



How Egyptian is AI?

A comparative assessment of ChatGPT and Google Gemini v Human English Translations of Egyptian cultural references

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ABSTRACT: This study evaluates the effectiveness of AI-generated translation for literary Arabic to English texts. It focuses on the translations generated by Chat GPT (GPT) and Google Gemini (GG) for 100 Arabic cultural references (CRs) extracted from the Egyptian award-winning novel *بيت الديب* by Ezzat El Kamhawy (2010) and rendered into English by Nancy Roberts as *House of the Wolf* (2013) as the reference translation (RT). The translatability of CRs has been a major problem for human translators, let alone AI translation tools. In this study, the AI-generated translations were assessed first using BLEU, METEOR, and chrF metrics vis-à-vis the human translation (HT), then both AI-translations and HT were analysed using Pedersen's (2011) taxonomy of strategies for assessing the translation of CRs. The scores by the three metrics indicate that BLEU produces the lowest results, while METEOR and chrF scores are significantly higher, and that the scores for GG are slightly better than GPT. The analysis of the strategies indicates that both GPT and GG relied heavily on source language-oriented strategies (SO), while HT adopted target language-oriented strategies (TO) more. GPT used TO strategies 24 times for GG's 17 times only, giving its translations an edge over GG. Further, while GPT and GG generated 9 mistranslations between them, HT produced zero. The scores yielded by the three metrics tend to overall confirm the statistics for the strategies.

Keywords: Artificial intelligence, ChatGPT, Google Gemini, machine translation, Arabic-English translation, cultural references, literary translation.

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1. Introduction

Translation has not escaped the effects of the rapid advances in information technology, social media, and the forces of globalization (Sohail et al., 2023). With increased demand, machine translation (MT) has developed rapidly over the last six decades or so. Google Translate (GT) is the culmination of such developments (launched in 2006 with its latest iteration released in 2015). Early MT was basic and relied

heavily on formal and structural rule-based systems, which could not effectively handle the complexities of human communication (Poibeau 2017; Muftah 2022). The advances in neural machine translation (NMT) revolutionized MT (Aiken, 2019, Wang et al. 2023). Employing advanced NMT algorithms, GT is now able to produce appropriate translations across many languages. However and despite its global deployment, GT is still deemed inefficient when handling translations from and into some languages such as Arabic as it is largely unable to effectively process subtleties of cultural meanings of Arabic cultural references (CRs) and collocations (e.g. Almahasees 2021; Alkhawaja, 2024).

Then came the recent rapid deployment of artificial intelligence (AI), which transformed information technology and caused major shifts in knowledge production, fundamentally disturbing all sectors of human and non-human activities. Although it has been around for almost seven decades, the launch of the large language models (LLM) ChatGPT (GPT) by OpenAI and Google Gemini (GG) in 2022 and 2023 respectively, has firmly put AI at the heart of all debates that are not only about the benefits of these models due to their high computing powers, but also about their potential consequences in many fields (Thirunavukarasu et al. 2023; Kasneci et al. 2023; Teubner et al. 2023). While machine translation systems, like GT, may still be developing, AI-powered tools, including GPT and GG represent a revolution in natural language processing, including automated translation. With human-like capability of processing language structures that are contextually and culturally-embedded, such as CRs, both GPT and GG are on their way to perhaps cause serious disruption in automated translation, particularly due to their functions of conversing with users to better understand contextual cues of complex language structures (Jiao et al. 2023; Li et al. 2024; Son et al. 2023; Zhang et al. 2023). The increasing encounters between users from culturally and linguistically divergent backgrounds through various social media platforms and others, only augment the need for real-time translation across different languages (almost all social media platforms have built-in translation options). Both GPT and GG offer instant translations of large amounts of information at phenomenal speed. Such AI-powered tools enable intercultural encounters and communication about almost all sectors of human activity (economy, society, health, education, diplomacy, academia, etc) thus providing greater global benefits, as Isabelle and Cancedda (2017: 132) aptly point out: "The integration of AI in translation tools has democratized access to information, enabling individuals to engage with content in languages they do not speak." Despite their computing capabilities, AI-tools still face problems handling many languages (often labelled complex and less common), such as Arabic (Omar and Salih, 2024; Vashee, 2024).

Literary translation has been a thorn in the side of any automated translation system. Therefore, it has been argued that the best solution for this kind of texts is to strike "a balance between human expertise and machine power to ensure faithful translations of literary works while preserving their inherent artistic value" (Škobo and Petričević 2023: 317). Researchers of Arabic literary MT have examined various approaches to achieve high levels of accuracy. Alowed and Al-Ahdal (2023), for example, compared AI-based MT and HT of Arabic poetry, revealing that MT often fails to capture effectively cultural nuances and figurative language. Tahseen and Hussein (2024) highlighted common errors in MT of English literary texts into Arabic, finding that HT is better at maintaining rhetorical and semantic nuances. Al-Batineh and Rabadi (2019) suggested to solve understanding problems in automated literary translation by adding a layer of latent semantic analysis in the workflow. A further hurdle AI-translation tools face is the difficulty in handling CRs, especially in literary texts. While being architecturally adept at dealing with syntactic structures successfully, they usually lack the capability of processing overall contextual contours of natural language use, including CRs.

Rendering CRs remains a challenging undertaking for both machine and AI-tools, oftentimes for human translators. CRs are usually defined as those "elements within a text that point to the culture from which the text originates. These can include idioms, historical events, customs, or artifacts specific to a particular culture" (Bassnett, 2002: 23). CRs are firmly embedded in their respective cultures often within unique historical contexts that may cover some or all of tangible and nontangible elements of culture, including religion, history, social structure, and values as well as habits, traditions, flora and fauna, transportation modes, housing, etc (Faiq, 2019). Culture is mediated by language or other media of communication. CRs

are significant components that represent the richness of a culture and they usually resonate with members of each culture as they stand-for shared knowledge and historical references. Differences in terminology notwithstanding, researchers tend to categorize CRs under these broad categories (Newmark, 1988; Leppihalme, 1997; Katan, 2004; Tymoczko, 2010):

- Proper names
- Grammatical forms which show respect or euphemism
- Social relationships
- Life-styles / habits / customs / traditions
- Values
- Symbols (social, religious, historical, legend)
- Ceremonies (national, religious)
- Food

The data used in this study consist of CRs embedded in Egyptian culture. They reflect Egyptian history of thousands of years and different traditions, religions, ethnicities (Coptic and Muslim cultures, for example). Produced almost exclusively in Egyptian Arabic, CRs used in literary works, pose challenging, but also fascinating, problems for translation. Machine and AI translations face significant challenges in handling CRs in Arabic literature due to the complexity and diversity of the language, as has been discussed by many researchers. For example, Sawaf (2010) discusses hybrid MT systems, which combine different translation methods and normalize dialectal Arabic into Modern Standard Arabic, improving translation accuracy and cultural relevance. Salloum (2018) highlights the difficulties in translating Arabic dialects, emphasizing the need for specialized approaches to capture effectively the linguistic variations and cultural context. Zahrawi (2018) discusses the strategies for maintaining cultural identity in translated literary texts, stressing the importance of translators acting as cultural mediators to faithfully transfer nuances such as proverbs, figurative language, and CRs.

