

A Probabilistic Inductive Model for Translation Error Analysis among EFL Learners through Al-Sadr's Induction Theory

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Abstract

This quasi-experimental study investigated the prediction of recurrent translation errors among EFL learners using a Bayesian probabilistic model within the framework of Sayyid Muhammad Baqir Al-Sadr's theory of probabilistic induction. 65 university students participated in the study, completing two translation tests to examine the recurrence of ten types of translation errors under similar linguistic conditions. The results of Test 1 showed that grammatical errors were the most frequent (31.8%), spelling errors (28.8%) and semantic errors (19.4%). Similar trends were also evident in Test 2; however, the frequency of semantic errors decreased slightly (from 19.4% to 16.3%) compared with Test 1, while contextual errors (from 8.0% to 11.6%) and terminology errors (from 2.4% to 6.4%) each showed a moderate increase. Idiomatic, cultural and omission/addition error frequencies remained low. The Bayesian model performed reasonably well as a predictive tool. It was able to demonstrate high levels of predictive consistency by providing close correspondence between the predicted probability of an error occurring and its observed frequency on the second translation task. The findings suggest that recurrent translation errors can be interpreted as predictable probabilistic patterns rather than isolated learner deviations. The study concludes that integrating Bayesian reasoning with Al-Sadr's probabilistic induction theory may help instructors predict learner difficulties and design more effective pedagogical interventions in teaching.

1. Introduction

1.1. Background of the Study

Beginning with the fact that error identification is crucial in defining learners' linguistic capabilities, as well as their transitional phase through linguistic and cultural boundaries. The identification of common errors allows instructors to identify areas of weakness for students and develop better instructional methods for language education (Gass & Selinker, 2008; Lado, 1957).

However, a fundamental distinction must be made among common linguistic errors, and those that appear to be exclusive to translated materials. Common linguistic errors are generally a result of a learner's lack of understanding of the second language, and can include a variety of aspects such as pronunciation, syntax, and lexical selections that may occur at any time during the process of linguistic communication. Errors associated with translating materials will generally arise from misunderstandings related to sharing ideas across languages and cultures. These errors can result in misinterpretations, lost nuances, or cultural oversights which may result in inaccurate understandings, failing to grasp the point, or ignoring cultural facts. It is essential to recognize this difference because problems associated with translation are likely to extend beyond typical language issues, and are often based on cultural differences (Carl, 2015; Alves, 2003).

In addition to simply identifying errors, examining translation errors in the context of EFL has the potential to provide a deeper insight into how learners utilize a second language, to convey information from one location to another, and to communicate across cultures. In doing so, it offers both translation education and EFL education new avenues for developing ways for teachers to anticipate, classify, and organize errors. As a result, this provides teachers with the ability to enhance their students' language accuracy, expand their cultural awareness, and ultimately enhance overall communication skills (Carl, 2015; Kussmaul, 1995).

The examination of translation mistakes in EFL education identifies deep-seated conceptual frameworks related to the learner's knowledge regarding language and culture. An examination of common errors will help teachers develop lesson plans that are tailored toward improving the learners' overall quality of communication

through both accurate use of language and effective cross-cultural interaction (Lado, 1957; Gass & Selinker, 2008). In order to meet this need for developing more appropriate lessons in the classroom, this study will investigate errors in translations made by EFL students using a probabilistic inductive model based on Al-Sadr's inductive theory.

1.2. Rationale of the Study

A key distinction must be made between common linguistic errors and those that appear exclusive to translated material. Common linguistic errors usually arise from the learner's lack of understanding of the second language and may include pronunciation, grammar, and vocabulary selection at some stage of linguistic communication. This is with regard to linguistic errors in general. As for errors related to translation, they usually arise from misunderstanding in the exchange of ideas between different languages and cultures, and this may lead to incorrect interpretations, loss of nuances, or overlooking cultural aspects. Recognizing this distinction is crucial because translation-related problems often extend beyond typical linguistic issues and are frequently rooted in cultural differences (Carl, 2015; Alvis, 2003). Examining translation errors in the context of English as a foreign language provides teachers with a deeper insight into how learners use a second language, opening up new avenues for teachers to anticipate, classify, and organize errors to enhance students' language accuracy, cultural awareness, and overall communication skills (Carl, 2015; Kussmaul, 1995).

1.3. Literature Review

The examination of translation mistakes in EFL education reveals deep conceptual frameworks related to learners' knowledge of language and culture; an understanding of common errors helps teachers design lesson plans aimed at improving learners' communicative accuracy and cross-cultural competence (Lado, 1957; Gass & Selinker, 2008). More recent scholarship has extended this line of inquiry through corpus-based approaches to learner error analysis: for example, Wongranu (2017) examined the types and causes of translation errors made by English-major students, while Ehsanzadeh and Dehnad (2024) used a large learner corpus to catalogue high-frequency errors and recurring linguistic patterns among EFL writers, and Zhuang and Chen (2025) analyzed recurrent interpreting errors among EFL learners using a parallel learner corpus. In parallel, probabilistic and Bayesian approaches have increasingly been applied to model recurrent learner and student behavior in educational settings more broadly (Bertolini, Finch, & Nehm, 2023), suggesting the potential value of similar reasoning for translation error prediction.

