

Semantic Change of Arabic Loanwords in German Across Selected Scientific Domains

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Selsabil Ayache

Doha Institute for Graduate Studies, Qatar

Mohamed Mohamed Yunis Ali

Doha Institute for Graduate Studies, Qatar

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Abstract: This research aims to examine the semantic change of Arabic loanwords in German within selected scientific domains. While scholarship on Arabic loanwords has primarily concentrated on etymology and transmission history, German as a receiving language has been comparatively understudied with respect to semantic change, especially from a domain-specific perspective. This study investigates the linguistic contact between Arabic and German, measures the extent of Arabic influence in the German scientific vocabulary, and conducts a detailed analysis of the processes of semantic change in these terms. The analysis is based on a lexicographically documented dataset of forty loanwords distributed across four scientific domains that emerged from the data. The findings reveal varied patterns of semantic change, of which broadening and narrowing are the most frequent, alongside instances of retention, while metaphorical shifts were attested in limited terms. Semantic broadening reflects the integration of terms into wider scientific contexts, whereas narrowing corresponds to the demands of precision characteristic of scientific discourse. Certain terms retained their original meanings, and metaphorical shifts emerged from cultural reinterpretation. Metonymy was absent, which affirms the nature of scientific terminology that favours standardization and stable definitions over associative meaning typical of metonymy.

Keywords: Arabic-German linguistic contact, linguistic borrowing, loanwords, scientific terminology, semantic change

1. Introduction

Languages evolve and diversify as they interact with others, and such interaction inevitably expands their vocabulary (Haugen 1950). German is no exception, as its history consisted of widespread interaction with many languages, which led to the incorporation of so many foreign terms. The historical context of Germany indicates that trade, migration, education, and cultural contacts have influenced the language significantly, adopting new terms from various parts of the world (Clyne 1995). The Arab influence on German has been around since the Middle Ages, when Europe was avidly engaging with the rich scientific and philosophical knowledge emanating from the Arab world (Versteegh 2001). The translation of Arabic academic written works led to the integration of Arabic words into European languages, and German was no different. This process of integration is part of the

notion of linguistic borrowing, which often occurs as a natural outcome of language contact. Borrowing is generally associated with language contact, often involving some degree of bilingual interaction between speakers (Haugen 1950).

Although previous research (Tazi 1998; Lipczuk and Sztandarska 2015; Al Zou'bi 2021; Abidin 2022) has studied Arabic loanwords in German, it merely addresses the integration of loanwords across various domains, with broad overviews of their phonological, etymological, and semantic aspects. Scientific terminology has also been tackled by the aforementioned studies, but it is normally incorporated within a general description and not a thorough, detailed study of this specific field. This research seeks to address this gap by examining the semantic change of Arabic loanwords in German scientific vocabulary. Therefore, it aims to investigate how these words have undergone semantic change within the German language and to understand the cultural and intellectual drives behind these changes. For it to achieve these objectives, this study seeks to answer the following questions: How have Arabic loanwords in scientific fields changed semantically in German? What kinds of patterns of semantic change can be found in these words? And how did intellectual and cultural contexts influence their semantic change?

2. Literature review

In order to provide a clearer context for the study, a selection of relevant literature is reviewed in this section.

2.1 Linguistic borrowing

Language borrowing can be defined as the reproduction of linguistic patterns from one language in another (Haugen 1950). This process involves not just the adoption of foreign words but also their adaptation to the phonological and morphological systems of the receiving language.

Borrowing in languages is a natural outcome of linguistic contact, and it can be driven by various social, cultural, as well as linguistic factors (Thomason and Kaufman 1988; Campbell 2004). One of the primary reasons for borrowing is the historical and social interaction between language communities. Borrowing often occurs when bilingual speakers influence each other's linguistic practices (Schendl 2001). The extent of borrowing correlates directly with the intensity of the linguistic contact. English, for example, has borrowed extensively from multiple languages due to its confrontational history during periods of exploration, colonization, and conquest (Jendra 2012).

Another reason for borrowing is the need to fill lexical gaps. Campbell (2004) states that when speakers encounter new things, concepts, or cultural phenomena where there are no native terms, they borrow from other languages. Prestige is another factor for borrowing, which occurs when words that are borrowed in a superior socially or culturally valued language are utilized to create an impression of sophistication or higher social standing (Schendl 2001). For instance, in Norman French domination in England, there were many French words, particularly those in food (pork, beef), law (judge, crime), and governance (court, reign), which were added to English to express the prestige of French culture (Schendl 2001).