Given computational challenges Arabic is said to pose (Alkhatib and Shaalan, 2018), this study examines automatic translation of 100 Arabic CRs from the Egyptian cultural context by GPT and GG and compares these translations with a published HT. This study aims to yield useful insights into the capacities and limitations of the two AI-tools in handling Egyptian CRs. Using the human renderings of these CRs as RT, the study employs a combination of quantitative and qualitative approaches in evaluating the quality of the translations and the strategies used. The quantitative approach uses the metrics of BLEU, METEOR and chrF to evaluate the English translations generated by the two AI-tools. These metrics are widely recognized and utilized evaluation measures of machine-generated translation (Chauhan, et al., 2023). Quantitatively, this is supplemented by statistics about the frequencies of the strategies used by GPT, GG and HT. From a qualitative perspective, the AI-and human English translations were all assessed using Pedersen's (2011) taxonomy of strategies to evaluate the translation strategies of CRs. Overall, the objectives of this study are:

1. Evaluate the performance of AI-generated translations of 100 CRs in Arabic literary texts from Egypt against a human translation.
2. Deploy the metrics BLEU, METEOR and chrF in assessing the translations by GPT and GG, and outline limitations of such automatic metrics in evaluating literary translation.
3. Using Pedersen's (2011) taxonomy plus 2 strategies added specifically for this study, identify the frequencies and compare the strategies used in the English translations of the 100 CRs generated by GPT, GG and HT.

The remainder of this study is as follows: section 2 outlines the data and the analytical tools used. Section 3 presents the scores from the three metrics and the evaluation from Pedersen's taxonomy of

strategies. This is followed by the discussion section where the results are quantitatively and qualitatively interpreted. Finally, a conclusion wraps up the study and suggests some further research questions.

2. Materials and Methods

The material for this study is the first chapter of the acclaimed Arabic novel بيت الديب (Beit al-Deeb) by the Egyptian author Ezzat El Kamhawwy (2010), which won the Naguib Mahfouz Award for literature in 2012. The English translation, by Nancy Roberts, was published in 2013 titled *House of the Wolf*. Choosing this chapter conforms with current copyright regulations on the amount of material from one source that can be translated for academic and research purposes. Using a whole chapter is also intended to provide a context for the two AI-tools. Having selected the Arabic source text and its published HT, the generation of English translations by the LLM-based models ChatGPT (version 4.0) and Google Gemini (advanced version) was carried out on 09 July 2024. The prompt for both tools was the same: 'Translate this literary text from Arabic to English'.

There are several widely-used metrics and scoring systems to evaluate the quality of MT such as BLEU (Bilingual Evaluation Understudy), TER (Translation Edit Rate), ROUGE (Recall-Oriented Understudy for Gisting Evaluation), and many others. For the purposes of this study, three metrics were deployed in the assessment of the English translations by GPT and GG of the 100 Egyptian CRs, mined from *House of the Wolf*. These were BLEU, METEOR and chrF. BLEU (Papineni et al. 2002) is a widely-used metric for evaluating the quality of MT that measures the precision of n-grams (typically up to 4-grams) between the machine-translated text and one or more reference translations. It corresponds with a way a human would evaluate a translation. METEOR (Metric for Evaluation of Translation with Explicit ORdering) is another metric that considers word-level matches as it is used for its ability to handle synonyms, stemming, and paraphrasing, providing a broader evaluation of translation quality and making it well-suited for capturing the nuances of literary translation (Lavie and Denkowski (2009). Arabic, being a morphologically rich language, benefits from METEOR's flexible matching. Finally, chrF (Character F-score) evaluates translations at the character level. This metric (Popović 2015) can capture fine-grained variations and ensure that the translation maintains the morphological integrity of the original text. In this study, the Arabic text is referred to as the source text (ST) or Arabic text, the AI-generated translations are referred to by the name of the AI tool, namely either GPT or GG, and the published human translation (HT) is also referred to as the reference translation (RT).

Since automated metrics can miss aspects like cultural nuances, tone, and style, using human evaluators, especially those proficient in both Arabic and English, in this case, can provide insights into the cultural and stylistic accuracy of the translation. For this purpose, the renderings of the 100 CRs in the English translation by Nancy Roberts (2013) were used as RT. Both AI and HT were assessed along Pedersen (2011) taxonomy of strategies for the assessment of the translation of CRs. This is a comprehensive framework that provides six main strategies for assessing the translation of CRs primarily on semantic grounds. The strategies are divided into two categories: source language/culture oriented (SO) and target language/culture oriented (TO):

Source-oriented strategies (SO).

1. Retention: The source CRs are retained in the translation as are or adapted to fit the requirements of the target language/culture. The translations may be singled out using italics, for example.
2. Specification: This may include explication (inserting additional information to make the CRs clearer to the target receivers) of addition (providing information to explain or clarify the CRs).
3. Direct Translation: This involves translating the CRs directly without any additional explanation or alteration. The only thing that gets changed using this strategy is the language; no semantic alteration is made. Names are cases in point.

Target-oriented strategies (TO).

1. Generalization: This involves the use of more general words/terms in the target language that encompass the source CRs without specific cultural connotations. Generalization may make translations less specific than the original CRs.
2. Substitution: Here, the source CRS are replaced with ones that have equivalent connotations in the target culture. CRs may well be replaced by completely different translations.
3. Omission: Here, the CRs are deleted if deemed unnecessary or pose rather difficult to handle leading thus to zero translation.

Pedersen (2011) postulates another strategy under the TO category called official equivalent (ready-made). This strategy primarily applies to audio-visual translation. It refers to using an official or standard translation that is widely accepted and recognized in the target language through common use or through some administrative decision. Most of the strategies have subcategories, and some of these also have further subcategories.