Contrastive Analysis Hypothesis (CAH): The Contrastive Analysis Hypothesis (CAH) suggests that mistakes learners make mainly come from the structural differences between their first language (L1) and the second language (L2). This idea posits that we can expect problems in learning an L2 by identifying where the two languages differ structurally. Errors occur due to L1 interference. For example, Arabic learners of English often omit "to be" in sentences like "He happy", which shows how Arabic sentence structure affects their English (Lado, 1957; Gass & Selinker, 2008). Some people have problems with this idea because it looks too much at how a person's first language affects their second language learning, and not enough at how thinking and cognitive development play a role.

Error Analysis (EA): EA emerged as an alternative to Contrastive Analysis Hypothesis by emphasizing that learner errors are not solely caused by first-language interference, but may also result from developmental, cognitive, and communicative factors (Corder, 1967). EA examines learner errors systematically in order to identify patterns, sources, and stages of language development. Unlike CAH, which attempts to predict errors before they occur, EA focuses on analyzing actual learner performance after errors are produced. In translation studies, EA helps identify frequent grammatical, semantic, and contextual errors among EFL learners. However, despite its usefulness in classification and diagnosis, EA remains primarily descriptive and does not provide a quantitative framework for predicting future recurrence of translation errors.

Behavioral Theory: Behavioral theory suggests that language learning involves forming habits as a result of repetition, reinforcement and observation. Mistakes are viewed as undesirable habits resulting from interference between previously learned linguistic patterns and newly acquired language structures. As an example, students may say He go to school every day rather than He goes to school every day transferring first language patterns to second language (Skinner, 1957; Lado, 1957). This perspective regards errors as outcomes of the development of bad habits that should be fixed by means of practice, not as developmental products.

Interlanguage Theory (Selinker, 1972): Second language acquisition is regarded as a dynamic and developmental process. Learners naturally produce errors during the process of second language acquisition. The interlanguage theory helps us to observe how the language of a person evolves with time. However, it does not provide a way to measure or predict the types of mistakes that will happen. Other scholars such as (Khansir, 2012; Erdogan, 2005) have indicated that this theory does not show a clear roadmap on how to correct frequent errors. The theory is not so much about providing any particular solutions, but rather, describing the way people learn. It states that errors should be treated as a learning experience as opposed to failure. Yet, in a classroom this theory isn't as useful as it does not particularly focus on the errors that continue to occur. Overall, the

interlanguage theory is useful for understanding how people learn a new language, but it needs to be used with other approaches to help fix common mistakes.

Skopos Theory (Vermeer, 1978; Reiss & Vermeer, 1984): Skopos Theory (Vermeer, 1978; Reiss & Vermeer, 1984) proposes that the main thing in translation is how the final text will be used. The communicative purpose of the target text is considered more important than strict adherence to the source text. Mistakes occur in cases where a translator's decisions aren't able to achieve what the translation is intended to achieve for its audience. Such as, a word-for-word translation might be correct, but still an error if it doesn't work for the people reading it (Vermeer, 1978). Skopos Theory also posits that there can be a variety of suitable translations of the same source text, according to the recipients and their goal (Reiss & Vermeer, 1984). This theory helps us understand translation choices, but it also shows some problems with authoritative rules in classrooms. It's good for professional translators because it focuses on why they're translating something. But because it's not very specific, it's better for talking about translation than for teaching people how to translate (Munday, 2008).

Translation Criticism / Quality Assessment Model: Translation Criticism, also known as the Quality Assessment Model, considers translation to be a communicative act that can be systematically evaluated according to specific standards of adequacy and equivalence. That is, the occurrence of mistakes is not perceived as some random imperfections but as an attempt to diverge the functional and communicative needs of the target text. As an illustration, a translation may cause an exact interpretation of a metaphor and misinterpretation of meaning, however, a subsequent review step will decide on how and where to reformulate to suit the intention of the target audience (House, 1997; Williams, 2009). The functional adequacy and equivalence of texts can be studied especially with translation criticism, but this cannot be applied to explain the cognitive process of translation, which plays an extremely important role in modeling the mechanisms of error production and decision-making strategies.

Common EFL translation errors: Translation Errors (TE) are among the most common phenomena studied in applied linguistics and translation studies. TE accounts for variations in the translated text that distort meaning, style, or grammaticality in contrast to the source text (Nida, 1964; House, 2015). TE considers errors to be essentially due to discrepancies in linguistic, cultural, or pragmatic features between the source language (SL) and the target language (TL). Analysis of such mistakes can give the translator or teacher an indication of frequent trouble spots among students or practitioners. An example is the tendency for novice translators to render idiomatic expressions literally, such as rendering "kick the bucket" into Arabic as *يركل الدلو* instead of using the equivalent idiom for dying (*توفي*) (Baker, 2018).

