

Cultural dimensions in the perception of success: Comparative analysis of word associations across languages using LLM word embedding

Hayri Baytan Ozmen^{*a}

Faculty of Engineering and Natural Sciences, Uşak University, Uşak, Türkiye.

Article Info

Abstract

Article History:

Received:

14 Apr 2025

Accepted:

26 May 2025

Keywords:

Ambition;
computational social
science;
cross-cultural analysis;
cultural values;
effort;
semantic similarity

This study investigates how the concept of success is semantically associated with culturally salient attributes across nine languages using monolingual embeddings derived from large language models. Twelve key attributes—effort, ambition, talent, collaboration, happiness, luck, creativity, discipline, education, status, wealth, and respect—were analyzed based on their cosine distances to “success.” Lower distances indicate stronger conceptual ties. Findings reveal that effort is universally central, appearing closest to success in all languages studied. Cultural nuances were evident: collaboration and ambition showed varying levels of association, with collectivist cultures such as Chinese and Arabic emphasizing collaboration, while individualistic cultures like Finnish and English highlighted ambition. Talent and happiness emerged as significant in specific contexts, particularly in Finnish, Russian, and Turkish corpora. Luck showed a stronger link in European languages like German and Russian, suggesting higher attribution of success to chance. Conversely, external markers like status and wealth showed weaker associations overall. These results offer a data-driven, cross-linguistic perspective on how success is framed within different cultural value systems.

© 2025 MIM Research Group. All rights reserved.

1. Introduction

Language extends far beyond its role as a mere medium of communication; it serves as a profound reflection of the cultural values and social paradigms intrinsic to the communities that speak it. Each language embodies the shared history, beliefs, and practices of a culture, thus acting as a repository of collective identity and a framework through which individuals understand their world. The interconnection between language and culture suggests that the words we choose to convey ideas are heavily laden with cultural significance, shaping and mirroring societal norms and values.

The significance of this relationship is supported by traditional sociological frameworks, such as Hofstede’s dimensions of culture and the Inglehart–Welzel cultural map [1, 2]. Hofstede’s work elucidates how different cultures prioritize values differently, distinguishing between individualism and collectivism, uncertainty avoidance, power distance, masculinity versus femininity, long-term versus short-term orientation, and indulgence versus restraint [3]. These dimensions highlight that language is a vessel that

carries the weight of cultural priorities, influencing how foundational concepts such as “success” are perceived and articulated across different societies.

Similarly, Inglehart and Welzel’s cultural map positions countries along various axes such as traditional versus secular-rational values and survival versus self-expression values [2]. This mapping enables scholars to uncover deeper patterns of cultural differentiation and resonance, providing a framework for analyzing how language encapsulates these broader existential orientations. As such, cultural values become manifest in linguistic expressions and word choices, highlighting the intersections between linguistic constructs and sociocultural frameworks.

The sociological discourse surrounding culture and language emphasizes the importance of examining these constructs to gain nuanced insights into human behavior. McGuigan and Moran assert that cultural materialism facilitates a deeper understanding of social phenomena by linking cultural expressions to the specific socio-economic conditions and power dynamics from which they arise [4]. This reinforces the need for a holistic approach in understanding language as a cultural artifact; it is not only shaped by culture but also actively shapes cultural perceptions and behaviors.

Furthermore, the exploration of how language reflects cultural values enhances our comprehension of cultural autonomy and the myriad ways in which social structures influence linguistic practices. Watts highlights how sociological investigations into culture demonstrate its dual role as both an independent variable, influencing social structures, and a dependent variable, shaped by prevailing social contexts [5]. Hence, analyzing word meanings and spaces in word meanings across languages provides an empirical basis for exploring these intricate cultural dynamics.

1.1 Problem Statement and Research Question

The relationship between language and culture has long been recognized as a critical area of study, illuminating how linguistic constructs shape and reflect cultural values and social norms. Focusing specifically on the concept of “success,” this research aims to quantitatively compare the semantic associations of success with relevant cultural concepts across distinct languages using word embeddings. Traditional frameworks for understanding culture, such as Hofstede’s cultural dimensions, provide foundational insights into how various dimensions, including individualism versus collectivism and uncertainty avoidance, can influence perceptions of success across different societies [6]. However, some scholars critique these dimensions for their limitations, arguing that they do not account for the complexities of language differences, religious influences, and political contexts which further nuance the cultural landscape [7, 8].

Understanding success through the lens of word embeddings allows for an empirical analysis of closely related concepts in different languages, thus transcending the boundaries of traditional cultural metrics. Previous studies have shown that applying Hofstede’s dimensions in exploring cultural disparities in contextual perceptions can yield significant insights into behaviors and decision-making processes across cultures [9]. Considering the significant role of language in shaping cognitive frameworks, employing word embeddings can reveal underlying cultural associations and the linguistic constructs of success that may vary from one culture to another [7].

