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Formulaicity of Interpersonal Grammatical Metaphor: A Computational Vectorization Approach

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Abstract

Interpersonal grammatical metaphor expresses assessments of possibility through projecting structure like "I think that", raising questions about how their interpersonal functions relate to formulaic organization across languages. This study examines the semantic similarity and typological variation of possibility-type interpersonal grammatical metaphor frames in Chinese, English, French, German, Japanese, and Hebrew. Drawing on Systemic Functional Linguistics and research on formulaic language, it treats projecting formulaic sequence as expressions whose relatively stable wording accommodates variable propositions. Multilingual embeddings from pre-trained model LaBSE and cosine similarity are used to compare these formulaic sequences across languages. These results are consistent with cross-linguistic semantic resemblance among the selected frames and a shared role in construing possibility. At the language level, Hebrew shows the highest overall alignment and English the lowest. It considers how these features organize the relationship between the assessor, the projecting predicate, and the proposition, while distinguishing linguistic explanations from possible effects of model representation. Morphology is approached as a construction-specific contributor to similarity, whose relevance depends on the categories encoded and their realization within particular formulaicity. The findings motivate further investigation of interpersonal grammatical metaphor as a potentially formulaic resource for expressing possibility. The study connects multilingual embedding analysis with functional accounts of interpersonal meaning and outlines further research integrating corpus recurrence, contextual annotation, and processing evidence.

Keywords: formulaic language, interpersonal grammatical metaphor, cosine similarity, typology, computational linguistics, vectorization

1. Introduction

1.1 Formulaic Language

Formulaic language is prevalent in both written and spoken language (Wood, 2015). It is generally understood as continuous or discontinuous sequences that appear to be prefabricated and retrieved as units rather than assembled entirely anew (Wray & Perkins, 2000; Wray, 2002). It has attracted attention in second language acquisition (Ellis, 2012), language disorders (Bridges & Van Lancker Sidtis, 2013), and research using large language models to estimate properties of multiword expressions

(Martínez et al., 2024).

Corpus research has mapped how formulaicity distributes unevenly across registers and fulfills distinct textual functions. Biber & Barbieri (2007) show that lexical bundles serve stance, discourse-organizing, and referential functions, with their distributions varying across university registers. Biber (2009) further distinguishes fully fixed sequences from patterns containing variable slots. These findings support treating formulaicity as a register-sensitive resource rather than restricting it to immutable strings. This distinction matters for interpersonal grammatical metaphor because a recurrent projecting frame can accommodate different propositions and, in some cases, intervening material. The distinction between a frame and its individual realizations is central to this comparison. A frame such as "I think (that) + proposition" contains relatively stable wording and an open position for new content (Halliday & Matthiessen, 2014). "I think the train is late" and "I think the answer is correct" instantiate that pattern while making different claims. These constructed examples illustrate how a recurrent interpersonal expression can coexist with propositional variation. Counting complete sentences would obscure this recurrence, whereas counting only the verb would overlook the contribution of person, tense, and complementation. The frame is therefore a useful intermediate unit between the isolated lexical item and the whole utterance.

Psycholinguistic studies report processing advantages for formulaic sequences, including some discontinuous forms (Carrol & Conklin, 2020; Jiang & Siyanova-Chanturia, 2024). However, formulaicity requires evidence of recurrence, conventionalized function, and processing behavior, which semantic similarity alone cannot establish. For projecting frames, a central question is how stable wording accommodates variable propositions while maintaining a recognizable interpersonal function. This question connects formulaic language with interpersonal grammatical metaphor, where expressions such as "I think (that)" can assess a proposition rather than primarily report cognition (Halliday & Matthiessen, 2014). Their recurrent association with the semantics of possibility motivates examining them as candidate formulaic frames, a connection developed in the following section.

1.2 Interpersonal Grammatical Metaphor

The present study focuses on the possibility type of interpersonal grammatical metaphor (hereafter interpersonal GM). In Systemic Functional Linguistics, possibility concerns assessments of how likely a proposition is to hold. A modal operator or adjunct, as in "She ***may*** be right" or "She is ***probably*** right," can be related to an explicitly subjective realization such as "I think she is right" (Halliday & Matthiessen, 2014). The metaphorical realization expresses modal assessment through an additional projecting clause. This is a relation between ways of construing meaning, rather than a claim that speakers mechanically transform one sentence into another.

The boundary between a projecting frame and the projected proposition requires particular attention. On the one hand, projection elevates stance into a separate clause; on the other, the two clauses can form a single interpersonal move in context. Taverniers (2008) models this relationship through double scoping and double grounding, connecting the formal layering of clauses with the anchoring of a proposition in an interpersonal perspective. From a phraseological angle, projecting frames provide a bridge between GM and formulaic language, wherein recurrent wording can organize the meaning while leaving the proposition variable. Projection alone is generally sufficient to identify interpersonal GM. For example, the formulaic sequence "I think that …" basically functions as a subjective assessment depending on context. Third-person expressions such as "she thinks that …" can also report the current speaker's modal assessment, with a degree of chances that it reports only the speaker's subjective feeling. The relevant diagnostic is whether the projecting expression functions primarily as a modal assessment of the proposition being negotiated (Taverniers, 2008, 2018). Accordingly, the present materials are described as candidate GM frames. Their grammatical shape must be distinguished from their contextual function.