Although previous studies on translation error analysis have positively acknowledged and classified common error types among EFL learners, most of them remain descriptive and retrospective. They explain errors after they occur, but do not provide a systematic or quantitative method for predicting the recurrence of these errors over time. Moreover, little attention has been given to integrating probabilistic models with a solid philosophical theory of induction in translation studies. As a result, translation errors are often treated as isolated learning problems rather than as stable or predictable patterns. This study addresses this gap by applying a Bayesian probabilistic model based on Al-Sadr's induction theory to predict the recurrence of translation errors among EFL learners.

Bayesian Translation Error Prediction Model: The Bayesian equation is a powerful instrument to make predictions about the probability of a foreign language learning translation error recurrence. Combined with the Probabilistic Inductive Theory of Sayyid Muhammad Baqir Al-Sadr, the method applies the use of Bayesian probability to determine the probability of the reoccurrence of a particular translation mistake that has already been detected. This is especially useful in didactics of translation where the outcomes of an analysis of information can serve not only to inform teaching intervention but also to individualize learning. The formula is given below:

$$P(\text{TranslationError}|\text{PastOccurrences}) = \frac{P(\text{PastOccurrences}|\text{TranslationError}) \cdot P(\text{TranslationError})}{P(\text{PastOccurrences})}$$

This gives teachers a way to measure and predict the problems learners might face, so they can prepare and counter them. Bayesian probability provides a statistical framework for estimating the likelihood of translation error recurrence based on prior observations and newly observed evidence. Within translation studies, Bayesian inference allows researchers to model recurrent learner errors probabilistically rather than treating them as isolated events. Combined with Al-Sadr's probabilistic inductive theory, Bayesian reasoning provides a framework for predicting future translation behavior based on repeated patterns observed under similar linguistic conditions.

Al-Sadr's Induction Theory: Sayyid Muhammad Baqir Al-Sadr (1977) developed what is now known as the Probabilistic Inductive Theory, a philosophical reformulation of classical induction that introduces statistical inference as the epistemological basis for generalization. In his seminal treatise *Al-Usus al-Mantiqiyya lil-Istiqra'*

(The Logical Foundations of Induction), Al-Sadr argues that inductive reasoning does not yield certainty — a limitation identified by Hume (1748) but instead generates degrees of rational belief that increase as the number of confirming instances accumulates under identical or equivalent conditions. Al-Sadr grounds the strengthening of inductive conclusions not in the mere accumulation of instances, but in the consistency of evidential conditions under which they occur. This approach maps directly onto Bayesian inference, in which the posterior probability $P(H|E)$ — the probability of a hypothesis given evidence — increases proportionally as each new observation (E) confirms the prior probability $P(H)$ (Tenenbaum et al., 2011; Griffiths, Kemp & Tenenbaum, 2008).

The structural isomorphism between Al-Sadr's model and Bayes' theorem is based on each's recognition that repeated consistent evidence (as long as conditions remain constant), logically leads to an increase in the probability of similar or identical events occurring in the future. Using translation error analysis, when a learner makes a grammar error under certain conditions during Task 1; they provide prior information (or $P(E)$), which can be used to update task two results ($P(R|E)$), resulting in a posterior estimate ($P(E|R)$) of the probability of making a similar error again in other similar tasks. Inductive reasoning has historically been a fundamental aspect of scientific research, allowing scientists to generalize about phenomena based upon trends and/or patterns. However, traditional inductive models have several criticisms, including those made by Hume (1748); primarily, that there is no assurance of being able to know anything for certain using these methods and secondly, the disconnect between what was experienced in the past and what may occur in the future.

This model has particular application in second-language learning; this is because, for example, frequent error types are created by the same cognitive processes and linguistic knowledge, which include L1 structural influence, habitual lexical choice, and lack of pragmatic ability; and these processes occur through similar communication activities. Therefore, frequent translation errors, such as frequent use of a literal rendition of an idiom, consistent failure to agree tenses, or frequent omissions of the definite article, may be seen as not being a result of sporadic failures in performance, but rather as likely manifestations of the learner's interlanguage system (Selinker, 1972).

In addition to this, using Al-Sadr's framework will allow for moving from descriptive analyses of past errors toward future (prospective) probabilistic models of language use. The ability to model anticipated patterns in student language use (under similar linguistic conditions) provides a mechanism to provide more anticipatory and targeted instructional responses. Overall, Al-Sadr's probabilistic inductive framework provides instructors and researchers with a principled theoretical basis for improving translation pedagogy and supporting more effective language learning outcomes. By systematically examining error recurrence patterns through the lens of probabilistic induction, educators can develop data-informed instructional strategies that target persistent learner difficulties and prioritize high-probability error categories in curriculum design. The Bayesian updating mechanism operationalizes this approach empirically, enabling the integration of new observational evidence to refine probabilistic predictions of learner error behavior across successive tasks and support more effective language learning outcomes. Previous studies primarily described translation errors retrospectively, whereas the current study attempts to predict recurrence probabilistically using Bayesian induction. Accordingly, Al-Sadr's probabilistic framework provides a theoretical basis for interpreting recurrent translation errors as predictable patterns rather than isolated learner deviations.