Unnecessary borrowing also occurs, where foreign words are taken even where indigenous, identical equivalents already exist. This is typically caused by attitudes of internationalism or modernity. In Indonesian, to name but a few examples, words such as *fokus* (focus) and *snack* are more prevalent than native equivalents because they sound newer and globally understood (Jendra 2012). This type of borrowing, though unnecessary, is a sign of a psychological or social wish to adapt to supposed global linguistic streams. Finally, words are borrowed with pejorative connotations. This type of borrowing, Campbell (2004) suggests, occurs when foreign words are borrowed in an attempt to convey negative judgments. Haugen (1950) also categorises borrowing into three-stage process: imitation, adaptation, and integration. Foreign words are adopted without change at the imitation stage. At the adaptation stage, the words are modified to fit the phonological and morphological structure of the recipient language. At the integration stage, the borrowed words become integrated in the language's lexicon (Haugen 1950).

2.2 Semantic change

Semantic change frequently accompanies borrowing, where borrowed words go through a change in meaning to adapt to the recipient language's conceptual and cultural system (Ullmann 1962). This process has been researched systematically by linguists, and it is considered a basis for understanding the general process of borrowing. Ullmann (1962) identified six primary types of semantic change: narrowing, in which a word's meaning becomes more specific than it originally was; broadening, whereby a word takes on a general meaning; pejoration, which occurs when a word develops a negative connotation; and amelioration, in which a word gains a positive connotation. He further distinguishes metaphorical shift, where a word adopts a figurative meaning based on perceived similarity, and metonymy, where a word is used to refer to something that is connected to it by association rather than similarity.

Building on this theoretical framework, subsequent scholars have included additional aspects of semantic change. Moghaddam and Moghaddam (2013) most recently proposed a new semantic change model, where they examined French loans in Persian. They argued that earlier models were too narrow to accurately describe their data and introduced a model to organize semantic change as denotational changes (central meaning changes), connotational changes (changes in the related meanings), and their combination. This model contained subcategories such as widening, narrowing, metaphorical extension, and pejoration, and demonstrated its applicability in diverse language contexts.

Traugott and Dasher (2002) offer important insights into the process of semantic change, proposing that recurrent tendencies in meaning change arise from the interaction between language use and linguistic structure. Speakers and writers may innovate new uses of existing lexemes by drawing on pragmatic meanings, especially "invited inferences," and such innovations become semanticized when they are adopted and replicated by others. Their account is especially useful for the present study because it foregrounds the pragmatic and discourse-based

mechanisms through which semantic change takes place (Traugott and Dasher 2002).

2.3 Studies on Arabic-German linguistic contact

Arabic-German language contact has been shaped by cultural, social, and historical contexts. Previous research has examined this contact through borrowing, adaptation, and linguistic incorporation approaches.

The history of Arabic-German linguistic contact is essentially rooted in the role of intermediary languages that facilitated the transfer of Arabic-origin words into German (Tazi 1998). Of these, Medieval Latin was the most significant mediator language, serving as a “cultural superstrate” through which and in which the scientific and intellectual advancements of the Arabic-speaking world entered Europe (Tazi 1998:52). This was precipitated by the incorporation of ideas from earlier civilizations such as Greek, Indic, Persian, and Babylonian cultures into Arabic, mainly from translated works that enhanced the vocabulary of Arabic as well as its scientific and intellectual discourse (Tazi 1998:60). The medieval expansion of Islamic rule in the Mediterranean, together with trade and cultural exchange, facilitated contact between the Arabic-speaking world and Europe, contributing to the transmission of Arabic scientific knowledge and terminology. Urban areas like Palermo, Salerno, Naples, and Toledo became central places where Arabic scholarship had an impact on the Western world (Tazi 1998). From the eleventh to the thirteenth century, European scholars who were interested in Aristotle's works and in Arabic scientific discovery started translating books in Arabic into Medieval Latin. Such was a process wherein areas like medicine, pharmacology, alchemy, astronomy, and mathematics were influenced by the use of Arabic terms, even where Latin translation was already in place, especially in special nomenclatures like medicinal herbs and minerals (Tazi 1998:65).

In the context of multilingualism and migration, Hassan (2018) examines the integration of German-origin lexical items into Iraqi Arabic among Iraqi Arabic-German bilingual refugees and asylum seekers in Germany, focusing on whether these items are established borrowings or instances of code-switching. Drawing on spontaneous and elicited conversations and questionnaire data, the study identifies thirty-nine German-origin lexical items used in Iraqi Arabic, in reference to administrative institutions, social services, and everyday life. Terms such as *Wohnungsamt* (housing office), *Sozialhilfe* (social benefits), and *Heim* (refugee home) are adapted into Arabic grammatical frameworks, often marked with the definite article *il-* or pluralized with the feminine suffix *-āt*, as in *Ticket-āt* (tickets) and *Heim-āt* (refugee homes) (Hassan 2018:147). Hassan also identifies gender-assignment strategies, including classifying certain German-origin nouns ending in *-e* as feminine or using the masculine demonstrative *hāḍa* as a default across grammatical genders (Hassan 2018:152). Based on these morphological patterns, the study concludes that the examined German-origin lexical items constitute established borrowings rather than instances of code-switching. Although Hassan (2018) examines contemporary bilingual practices, it nonetheless contributes to situating the present research within a broader context of Arabic-German linguistic contact. More specifically, it illustrates that contact between Arabic and German