Functional descriptions provide a basis for comparing interpersonal resources across languages (Caffarel et al., 2004; Simon-Vandenbergen et al., 2003), but cross-linguistic recurrence does not establish universality. This exploratory study compares Chinese (Sino-Tibetan), English and German (Germanic, Indo-European), French (Romance, Indo-European), Japanese (Japonic), and Hebrew (Semitic, Afro-Asiatic), collectively covering five language

families. The languages offer contrasts in morphology, writing systems, and projection order, but they represent five language families rather than six independent genealogical groups.

1.3 Research Questions

The two research questions therefore connect this functional account with a measurable comparison.

1) To what extent do candidate possibility-type interpersonal GM frames exhibit semantic similarity across the six languages in computational embedding space?

2) What differences occur among language pairs, and how can these differences inform hypotheses about formulaicity and morphosyntactic organization?

2. Methodology

2.1 Cosine Similarity and LaBSE Model

For semantic comparison, cosine similarity is used. The embedding model first represents a text as a numerical vector; cosine similarity then compares the directions of two vectors. It is the comparison metric, not the procedure that generates the embeddings. For nonzero vectors u and v, it is defined as follows (Jurafsky & Martin, 2025):

$$cos(u, v) = \frac{u \cdot v}{\|u\| \, \|v\|}$$

Here, $u \cdot v$ is the dot product and $\|u\|$ and $\|v\|$ are Euclidean lengths. Cosine similarity is a metric to measure the angle between two vectors, and its value ranges from 0 to 1, wherein 1 denotes the high semantic similarity between two language units and 0 denotes no semantic similarity. The visualization in Figure 1 illustrates the geometric intuition. The smaller angle between "digital" and "information" indicates greater similarity in the illustrated space. This count-based example explains the metric. For the present study, we use pre-trained multilingual embeddings model LaBSE. Such pre-trained model can yield vectors of linguistic units by applying algorithm and calculation. LaBSE is a multilingual sentence-embedding model whose training combines language-model pretraining with translation-ranking objectives. It supports 109 languages and places cross-linguistically related inputs in a shared representation space (Feng et al., 2022). This makes it useful for comparing candidate frames across languages, and its translation-oriented training means that high similarity may also reflect lexical equivalence or generic semantic relatedness.

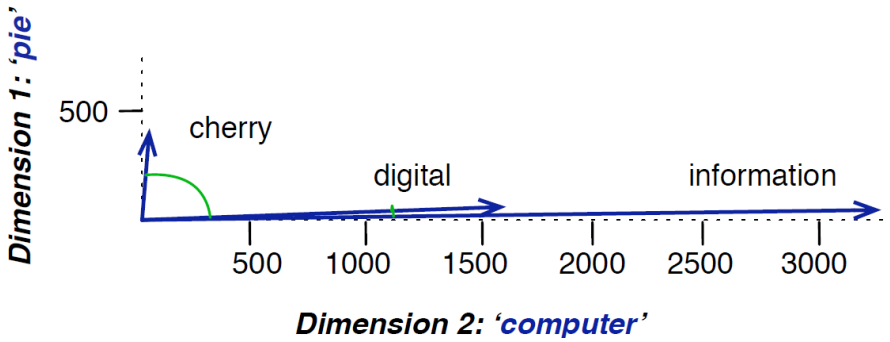


Figure 1. Illustration of cosine similarity (Jurafsky & Martin, 2025)

The choice of input is particularly consequential for short expressions. A full sentence supplies lexical and syntactic context, but its representation may reflect the topic of the proposition as well as the projecting frame. An isolated frame concentrates attention on the relevant wording while removing cues that help distinguish an epistemic use from a literal cognition report. Neither representation answers every question. Isolated inputs are appropriate for examining similarities among decontextualized forms. By contrast, contextual representations address how those forms are interpreted within sentences. Therefore, the current study adopts the contextual consideration for better capturing the nuance meaning of the formulaic sequence.

2.2 Data Generation

All linguistic examples in this study were generated with ChatGPT-4o and subsequently subjected to careful checking by the author for grammatical well-formedness, semantic coherence, and pragmatic plausibility. The dataset consists of curated, model-generated

stimuli for exploratory comparison of selected constructions. Torrent et al. (2023) show how language models can assist linguists in proposing and exploring constructional patterns. Because the present analysis focuses on delimited projecting structures, this approach provides a practical source of candidate examples. Shared prompts or translation procedures can also make generated frames more similar by design. The dataset should therefore be interpreted as exploratory stimulus material whose linguistic validity and comparability require explicit documentation. Generated stimuli offer a practical way to explore contrasts that might be unevenly represented in a small naturally occurring sample. Such a design would make the comparison more transparent because the source of variation would be specified in advance. Torrent et al. (ibid.) deploy large language models to generate linguistic patterns, refeered to as constructions, and to analyze linguistic patterns as well. Given that the current study focuses on specific formulaic patterns that express uncertainty with highly defined structure, it is also feasible to use large language models to generate examples for further analysis.