1.4. Gap Analysis

Although these studies have usefully categorized errors, most remain descriptive and retrospective, explaining errors after they occur but failing to offer a systematic or quantitative method for predicting their frequency. Furthermore, little attention has been paid to integrating probabilistic models with philosophical inductive reasoning in translation studies. Consequently, translation errors are often treated as isolated learning problems rather than as consistent and predictable patterns.

1.5. Purpose of the Study

To address this gap, this study investigates errors in translations made by EFL students using a probabilistic inductive model based on Al-Sadr's induction theory. This investigation seeks to answer the following questions:

- a. What are the most frequent and recurrent types of translation errors committed by EFL learners?
- b. What patterns or factors contribute to the recurrence of specific translation errors among EFL learners?
- c. To what extent is the model able to assess the frequency of translation errors made by EFL learners?

2. Method

This study employed a mixed-methods approach, combining quantitative statistical analysis and qualitative error analysis, to examine the frequency patterns of translation errors among learners of English as a foreign language. The quantitative aspect focused on measuring the frequency and predictability of translation errors in two translation tasks, while the qualitative aspect addressed the linguistic and contextual nature of the recurring errors. The methodological framework was based on Abdulridha's (2025) probabilistic approach to error analysis and Al-Sadr's theory of probabilistic induction.

2.1. Participants

The participants of the study consisted of sixty-five Iraqi female senior students at Al- Zahraa University for Women/ Karbala studying English, specifically translation. The age of the students ranged between 22 and 30. They were EFL students with B1 to B2 level according to the CEFR. The participants completed two translation sessions. At the first session, the students translated a text and at the second session, they translated another text to examine the repeated errors. The participants participated voluntarily and provided their consent after being informed about the research, and the confidentiality of the participants' information was assured. The study was ethically approved before any data was collected.

2.2. Data Instruments

The participants were asked to take the Oxford Placement Test (OPT) at the outset of the study. This was done to measure how well they knew English and to make sure that they were all at the same level of proficiency. The outcome showed that all of the students demonstrated a proficiency level ranging from intermediate to upper-intermediate level (B1-B2) of the Common European Framework of Reference (CEFR).

Two translation tasks were administered, both from L. G. Alexander's Developing Skills (1978). Selected passages from the same source text was a deliberate methodological choice, by holding the text type, register, and difficulty level constant across tasks, this design isolates error recurrence as a function of learner behavior rather than textual variation. Using selected passages from the same textbook may also constrain the range of observable error types particularly cultural and pragmatic errors and future studies should replicate findings with typologically varied translation materials.

2.3. Data Analysis

Descriptive Statistics: To find out the recurrence rate of each of the ten types of errors (semantic, grammatical, idiomatic, literal, contextual, cultural, spelling, punctuation, omission/addition, and terminology) committed before and after the feedback provided, the researchers also employed frequency and percentage calculations. This helped in identifying how the errors were distributed over the two translation tasks and which error types were the most frequent among the EFL learners.

Inferential Statistics: A paired-samples t-test was performed by SPSS version 26 to examine the differences in performance across the two translation tasks and to see whether there were significant differences in the recurrence of recurrent translation errors. Significance levels were used to assess statistical differences between error frequencies across the two translation tasks. Normality assumptions were examined prior to conducting the paired-samples t-test. The conditional probability values were estimated based on the proportion of participants who repeated the same error category across the two translation tasks under comparable linguistic conditions.

Bayesian Computational Procedure: To determine whether the same types of translation errors are likely to occur again with English as a Foreign Language (EFL) learners, this study used Bayesian statistical theory within the framework of probabilistic induction. The goal of this model was to determine how likely it is that an EFL learner would translate similarly in both the first and second translation tasks given the same learning conditions. Bayesian statistical models were selected due to their ability to update the probabilities of new observations using previously available information. The Bayesian equation used in this study is as follows:

$$P(E|R) = [P(R|E) \times P(E)] / P(R)$$

Where:

P(E|R) = The posterior probability of the translation error recurring, given its previous occurrences.

P(R|E) = The conditional probability of the error recurring under similar conditions.

P(E) = The prior probability of the error occurring in the first translation test.

P(R) = The recurrence rate of translation errors in the dataset.