For the purposes of this study, only the main six strategies were used in assessing the translations by GPT, GG and HT. Often, strategies are used in combination to solve certain translational problems. For the data analysis reported in this study, two strategies were added as other strategies (OS) namely mistranslation (MT) for technically wrong translations and the combination of strategies (CS) for cases when two or more strategies arsed to deal with the rendering of one CR.

3. Results

3.1 Basic statistics and metrics results

Table 1 presents basic quantitative information about the datasets, which have been performed using Voyant text analysis software. It shows that the longest translation is the HT, while the one with the highest vocabulary density and the highest readability index is GPT.

	Arabic source	GPT	GG	HT
Total words	3284	3770	4387	5049
Unique word forms	1776	1267	1258	1443
Vocabulary density*	0.540	0.336	0.287	0.286
Average words per sentence**	19	23.6	33.5	22.4
Readability index***	9.803	10.858	9.018	9.053

* This is a measurement of vocabulary usage in comparison to the length of a document calculated by ratio of unique word forms to the total number of words.

** This is an approximation due to complications of punctuation.

*** This is an estimation of the text readability using Coleman-Liau formula.

Table 1: Quantitative information for the datasets

Table 2 presents the results of performing the translation evaluation metrics. Three metrics were deployed to multi-evaluate the translations as one metric works on character-level matching, and the other two on ngrams matching including, synonyms, stemming, and paraphrasing. The three metrics use a scoring system of 0 to 1, with 1 being the perfect match. Crucially, all three have strengths and weaknesses, therefore the results are presented here as guidelines, which should be considered in conjunction with the human evaluation of the three English translations (GPT, GG, HT) of the 100 CRs using Pedersen (2011) taxonomy of strategies (see Table A1, Appendix A).

	GPT	GG
BLEU	0.1786	0.2238
METEOR Score	0.3455	0.3813
chrF Score	0.5642	0.6217

Table 2: Results of evaluation metrics

Individually, it can be noted that GPT translations scored 0.1786 in BLEU, which suggests that it has a low level of overlap with the RT, i.e., some n-grams (phrases of length n) in the GPT renderings match those in the RT, but there are many differences. A METEOR score of 0.3455 suggests moderate quality in the translation. This indicates that there is a fair amount of matching content between the translated text and the reference translation, but there is still room for improvement. The improved score might be due to the fact that METEOR is more sensitive to recall, is good at identifying synonyms and paraphrases and penalizes incorrect word orders less than BLEU. A chrF score of 0.5643 suggests a moderate to high level of similarity at the character level. Since chrF compares sequences of characters between target and reference translations, it can detect similarities even at the sub-word level.

As for GG, its score of 0.2238 on BLEU indicates a better overlap with the RT. A METEOR score of 0.3814 indicates moderate to good quality in the translation, showing better alignment with the RT in terms of meaning, synonyms, and sentence structure, and reflects better handling of lexical choices and paraphrasing, making the translation closer to the RT in terms of content and meaning. A chrF score of 0.6217 suggests a high level of similarity at the character level, indicating that the translation captures fine-grained details and morphological aspects more accurately. Figure 1 shows the comparison of these scores for both AI-generated translations where GG slightly edges GPT.

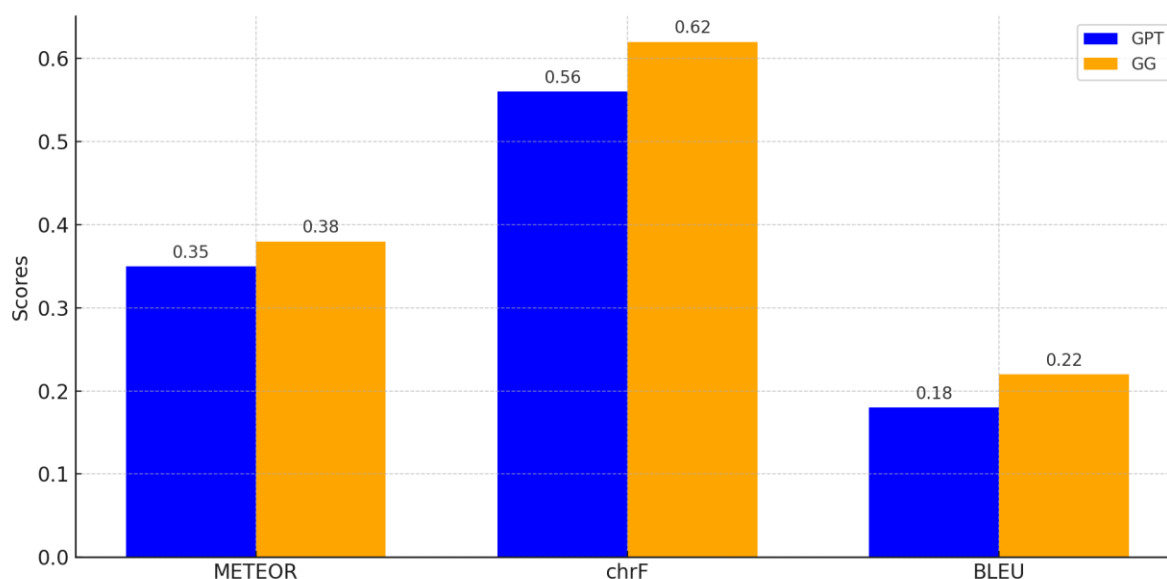


Fig. 1: Comparison of evaluation scores (METEOR, chrF, BLEU)

3.2 Translation strategies results

Table A1, Appendix A shows the complete 100 Arabic CRs, with the three English translations by GPT and GG and the human translator, in addition to the assigned translation strategies for each CR in each translation type. Based on the data in table A1, Table 3 below summarises the results:

Strategy		GPT	GG	HT	Total	%
Source Oriented (SO)	Retention (R)	7	8	9	24	8
	Specification (SP)	11	19	36	66	22
	Direct Translation (DT)	55	48	19	122	41
Target oriented (TO)	Generalisation (G)	13	10	5	28	9.33
	Substitution (SU)	10	6	28	44	14.66
	Omission (O)	1	1	0	2	0.66
Other Strategies (OS)	Mistranslation (MT)	2	7	0	9	3
	Combination of strategies (CS)	1	1	3	5	1.66

Table 3: Summary of translation strategies assessment for GPT, GG and HT.