has not been unidirectional but has involved reciprocal lexical influence when the two languages come into recurrent contact. In this sense, this study is relevant as an indication that Arabic-German contact has continued into the present, albeit in a different sociolinguistic context shaped by migration rather than scientific transmission or scholarly exchange. Another example in the context of migration is the German hip-hop scene, where artists of Middle Eastern descent incorporate Arabic and Turkish words into their lyrics, reflecting their multicultural backgrounds and shaping the slang of German youth (Unicomb 2022).

2.4 Previous studies on Arabic loanwords in German

This section reviews studies of Arabic loanwords in German. Among them is Tazi (1998), whose systematic study *Arabismen im Deutschen: Lexikalische Transferenzen vom Arabischen ins Deutsche* (*Arabicisms in German: Lexical Transfers from Arabic into German*), analyses around 200 Arabic-based words in German, their etymological traces, and cultural dimensions. The study points out that most Arabic borrowings into German were indirect, having entered the language through intermediaries such as Latin, Italian, French, and Spanish during the Middle Ages (Tazi 1998:4). Direct Arabic-German borrowings were rare due to limited historical and geographical contact. Nevertheless, examples such as *Scheich* (sheikh) and *Kadi* (judge) illustrate direct Arabic influence (Tazi 1998:4-6).

The article *Arabismen in Deutschen Wörterbüchern* (*Arabic Loanwords in German Dictionaries*) by Lipczuk and Sztandarska (2015) investigates the presence and treatment of Arabic-origin words in three nineteenth-century German dictionaries of borrowed words namely Wiedemann (1811), Wander (1858), and Köhler (1882). The authors compare these nineteenth-century dictionaries with modern etymological literature, particularly *Kluge/Seebold* (1995), in order to identify differences in etymological attribution. A pattern was observed in which several lexical items in older dictionaries were classified as direct borrowings from Arabic, whereas in contemporary studies, the role of intermediary language was emphasized. Lipczuk and Sztandarska (2015) suggest that these Arabic borrowings indicate the interconnectedness of linguistic and cultural histories and conclude that the role of dictionaries is not only offering linguistic records but also being reflections of the evolving understanding of language contact and etymology.

The study *Lexical Borrowings of Romance and Germanic Languages from Arabic: An Etymological Analysis*, by K. Sainul Abidin (2022), focuses on Arabic's influence on Romance and Germanic languages and traces the historical and linguistic processes through which loanwords were transmitted. It traces the phonological and morphological changes that Arabic loanwords underwent, including the simplification of sounds and the processes of integration into European grammatical systems. For example, the Arabic word *sukkar* evolved into Italian *zucchero*, and later influenced French *sucre* and English *sugar*. In the same way, Arabic *qutn* became Spanish *algodón* (cotton) and English *cotton* (Abidin 2022:6). In this respect, this study helps clarify the historical conditions under which Arabic-origin terms became established in German vocabulary.

In another study, Al Zou'bi (2021) examines Arabic loanwords in French and German, with the aim of identifying Arabic-origin words that have been fully assimilated into the latter languages. The study traces how such borrowings entered European languages both directly and indirectly through intermediary languages, often with contexts of trade and scientific exchange. For instance, the Arabic word *makhzan* (storehouse) entered German as *Magazin* in the early sixteenth century through Italian *maggazzino* or Spanish *magacén*, where it originally referred to a warehouse or place for storing goods. The term was later reintroduced into German in the eighteenth century via the French *magasin*, meaning a shop or store. Over time, the word underwent further semantic change, shifting from the notion of storing physical objects to that of storing information to denote a periodical or journal (*Magazin* in German and *Magazine* in French). Notably, the word has retained both its earlier and newer meanings in German and French, resulting in a case of semantic coexistence, despite the presence of other lexical items that express the original sense, such as *Lager* in German and *Entrepôt* in French (Al Zou'bi 2021:224). However, while this research adopts a broad comparative perspective on French and German and addresses borrowing in general terms, it falls short in narrowing the focus to the semantic change of Arabic loanwords in only one recipient language, with particular attention to a domain-specific analysis. This level of specificity is important, as it makes it possible to examine more closely the mechanisms of semantic change within a controlled linguistic and disciplinary context.

3. Methodology

The research employs a descriptive qualitative methodology to examine the integration of Arabic loanwords into the German scientific lexicon. It relies mainly on Ullmann's (1962) theoretical framework to analyse the types of semantic change and to assess how loanwords have evolved in the recipient linguistic context.