Word embeddings are a foundational tool in natural language processing (NLP) that represent words as dense vectors in a continuous multidimensional space, capturing semantic and syntactic relationships based on contextual similarity [10]. These embeddings are typically learned from large text corpora using neural network-based models and are encoded in matrices where each row corresponds to a word and its position

in the embedding space. In the context of social science research, such as cross-cultural studies of meaning, word embeddings allow for the quantitative comparison of concepts across languages by measuring the similarity between vectors [11]. This method facilitates the analysis of how abstract social constructs—like "success"—are conceptualized differently across cultures by examining their proximity to culturally loaded terms in high-dimensional space [12]. Importantly, embedding matrices provide a non-invasive, data-driven approach to mapping collective semantic associations, making them particularly suitable for exploring cultural dimensions in psychological and sociolinguistic research.

By quantitatively assessing the distances between the word "success" and its culturally relevant counterparts, this study aims to deepen the understanding of how cultural contexts influence conceptual interpretations. Such analysis is vital not only for theoretical frameworks of cultural psychology and linguistic anthropology but also for practical applications in cross-cultural communication and international business where understanding diverse cultural perspectives can influence effectiveness and receptivity [13, 14]. Therefore, this research seeks to bridge the gap in existing literature by providing a quantitative foundation for exploring cultural differences in the conceptualization of success through word embeddings.

The investigation into the cultural dimensions of the concept of "success" entails understanding various attributes that are strongly associated with success in different cultural contexts. Each culture may prioritize distinct characteristics in their definitions of success, highlighting the interplay between cultural and linguistic frameworks. Recognizing how these attributes manifest elucidates the diversity in societal values and aspirations, facilitating a deeper comprehension of what qualities individuals in different cultures consider essential for achieving success.

Additionally, exploring how these associations differ across cultures unveils patterns of cultural divergence and convergence. By examining the embedding distances among word representations in different languages, the research will reveal specific linguistic nuances that illustrate varying cultural interpretations. This comparative analysis will not only illuminate the richness of cultural perspectives on success but also contribute to a broader understanding of how language captures these complexities. Through the lens of cross-cultural psychology, this inquiry aligns with the growing recognition that language acts as a significant cue for cultural mindsets, revealing underlying values and beliefs [15]. The insights gained from such an analysis will underline the intricate relationship between language and cultural identity, significantly enriching discussions on the sociology of culture and the psychological dimensions of human behavior [16].

In short, this research endeavors to uncover both the attributes associated with success in various cultures and the variances in these associations, thereby fostering a more nuanced understanding of how cultural values are reflected in language and how they influence perceptions of key concepts such as success.

1.2 Overview of Methodology

To explore the culturally specific semantic associations of "success" across languages, this study utilizes monolingual word embeddings developed by Joulin et al. [17, 18]. These embeddings, trained on large-scale text corpora from Wikipedia and Common Crawl, represent words as dense vectors in high-dimensional semantic spaces. Crucially, they preserve both semantic similarity and subword information, making them especially effective for languages with rich morphology or less-resourced linguistic contexts.

Each embedding space is language-specific, thereby capturing the nuanced ways in which semantic associations are shaped by the cultural and discursive patterns within that

language community [19, 20]. In this study, we select “success” as the anchor concept in each language and compute its semantic proximity to a curated list of culturally significant values and traits (e.g., ambition, effort, wealth, freedom, status, etc.). These concepts were uniformly translated across all target languages to ensure cross-linguistic comparability.

The primary metric for quantifying these associations is the cosine similarity between word vectors. Cosine similarity is a normalized measure that captures the angle between two vectors, reflecting the direction of their semantic orientation irrespective of their magnitude [21]. This property makes cosine similarity particularly suitable for analyzing conceptual relatedness within high-dimensional vector spaces and has been widely applied in sociolinguistic and cultural NLP research [12, 22].

By using these vector-based measurements, closeness in semantic space is treated as a proxy for cultural salience or relevance. For example, if the word for “success” in a given language is closely aligned with “effort” or “wealth,” this is interpreted as indicative of a cultural valuation of those traits in relation to the concept of success. This method allows for a scalable, data-driven approach to examining cultural variation without relying on survey instruments or interpretive interviews.

1.3 Novelty and Contribution

This study offers a novel interdisciplinary contribution at the intersection of computational linguistics, cultural sociology, and cross-cultural psychology. While prior research has employed word embeddings to trace historical language change [12], ideological shifts [22] or gender bias [23], few studies have leveraged monolingual embedding spaces as direct proxies for cross-cultural value systems.

Core innovation lies in using static, language-specific embeddings—rather than multilingual or translation-aligned embeddings—as mirrors of cultural meaning-making. Unlike multilingual embeddings that are optimized for cross-language equivalence, monolingual embeddings preserve culture-specific usage patterns [19]. As such, they allow us to infer intra-cultural conceptual hierarchies with greater fidelity.