Schematically, the information is represented by Figure 2, which visualises the comparison of the frequency for all strategies across the three translations. This reveals that the two AI-generated translations have generally similar patterns in the strategies used compared with HT, which stands out as visibly different. Figure 3 shows the total numbers of the categories of strategies used where SO ones lead by more than half.

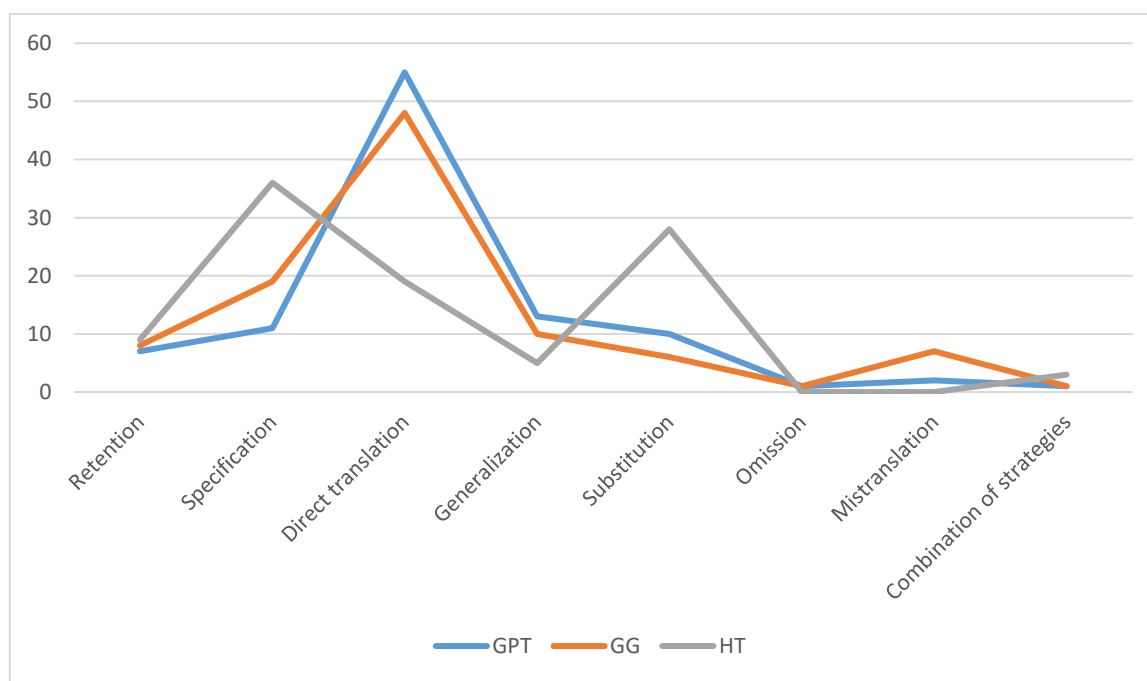


Fig. 2: Frequencies of strategies used by GPT, GG and HT.

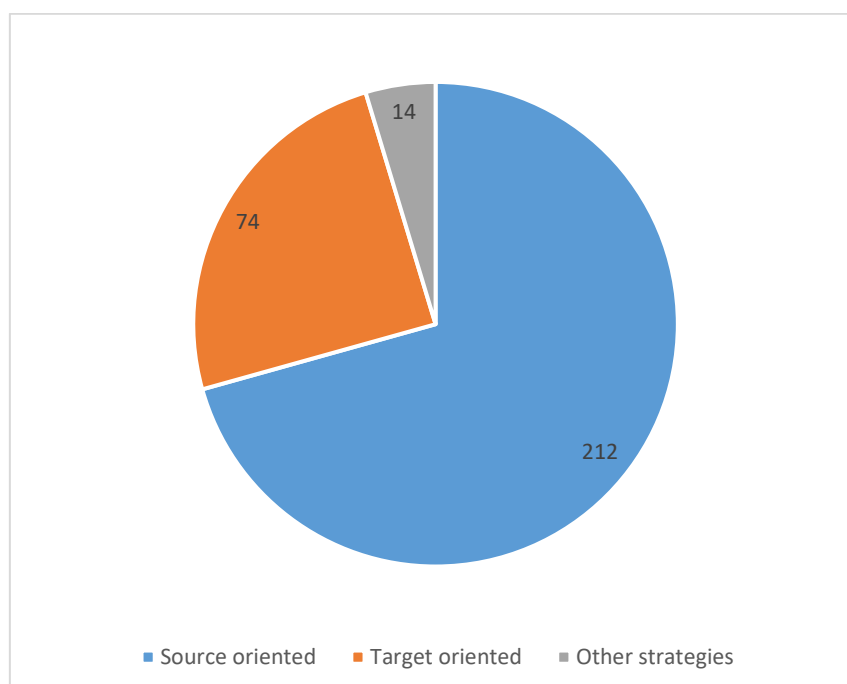


Fig. 3: Total numbers of the categories of strategies used by GPT, GG and HT.

4. Discussion

Automatic evaluation metrics for machine and AI-generated translation allow for fast results by comparing MT outputs (as hypotheses) to human references. Both BLEU and METEOR are considered lexical-based metrics which are “designed to measure the overlap between the hypothesis and the reference translation, taking into account both the precision and recall of lexical items” (Lee et al. 2023: 3). In this sense, lexical-based metrics have been very popular in the literature due to their simplicity and fast computation. However, they have also been criticised for being limited in capturing the overall meanings and fluency of texts (Lee et al. 2023; Sai et al. 2022; Babych 2014). For example, BLEU only uses n-gram precision, not recall (which means that short sentences will be penalised), and it only considers exact word-matching with no regard for the meaning and sentence structure of the translation. METEOR, on the other hand, was designed to address some limitations of BLEU in that it uses a weighted F-score and considers both precision and recall. Also, one of the main advantages of METEOR is that it considers the stem and synonyms of the word as well as word inflections in its alignment of target and reference translations. This yields better measuring of semantic similarity. Finally, chrF metric measures character n-gram overlap instead of word n-grams, which makes it effective in languages that are morphologically rich where morphemes encode meanings. However, this also means that chrF focuses more on the form rather than the content in its evaluation and its scores might be less intuitive to interpret compared to word-level metrics. Therefore, it is best used in conjunction with other metrics to provide a comprehensive evaluation on various levels.