2.3 Processing and Analytical Scope

A Python script was used to compare candidate GM frames between every pair of the six languages. The annotation procedure distinguishes the projecting frame from the projected proposition. Sentences and manually marked GM spans are stored in an excel file. The spans are identified manually rather than by automatic phrase extraction. Manual segmentation is part of the construct definition. In English, a span may include "I think" with or without "that"; in Japanese, an overt topic expression and a clause-final projecting verb can be separated by the proposition. A consistent analysis must specify which pronouns, complementizers, particles, and modifiers belong to the frame and how discontinuous spans are represented. Otherwise, a language difference in similarity may partly reflect different annotation boundaries.

The distinction between sentence and span embeddings is equally consequential. Encoding an extracted frame as a separate input is different from pooling contextual token representations for that frame within a full sentence. Character offsets can identify corresponding token positions, but cannot select a linguistic span from a single pooled sentence vector. Because the vector's dimensions are features, not character positions. Any contextual span procedure therefore needs an explicit token-alignment and pooling rule, together with the model checkpoint and software configuration.

Three units should be distinguished when interpreting the analysis: a frame type, a frame occurrence in a sentence, and a scored comparison between two encoded inputs. Several occurrences can instantiate one type, and one input can participate in several comparisons. These distinctions matter even when each language pair contributes the same number of scores. Equal comparison counts provide balanced numerical representation at the pair level, but do not establish equal lexical diversity or equal numbers of independent items. Recording a stable identifier for each sentence and frame would allow the observed variation to be traced to its source and would make subsequent analyses of repeated items possible.

The present results concern cross-linguistic frame-to-frame comparisons. The relationship between a frame and its projected proposition is a separate analytical question, because cross-linguistic similarity does not itself establish that the frame is semantically independent of its context. Therefore, the thresholds 0.5, 0.6, and 0.7 are retained as descriptive reference points for the score distributions. Without validation against appropriate comparison items, none constitutes a diagnostic boundary for formulaicity.

3. Results

The cosine-similarity scores for the 15 language pairs are represented in Figure 2. The curves are displayed in descending score order, allowing comparison of their ranges and relative positions. Such an ordered plot is not by itself evidence of statistical skewness. Figure 3 shows the mean score for each pair, ranging from 0.5573 for English–Japanese to 0.6335 for French–Hebrew.

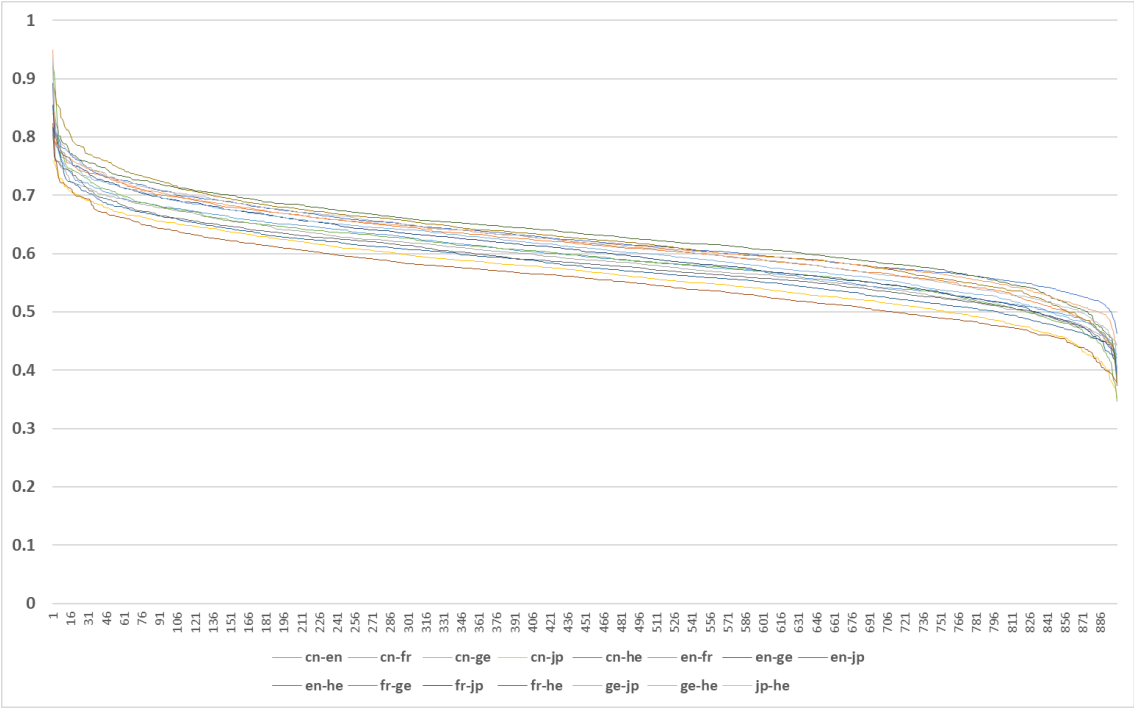


Figure 2. Ranked cosine-similarity scores for the 15 language pairs. Codes: cn = Chinese, en = English, fr = French, ge = German, jp = Japanese, he = Hebrew