Furthermore, while previous sociological research on values has relied heavily on surveys and questionnaires—methods which are resource-intensive and vulnerable to self-report bias—used approach offers a scalable, language-based proxy for cultural cognition [24, 25]. By mining large-scale linguistic data, we tap into naturally occurring discourse, capturing the implicit, everyday salience of concepts without needing direct elicitation.

In addition, this study introduces a comparative framework for analyzing the semantic centrality of key success-related values across ten distinct linguistic-cultural contexts: Arabic, Chinese, English, Finnish, German, Hindi, Russian, Spanish, Turkish, and Japanese. To author knowledge, this is one of the first efforts to systematically map semantic models of success across such a wide and diverse range of languages using a unified, quantitative methodology.

2. Literature Review

Recent advancements in computational linguistic methods, particularly through the use of word embeddings, have provided significant insights into the study of cultural narratives. Scholars have utilized these techniques to analyze semantic shifts and word association networks, revealing how language reflects and constructs cultural meanings over time. For instance, Deyne and Storms examined word associations through network and semantic properties, highlighting the small-world structure of word associations and its implications for understanding semantic relationships across cultures [26]. Their findings align with the

general consensus that language is inherently social and shaped by the cultural contexts in which it operates.

Similarly, Utsumi's work on distributional semantic models emphasizes how word co-occurrence statistics can effectively model human semantic knowledge, thereby reflecting the influence of cultural frameworks on language use [27]. This aligns with the perspective presented by Steyvers and Tenenbaum, who found that large-scale semantic networks exhibit characteristics of complex, interconnected structures, effectively modeling language acquisition and semantic understanding [28]. Their exploration into the statistical properties of these networks reinforces the notion that cultural dynamics are deeply embedded in linguistic structures.

The notion of semantic facilitation is also underscored by Griffiths et al., who employed network analysis to elucidate the connections within semantic networks, thereby illustrating the ways in which cultural narratives can be quantitatively assessed via computational methods [29]. The evolution of language and its ties to social constructs are evident in studies like those of Hills et al., who tracked the longitudinal analysis of semantic networks, providing insights into how cultural shifts influence word learning and usage over time [30].

Moreover, as demonstrated by Kovács et al. [31], the community structures within word association networks can reveal not only linguistic but also social and cultural categories, illustrating how networks of words reflect broader societal values and norms. Such analyses point to the vital role of network approaches in cultural studies, as they uncover hidden patterns and structures underlying language use, supporting the argument that language serves as a cultural artifact.

The integration of computational linguistic methods with traditional cultural theories represents a fertile ground for generating new insights into language and culture. By combining large-scale text analysis with established theoretical frameworks, researchers have the opportunity to deepen their understanding of cultural phenomena. This interdisciplinary approach leverages the strengths of computational methodologies to address longstanding sociological inquiries regarding cultural narratives, social identities, and collective memory.

For example, Hunter and Smith's application of network text analysis to film narratives demonstrates how linguistic techniques can reveal cultural codes embedded in storytelling, thereby linking computational analysis with sociological insights into genre conventions [32]. The findings from such studies suggest that language not only conveys meaning but also acts as a medium through which cultural values are negotiated and expressed.

Emphasizing collaboration between computational methods and sociological inquiry, researchers like Guo et al. [33], have employed activation force-based measures to analyze complex networks, reflecting the interrelations between language and cognition as influenced by sociocultural factors. By recognizing that word associations and linguistic constructions are contingent upon cultural contexts, scholars can utilize computational techniques to unveil the subtleties of cultural discourse in ways that traditional qualitative methods may not fully capture.

Ultimately, this integration paves the way for methodological innovations that can elucidate the dynamic interplay between language and culture. The combination of quantitative data analysis with theoretical substantiation helps illuminate how cultural constructs evolve and manifest linguistically. Studies utilizing approaches from both realms endorse the belief that computational methods can augment sociological

interpretations, yielding richer, multidimensional understandings of how we communicate and construct meaning within varied cultural landscapes.

3. Methodology

This study employs a computational linguistic approach to investigate how different cultures semantically associate the concept of "success" with various related terms. Using monolingual word embeddings for nine languages—Arabic, Chinese, English, Finnish, German, Hindi, Russian, Spanish, and Turkish—we analyze the relative semantic proximity of the word "success" to a set of culturally and conceptually relevant terms.

3.1 Word Selection and Translation

To ensure conceptual consistency across languages, we began with a canonical list of English words representing personal traits, social conditions, and life outcomes frequently associated with success. These included terms such as wealth, effort, education, discipline, luck, and others. For each target language, native-speaking collaborators or validated translation tools were used to generate semantically equivalent terms that reflect typical usage in that cultural and linguistic context. The complete set of words used in this study—including the main word for "success" and the corresponding related terms in each language—is presented in Appendix as Table A1.