This research is grounded and based on a synthesis of primary and secondary sources. The primary sources include dictionaries and glossaries that trace the etymological roots and usage of Arabic loanwords in German, whereas the secondary sources include a seminal work that traces the historical pathways of loanwords integration into German as follows:

- (a) Kleines Lexikon deutscher Wörter arabischer Herkunft: rund 500 Wörter mit ihrer ursprünglichen arabischen Bedeutung und ihrer geschichtlichen Wandlung (Beck'sche Reihe).
- (b) DWDS Etymological Dictionary.
- © The Doha Historical Dictionary of Arabic.
- (d) Raja Tazi, *Arabismen im Deutschen: Lexikalische Transferenzen vom Arabischen ins Deutsche*.

Loanwords were selected based on the following criteria:

- (a) Scientific relevance:
 - The term is used within a recognized scientific domain.
 - It denotes a concept, substance, process, or instrument associated with scientific knowledge or practice.

- Its classification as scientifically relevant is supported by lexicographic labelling, etymological description, or domain-specific usage in the consulted sources.

(b) Etymological clarity:

- Only loanwords with well-documented Arabic origins were included to ensure precision and reliability in tracing their semantic change.
- Terms that do not derive from Arabic in a strict genealogical sense were included only when their integration into Arabic scientific discourse is explicitly documented in the consulted lexicographic sources.

The analytical framework for this study is grounded in a standard typology of semantic change, as identified in early contributions by Bréal (1964), Stern (1965), and Ullmann (1957). This framework particularly categorizes loanwords based on six types of semantic change as outlined by Ullmann (1962): narrowing, broadening, metaphorical shift, amelioration, pejoration, and metonymy.

A total of forty Arabic-origin loanwords were compiled and analyzed on the basis of their scientific relevance; the full dataset is provided in the Appendix. The selection of the forty loanwords was not based on a subjective or predefined classification, but rather on a qualitative examination of the lexicographic sources consulted. These loanwords were grouped into four scientific domains: Medicine/Pharmacology, Chemistry, Mathematics, and Astronomy. The etymology of these terms was then traced through primary and secondary sources to establish their Arabic roots and historical usage. The analysis was processed by first comparing the original meaning of the Arabic loanwords with their contemporary usage in German, in order to classify each term according to its type of semantic change. Finally, a visual chart was designed to illustrate the overall frequency and distribution of semantic changes across the four examined domains and establish a comprehensive representation of the data to facilitate cross-domain comparison.

Arabic lexical forms are represented using scholarly transliteration rather than phonetic transcription, as the analysis focuses on their etymological origins and semantic change rather than pronunciation.

4. Analysis and results

The analysis yields distinct patterns of adaptation within the German lexicon. The dataset comprises forty distinct loanwords with a total of forty-nine semantic classifications, as some lexical items exhibit more than one type of semantic change and are therefore assigned to multiple categories. Accordingly, the reported frequencies reflect the distribution of semantic classifications rather than the number of individual loanwords. Semantic broadening was the most frequent category, occurring in seventeen instances. This suggests that many of these borrowings have expanded to cover a wider conceptual scope within the scientific lexicon. Narrowing was observed in sixteen instances, which reflects the opposite tendency, that is, the specialization of meanings into more restricted and technical contexts. Metaphorical shifts appeared five times. Terms that did not undergo semantic change were retained in the analysis as a baseline category, allowing for

a more accurate assessment of the distribution and types of semantic change observed in the dataset. On this basis, semantic retention occurred eight times. Meanwhile, amelioration appeared twice, and pejoration was observed once. Significantly, the complete absence of metonymy in the analyzed data affirms the dominance of other types of semantic change and indicates how scientific discourse tends to suppress context-dependent associative meanings in favour of stable definitional precision.

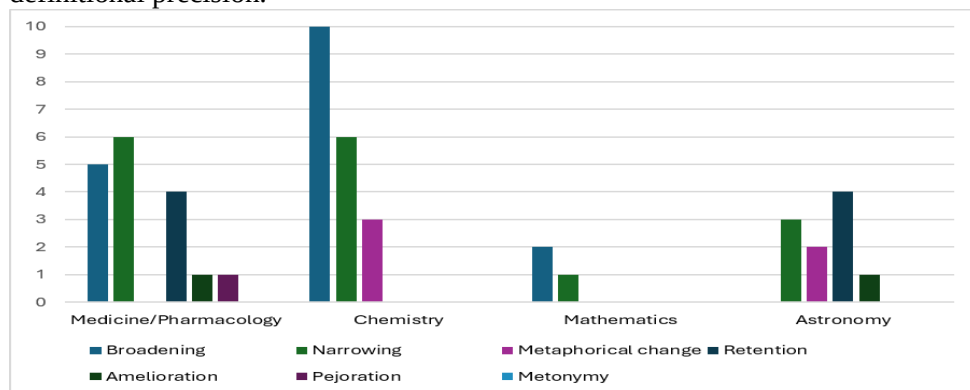


Figure. Frequency of semantic change types across scientific domains

5. Discussion

In order to provide a clearer understanding of the data, a selection of examples is discussed in detail in this section.