The prior probabilities (P(E)), that is the probability of occurrence of each type of error, are based on the empirical results, which show the percent frequency of each type of error within the first translation task. The

prior probabilities represent the relative proportion of total errors associated with each particular error type. Based on participant level data, conditional probabilities ($P(R|E)$), or the probability of a student producing the same error category in both translation tasks, while subjected to similar linguistic conditions, were determined by examining the proportion of students that exhibited an error category common to both translation tasks.

These values were not assumed arbitrarily but derived from cross-task recurrence rates within the dataset: for example, grammatical errors were observed to recur in approximately 95% of students who produced them in Task 1, yielding $P(R|E) = 0.95$, while idiomatic errors, being far less stable, yielded $P(R|E) = 0.30$. The denominator $P(R)$ represents the overall aggregate recurrence rate of translation errors across both tasks. This value was calculated as the proportion of total error instances in Task 1 that were also observed in Task 2, yielding an empirically grounded estimate of $P(R) = 0.90$. Applying a unified $P(R)$ value across categories is an acknowledged simplification; future studies should calculate category-specific denominators to refine predictive precision. This value functions as a normalization factor within the Bayesian framework to ensure proportional probability estimation across error categories. For example, grammatical errors represented 31.8% of the total errors identified in the first translation test: $P(E) = 0.318$.

The probability of grammatical errors recurring among learners in similar contexts was estimated at 0.95 based on their observed cross-task recurrence rate: $P(R|E) = 0.95$. The overall frequency in the dataset was estimated at 0.90: $P(R) = 0.90$. The value of $P(R)$ was derived from the aggregate recurrence frequency of translation errors across both translation tasks. The posterior probability of grammatical errors recurring was calculated as follows: $P(E|R) = (0.95 \times 0.318) / 0.90$. $P(E|R) = 0.336$. The standardized recurrent normalization constant ($P(R)=0.90$) which is an empirical estimate of the overall frequency of cross-task recurrences in this data set, was used consistently across each of the three types of errors to allow for comparison of posterior estimates, as well as to establish a common probabilistic reference point for evaluating recurrences. Note that the zero frequency categories (culture-based errors; omission/addition errors) are omitted from assessing predictive accuracy because it does not represent an appropriate measure of model discrimination.

Therefore, the predicted probability of grammatical errors recurring was approximately 33.6%, which was then compared to the actual frequency observed in the second translation test (30.2%). Similar calculations were performed for spelling, semantic, contextual, literal, terminological, and idiomatic errors. The predictive accuracy of the model was assessed by comparing the posterior probability derived from the first test with the actual frequencies observed in the second test. Relatively small differences between predicted probabilities and observed frequencies were interpreted as evidence of approximate predictive consistency within the Bayesian inductive framework.

The model was specifically developed to assess if repeated translation errors could be identified as predictable stable patterns (i.e., probabilistic patterns) or as learner-specific deviation. This is an example of a probabilistic induction theory that suggests the occurrence of similar events in similar contexts will increase the likelihood of their occurring again. Therefore, the translation errors were examined not as isolated linguistic mistakes; however, they were viewed as habitual cognitions formed through the influence of language interference and contextual similarities.

Qualitative Analysis: A purposive sample of student translations was qualitatively analyzed for errors and error corrections to trace the persistence and correction modes. The modes were discussed in light of communicative translation and pragmatic equivalence (Nida, 1964; Newmark, 1988; Nord, 1997) and the textual translation view (Nord, 1997). The qualitative data helped to explain the statistics and the source of the repeated errors whether it was due to cultural influence, literal translation, or lack of context. thus adopting Al-Sadr's inductive reasoning that connects evidence with probability.

Error Coding Reliability: To ensure the reliability of error classification, a second specialist in translation studies independently reviewed and coded 20% of the translation samples using the same error classification criteria. Inter-rater reliability was calculated using Cohen's Kappa coefficient, which yielded a value of 0.82, indicating strong agreement between coders.

3. Results and Discussion

3.1. Results

This section presents the findings related to the study's three research questions. The results are organized into descriptive statistical findings, recurrence pattern analysis, Bayesian predictive analysis, and inferential statistical testing. For the first question, according to the data analysis that we conducted, the answer will be presented in Table 1.

Table 1. Recurrence Rate of Translation Error Types (Test 1 & Test 2)

Error Type	Test 1 Frequency	Test 1 Percentage (%)	Test 2 Frequency	Test 2 Percentage (%)	Rank
Grammatical Errors	318	31.8	260	30.2	1
Spelling Errors	288	28.8	210	24.4	2
Semantic Errors	194	19.4	140	16.3	3
Contextual Errors	80	8.0	100	11.6	4
Literal Translation Errors	90	9.0	75	8.7	5
Punctuation Errors	35	3.5	60	7.0	6
Terminology Errors	24	2.4	55	6.4	7
Idiomatic Errors	20	2.0	5	0.6	8
Cultural Errors	0	0.0	0	0.0	9
Omission/Additions	0	0.0	0	0.0	9

Table 1 shows the general error distribution of the errors committed by the respondents in Test 1 and Test 2. The findings show that there is an error hierarchy in Test 1 which is repeated in Test 2. The similarity in error distribution across the two translation tasks suggests relative stability in the occurrence of specific translation error categories among the participants. In Test 1, grammatical errors were the most frequent (31.8%) followed by spelling errors (28.8%). In Test 2, grammatical errors remained the most frequent category (30.2%) followed by spelling errors (24.4%). Semantic errors are the third most frequent errors in Test 1 (19.4%) and Test 2 (16.3%).