3.2 Embedding Models

The analysis utilizes pre-trained monolingual word embeddings released by Joulin et al. [17], which are publicly available. Each language's embeddings are trained independently on respective Common Crawl or Wikipedia corpora using subword information, allowing robust representation even for infrequent words. These embeddings reflect semantic similarity as encoded in the co-occurrence patterns within large-scale text data, which are taken here as proxies for culturally dominant narratives.

To manage computational efficiency, only the vectors for the words of interest were loaded from each language's embedding file. This selective loading strategy significantly reduced memory requirements while maintaining full fidelity for the analysis.

3.3 Semantic Similarity Measurement

The core of the analysis involves computing the cosine distance between the vector representing the main word for "success" and the vectors of the associated terms within each language's embedding space. Cosine distance, defined as one minus the cosine similarity, captures the angular difference between two word vectors and serves as a widely accepted metric for semantic dissimilarity. A smaller cosine distance indicates a closer semantic relationship between the two words in the given language corpus.

By calculating the cosine distances between "success" and each associated term, we are able to construct a profile of conceptual proximity unique to each cultural-linguistic context. These profiles form the basis for both within-culture evaluations and cross-cultural comparisons that follow in the subsequent sections.

4. Results

This study analyzed the semantic associations between the concept of success and fifteen related terms across eight different languages using cosine distance values derived from vector representations. In the context of cosine distances, lower values indicate higher semantic similarity—i.e., a stronger association with the word "success"—while higher values denote weaker associations. The distances obtained as the result of the analyses are

given in Table A2 and related heatmap for visualization of data is given in Fig. 1. Darker values indicate closer relation for the heatmap.

Across the eight languages analyzed—Arabic, Chinese, English, Finnish, German, Hindi, Russian, Spanish, and Turkish—some terms such as effort, ambition, and talent consistently showed lower distance values, suggesting a close semantic connection with success. In contrast, words like status, wealth, and respect tended to exhibit higher distances, indicating a weaker association with the concept.

Table 1. Some common patterns for considered words

Term	Common Pattern
Effort	One of the most strongly associated terms across nearly all languages
Ambition	Consistently shows strong semantic connection, especially in Arabic, English
Talent	Often appears among top associated terms in Finnish, Russian, Turkish
Luck	Highly associated in German, Russian, and English, less so in Asian languages
Respect, Status, Wealth	Frequently show weaker associations across most languages

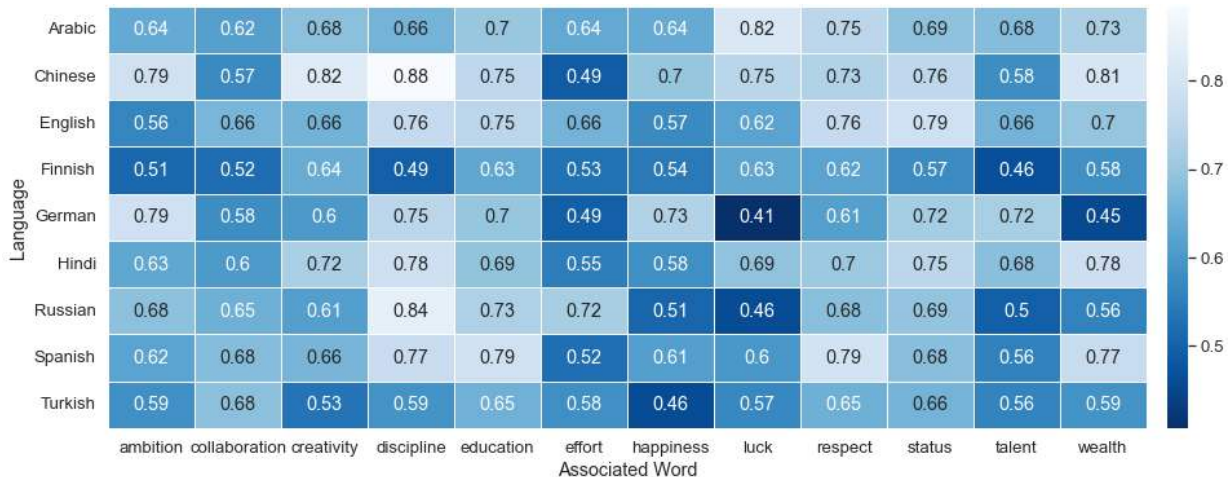


Fig. 1. Heatmap of distance to success of associated words for different languages.

4.1 Language-Specific Observations

Arabic: Effort (0.6355), ambition (0.6364), and happiness (0.6384) were the most strongly linked with success. In contrast, respect (0.7496), wealth (0.7253), and status (0.6878) were among the least associated.