The results of this study indicate that GG has done better than GPT in all metrics. This suggests that it has a better alignment with the RT, capturing more of the same n-grams and potentially adhering more closely to the RT’s phrasing and structure, reflecting better character-level similarity and morphological accuracy. However, it is important to note that, for BLEU, even though scores below 0.2 typically indicate that there are significant differences between the translation and the RT, for complex and literary texts, BLEU scores tend to be lower because they often involve creative language use and varied expressions that BLEU may not fully capture. METEOR scores from 0.3 to 0.5 generally indicate decent quality, but might have some issues with lexical choices, fluency, or capturing nuances.

However, when dealing with literary translation in general, and CRs in particular, automatic evaluation metrics provide only half the story. Human evaluation of translation becomes an essential component to complement the results of these metrics, and perhaps offer insights on how to interpret their results. The assessment of the strategies in all three translations indicate that source-oriented strategies (SO) dominate the translations of the 100 CRS. As shown in Table 3 and Figures 2 and 3 above, the three SO strategies were used 212 out of 300 yielding a percentage of 70.66%. GG slightly edges GPT with 75 uses (35.37%) and GPT with 73 (34.43%) respectively. HT, on the other hand, shows 64 uses only of SO strategies at a percentage of 30.18% of the total uses of SO strategies. Conversely, target-oriented strategies (TO) were deployed only 74 times out of 300 at a percentage of 24.66% overall. HT exhibited the highest use of these strategies at 33 uses (44.59%), followed rather far behind by GPT with 24 uses (32.43%) and GG with just 17 uses (22.97%). These numbers indicate that GPT seems to generate more human-like renderings. As to other strategies (OS) observed in the data analysed here, mistranslation (MT) and combination of strategies (CS) were used 14 times (4.66%). There were 9 occurrences of MT almost exclusively by GG at 7 uses (77.77%) and GPT with 2 uses (22.22%). No MT was observed for HT. There were also 5 uses of CS, 1 each in GPT and GG and 3 uses in HT.

Statistically, SO strategies were favoured by both AI-tools and the HT. But while AI-tools relied heavily on these strategies, HT did not, indicating that GPT and GG tend to stick to the source language more than venturing into the target language and culture. The high use of target-oriented strategies by HT is self-explanatory: human translators can explore the target language and culture in more exploratory manners than AI-tools. However, it is important to note that there is no consensus on which type of strategy is more suitable for literary translation (Vanderauwera, 2014).

For SO strategies, retention (R) was least used at only 24/212 times (11.32%). Both GPT and GG used it 7 and 8 times, while HT employed it 9 times. The HT provides a short glossary explaining retentions in the form of transliteration as in items 77, 80, 85 (Table A1, Appendix A). The glossary appears on pages 267-72 of the English translation (2013) by Nancy Roberts. Of the 100 CRs analysed here, items 7, 25, 42, 77, 80, and 85 are included in the glossary as follows:

- Feddan: A feddan is equal to 4,200 m², 0.42 hectares, or 1.038 acres.
- Gilbab: A long, flowing robe with long, billowing sleeves that opens at the front.
- Mansur: The name Mansur means “granted victory,” while the name Muntasir means “victorious.”
- Maybe you grabbed a cat’s tail: This statement, made by Mubarka’s father, reflects a popular belief that grabbing hold of a cat’s tail will afflict the person with a curse that causes him or her to drop things. This, in turn, is based on superstitions claiming that cats are possessed by jinn.
- Mulid: Annual public celebrations held on the occasion of the birth of the Prophet Muhammad or local Muslim saints.
- Recite the Fatiha: When families have agreed that a marriage will take place between two of their members, the initial formality is to recite the Fatiha, which is the opening chapter of the Qur’an.

As shown in the quoted glossary, HT only mentions the name of the main male character Muntasir (item 7, Table A1, Appendix A), but intriguingly no other names were included. Arabic names often carry specific semiotic meaning and stand-for certain references. The name of the main female character (مباركة الفولي - Mubarka Al-Fouli, (item 1)), for example, has very specific references in Egyptian Arabic. The first name Mubarka literally means the blessed one and the last (family, tribal) name Al-Fouli is based on the word ‘foul = broad beans,’ which remains a most vital ingredient of Egyptian diet, particularly for poor and middle social groups. GPT, GG and HT all used R to render items 46 (Badr) and 51 (Nabiha). As with item 1, the connotations intended in the literary work are lost through mere transliteration. Badr literary means (full moon) and Nabiha means (intelligent, nimble). Normally glossaries or footnotes tend to help contextualise the choice of names in Arabic literary texts.

The strategy of specification (SP) was used by both AI-tools and HT, with the latter deploying it 35 times, almost twice more than GG (20 times) and thrice more than GPT (11 times). All three translations used SP in rendering items 2, 13 and 40, for example. For item 2, the use of Him (with H) mid-sentence, specified the reference to Allah (God). For items 13 and 40, the literal Arabic Egyptian source means (cut wheat), but GPT, GG and HT, each in its own fashion, managed to specify the intended reference to some act of sabotage or theft.

But these numbers are eclipsed by those of the strategy of direct translation (DT), on which the two AI-tools relied heavily. GPT used it the most at 65 times, followed closely by GG at 57 times, while HT resorted to DT only 27 times. This is an indication that GPT and GG do not tend to deviate much from the semantic load of the ST, whereas the human translator can, especially in literary translation. DT dominated SO strategies, and TO ones as well, as shown in Table 3. However, the three translations did not systematically use DT in tandem. For item 11 (الاستعانة بمعمرين), for example, both GPT and GG used DT (‘the help of elders’ and ‘seeking help from the elderly’ respectively), but HT used substitution (SU), a strategy from the TO category, by rendering item 11 into English as (‘assistance from elderly folks’). For items 15 and 25, for example, DT was used in the three translations. If this is interpreted in conjunction with the results from the automatic evaluation metrics, it is perhaps surprising to note that, even with a majority of DT strategies, the BLEU score is relatively low since it is based on n-gram matching. However, given the limitations of BLEU mentioned above, it makes sense that the scores from the other metrics are higher. With moderate to high scores for both METEOR and chrF, these results seem consistent with a general tendency to follow SO translation strategies.

Table 3, Figures 2 and 3 show that target-oriented (TO) strategies, on the other hand, were mostly deployed by HT with GPT in second place and GG further behind. For all TO strategies, G was used 28 times (37.83%), SU 44 times (59.45%) and O twice, (2.70%). GPT used G almost three times more than HT, while GG used it twice as many times as HT (13, 10, and 5 times respectively). This may be due to the fact that G may be an easier way out of the complexities of handling CRs through translation. For this TO strategy, the three translations did not seem to apply it for the same items. For item 56 (أبنائه الذين من صلبه), for example, GPT used G ('his biological children'), but both GG and HT opted for DT ('his sons, who were from his loins,' and 'his own sons,' respectively). For items 68 (حضن الأم) and 69 (الفتوة), to give further examples, both GPT and GG used G ('a mother's embrace' and 'a mother's embrace,' for 68, and 'the hero' and 'the chivalrous man,' for 69), while HT used SU to render 68 as ('a mother's tender loving care') and SP to render 69 ('the strongman').