Errors in context, literal translation, punctuation, and terminology are present in low frequencies in both tests. Idiomatic, cultural, and omission addition errors are almost absent in both tests. To sum up, the table shows that the most frequent errors are those of grammar, spelling, and semantics. However, those of context, literal translation, punctuation, terminology, idiomatic, cultural, and omission addition are in low frequencies. This answers the first research question which is: "What is the frequency and distribution of translation errors among EFL learners?". Percentages represent the proportion of total identified error instances rather than mutually exclusive participant categories; therefore, cumulative percentages may exceed 100% because individual translations could contain multiple error types.

To answer the second question, which is: "What patterns or factors contribute to the recurrence of specific translation errors among EFL learners?" Table 2 shows the results.

Table 2. Recurrence Patterns of Translation Error Types Across the Two Translation Tasks

Error Type	Test 1 (%)	Test 2 (%)	Recurrence Pattern	Recurrence Level
Grammatical Errors	31.8	30.2	Slight decrease but remained dominant	High
Spelling Errors	28.8	24.4	Moderate decrease	High
Semantic Errors	19.4	16.3	Slight decrease	Moderate-High
Literal Translation Errors	9.0	8.7	Relatively stable	Moderate
Contextual Errors	8.0	11.6	Increased recurrence	Moderate
Terminology Errors	2.4	6.4	Increased recurrence	Low-Moderate
Idiomatic Errors	2.0	0.6	Sharp decrease	Low
Cultural Errors	0.0	0.0	No occurrence detected	None
Omission/Additions	0.0	0.0	No occurrence detected	None

The data in Table 2 is an answer for the second research question which is: "What patterns or factors contribute to the recurrence of specific translation errors among EFL learners?" These results indicate that the grammatical, spelling and semantic errors occurred frequently among the participants, hence, the findings suggest relatively stable translational tendencies. The research question has been answered that the learners have the same translation errors from one time to another and that is a sign of persistent linguistic difficulties that needs further pedagogical implications. In contrast, the contextual and the terminological errors increased in the second test, this is a sign of the effect of context and terminology in the performance of the learners. These findings indicate relative stability in recurrent translation error patterns across the two translation tasks.

Qualitative examination of selected student translations further supported the statistical findings regarding recurrent error patterns. For instance, several participants translated idiomatic expressions literally resulting in semantic distortion and loss of communicative meaning. In one example, the English expression "break the ice" was translated word-for-word into Arabic rather than using an equivalent culturally appropriate expression. Grammatical errors frequently involved omission of auxiliary verbs and incorrect tense agreement, reflecting persistent first-language interference patterns among the learners while contextual and terminology errors were also observed when students selected direct lexical equivalents without considering the broader textual meaning.

To answer the third research question which is: “To what extent is the model able to assess the frequency of translation errors made by EFL learners?” Table 3 compares the statistically predicted values with the actual outcomes in test two, this table is used to show how far is the model able to predict different types of errors and this table is used as a measure of how far the model is efficient in predicting the translational behavior of the learners. The posterior probabilities reported in Table 3 were calculated using the Bayesian equation presented in the methodology section with a standardized recurrence normalization value of $P(R) = 0.90$. Predictive accuracy levels were interpreted qualitatively based on the magnitude of difference between posterior probabilities and observed frequencies, where smaller differences indicated stronger predictive consistency

Table 3. Bayesian Prediction and Actual Recurrence of Translation Errors

Error Type	Prior Probability P(E)	Conditional Probability P(R E)	Posterior Probability P(E R)	Actual Frequency in Test 2	Difference	Predictive Accuracy
Grammatical Errors	0.318	0.95	0.336	0.302	0.034	High
Spelling Errors	0.288	0.90	0.288	0.244	0.044	Moderate-High
Semantic Errors	0.194	0.88	0.190	0.163	0.027	High
Literal Translation Errors	0.090	0.85	0.085	0.087	0.002	Very High
Contextual Errors	0.080	0.92	0.082	0.116	0.034	Moderate
Terminology Errors	0.024	0.80	0.021	0.064	0.043	Moderate
Idiomatic Errors	0.020	0.30	0.007	0.006	0.001	Very High
Cultural Errors	0.000	0.00	0.000	0.000	0.000	Perfect
Omission/Additions	0.000	0.00	0.000	0.000	0.000	Perfect

The Bayesian posterior probabilities presented in Table 3 were compared with the actual frequencies observed in the second translation task in order to evaluate the predictive consistency of the probabilistic model. The findings indicate that the Bayesian model demonstrated relatively high predictive accuracy for the most frequent error categories, particularly grammatical, spelling, semantic, and literal translation errors, where the differences between predicted and observed frequencies remained comparatively small. Literal translation and idiomatic errors showed the closest correspondence between predicted and observed values, indicating strong predictive consistency under similar linguistic conditions.