Chinese: The closest associations appeared with effort (0.4872), collaboration (0.5739), and talent (0.5789). The highest distances—and thus weakest connections—were observed with creativity (0.8249), discipline (0.8845), and power (0.8123).

English: Strongest semantic ties to success were found with ambition (0.5648), happiness (0.5727), and luck (0.6222). Less associated were status (0.7860), power (0.8180), and respect (0.7633).

Finnish: This language showed a close clustering of strong associations, particularly with talent (0.4641), discipline (0.4947), and ambition (0.5104). Weakest associations included education (0.6279), luck (0.6270), and respect (0.6212).

German: Words like luck (0.4060), wealth (0.4541), and effort (0.4942) were most strongly connected to success. The weakest associations were with respect (0.6148), ambition (0.7866), and discipline (0.7487).

Hindi: Closest associations occurred with effort (0.5482), happiness (0.5835), and ambition (0.6285). In contrast, discipline (0.7839), wealth (0.7812), and status (0.7498) showed the least similarity.

Russian: Strongest links were seen with luck (0.4581), talent (0.4955), and happiness (0.5064). Higher distances—and weaker links—were recorded for discipline (0.8427), respect (0.6811), and status (0.6924).

Spanish: Effort (0.5235), talent (0.5574), and ambition (0.6214) had the strongest semantic relations with success, while respect (0.7941), wealth (0.7703), and discipline (0.7741) were less connected.

Turkish: Happiness (0.4565), talent (0.5597), and effort (0.5822) were most closely associated with success. Words like status (0.6570), respect (0.6499), and collaboration (0.6843) showed weaker ties.

5. Discussion

The semantic associations between success and related terms across eight languages reveal both universal and culturally specific patterns. Notably, concepts such as effort, ambition, and talent consistently exhibit strong associations with success, suggesting a shared emphasis on individual merit and personal achievement. Conversely, terms like status, wealth, and respect often show weaker associations, indicating that external markers of success may be less central in certain cultural contexts.

Universal Emphasis on Effort and Talent

Across the languages analyzed, effort emerges as one of the most strongly associated terms with success. This finding reflects the nearly universal endorsement of perseverance and hard work as key contributors to achievement [34]. Similarly, talent shows strong associations, particularly in Finnish, Russian, and Turkish contexts, suggesting that natural aptitude is also widely considered an important driver of success.

These results align with Hofstede's [35] framework, in which cultures with low power distance and high individualism often emphasize personal achievement and meritocracy. However, the consistent emphasis on effort and talent even in more collectivist cultures points to their global importance in perceptions of success.

Cultural Variations in Perceptions of Success

While some patterns are universal, notable cultural differences are evident. For example, luck shows a relatively strong association with success in the German and Russian contexts, indicating a belief in external and uncontrollable factors. This is consistent with prior findings suggesting that people in uncertainty-tolerant cultures may be more willing to attribute outcomes to chance or fate [36].

On the other hand, ambition is strongly associated with success in Arabic and English-speaking cultures. This reflects the cultural emphasis on individual initiative and goal-setting often observed in these societies [37]. In collectivist cultures, like those in parts of Asia, success is often viewed through the lens of communal harmony and collaboration rather than pure individual ambition [38].

Alignment with Cultural Models of Success

The observed semantic associations align with existing cultural models of success. In Latin American cultures, for example, ambition and striving for success are often valued within the bounds of family and community loyalty [39]. Meanwhile, in Chinese culture, the importance of *guanxi*—social networks and interpersonal connections—helps explain the relatively strong association between success and collaboration in the Chinese dataset [40]. These associations suggest that while effort and talent are broadly appreciated, cultural context significantly shapes how success is perceived, pursued, and achieved.

Implications for Cross-Cultural Understanding

Understanding the cultural semantics of success is critical for global collaboration, international education, and multicultural organizational management. The universal appeal of effort and talent supports merit-based strategies across cultural boundaries. At the same time, recognizing culturally specific success indicators—such as collaboration in Chinese contexts or ambition in Arabic societies—can enhance intercultural empathy and effectiveness [41].

6. Summary & Conclusion

This study employed monolingual Large Language Model embeddings to quantify how the concept of success is semantically related to twelve culturally salient attributes—effort, ambition, talent, collaboration, happiness, luck, creativity, discipline, education, status, wealth, and respect—across nine languages. Lower cosine distances indicate stronger associations with “success,” while higher distances denote weaker links. Summary of key findings may be listed as:

- **Universal Centrality of Effort:** In every language, effort consistently appeared among the closest terms to success (e.g. Chinese 0.487; Spanish 0.524; German 0.494; Finnish 0.529). This underscores a near-universal cultural belief that perseverance and hard work are fundamental to achievement.
- **Cultural Variations in Collaboration and Ambition:** Collaboration is most tightly bound to success in Finnish (0.522) and Chinese (0.574); and also ranks highly in Arabic (0.616), and English (0.663). This suggests that some cultures, especially those with more collectivist orientations, view cooperative effort as integral to success.
- **Ambition shows its strongest ties** in Finnish (0.510), English (0.565), and Turkish (0.585), reflecting societies that prize individual drive and goal-setting. In contrast, Chinese (0.788) and Russian (0.685) place less semantic weight on ambition.
- **Talent and Happiness as Differentiators:** Talent is exceptionally closely linked with success in Finnish (0.464), Russian (0.495), and Spanish (0.557) corpora, indicating that natural aptitude is viewed—sometimes even more than ambition—as a key success ingredient.
- **Happiness is most strongly associated** in Turkish (0.456), English (0.573), Russian (0.506), and Finnish (0.541), pointing to cultures that incorporate well-being and personal fulfillment into their conceptualization of success.
- **Role of Luck in European Contexts:** Luck exhibits its lowest cosine distances—and thus strongest semantic ties—in German (0.406) and Russian (0.458) texts, suggesting an attribution of success to chance or external circumstances more than in many Asian or Middle Eastern contexts.

- Weaker Links with External Markers: Across most languages, status and respect tend to have higher distances, indicating that material or socially granted markers are less semantically central to the notion of success than personal qualities and actions.
- The universal prominence of effort aligns with cross-cultural theories that emphasize hard work as a near-universal virtue in goal attainment [34].
- Strong association in Chinese and Arabic contexts accords with these cultures' collectivist orientations [38].
- The high semantic weight of ambition in English and Finnish reflects individualistic value systems, whereas its weaker association in Russian and Chinese embeddings mirrors their more collective or fate-oriented outlooks [35].
- The notable role of luck in German and Russian corpora supports findings that high-uncertainty-avoidance cultures sometimes acknowledge external influences on outcomes [36].

Overall, this computational analysis of word embeddings confirms that while certain values—particularly effort—are universally linked to success, other associations vary in ways that map onto established cultural dimensions. By quantifying these semantic patterns, we gain a nuanced, data-driven perspective on how different societies conceptualize success, complementing traditional sociological and psychological insights. However, this study has certain limitations that should be noted. Specifically, the semantic field analysis is restricted to individual lexical units rather than a broader network incorporating behavioral or experiential data. While this approach allows for precise lexical comparisons, it may not capture dynamic, context-dependent semantic relationships that might emerge in real-world usage or embodied cognition frameworks. Future research could extend this work by integrating behavioral datasets or experimental methods to explore how semantic fields operate within situated contexts.

References

- [1] Hofstede G, Hofstede GJ. Dimensions of national cultures. *Divers unity cross-cultural Psychol.* 1982;173–87.
- [2] Inglehart R. *Christian welzel modernization, cultural change, and democracy The human development sequence*. Cambridge: Cambridge university press; 2005.
- [3] Göttlich U. Cultural Studies and Sociology of Culture in Germany: Relations and Interrelations. *Cult Unbound.* 2013; 5(1):33–41.
- [4] McGuigan J, Moran M. Raymond Williams and Sociology. *Sociol Rev.* 2014; 62(1):167–88.
- [5] Watts I. Book Review: Lyn Spillman, What Is Cultural Sociology? *Sociol Res Online.* 2023; 28(4):1160–2.
- [6] Su C. Geert Hofstede's Cultural Dimensions Theory and Its Implications in SLA. *Acad J Humanit Soc Sci.* 2022; 5(14).
- [7] Li Y, Kobsa A, Knijnenburg BP, Carolyn Nguyen M-H. Cross-Cultural Privacy Prediction. *Proc Priv Enhancing Technol.* 2017; 2017(2):113–32.
- [8] Kaufmann W, Hooghiemstra R, Feeney MK. Formal institutions, informal institutions, and red tape: A comparative study. *Public Adm.* 2018; 96(2):386–403.
- [9] Taras V, Kirkman BL, Steel P. Examining the impact of Culture's consequences: A three-decade, multilevel, meta-analytic review of Hofstede's cultural value dimensions. *J Appl Psychol.* 2010; 95(3):405–39.
- [10] Mikolov T, Chen K, Corrado G, Dean J. Efficient Estimation of Word Representations in Vector Space. 2013;
- [11] Goldberg Y. *Neural Network Methods for Natural Language Processing*. Synth Lect Hum Lang Technol. 2017; 10(1):1–309.