The differences in processing the cultural context of language use, particularly CRs, between AI-powered tools and human translators are very clear in the use of the substitution (SU) strategy that requires cultural gymnastics to render CRs. SU was the most used TO strategy, particularly in HT (28 times compared with 10 and 6 for GPT and GG respectively). Overall, the three translations seemed to use SU for the same CRs. In rendering items 38 (يا سلام) and 41 (على بركة الله), for example, the three translations used SU for both items respectively ('Wonderful!' and 'With God's blessing...' by GPT; 'Oh my...' and 'May God bless...' by GG; and 'My goodness!' and 'We'll proceed with God's blessing, then' by HT). However, for item 32 (قصة النار), for example, only HT used SU ('the stove') while GPT and GG used DT ('the fire pit' and 'fire bowl,' respectively). As to the strategy of omission (O) only two occurrences were observed, 1 each for GPT and GG, but zero in HT. O was the least used of all strategies. GPT omitted item 45 (حجرة الخبز), while both GG and HT used DT to render it as 'the bakery room' and 'the baking room' respectively. GG omitted item 87 (الغجر), while GPT and HT used G to render it as 'gypsies' and 'gypsy.'

For the data analysed here, the two strategies of mistranslation (MT) and combination of strategies (CS) were devised and used to cater for 14 translations. When a translation is deemed MT, then the wrong meaning is usually given. 9 cases of MT were noticed (64.28%), with GG producing 7 and GPT 2, while HT produced zero MT. 5 CS occurrences, (35.71%, with 1 each in GPT and GG and 3 in HT, were observed. Concerning MT, in the case of item 10 (لم تر العش مثله), for example, both GPT and GG generated wrong translations by missing that the village (al-Ish) is the subject and by rendering it as "she" confusing along the way matters and readers ('a sight she had never seen before' and 'she had never seen anything like it,' respectively). In Arabic, inanimates take feminine pronouns. HT produced the intended meaning by retaining "al-Ish" as subject of the sentence but added SU as part of a CS case ('the likes of which al-Ish had never seen before'). For item 93 (انت بقالك كلمة), to further exemplify, GG mistranslated it ('do you still have a word to say?!'), while GPT DT-ed ('now you've got a say?!') and HT SP-ed ('So now you have some say-so in these matters?') it respectively.

A combination of strategies (CS) means the use of 2 or more strategies to render one CR. The combination may include strategies from source or target or both categories. Items 10, 43 and 72, for example, were translated using CS. For item 10 (لم تر العش مثله), both GPT and GG mistranslated it into English, while HT used a CS to render it, whereby R was used to keep the name of the village and SU was used to render the rest of the CR into idiomatic English ('the likes of which al-Ish had never seen before'). For item 43 (مجاهد طلب إيدك), all translations used CS. While GPT and GG both used R and DT to render this CR, HT added SP by using (g) in the name (Mugahid) instead of (j), since this letter in Arabic is pronounced as /g/ in Egypt, with a few regional exceptions. The same applies to item 72 (ناجي) which both GPT and GG rendered using R (Naji) following standard Arabic phonetics, but HT used a CS through R and SP by transliterating the name as (Nagi) to reflect how the sound /j/ is transformed into /g/ in Egyptian Arabic.

Overall, the findings of this study seem to fit general trends within the context of existing literature on translating CRs. For example, in their discussion of culturally unique terms in literary texts, Fouad and Sadikhan (2019) observed that translation shifts were inevitable, including adjustments to the source Arabic text to create an appeal and naturalness in the target text. This supports the mostly TO strategies used in the HT examined in this study. In examining translation of CRs from Azerbaijan-Turkish into

English, Akheshmeh et. al., (2015) also observed that cultural substitution was the most commonly used strategy. Abdelaal (2016) also concluded that adaptation to fit the target language and culture was the main strategy in translating some Disney animated movies into Egyptian Arabic. On subtitling, El-Farahaty and Alwazna (2024) examined the translation strategies used in the subtitles between Arabic and English (both directions) of two films available on Netflix. Their main conclusion was that the subtitlers for both films missed to use enough TO strategies to produce appropriate subtitles of cultural and sensitive language for the target receivers. But Horbačasienė et. al. (2016), on the other hand, noted that despite some policies on language preservation in Lithuania, cultural references were mostly transferred through source-oriented translation strategies.

5. Conclusions

This study evaluated English translations of 100 CRs by GPT and GG vis-à-vis renderings by a published human translation. The CRs were mined from the Arabic novel بيت الديب by Ezzat El Kamhawy (2010) that was rendered into English by Nancy Roberts as *House of the Wolf* (2013). The CRs all relate to Egyptian cultural contexts. CRs are well documented in the literature to pose difficulties for human translators and most certainly, theoretically at least, for machine and AI translation. The study deployed the BLEU, METEOR, and chrF metrics to assess the translations by GPT and GG against HT. It further assessed the three translations (GPT, GG and HT) using the taxonomy of strategies by Pedersen (2011). The analysis indicates that the scores by the three metrics tend to corroborate the results from the analysis of strategies used in the three English translations. While GPT and GG tended to use mostly SO strategies, HT deployed TO strategies more. Both GPT and GG omitted information in the ST, but HT did not. All the six strategies in Pedersen's taxonomy were used with varying degrees of frequency that ranged from 1 use to 55 uses. Out of a total of 300, SO strategies were used most at 212 compared with 74 times for TO and 14 time for OS strategies.

AI is certainly transforming translation studies—theory and practice. AI offers speed accessibility, and surely some decent degree of accuracy as the results reported here indicate. However, the future may well lie in collaboration and integration between different developers and tools to serve better the ever-growing demand for translation. In the case of Arabic, more work on further integrating Arabic into existing and future AI-tools is needed. More studies, like this one, are needed to explore further culturally embedded texts, literary texts, online Arabic digital content, etc. But, perhaps most importantly, how all this can be integrated into translator training and academic programmes of translation that involve Arabic is paramount.