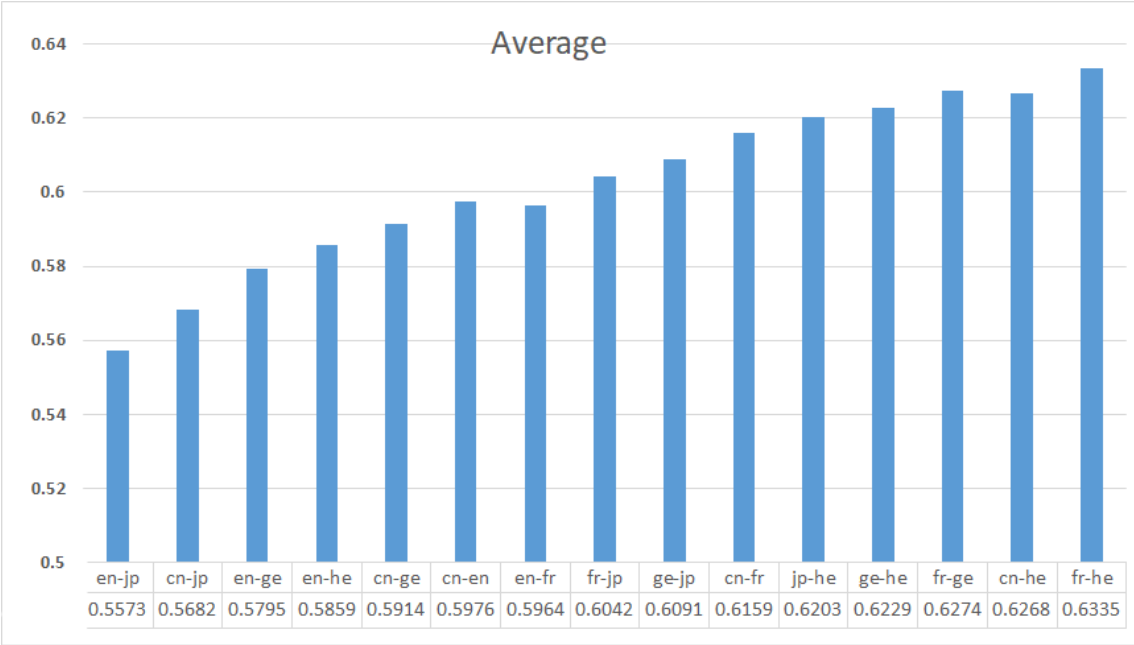


Figure 3. Mean cosine-similarity scores for the 15 language pairs

Table 1 reports the numbers and proportions of scores above three reference values, alongside the reported t-test results. All 15 pairwise means significantly exceed 0.5 ($p < .001$), although not all individual scores do. The proportion above 0.5 ranges from 78.89% for English–Japanese to 99.44% for Chinese–Hebrew. At the reference value of 0.6, seven pairs show significant positive departures ($p < .001$): German–Japanese, Chinese–French, Japanese–Hebrew, German–Hebrew, French–German, Chinese–Hebrew, and French–Hebrew. Across all pairs, the proportions above 0.6 range from 26.00% to 70.56%. No pair is marked as significantly exceeding 0.7, although 2.22%–16.78% of individual scores surpass this value. The findings therefore indicate substantial

variation within language pairs despite the relatively narrow interval occupied by their means.

The cumulative thresholds further clarify these distributional differences. For English–Japanese, 710 scores exceed 0.5, 234 exceed 0.6, and only 20 exceed 0.7; consequently, 476 lie above 0.5 and at or below 0.6. For French–Hebrew, the corresponding cumulative counts are 875, 635, and 151, leaving 240 scores in the same interval. French–Hebrew thus places a larger proportion of comparisons in the higher score ranges, whereas English–Japanese is more concentrated between 0.5 and 0.6. These interval counts, obtained by subtraction from Table 1, complement the tests of mean scores by showing how comparisons are distributed across the reference values.

Table 1. Cumulative numbers and percentages above three reference values

	en-jp	cn-jp	en-ge	en-he	cn-ge	cn-en	en-fr	fr-jp	ge-jp	cn-fr	jp-he	ge-he	fr-ge	cn-he	fr-he
cosine value >0.5	710***	754***	798***	829***	823***	843***	823***	831***	841***	859***	867***	884***	858***	895***	875***
	78.89%	83.78%	88.67%	92.11%	91.44%	93.67%	91.44%	92.33%	93.44%	95.44%	96.33%	98.22%	95.33%	99.44%	97.22%
cosine value >0.6	234	293	343	355	402	420	429	471	501***	544***	550***	566***	568***	585***	635***
	26.00%	32.56%	38.11%	39.44%	44.67%	46.67%	47.67%	52.33%	55.67%	60.44%	61.11%	62.89%	63.11%	65.00%	70.56%
cosine value >0.7	20	22	35	37	45	54	58	82	87	93	116	100	134	106	151
	2.22%	2.44%	3.89%	4.11%	5.00%	6.00%	6.44%	9.11%	9.67%	10.33%	12.89%	11.11%	14.89%	11.78%	16.78%

Note: * p<0.05, ** p<0.01, *** p<0.001.

Figure 4 reorganizes the same pairwise means by language. Averaging the five displayed pairwise means for each language gives English 0.5833, Japanese 0.5918, Chinese 0.6000, German 0.6061, French 0.6155, and Hebrew 0.6179. English has the lowest aggregate and Hebrew the highest. Because every language-pair value contributes to two language aggregates, these summaries are interdependent. They describe relative alignment within this sample and model, representing a ranking of the languages' intrinsic semantic strength.