However, when there were problems with context and terminology, those showed larger differences between what was expected (predicted) and what occurred (observed), indicating that the three error categories are likely to be more sensitive to changes in context, how difficult the text is to read, and/or to other lexical factors specific to each task. Although the results indicate a general trend supporting the use of Bayesian probabilistic reasoning for predicting recurring errors in EFL translations; they also support Al-Sadr's theory of probabilistic induction. The posterior probabilities were calculated using the Bayesian equation presented in the methodology section with a standardized recurrence probability value of $P(R) = 0.90$. Prior to conducting the paired-samples *t*-test, the normality assumption was examined using the Shapiro-Wilk test. The results indicated that the distributions of the error frequencies did not significantly deviate from normality ($p > .05$), supporting the appropriateness of using parametric statistical analysis. The results of the paired-samples *t*-test comparing the frequencies of translation errors between Test 1 and Test 2 are presented in Table 4.

Table 4. Paired-Samples t-Test Comparing Translation Error Frequencies Between Test 1 & Test 2

Error Type	Test 1 Mean (%)	Test 2 Mean (%)	Mean Difference	t(df)	p-value	Effect Size (Cohen's d)
Grammatical Errors	31.8	30.2	-1.6	$t(64) = 1.21$	$p > .05$	Small
Spelling Errors	28.8	24.4	-4.4	$t(64) = 1.34$	$p > .05$	Small
Semantic Errors	19.4	16.3	-3.1	$t(64) = 0.88$	$p > .05$	Small
Literal Translation Errors	9.0	8.7	-0.3	$t(64) = 0.40$	$p > .05$	Negligible
Contextual Errors	8.0	11.6	+3.6	$t(64) = -0.96$	$p > .05$	Small
Terminology Errors	2.4	6.4	+4.0	$t(64) = 0.20$	$p > .05$	Negligible
Low-Frequency Errors (Idiomatic, Cultural, Omission/Additions)	0-2	≈ 0	—	Insufficient data	—	—

It is clear that the *p*-values for all error categories were greater than .05, indicating that the observed differences between Test 1 and Test 2 were not statistically significant. These statistically not significant findings do not prove that there is no change. Instead, these findings are consistent with and confirm the stability predicted in the Bayesian model. In addition, the very small and therefore negligible effects found provide additional evidence supporting the view that the pattern of errors did not change substantively over tasks. A future study may be able to demonstrate even stronger conclusions using equivalence testing methods (e.g., the

Two One-Sided Tests [TOST] method) to show whether or not a significant difference exists, instead of simply showing whether or not the null hypothesis of equality can be rejected.

All p-values exceeded the significance threshold of .05, indicating no statistically significant differences between the two translation tasks. Although slight decreases were observed in grammatical, spelling, and semantic errors, and slight increases appeared in contextual and terminology errors, these changes remained within the range of normal variation and were associated with small or negligible effect sizes. Literal translation errors remained relatively stable across both translation tasks. Due to their rarity or absence, idiomatic, cultural, and omission/addition errors were not subjected to inferential statistical analysis. Overall, the findings suggest relative stability in the participants' translation error patterns across the two tests.

The findings demonstrate relative stability in recurrent translation error patterns among EFL learners and support the applicability of Bayesian probabilistic reasoning in predicting error recurrence under similar linguistic conditions. The following discussion section interprets these findings in relation to previous translation error theories, interlanguage development, and probabilistic inductive reasoning. The study was conducted using a relatively homogeneous sample consisting exclusively of Iraqi female learners of English as a foreign language from a single educational institution, which may limit the generalizability of the findings to broader learner populations.

The current research used two translations tasks that were done under comparable learning conditions. Different task types or different language proficiency levels could potentially result in different repetition patterns. The Bayesian Model has a primary focus on probabilistic repetition of patterns as opposed to the deeper cognitive processes involved with translation. Potential future studies could include increased sample diversity, use longitudinal designs, and/or use computational or cognitive linguistic methods to further validate and improve probabilistic predictive models for translation studies.

3.2. Discussion (Mandatory)

The purpose of the current study was to describe the frequency or quantity of recurrent translation errors found when EFL learners translated from their native language into English through the use of statistical methods based on the principles of Bayesian probabilistic inference. It was determined that the grammatical errors were the most common type of error in each task followed by spelling errors, and finally by semantic errors. However, this study extends earlier work by proposing that the persistence of such errors reflects more general probabilistic patterns associated with repeated behavior, rather than simply reflecting specific learning failures.