5.1 Medicine/pharmacology

The domain of Medicine/Pharmacology includes compelling examples of how Arabic loanwords have been integrated into German. Broadening, for instance, occurred in terms such as *Benzin* and *Sirup*. The term *Benzin*¹, from Arabic لُبَان جَاوِي (lubān jāwī), originally referred to a medicinal aromatic resin known as “benzoin resin.” This resin, derived from various *Styrax* species found in regions such as Sumatra, was historically used in incense-making and valued for its vanilla-like fragrance. The Arabic term لُبَان جَاوِي *lubān jāwī* translates to “incense from Java,” a reference rooted in early trade routes. However, due to geographical misconceptions, the resin from Sumatra was mistakenly associated with Java. The term entered European languages through Catalan trade, where the Arabic *lubān* was misinterpreted as part of the Catalan definite article “lo,” resulting in the simplified Iberian forms *benjuí* (Catalan), *bejoim* (Portuguese), and *benjuí* (Spanish). These terms further evolved into French *bengin* or *benzoin* and Italian *belgioino*. In 1834, Justus von Liebig introduced the term *Benzol* to designate the simplest aromatic hydrocarbon, inspired by the stem *Benz-* and the suffix *-ol*, possibly referencing the Latin *oleum* (“oil”) or mirroring the structure of *Alkohol* (“alcohol”). By the late nineteenth century, *Benzin* became associated with hydrocarbon mixtures obtained from petroleum and was semantically distinguished from *Benzol*, adopting the broader usage of describing fuels such as gasoline. This

change can be traced to a sequence of identifiable processes, including transmission through multiple linguistic intermediaries, the scientific reclassification of the original substance, and its subsequent extension into industrial usage. Accordingly, *Benzin* exemplifies a case of semantic broadening shaped by the classificatory logic of modern chemistry and the expanding functional contexts of industrial application.

Similarly, the term *Sirup*², derived from the Arabic term شراب (*šarāb*), originally referred to a medicinal drink prepared by Arab physicians, underwent semantic broadening to refer to sweetened liquids used in culinary contexts. Historically, the term *Sirup* was introduced into medieval medical vocabulary through Middle Latin (*sirupus*), which itself is derived from the Arabic term *šarāb* (“drink”). In Arab medical practice, the term referred to thickened plant extracts often combined with sugar used as medicinal remedies. By the eighteenth century, *Sirup* had transitioned to refer to viscous sugar solutions produced during sugar manufacturing, such as from sugarcane or sugar beets (Tazi 1998:99-100). This transition reflects a process of domain shift and functional recontextualization, through which the term expanded from pharmacological usage in response to the changing socio-economic conditions surrounding sugar production and consumption. As sugar-based substances became increasingly integrated into culinary and commercial practices, the term lost its earlier domain-specific restriction and acquired a broad range of application.

Conversely, semantic narrowing exemplifies a more precise adaptation of meaning, as illustrated by *Borretsch*³, derived from the Arabic term أبو عرق (*abū ‘araq*) or “Father of Sweat,” originally referring to a plant valued in Arabic medicine for its sweat-inducing properties and other medicinal applications. The term entered medieval European languages through Middle Latin (*borrago*), which is generally regarded as deriving from the Arabic *abū-raq*. In German, however, the semantic scope of *Borretsch* gradually narrowed. While the plant (*Borago officinalis*), known for its cucumber-like flavour, had originally been associated with medical use, it came to be used primarily as a culinary herb in modern European cuisines. This change suggests a case of functional specialization, in which semantic narrowing does not arise arbitrarily, but through the gradual privileging of one culturally salient use of the referent over others. The plant’s earlier medicinal associations did not necessarily disappear at once; rather, they lost semantic centrality as culinary usage became increasingly conventionalized in the recipient language.

Retention, though less frequent, demonstrates meaning stability over time. A case in point is *Harmel*⁴, from Arabic حرملة (*harmal*), referring to a strong-scented, white-flowered steppe plant, native to regions of the southern Mediterranean and Spain. Historically, *Harmel* was used in the Orient for both dyeing fabrics (via a substance called *Harmalin* derived from its seeds) and medicinal purposes. The term was borrowed directly into various European languages, such as Spanish (*alharma*, *alharmaga*), Middle Latin (*harmala*), French (*harmale*), Portuguese (*harmala*), Catalan (*armalà*), and Italian (*armora*). Despite the passage of centuries, the German usage of *Harmel* has preserved these original meanings. The retention

of meaning can be explained by referential continuity, as the term continues to denote the same specific plant and was not redefined within different scientific or technical contexts.