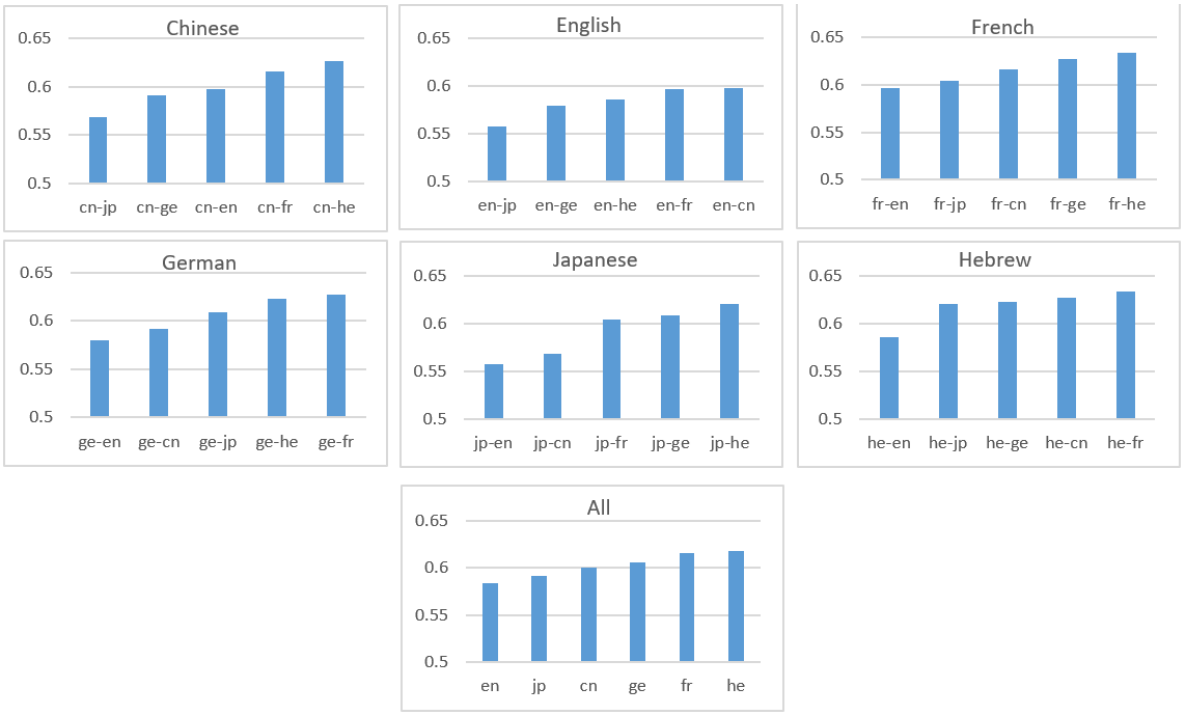


Figure 4. The Cross-Mapping Among Six Languages and the Overall Mean Value

4. Discussion

4.1 Formulaic Frames and Interpersonal Meaning

The results identify semantic resemblance among candidate projecting frames of GM in all six languages. This is compatible with a shared role in construing possibility meaning. The theoretical connection to formulaicity of GM rests on the combination of recurring form and interpersonal function. The meaning associated with a projecting frame is not confined to a completely fixed string of words. Modifying elements such as "sort of" can intervene in English, and the components of a Japanese frame may surround the projected proposition. The distinction between fixed and variable slots developed in formulaic-language research helps characterize these possibilities (Biber, 2009). What remains comparable is the relation between an assessor, a projecting process, and a proposition, rather than an identical linear sequence in every language. The verbs are mental or verbal processes in the relevant analyses, not simply linking verbs.

The interpersonal contribution can be illustrated by varying a frame while retaining its proposition. In "I think the proposal is feasible," the speaker presents the meaning of possibility through an assessment "I think…", while in "I am certain the proposal is feasible," commitment is expressed more strongly by "I am certain…". These constructed examples share a topic and a broad semantic domain of possibility, but their meanings are not interchangeable. A model might place them relatively close because of that shared content. For the linguistic analysis, however, the difference in commitment is precisely what requires explanation. Similarity should therefore be read alongside contrasts in modal value, assessor, and realization, so that a common functional domain does not obscure distinctions within it. The following examples illustrate the projection structures discussed here. They are regarded as subjective possibility interpersonal GM, as they report a third party's assessment of possibility towards the following proposition.

Chinese: experiencer + mental verb + projected clause

她感觉那边有吃的。

(She feels that there is food over there.)

English: experiencer + mental verb + (that) + projected clause

I think that you are right.

French: experiencer + mental verb + que + projected clause

Les familles considèrent que le moment est

bien choisi.

(The families consider that the timing is right.)

German: experiencer + mental verb + dass + verb-final projected clause

Sie glaubt, dass das neue Projekt möglicherweise ein großer Erfolg wird.

(She believes that the new project might be a great success.)

Japanese: (topic) + projected clause + と + mental verb

私は明日は多分晴れる***と思います***。

(I think it will probably be sunny tomorrow.)

Hebrew: experiencer + mental verb + she- + projected clause

הם מאמינים שהרעיון הזה יעבוד.

(They believe that this idea will work.)

In English, "that" is optional in the example, whereas French "que" is required in the illustrated finite complement. German permits a dass-clause with verb-final order; a complement without "dass" can instead have verb-second order. Japanese と marks the projected content before the projecting verb, and Hebrew ש(she-) is a prefixed complementizer, not the name of a letter. Such differences matter for identifying comparable frame boundaries.