Finally, how Egyptian is AI? The results of this study indicate that the two AI-tools of GPT and GG seem to do well indeed compared with HT, but they remain largely source-language oriented while HT produced more target-language oriented translations. More research is needed to see if both tools can handle CRs from other varieties (dialects) of Arabic the way they did for Egyptian Arabic, which, for historical reasons, remains by far the most known and understood Arabic variety in the Arab world and globally.

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Appendix A

Table A1: Cultural References with English translations (GPT, GG and HT) and strategies employed.

Abbreviations for translation strategies (1-6 from Pedersen (2011), and 7 and 8 added specifically for this study).

- | | | |
|---|------------------------------|----------------------------|
| 1) R = Retention
Mistranslation | 4) G = Generalization | 7) MT = |
| 2) SP = Specification
of strategies | 5) SU = Substitution | 8) CS = Combination |
| 3) DT = Direct translation | 6) O = Omission | |

No	Arabic Source Text	GPT		GG		HT (RT)	
		Translation	Strategy	Translation	Strategy	Translation	Strategy
1	مباركة الفولي	Mubarakah El-Fouli	R	Mubaraka Al-Fawli	R	Mubarka al-Fouli	R
2	بسّ تفكروه بيّا	to make Him think of me	SP	but just remind Him of me	SP	just to remind Him of me	SP
3	أصله عيب، بجد عيب أوي	Because it's shameful, really very shameful	DT	Originally, it's shameful, really, really shameful	DT	For starters, it's not nice. It's really not nice at all	SU
4	عتاب خفيف كده	Just a light reproach	DT	A little reproach	DT	It's just a gentle reprimand	SU
5	ما هو معذور	he's excused, after all	MT	so it's excused	MT	I mean, He has an excuse	SP
6	هيفتكر مين ولا مين	How can he remember everyone?	G	who will remember who or who	G	He'll think, who is this, after all?	SU
7	منتصر	Montaser	R	Muntasir	R	Muntasir	R

8	ريحة راجل	The scent of a man	DT	The smell of a man	DT	His manly smell	SU
9	أجران القمح	the wheat fields	G	the wheat fields	G	the threshing floors	SP
10	لم تر العش مثله	a sight she had never seen before	MT	she had never seen anything like it	MT	the likes of which al-Ish had never seen before	CS (SU/R)
11	الاستعانة بمعمرين	the help of elders	DT	seeking help from the elderly	DT	assistance from elderly folks	SU
12	التقليب في الماضي كالنّيش في الخرّاء	digging into the past is like sifting through filth	DT	digging into the past is like digging in dung	DT	stirring up the past is like digging around in a pile of dung	SP
13	حشّ زرع	a crop theft	SP	uprooting crops	SP	mowing down somebody's crop	SP
14	تسميم بهائم	poisoning livestock	DT	poisoning livestock	DT	poisoning some livestock	SP
15	الأرواح الهائمة	wandering spirits	DT	the wandering spirits	DT	wandering spirits	DT
16	القشّ يشعل	the straw ignite	DT	the straw ignite	DT	the straw catching fire	SP
17	وشيش البحر	the hiss of the steam	SP	the whisper of the sea	SP	steam rising	SP
18	ربلتي ساقيه	his calves	DT	his calves	DT	his thighs	SP
19	تنتظره بشقّ الباب	behind a slightly open door	DT	by the crack of the door	SP	wait for him with the door ajar	G

20	إزيك يا مباركة	How are you, Mubarakah ?	DT	Hello, Mubaraka	SU	How are you, Mubarka?	DT
21	دكة اللباس الباتيسا	the batista dress	DT	the worn baptiste dress	SP	her batiste waistband	SU
22	الزغب السري	belly button	G	the secret downy area	SP	the fuzz in her navel.	SP
23	درس القمح	threshing wheat	DT	threshing wheat	DT	threshing the grain	G
24	حصد بوص المستنقع	reed harvesting	DT	borrowed from the swamp reed harvest	SP	removed the swamp's reeds	SP
25	مسكت دبل قطّة	Maybe you grabbed a cat's tail!	DT	Could it be that you touched the tail of a cat?	DT	Maybe you grabbed a cat's tail!	DT
26	ورا داركم بعد العشا	Behind your house after dinner	DT	Behind your house after dinner.	DT	Behind your house after supper.	SU
27	المجنونة بنت بدر الفولي	The mad daughter of Badr El- Fouli?!	DT	The crazy daughter of Badr Al- Fawli?!	DT	That crazy girl, Badr al- Fouli's daughter?	G
28	دي كلّ العش بتقول مخاوية	All the village says she's possessed	SP	All the tribe says she's crazy	SP	Everybody in al-Ish says she's possessed!	DT
29	عايز أشرب شاي عندك	I want to have tea at your place.	DT	I want to drink tea at your place.	DT	I'd like to come by for a cup of tea	SU
30	الكنكة النحاس	the brass teapot	DT	the copper kettle	MT	the copper teapot	DT
31	سيدة بيت	lady of the house	SU	mistress of the house	SP	the kind of housewife she promised to be	SP

32	قصعة النار	the fire pit	DT	fire bowl	DT	the stove	SU
33	المنضرة	the living room	SU	the veranda	G	the sitting room	SU
34	الحارة	the alley	DT	the alley	DT	courtyard	SP
35	ترشها بالماء	sprinkling water to settle the dust	DT	sprinkle it with water.	DT	sprinkling them with water	DT
36	اللهم صل على النبي	Peace be upon the Prophet.	SP	Oh God, bless the Prophet.	DT	O God, send down blessings on the Prophet	SP
37	آخر قاعة بالدار	farthest room in the house	SP	the last hall of the house	DT	the farthest room of the house	SP
38	يا سلام	Wonderful!	SU	Oh my...	SU	My goodness!	SU
39	دي تروح خدامة	She'll make a good servant...	DT	She's going to be a servant...	DT	We'd even send her along as a maid if you asked!	SP
40	إحنا هانلاقي أعز منك؟	We couldn't find anyone more honored than you!	SP	Are we going to find someone more precious than you?!	SP	After all, could we find anybody better than you?	SP
41	على بركة الله	With God's blessing...	SU	May God bless...	SU	We'll proceed with God's blessing, then	SU
42	الفاتحة	the Fatiha	DT	Al-Fatihah	DT	Let's recite the Fatiha	SU
43	مجاهد طلب إيدك	Majahid asked for your hand	CS (R/DT)	Mujahid asked for your hand	CS (R/DT)	Mugahid asked for your hand	CS (R/SP/DT)
44	أخشاب السقف	the tarred wooden	DT	the thatched	SP	tar-daubed wooden	DT