5.2 Chemistry

In the domain of Chemistry, semantic broadening constitutes the most dominant type of semantic change, as illustrated by terms such as *Alchemie*, *Alkohol*, and *Borax*. The term *Alchemie*⁵, derived from Arabic الكيمياء (al-kīmiyā'), originally referred to mystical practices such as gold-making and the “art of metal transformation.” Etymologically, the Arabic term al-kīmiyā' is considered to have originated from the Greek chēmēia (χημεία) or chymēia (χυμεία) meaning the “art of metal transformation.” In medieval European usage, *Alchemie* became synonymous with the search for the transmutation of base metals into gold and the pursuit of the elixir of life. Following its transmission into German, the term came to refer not only to the alchemical pursuit of transmutation, but broadly to the scientific study of material transformation. This change was shaped by a gradual epistemic recontextualization, whereby the term, originally situated with mystical and proto-scientific discourse, was progressively reinscribed within the conceptual and terminological framework of modern empirical science. Importantly, the earlier esoteric associations did not disappear through an abrupt semantic rupture; rather, they gradually receded as the term was integrated into a new scientific context. At the same time, the semantic core of the term, namely the idea of material transformation, remained intact, but was expanded and reformulated in accordance with the explanatory logic of chemistry as an empirical discipline. The resulting change is therefore better described not as a complete break with the past, but as a transition from a relatively restricted alchemical meaning to a broader and more systematized scientific understanding of transformation in matter.

Similarly, *Alkohol*⁶ الكحل (al-kuhl), which originally referred to finely ground antimony powder used as a cosmetic substance, has semantically broadened to include ethyl alcohol and alcoholic beverages. The term, derived from the Arabic *kuhl*, described various substances obtained through processes such as sublimation or distillation, including refined essences and other pure substances. The term entered European languages via Hispano-Arabic *al-kuḥūl* (with the article *al*), which influenced Spanish *alcohol* and Catalan *alcohol*. Medieval alchemists adopted the Latinized forms *alcohol* and *alcohol*, eventually associating the term with “the essence of wine” (*alcohol vini*), as evidenced in the writings of Paracelsus in the early sixteenth century. Over time, *Alkohol* in German became exclusively linked to ethyl alcohol, concurrently with the influence of industrial and scientific advancements. This change entails a process of referential extension through scientific reclassification, whereby a term originally tied to a specific cosmetic substance was gradually extended to a broader class of refined materials and eventually stabilized within chemical and industrial discourse.

The term *Borax*⁷ بورق (būraq) originally referred to a substance used in alchemical processes, mainly as a soldering agent for gold. Derived from the Arabic *būraq* or *baurāq*, the term originated from the Persian *būrāh* (modern Persian:

bure), meaning an alchemical compound. The term entered medieval Latin as *borax* and subsequently appeared in Middle High German as *buras* and its variants (*bor(r)as*, *burros*, *Borax*). In contemporary German, *Borax* has semantically broadened to encompass a range of industrial applications, such as glassmaking, enamel production, and cleaning products. Such change is characteristic of scientific and technical vocabulary, in which lexical items tend to follow the epistemic trajectory of the substances they denote. As a material becomes incorporated into new domains, the semantic scope of the term expands accordingly. The broadening of *Borax* can therefore be understood as the linguistic correlate of a shift from specialized alchemical material to a multi-functional industrial compound.

Semantic narrowing is likewise evident in the domain of chemistry, where the progressive systematization of scientific knowledge led to the specialization of previously broader terms. For instance, *Markasit*⁸ المرقشيتا (*marqašīta*) originally referred to a broad category of sulfide minerals in Arabic. In contemporary German usage, however, the term specifically refers to iron sulfide (FeS_2), a metallically lustrous, yellow mineral that can develop iridescent hues. The semantic narrowing in this case is linked to the emergence of mineralogical classification systems, which impose a one-to-one correspondence between lexical items and scientifically defined referents. Whereas earlier usage allowed the term to be applied more loosely to a range of visually or functionally similar substances, the development of systematic mineral classification required the differentiation of distinct compounds based on their chemical composition. As a result, the term *Markasit* was reassigned a more narrowly defined referent.

A similar process is observed in *Naphtha*⁹ نفت (nift), which initially held a broad meaning of ‘petroleum’ in general, and now refers to a specific refined petroleum fraction. This narrowing appears to have been closely linked to chemical fractionation and industrial standardization, whereby crude petroleum, once treated as a single substance, was analytically decomposed into distinct fractions with defined properties and uses. As refining technologies advanced, the need for terminological precision led to the reassignment of *Naphtha* to one particular subset within a larger class of hydrocarbons within the field of industrial chemistry. Likewise, *Athanor*¹⁰ التانور [*at-tannūr*], originally meaning a “bread oven” or “water pipe.” Over time, the term referred to a general utility object to describe a specialized furnace in the context of alchemy. This furnace, known for its self-sustaining nature, required minimal maintenance and was integral to alchemical processes, earning it the nickname “Lazy Henry” (*fauler Heinz*) in historical German texts. As chemical procedures became more systematized, the term became specialized through repeated association with a particular apparatus in alchemical practice. A lexeme that could once refer more broadly to oven-like or furnace-like objects became fixed around one specialized technical referent.