- [12] Hamilton WL, Leskovec J, Jurafsky D. Cultural shift or linguistic drift? Comparing two computational measures of semantic change. In: Proceedings of the 2016 Conference on Empirical Methods in Natural Language Processing. 2016.
- [13] Rutherford G, Tuntivivat S. Social-ecological semiotics and the complex organization of psyche, language, and culture. *Cult Psychol.* 2024; 30(4):871–86.
- [14] Xu J. Brief Analysis on Cross-cultural Communication. *Theory Pract Lang Stud.* 2011; 1(7).
- [15] Ng V, Woo SE, Tay L, Foster J. Examining Variability in Values Attributed to Culture. *J Cross Cult Psychol.* 2016; 47(7):981–96.
- [16] Parajuli B. Role of Language in Shaping Cultural Identity. *Marsyangdi J.* 2021;112–8.
- [17] Joulin A, Grave E, Bojanowski P, Douze M, Jégou H, Mikolov T. FastText.zip: Compressing text classification models. *arXiv Prepr arXiv161203651.* 2016;
- [18] Joulin A, Grave E, Bojanowski P, Mikolov T. Bag of Tricks for Efficient Text Classification. *arXiv Prepr arXiv160701759.* 2016;
- [19] Hellrich J, Hahn U. Bad company—neighborhoods in neural embedding spaces considered harmful. In: Proceedings of coling 2016, the 26th international conference on computational linguistics: Technical papers. 2016. p. 2785–96.
- [20] Bender EM. On achieving and evaluating language-independence in NLP. *Linguist Issues Lang Technol.* 2011; 6(3).
- [21] Mikolov T, Sutskever I, Chen K, Corrado GS, Dean J. Distributed representations of words and phrases and their compositionality. In: Advances in neural information processing systems. 2013. p. 3111–9.
- [22] Kozlowski AC, Taddy M, Evans JA. The geometry of culture: Analyzing the meanings of class through word embeddings. *Am Sociol Rev.* 2019; 84(5):905–49.
- [23] Garg N, Schiebinger L, Jurafsky D, Zou J. Word embeddings quantify 100 years of gender and ethnic stereotypes. *Proc Natl Acad Sci.* 2018; 115(16).
- [24] Hofstede G. *Culture's Consequences: International Differences in Work-Related Values.* Sage Publications; 1980.
- [25] Schwartz SH. Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. *Adv Exp Soc Psychol.* 1992; 25:1–65.
- [26] De Deyne S, Storms G. Word associations: Network and semantic properties. *Behav Res Methods.* 2008; 40(1):213–31.
- [27] Utsumi A. A Complex Network Approach to Distributional Semantic Models. Zhang Z-K, editor. *PLoS One.* 2015; 10(8):e0136277.
- [28] Steyvers M, Tenenbaum JB. The Large-Scale Structure of Semantic Networks: Statistical Analyses and a Model of Semantic Growth. *Cogn Sci.* 2005; 29(1):41–78.
- [29] Griffiths TL, Steyvers M, Firl A. Google and the Mind. *Psychol Sci.* 2007; 18(12):1069–76.
- [30] Hills TT, Maouene M, Maouene J, Sheya A, Smith L. Longitudinal Analysis of Early Semantic Networks. *Psychol Sci.* 2009; 20(6):729–39.
- [31] Kovács L, Bóta A, Hajdu L, Krész M. Networks in the mind – what communities reveal about the structure of the lexicon. *Open Linguist.* 2021; 7(1):181–99.
- [32] Hunter SD, Smith S. A Network Text Analysis of David Ayer's *Fury*. *Adv Lang Lit Stud.* 2015; 6(6).
- [33] Guo J, Guo H, Wang Z. An Activation Force-based Affinity Measure for Analyzing Complex Networks. *Sci Rep.* 2011; 1(1):113.
- [34] Duckworth AL, Peterson C, Matthews MD, Kelly DR. Grit: Perseverance and passion for long-term goals. *J Pers Soc Psychol.* 2007; 92(6):1087–101.
- [35] Hofstede G. *Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations Across Nations.* Sage Publications; 2001.
- [36] Spector PE, Cooper CL, Sparks K. An International Study of the Psychometric Properties of the Hofstede Values Survey Module 1994: A Comparison of Individual and Country/Province Level Results. *Appl Psychol.* 2001; 50(2):269–81.

- [37] Furnham A. Personality and learning style: A study of three instruments. *Pers Individ Dif.* 1992; 13(4):429–38.
- [38] Triandis HC. *Individualism & collectivism*. Westview Press; 1995.
- [39] Torres L, Driscoll MW, Voell M. Discrimination, acculturation, acculturative stress, and Latino psychological distress: a moderated mediational model. *Cult Divers Ethn Minor Psychol.* 2012; 18(1):17.
- [40] Chen X-P, Chen CC. On the Intricacies of the Chinese Guanxi: A Process Model of Guanxi Development. *Asia Pacific J Manag.* 2004; 21(3):305–24.
- [41] Thomas DC, Inkson KC. *Cultural intelligence: Surviving and thriving in the global village*. Berrett-Koehler Publishers; 2017.