The multilingual examples similarly separate the availability of a projection pattern from the interpretation of a particular occurrence. Their shared composition makes it possible to ask how an assessor relates to an assessed proposition. Their differences show why a comparable function need not correspond to the same sequence of words. A frame may precede the proposition, follow it, or be distributed around it. Some grammatical information may be carried within a word rather than by a separate element. The relevant comparison therefore involves both the contribution of the whole construction and the contribution of its parts, defining the collective formulaic meaning in GM. This perspective makes discontinuity an analytical property of the frame rather than a reason to exclude it automatically.

The proposed separation between formulaic sequence of GM and its following proposition is consequently best treated as a hypothesis about semantic scope. Taverniers (2018) relates modality metaphors to grammaticalization perspective that involves discourse markers and epistemic adverbials, which motivates investigating how projecting expressions acquire recurrent meaning of possibility. However, neither a grammaticalization perspective nor cross-language cosine similarity proves contextual independence. The statistical results from Table 1 therefore reveal the fact that contextualized consideration proves the existence of GM as formulaic sequence that stores the meaning of possibility.

A useful interpretation of such formulaic stability is relative rather than absolute. If a projecting expression contributes a similar meaning across several topics, it functions as a reusable resource, and local discourse modulates its force in each occurrence. This view fits the SFL account in which an explicit projecting clause such as "I think" grounds a proposition in the speaker's subjective assessment (Halliday & Matthiessen, 2014; Taverniers, 2008), a grounding role that recurs whatever the proposition happens to be. Where the contribution of a projecting expression shifts with context, lexical form and contextual annotation work together to characterize the range of uses it covers, and register-sensitive accounts of stance-marking bundles offer a model for that combination (Biber & Barbieri, 2007). The formulaic sequence should therefore be further investigated through this balance between recurrence and adaptability. Cross-language alignment locates candidate correspondences, and within-language comparisons then establish whether each candidate consistently serves the proposed function. This division of analytical work connects the present results to the fuller account of formulaicity, in which a sequence is stored and used as a unit while remaining open to variable slots (Wray, 2002; Biber, 2009).

4.2 Typological Variation and Model Representation

The comparison is interpreted at two related levels. An internal feature describes how one focal language aligns with each of the other five languages; an external comparison relates the six language-level features to one another. This distinction preserves the focus on both local contrasts and the broader pattern in Figure 4. Here, "internal" refers to the feature centered on a language, that is, the set of its cross-language alignments. Chinese, for instance, is characterized by its five pairings with English, French, German, Japanese, and Hebrew.

Variation among the five pairwise means for each language forms one layer of the analysis, and variation among individual scores within a language pair forms a second layer. The distribution shown in Figure 4 display this latter heterogeneity and show how scores spread across the range within each pair, which complements the pair means by describing the shape of each distribution. Together, the two layers give a full picture, where partner's mean values indicate where a language sits relative to the others, and the ranked curves indicate how consistently a pair aligns across its 900 scored comparisons.

4.2.1 Typological Comparisons Among These Languages

The language-pair differences motivate typological questions and open a set of testable hypotheses about their sources. For Chinese, Chinese–Japanese has the lowest mean (0.5682), while Chinese–Hebrew has the highest (0.6268). A plausible hypothesis is that the contrast between preposed and postposed projecting structures shapes their representation, since the order of assessor, projecting verb, and proposition differs systematically between the two languages. The compared items also differ in lexical content, pronouns, particles, and the amount of context included in each span, so word order is one of several factors that jointly contribute to the Chinese–Japanese contrast. This multi-factor perspective is consistent with the tradition of functional typology, in which the realization of a shared interpersonal meaning is expected to vary across languages while the underlying function remains comparable (Caffarel et al., 2004).

Chinese provides a concrete starting point. Its comparisons with German (0.5914), English (0.5976), and French (0.6159) fall between Chinese–Japanese (0.5682) and Chinese–Hebrew (0.6268), so that the five Chinese pairings form a graded series with Japanese and Hebrew at its two ends. A possible interpretation is that preposed projecting frames contribute to alignment with the three European languages, while complementizer choices and the placement of the Japanese projecting verb differentiate the constructions. Table 2 illustrates these structural contrasts with a common proposition. The examples illustrate broadly comparable assessments of the same proposition, in line with the treatment of projecting clauses as metaphorical realizations of the meaning of possibility (Halliday & Matthiessen, 2014).

Table 2. Constructed projection examples expressing approximately "I think he is right"

Language	Example and transliteration where useful	Projection pattern
Chinese	我认为他是对的。 Wǒ rènwéi tā shì duì de.	我 认 为 "I think" precedes the proposition; no overt complementizer in this example.
English	I think (that) he is right.	Preposed projecting clause; optional "that".
French	Je pense qu'il a raison.	Preposed projecting clause; "que" appears as "qu' " before il.
German	Ich denke, dass er recht hat.	Preposed projecting clause; dass-clause with finite hat in final position.
Japanese	私は彼が正しいと思う。 Watashi wa kare ga tadashii to omou.	私は "as for me" precedes the proposition; と marks projected content and 思う "think" follows it.
Hebrew	.אני חושב שהוא צודק Ani khoshev she-hu tsodek.	Preposed אני חושב "I think"; the prefixed complementizer ש־ (she-) introduces the proposition.