Metaphorical shifts also occurred in this domain, as demonstrated in *Alembik* الإنبيق (*al-inbīq*) and *Amalgam* عمل الجماعة (*amal al-jamā’a*). Historically, *Alembik*¹¹ الإنبيق (*al-inbīq*) referred to a distillation apparatus in alchemical processes, which was made of glass, tin, or copper placed as a dome and was capable of capturing

and condensing vapors with very little help from heat. This apparatus symbolized the transformative process of distillation, both physically and symbolically. Its use and significance were documented as early as the tenth century in *Kitāb al-Asrār* (Book of Secrets) by Ar-Rāzī and in the Islamic encyclopedia *Miftāḥ al-‘ulūm* (Key to the Sciences). Over the years, the term’s application expanded beyond its literal meaning and entered into intellectual and cultural discourses as a metaphor for purification and refinement. The term thereby reoriented from concrete denotation toward a metaphorical structure derived from the process associated with the instrument. This semantic change, therefore, reflects a shift from instrument-based reference to process-based metaphor, whereby the functional properties of the object are reinterpreted as conceptual meanings.

The term Amalgam¹² is tentatively traced to the Arabic phrase *عمل الجماعة* (‘amal al-jamā‘a), meaning “act of union” or “work of unification,” through Medieval Latine *amalgama*, according to DWDS etymological Dictionary. In medieval Latin, the term was used by thirteenth-century alchemists as (*amalgama*) to describe a chemical alloy of mercury with other metals. Later, Amalgam evolved to carry a broader figurative meaning beyond its technical meaning, referring to any mixture or fusion of diverse elements. The metaphorical shift, therefore, rests on the preservation of this internal semantic schema, which is a controlled union of heterogeneous elements. In later usage, the term no longer needed to denote an actual chemical compound, yet it continued to evoke the same logic of composite formation, which explains why it could come to refer more generally to intellectual, cultural, or social mixtures. The semantic change is thus best understood as a movement from technical denotation to figurative conceptual modelling, where the chemistry of combination becomes the semantic template for describing mixed wholes in other domains.

5.3 Mathematics

Mathematical loanwords exhibit only two types of semantic change: broadening and narrowing. Broadening is depicted in terms like *Algebra*¹³ *الجبر* (al-jabr), originally referring to “restoration” or “reunion” in the context of bone-setting in Arabic medical practices. This meaning was preserved in the title of a groundbreaking mathematical treatise by the ninth-century Persian Arab mathematician Muhammad ibn Musa al-Khwarizmi, *‘Ilm al-Jabr wa al-Muqābala* (*The Science of Restorations and Comparisons*), where *al-jabr* referred to the transformation of negative values into positive ones within equations. As this work laid the foundation for systematic problem-solving using abstract symbols, *Algebra* broadened to denote an entire mathematical discipline and the study of equations, abstract structures, and operations. The meaning of the term expanded from referring to a single calculative procedure to referring to the broader system in which that operation was embedded. The broadening, therefore, lies in a shift from a restricted procedural meaning to a general disciplinary designation, driven by the increasing abstraction and formalization of mathematical knowledge.

In terms of narrowing, *Algorithmus*¹⁴ *الخوارزمي* (al-Khwarizmi) provides a clear example, as a term derived from the name of the ninth-century mathematician

Muhammad ibn Musa al-Khwarizmi, whose seminal works introduced the decimal numeral system and advanced mathematical concepts to Europe. Originally, *Algorithmus* referred to al-Khwarizmi's mathematical contributions, including arithmetic and algebra. However, in the course of time, the term's meaning became more specific, referring exclusively to step-by-step computational procedures or systems of rules for processing information. This semantic narrowing can be explained by terminological specialization, driven by both the terminological consolidation of mathematics and its adaptation to the precise requirements of modern computation and information theory.

5.4 Astronomy

Narrowing and retention occurred with similar frequency in the domain of Astronomy. Narrowing is observed in terms such as *Aldebaran*¹⁵, where earlier meanings became restricted to specific celestial phenomena. The Arabic term الدبران (ad-dabarān), meaning the follower, originally described the star's apparent motion as it follows the Pleiades cluster in the night sky, according to the observational practices of early Arab astronomers. Diachronically, the term became restricted in its application to specifically refer to the prominent first-magnitude star in the Taurus constellation, in line with the precision required in astronomical nomenclature. Under such conditions, the term became stabilized around a single, clearly identified referent through repeated contextual association. Conversely, *Fomalhaut*¹⁶ فم الحوت (fumm al-hūt) (mouth of the whale), represents a case of semantic retention, insofar as the term has maintained a stable referential function as the designation of a specific star position. This stability results mainly from the absence of reanalysis, where the term maintains a consistent one-to-one correspondence with its referent.