Table A1. The list of used words and their assumed equivalents in considered languages

English	Spanish	German	Japanese	Turkish	Russian	Arabic	Chinese	Finnish	Hindi
success	éxito	erfolg	成功	başarı	успех	نجاح	成功	menestys	सफलता
money	dinero	geld	お金	para	деньги	مال	钱	raha	धन
status	estatus	status	地位	statü	статус	مكانة	地位	asema	दर्जा
effort	esfuerzo	anstrengung	努力	çaba	усилие	جهد	努力	ponnistus	प्रयास
ambition	ambición	ambition	志	hırs	амбиция	طموح	抱负	kunnianhimo	महत्वाकांक्षा
collaboration	colaboración	zusammenarbeit	協力	işbirliği	сотрудничество	تعاون	合作	yhteistyö	सहयोग
education	educación	bildung	教育	eğitim	образование	تعليم	教育	opetus	शिक्षा
talent	talento	talent	才能	yetenek	талант	موهبة	才能	lahjakkuus	प्रतिभा
creativity	creatividad	kreativität	創造力	yaratıcılık	креативность	إبداع	创造力	luovuus	रचनात्मकता
luck	suerte	glück	幸運	şans	удача	حظ	运气	tuuri	भाग्य
discipline	disciplina	disziplin	規律	disiplin	дисциплина	انضباط	纪律	kurinalaisuus	अनुशासन
happiness	felicidad	Glück	幸福	mutluluk	счастье	سعادة	幸福	onnellisuus	खुशी
respect	respeto	respekt	尊敬	saygı	уважение	احترام	尊重	kunnioitus	सम्मान

Table A2. The cosine distance results for the considered words and languages

Language	Considered Word	Cosine Distance	Language	Considered Word	Cosine Distance
Arabic	collaboration	0.616	Hindi	effort	0.548
Arabic	effort	0.636	Hindi	happiness	0.584
Arabic	ambition	0.636	Hindi	collaboration	0.604
Arabic	happiness	0.638	Hindi	ambition	0.628
Arabic	discipline	0.658	Hindi	talent	0.682
Arabic	talent	0.678	Hindi	luck	0.689
Arabic	creativity	0.684	Hindi	education	0.691
Arabic	status	0.688	Hindi	respect	0.703
Arabic	education	0.698	Hindi	creativity	0.724
Arabic	wealth	0.725	Hindi	status	0.750
Arabic	respect	0.750	Hindi	wealth	0.781
Arabic	luck	0.815	Hindi	discipline	0.784
Chinese	effort	0.487	Russian	luck	0.458
Chinese	collaboration	0.574	Russian	talent	0.495
Chinese	talent	0.579	Russian	happiness	0.506
Chinese	happiness	0.696	Russian	wealth	0.559
Chinese	respect	0.734	Russian	creativity	0.613
Chinese	luck	0.746	Russian	collaboration	0.650
Chinese	education	0.754	Russian	respect	0.681
Chinese	status	0.755	Russian	ambition	0.685
Chinese	ambition	0.788	Russian	status	0.692
Chinese	wealth	0.808	Russian	effort	0.719
Chinese	creativity	0.825	Russian	education	0.731
Chinese	discipline	0.885	Russian	discipline	0.843
English	ambition	0.565	Spanish	effort	0.524
English	happiness	0.573	Spanish	talent	0.557
English	luck	0.622	Spanish	luck	0.598
English	creativity	0.655	Spanish	happiness	0.612
English	effort	0.658	Spanish	ambition	0.621
English	talent	0.658	Spanish	creativity	0.661
English	collaboration	0.663	Spanish	collaboration	0.678
English	wealth	0.695	Spanish	status	0.680
English	education	0.750	Spanish	wealth	0.770
English	respect	0.763	Spanish	discipline	0.774
English	discipline	0.765	Spanish	education	0.789
English	status	0.786	Spanish	respect	0.794
Finnish	talent	0.464	Turkish	happiness	0.456
Finnish	discipline	0.495	Turkish	creativity	0.531

Language	Considered Word	Cosine Distance	Language	Considered Word	Cosine Distance
Finnish	ambition	0.510	Turkish	talent	0.560
Finnish	collaboration	0.522	Turkish	luck	0.567
Finnish	effort	0.529	Turkish	effort	0.582
Finnish	happiness	0.541	Turkish	ambition	0.585
Finnish	status	0.575	Turkish	wealth	0.590
Finnish	wealth	0.584	Turkish	discipline	0.591
Finnish	respect	0.621	Turkish	respect	0.650
Finnish	luck	0.627	Turkish	education	0.651
Finnish	education	0.628	Turkish	status	0.657
Finnish	creativity	0.642	Turkish	collaboration	0.684
German	luck	0.406	German	education	0.696
German	wealth	0.454	German	status	0.715
German	effort	0.494	German	talent	0.720
German	collaboration	0.579	German	happiness	0.734
German	creativity	0.601	German	discipline	0.749
German	respect	0.615	German	ambition	0.787