The Chinese–Japanese contrast is visible in the position of the mental verb. In Chinese, 我认为 (*wǒ rènwéi*, "I think") forms a contiguous sequence before 他 是 对 的 ("he is right"). Chinese offers close alternatives such as 我觉得 (*wǒ juéde*) and 我想 (*wǒ xiǎng*), which pattern in the same preposed way. In Japanese, 私 は (*watashi wa*, "as for me") is separated from 思う (*omou*, "think") by 彼が正しい (*kare ga tadashii*, "he is right") and the linking marker と (*to*). The

closely related Japanese verb 考える (*kangaeru*, "consider") occupies the same final position in 私は彼が正しいと考える. When the selected frame includes the overt assessor and the mental verb, its Japanese realization is discontinuous, an arrangement that fits the discontinuous frames discussed in section 4.1 and the distinction between fixed and variable slots (Biber, 2009). The discontinuous frame arises when annotation includes both the overt topic and the clause-final verb. Omitting a contextually recoverable topic produces a shorter realization, …と思う, which still expresses the possibility meaning. Both realizations therefore belong to one construction family with a shared interpersonal function.

English, French, and German resemble the Chinese example in placing the projecting clause first, and each realizes its complement in its own way. English permits both "I think he is right" and "I think that he is right," and offers parallel frames such as "I believe" and "I suppose." French uses *que* in this finite complement, with elision producing *qu'il*, and pairs *je pense* with *je crois*. In German, *dass* places the finite verb at the end of the complement: *er recht hat*. The alternative "Ich denke, er hat recht" omits *dass* and takes verb-second order, and *ich glaube* follows the same two options: "Ich glaube, dass er recht hat" and "Ich glaube, er hat recht." Thus, the absence of a complementizer accompanies a structural change and omitting "dass" also changes the complement from verb-final to verb-second order, which gives German a two-way choice between a subordinate pattern and a main-clause pattern. This detail makes the proposed resemblance to Chinese more precise, as the three European languages share the preposed frame with Chinese and add complementizer options that are visible in the span.

Hebrew also offers a preposed frame, אני חושב (*ani khoshev*, "I think"), followed by a proposition introduced by *she-*. Close alternatives include אני מאמין (*ani ma'amin*, "I believe") and אני מניח (*ani mani'akh*, "I suppose"), which take the same *she-* complement. In the example, ש־ attaches orthographically to הוא ("he"), producing שהוא. This boundary marking differs from the separate English *that*, French *que*, and German *dass*, and remains distinguishable in a grammatical analysis.

4.2.2 Features Across the Six Languages

At the second level, Hebrew has the highest language-level average (0.6179), followed by French (0.6155) and German (0.6061); Chinese (0.6000), Japanese (0.5918), and English (0.5833) follow. Hebrew's consistently high position is also evident within the individual features. It is the highest-scoring partner for Chinese, French, and Japanese, the second for German, and the third for English. Its prominence therefore extends across the Chinese comparison and the wider set of features, and its ranks of first, first, first, second, and third across the five features give the pattern a stable character. This pattern motivates the hypothesis that overt, relatively compact grammatical cues contribute to alignment, where a Hebrew projecting frame packs assessor, verb, and complementizer boundary into a short, orthographically marked sequence such as אני חושב שהוא. The embedding model LaBSE was trained on translation pairs to place equivalent sentences close together (Feng et al., 2022), which makes compact overt cues of this kind informative for cross-language alignment. These descriptive aggregates offer a starting point for examining inflection, conventionalization, and holistic retrieval as candidate contributors, and they draw on the same pairwise comparisons reported above. Conventionalization and holistic retrieval in particular link the features to the notion of sequences stored as units (Wray, 2002; Carrol & Conklin, 2020), which gives the features a bridge to processing research.

4.2.3 Inflection and Written Realization

The relatively high aggregate similarities for Hebrew, French, and German raise the question of whether morphology contributes to the cross-linguistic resemblance of interpersonal GM frames. A morphological explanation requires attention to the grammatical information expressed by particular constructions. Morphological synthesis, fusion, and the categories encoded are distinct dimensions (Bickel & Nichols, 2013), and a general classification such as "inflectional" does not adequately capture their differences. Japanese, for example, has substantial verbal inflection despite its comparatively low aggregate similarity, whereas Chinese exhibits little inflection but has its highest pairwise similarity with Hebrew. These patterns suggest that morphological complexity alone cannot explain the observed ranking. The more relevant issue is how different languages organize grammatical information around a recurrent expression of

interpersonal assessment.

Morphology can contribute to this organization by marking features of the assessor and locating the assessment in time, while other elements establish polarity or interpersonal orientation. These distinctions matter because a formulaic frame need not retain exactly the same surface form across its realizations. A projecting expression can preserve a recognizable lexical and interpersonal pattern while varying systematically in person, number, tense, gender, or politeness. Such variation provides a way to connect morphology with the present argument. Formulaicity may reside in a conventional relationship between form and function that accommodates grammatically predictable alternatives. However, these alternatives can also introduce meaningful differences between expressions, potentially affecting their embedding similarity. Morphological variation should therefore be examined both as a source of continuity within a construction and as a source of differentiation among its realizations.

