Spain, and other countries of Europe, soup should always be taken from the end of the spoon, in Britain – and thus, also in Ireland – the proper way of eating soup, is taking it from the side of the spoon. Therefore, in continental Europe we use the oval spoon to have our soup, as it has a narrower end from which we can take the soup comfortably; and on the British Isles they use the round one, as they do not need a narrower end to slurp from.

As we do not want to meet our lovely friend Niamh smelling like hours of travelling, we decide to have a quick shower. This way we discover the next exciting difference: the shower. In almost every household in Ireland the shower is electric. The first impressions of the electric shower are that the water pressure is awful, and the water does not really get warm quicker either. So, we wonder, where is the sense in having one?

Once fresh and clean, we get the hair dryer out of our suitcase and go back to the bathroom, in order to dry our hair to avoid getting a cold from the harsh Irish weather. Here we can find two situations, depending on how optimistic and patient we are. The patient optimist will waste a great amount of time searching for a socket to plug in his or her hair dryer, because he or she firmly believes that there must be one somewhere. Whereas the pessimist will get frustrated very quickly by realizing that there is no bloody socket in the whole bathroom. And the pessimist is right. Because in Ireland, sockets are prohibited in the bathroom (ETCI, 2006).

After we have finally accepted that there is no socket in the bathroom we realize that this was not our biggest problem. A very common and well-known cultural difference, not just between Ireland and Spain but around the whole world, are the different plug types. In fact, nowadays we have about 15 different plug types spread around the world. While in Spain we use a two-pin plug, in Ireland they use a three-pin plug. This means that we cannot connect our hair dryer – or any other electronic device produced in Spain – into an Irish socket if we do not have an appropriate adaptor. This seems to drive travellers crazy, especially in our modern technological world, where electricity gets increasingly important.

Appendix B

Notation code (Muñoz & Cardona, 2019)

1. Color codes

black	text **typed** in the target text
blue	text pasted into the target text
green	switch of active window, and text entered elsewhere (e.g., web browser)
red	changes in existing copy (e.g., deletions)
orange	mouse actions
purple	functional actions (mainly, for combined keypresses)
grey	movements in the text (mainly, mouse movements)

2. Symbols

symbol	meaning	symbol	meaning
•	midpause	·¤·	mouse LEFT click
_	space	·d¤·	mouse double click
¶	return	·#·	mouse scroll
|ls|	left SHIFT key	·m·	cursor movement
[‹]	back	·h·	home
[›]	delete	{S01a}	Search
[c]	copy	{st}	switch to source text window
[p]	paste	{TT}	switch to target text window
<abc>	pasted text	{WB}	switch to browser, but no action

3. Conventions

1. The length of a single dot indicating a MP and the first dot in each set of several contiguous dots indicating a single MP equal the lower threshold (e.g., •=540). The length of any other dot (that is, of any and all chained dots in positions other than the first one) is 200 ms, starting from the lower threshold (e.g., ••=540+200, and •••=940). This graphic trick promotes visualization of differences without distorting them.
2. Numbers following symbols in the same color and with no space in between provide the number of repeated identical actions. For instance, [‹3]= [‹][‹][‹], or three backspace deletions; ·d¤2·=·d¤··d¤·, or two double clicks.

Web searches{S} are coded for accessed page (number) and for repetitions of access (letter): {S01a} For instance, in example 9 (Table 11), Rose goes back to search 12, types *soy[‹]upspoon¶* and accesses search 13comes back to the source text {ST}and then finally to the target text {TT}.