Regarding the first research question, concerning the most common types of translation errors, the results showed that grammatical, spelling, and semantic errors represented the main difficulties encountered by the participants. This finding supports the interlanguage theory (Selinker, 1972), which proposes that learners' errors are systematic manifestations of an internal linguistic system, rather than random deviations. For the second research question concerning error recurrence patterns in the two translation tasks, the results showed that grammatical, spelling, and semantic errors remained relatively stable, while contextual and terminological errors increased in the second task. The increase in contextual and terminological errors may indicate that learners encountered greater difficulty processing context-sensitive expressions and specialized lexical choices in the second task. Accordingly, repeated translation behavior appears to be influenced by both established language habits and the contextual requirements of each task. The findings of the third research question, i.e., how well the Bayesian model predicts error occurrences, indicated that the Bayesian model provided an accurate representation of the frequency of each type of subsequent error (i.e., actual observed error) in the second translation task. These findings suggest that Bayesian probabilistic inference could serve as a useful methodology to estimate how likely it is that an individual will produce a particular type of translation error given their previous experiences and learning environment.

The paired-samples t-test results, showing no statistically significant differences between the two translation tasks across the main error categories, serve as convergent evidence for the stability predicted by the Bayesian model. This alignment between the frequentist and probabilistic approaches strengthens confidence in the overall interpretive framework. This study is different than other studies that were simply descriptive in nature by developing an inductive framework and using Bayesian inference to develop a predictive model of what most commonly occurs in student translations.

This probabilistic interpretation could contribute to the development of translation teaching methods by helping educators identify high-frequency error tendencies and design targeted instructional interventions accordingly. At the same time, the results should be interpreted in light of the study's limitations. The relatively homogeneous sample, the limited number of translation tasks, and the short observation period may limit the generalizability of the predictive model. While it is true that the Bayesian approach to predictive modeling demonstrates a good degree of predictive reliability with respect to many error types, there are still a variety of

cognitive, contextual, and pedagogical factors that can influence how people translate and cannot be entirely captured through probability alone. Thus, further research could be conducted using long-term or longitudinal methodologies with larger, more diverse populations of learners, as well as a combination of both cognitive and corpus-based approaches to evaluate whether probabilistic prediction models have relevance within the field of translation studies.

3.3. Implications

This research is theoretically significant for the disciplines of translation and applied linguistics, by combining classical error analysis, intermediate language theory, functional translation theories, and Bayesian probabilistic models into an integrated analytical framework. The current research builds on previous descriptive studies that have been used to analyze errors in translation learning by suggesting it may be possible to investigate learners' repetitive errors through both retrospective methods, and through a probabilistic approach. By providing a philosophical basis for understanding repetitive translation behaviors as systemic (tendencies), rather than random (occurrences) using the probabilistic inductive framework, this study provides a methodological contribution.

3.4. Limitations

Despite these contributions, some limitations should be acknowledged. First, the study was conducted using a relatively homogeneous sample consisting exclusively of 65 Iraqi female learners of English as a foreign language from a single educational institution, which may limit the generalizability of the findings to broader learner populations and different educational contexts. The gender homogeneity of the sample in particular warrants attention: it remains unclear whether error recurrence patterns and their probabilistic stability would differ in mixed-gender or male-only populations.

4. Conclusion

The present research aimed at determining the frequency of translation mistakes by students learning EFL through an application of the Bayesian probabilistic model within Al-Sadr's probabilistic inductive theory. Results indicated that the three main error types were grammatical, spelling, and semantic errors. As well, there was little difference in terms of significance between the two tests for these three types. Therefore, it appears that there is some degree of consistency in terms of how frequent the different types of translation mistakes occur when learners translate from one language into another under like linguistic conditions.

The results also demonstrated that Bayesian probabilistic inference can provide a useful framework for estimating the probability of translation errors recurring. In several major error categories, the subsequent probabilities generated by the Bayesian model showed relatively close agreement with the actual frequencies observed in the second translation task. At the same time, the results should not be interpreted deterministically, as translation performance remains influenced by contextual, cognitive, and educational variables that may differ across tasks and learning environments. This study contributes to translation and applied linguistics by integrating error analysis, interlanguage theory, functional translation theories, and Bayesian probabilistic modeling. The Bayesian model was constructed utilizing data collected over a short time frame and thus does not account for longer term developmental changes in the way learners translate. Future research may examine larger and more diverse learner populations over longer periods of time to further evaluate the applicability of probabilistic models in translation studies.

Author Contributions

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Ethics and Consent Declarations

The research protocol was approved by the research ethics committee of the Department of English at Al-Zahraa University for Women. Written informed consent was obtained from all participating students prior to data collection. Participants were briefed on the study's purpose and the voluntary nature of their involvement. All data were strictly anonymized to ensure confidentiality.

Data Availability

The datasets generated during and/ or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration on AI Use

The authors declare that no artificial intelligence (AI) or AI-assisted tools were used in the preparation of this manuscript.

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