English, French, and German illustrate how agreement and tense operate within projecting frames. English distinguishes "I think" from "he thinks" and contrasts *think* with the irregular past *thought*. French has *je pense* ("I think"), *il pense* ("he thinks"), *nous pensons* ("we think"), and *je pensais* ("I thought/was thinking"). German similarly contrasts *ich denke*, *er denkt*, *wir denken*, and *ich dachte*. Agreement links the projecting verb grammatically to its subject, while tense distinguishes the temporal location of the assessment. Nevertheless, the verb does not always independently identify the assessor. For example, French *je pense* and *il pense* share the same written verb form. The contribution of morphology consequently depends on the complete construction. These languages share recognizable patterns combining an assessor with a projecting predicate, but their inflectional systems produce different sets of surface variants. Their relatively high similarities may partly reflect correspondence among these conventional patterns, although the scores do not isolate the contribution of agreement or tense.

Chinese organizes comparable meanings with an invariant projecting verb. The form 认为 remains unchanged in 我认为 ("I think"), 他认为 ("he thinks"), and 我们认为 ("we think"). Temporal and negative meanings can be expressed through surrounding material, as in 我当时认为 ("I thought at that time") and 我不认为 ("I do not think"). Grammatical information is thus distributed across the pronoun, the projecting verb, and additional words, rather than encoded through changes to the verb itself. This organization remains compatible with a recurrent interpersonal frame, in which the stable combination 我认为 can introduce different propositions and accommodate further specification. Chinese therefore demonstrates why limited inflection should not be equated with weak constructional integration. Its high similarity with Hebrew is especially relevant, because two morphologically different systems can nevertheless produce expressions that the model represents as closely related.

Japanese further separates morphological richness from person agreement. 思う (*omou*, "think"), 思った (*omotta*, "thought"), 思わない (*omowanai*, "do not think"), and 思います (*omoimasu*, a polite nonpast form) distinguish tense, polarity, or politeness without marking the assessor's person on the verb. The construction 思っている (*omotte iru*) adds an aspectual expression and is commonly used to report a continuing third-person stance. It should be treated as a construction containing additional grammatical material rather than simply another inflectional ending. These forms show that Japanese projecting expressions can be morphologically complex while differing substantially from European agreement patterns. Moreover, the projecting predicate generally follows the proposition, so morphology interacts with constituent order and construction length. The lower Japanese aggregate cannot consequently be attributed to a lack of inflection. It instead motivates examining which morphological and structural features distinguish the actual Japanese frames from their counterparts.

Hebrew provides a different configuration. In present-tense expressions, אני חושב (*ani khoshev*, "I think," with a male speaker) contrasts with אני חושבת (*ani khoshevet*, with a female speaker), while חושבים (*khoshvim*) and חושבות (*khoshvot*) distinguish masculine and feminine plural forms. These forms mark gender and number rather than grammatical person; the pronoun אני identifies the first-person assessor. They belong to the root ח־ש־ב and illustrate the interaction of root-and-pattern morphology with overt endings. Ordinary unvocalized spelling preserves these written distinctions even though

many vowels remain unmarked. Hebrew's high similarities therefore require an explanation grounded in its actual constructions, rather than an assumed absence of written inflection or an equivalence between Hebrew words and Chinese characters. Its projecting expressions may share a conventional assessor–predicate organization with other languages despite substantial differences in morphological realization.

Taken together, these comparisons make morphology a plausible construction-specific contributor to similarity, rather than a general predictor of stronger interpersonal meaning or formulaicity. Testing this account would require identifying the categories marked in each selected expression and comparing controlled variants that retain the projecting predicate and proposition while changing individual grammatical features. Orthographic words and model tokens must also be distinguished, because morphological variants may receive different token representations (Jurafsky & Martin, 2025). Such comparisons could establish whether predictable grammatical variation preserves embedding similarity and whether particular contrasts systematically reduce it.

5. Conclusion

This study compares candidate possibility-type interpersonal GM frames across Chinese, English, French, German, Japanese, and Hebrew using LaBSE embeddings and cosine similarity (Feng et al., 2022). The reported pairwise means range from 0.5573 to 0.6335, with a majority of scores in every pair exceeding the exploratory reference value of 0.5. The results are consistent with cross-linguistic semantic resemblance among the selected projecting frames and motivate a closer connection between SFL accounts of the possibility meaning (Halliday & Matthiessen, 2014; Taverniers, 2008, 2018) and research on formulaic patterns (Wray, 2002; Biber, 2009). Differences among the selected languages generate hypotheses about projection order, morphology, and model representation, and each hypothesis points to a controlled contrast, where preposed versus postposed frames, presence versus absence of a complementizer, and the tokenization of the selected span. By separating the computational observation from the broader linguistic construct, the study provides a basis for further work combining multilingual embeddings with contextual annotation, corpus recurrence, and processing evidence.

The broader implication is that a typological account of formulaicity explains both recurring interpersonal functions and the particular constructions that realize them. The present comparison supplies an initial set of numerical observations for that task, covering 15 language pairs with 900 scored comparisons each. Future study is to connect those observations with documented uses and controlled contrasts, allowing the proposed relationship between grammatical metaphor and formulaic organization to be evaluated across complementary kinds of evidence. In this way, interpersonal grammatical metaphor of possibility can be examined as a recurring, cross-linguistically comparable formulaic resource for expressing possibility meaning.

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