	المقطرنة	ceiling beams		ceiling		rafters	
45	حجرة الخبيز	-----	O	the bakery room	DT	the baking room	DT
46	بدر	Badr	R	Badr	R	Badr	R
47	يعيش عائلة على زوجته	lived off his wife	SU	lives as a burden on his wife	SP	was a burden to his wife	SP
48	ليس بوسعه أن يحمي دجاجة	could not protect a chicken	DT	he cannot protect a chicken	DT	he couldn't have protected a chicken	DT
49	رأس أسرته	the head of his family	DT	the head of his family	DT	the head of his family	DT
50	الدّوار	the homestead	G	the village	G	the farmhouse	SP
51	نبيهة	Nabihah	R	Nabihah	R	Nabiha	R
52	حفيفة	Hafiza	R	Hafiza	R	Hafiza	R
53	هيشوف	He'll see	DT	He will see.	DT	He'll see	DT
54	سجلّ له الأرض بيعاً وشراء	sold and registered all the land to him	DT	registered all the land for him ..., buying and selling,	SP	registered all the land in his name as if he'd bought it from him	SP
55	يعيّره	to taunt him	SU	blaming him	DT	raking Muntasir over the coals	SP
56	أبنائه الذين من صلبه	his biological children	G	his sons, who were from his loins	DT	his own sons	DT
57	منذ تلقّاه لحم	since he received him as a red	DT	since a piece of red meat	DT	since the time he took	SU

	حمراء	piece of meat				him in	
58	هذه المسحورة	this possessed one	DT	this enchanted one	SU	that bewitched girl	SU
59	كلها شخايات	They're all pissers	DT	They are all the same	G	It's nothing but piss and poop down there	SU
60	مابقاش ابن سلامة لو ماخدتش حقّي	I'll no longer be the son of Salama if I don't get my right	DT	"Ibn Salama will not remain if I do not take my right."	MT	I wouldn't be Salama's son if I didn't demand what's mine	SP
61	نهاية سهرته	after his early morning gathering	DT	his evening near dawn	DT	after his night out	SU
62	الشال	shawl	DT	the shawl	DT	muffler	SU
63	مطوحاً بيده	flinging his hand	SU	throwing him with his hand	DT	with a fling of the hand	SU
64	مولولة	wailing	DT	wailing	DT	wailing at the top of her lungs	SU
65	تحّمه في ليالي العيد	bathed him on festive nights	G	bathe him on Eid nights	DT	given him baths on holidays	G
66	تدعكها (رجليه) بالحجر	scrubbing (his legs)	DT	rubbed them (his feet) with a stone	SP	sloughed layers of dried skin off them with a stone	SP
67	طبقات القشّف	the calluses off them	SP	to remove layers of roughness	DT	sloughed layers of dried skin off them with a stone	SP
68	حضن الأم	a mother's embrace	G	a mother's embrace	G	a mother's tender loving care	SU
69	الفتوة	the hero	G	the chivalrous	G	the strongman	SP

				man			
70	الغيط	field	SP	the field	SP	the fields	SP
71	سلامة	Salama	R	Salama	R	Salama	R
72	ناجي	Naji	R	Naji	R	Nagi	CS (R/SP)
73	سمنت الجواميس	The buffaloes fattened	DT	The buffaloes became fat	DT	The buffaloes got fat	DT
74	حشّ البرسيم	cutting clover	SP	stuffing the alfalfa	DT	mowing the clover	SP
75	تمتلئ الكوى في الحوائط	the niches in the walls	DT	the holes in the walls	DT	the small windows in the farmhouse walls	SP
76	الأفيون والحشيش	opium and hashish	DT	opium and hashish	DT	opium and hashish	DT
77	فدان	acre	DT	acre	DT	feddans	R
78	تزويقها (المهرة)	decorating (the mare)	DT	decorating (the mare)	DT	decorating (the mare)	DT
79	يزف بها العرائس	He paraded her at weddings	G	take it to weddings	SP	escort brides to their new homes	SP
80	موالد المنطقة	regional fairs	DT	the shrines of the region	MT	the mulid celebrations	R
81	أذان العصر	the afternoon prayer	G	the afternoon prayer	G	the midafternoon call to prayer	SP
82	الديك المحمّر	the roasted rooster	DT	the roasted rooster	DT	the roast rooster	DT
83	فصّ	opium	SP	a piece of	SP	a joint of	SU

	أفيون	poppy		opium		opium	
84	حممة المهرة	mare's neighing	DT	the neighing of the mare	DT	the filly's neigh	SU
85	جلباب	robe	DT	jellaba	R	gilbab	R
86	لا تتطفئ الجوزة	the hookah did not stop	DT	the walnut would not go out	MT	the shisha wouldn't go out	SP
87	العجبر	gypsies	G	-----	O	gypsy	G
88	حثة الناس	the lowlifes	SU	the scum of people	SU	hooligans	SU
89	يلوي لجام المهرة	twisting the mare's bridle	DT	twisting the bridle of the mare	DT	tug on the filly's reins	SU
90	متحولاً عن الزراعية	away from the usual path	DT	turning from the agricultural land	SP	turn off the village's main street	SP
91	الخيزرانة الرفيعة	a thin cane	G	the thin bamboo	DT	a thin bamboo rod	DT
92	والله عال	Well	G	By God	G	Well, well, well.	SU
93	إنت بقالك كلمة؟	now you've got a say?!	DT	do you still have a word to say?!	MT	So now you have some say-so in these matters?	SP
94	زعى	yelled	DT	yelled	DT	screeched	SU
95	الشبورة	the mist	SU	the fog	SU	the mist	SU
96	يبدأ العيش أجيراً	start living as a laborer;	DT	start living as a laborer	DT	begin the life of a day laborer	SP
97	رائحة بول	the scent of	DT	The smell of animal	SP	the scent of	SP

	الركائب	mount urine		urine		their urine	
98	آثار روثها	their dung trails	DT	the traces of its grazing	G	traces of the mounts' dung	DT
99	استلقى قليلاً تحت توتة	resting under a mulberry tree	DT	lay down for a little under a mulberry tree	DT	lie down for a while under a mulberry tree	DT
100	سحابة ظلت اليتيم	a cloud shading the orphan.	DT	a cloud that shaded the orphan	DT	a cloud that had been sent to shade the orphan.	SP