Metaphorical shifts were also present in this domain, as exemplified by the term *Algol*¹⁷ الغول (al-ghūl), which was described as a shape-shifting creature with human features, donkey legs, mainly referring to a mythical desert spirit in the Arab folklore. Medieval Arab astronomers applied this term to a variable star in the Perseus constellation situated at the head of Medusa in Greek mythology. As the Greco-Roman mythological framework surrounding Medusa was culturally irrelevant in Arabic astronomy, the “head of Medusa” was reinterpreted through the culturally salient figure of the ghoul. With the passage of time, Algol transitioned from its folkloric roots to a precise scientific term, referring to a specific star characterized by its fluctuating brightness. In this process, the original mythological referent is not preserved literally, but its connotative profile, darkness, danger, unpredictability, is transferred to the astronomical domain. Over time, however, the term was stabilized as the proper designation of a specific variable star. The later scientific usage no longer activates the original folkloric meaning, indicating a shift from connotative metaphor to neutral technical designation. This change may also be interpreted as a case of amelioration, since the term acquires a neutral or even prestigious status within scientific discourse, despite its earlier associations with superstition and fear. Finally, *Zenit*¹⁸ سَمْت (samt) expanded from its literal meaning of “direction of the head” to include a figurative sense of pinnacle or peak.

Underlying this metaphorical shift is the association between vertical position and scalar value, whereby what occupies the highest point in physical space signifies what is greatest in degree, achievement, or intensity. Accordingly, the term shifts from spatial orientation to a more abstract meaning related to level, culmination, or maximality.

5.5 Cross-domain comparison of semantic change

A further analysis and comparison of the results across the four scientific subdomains indicates that semantic change is not randomly distributed but is conditioned by the epistemic structure and functional demands of each borrowing context. More specifically, there are several possible factors that might explain the semantic trajectories observed in the corpus.

The first factor is the type of referent, that is, the type of entity encoded by the borrowed term. It was observed that material-substance terms were particularly susceptible to semantic change, mainly due to processes of chemical analysis or taxonomic reclassification. *Benzin* is an exemplary case in this regard, as it was redefined across several epistemic contexts. Its meaning changed from an earlier association with medicinal and aromatic resin to a chemically classified substance associated with benzoin and benzoic compounds. Eventually, it stabilized as a broader industrial term that refers to petroleum-derived hydrocarbon mixtures. In comparison, the term *Markasit* moved in the opposite direction, with mineralogical classification restricting an earlier broader association with pyrite-like iron sulfides to marcasite proper, namely, iron disulfide (FeS_2). Despite the fact that both terms denote material substances, the outcome of semantic change was determined by whether the substance was an object of expanding application or an object requiring stricter classification in the receiving discourse.

A second factor is the functional profile of the referent. Terms like *Sirup* and *Borretsch* both originate in contexts associated with medicinal or therapeutic use, yet their later German trajectories diverge as different functions become salient. In *Sirup*, the meaning broadens as the earlier medicinal preparation became applicable across different culinary, commercial, and manufacturing contexts. In *Borretsch*, by contrast, the meaning narrows to its use as an edible herb while its earlier therapeutic associations become less salient. Accordingly, it can be inferred that functional recontextualization may either broaden or restrict meaning depending on whether the receiving context expands the range of uses or privileges one use over others.

A third factor is the degree of abstraction required by the receiving discipline. This can be observed in terms that denote mathematical procedures and formal systems, which differ in this respect from plant names or substance names that refer to material objects. For this reason, the trajectory of their semantic change is determined by abstraction and operational precision rather than by material classification. In particular, the term *Algebra* broadens because a procedural meaning becomes abstracted into the designation of an entire discipline. On the contrary, *Algorithmus* follows the opposite direction as its broader association with al-Khwarizmi's mathematical legacy becomes narrowed to a rule-governed

sequence of computational steps. Both terms are shaped by mathematical formalization, yet one expands into a disciplinary label while the other narrows into a precise operational concept, which indicates that the same epistemic domain may generate different semantic outcomes.

A fourth factor is the extent of referential fixation required by the borrowing domain. This is precisely found in the domain of Astronomy, where loanwords often stabilize around fixed referents such as identifiable stars or celestial positions. For example, the term *Aldebaran*, which originally derives from an Arabic descriptive expression meaning “the follower”, became fixed as the proper name of a particular star in astronomical usage. The term’s descriptive content was reduced in favour of terminological precision necessitated by the receiving domain.

Unlike the previous cases, terms that underwent metaphorical shift follow a different trajectory in which a salient feature encoded in the earlier meaning is abstracted and transferred into a new conceptual domain. In other words, the direction of change is shaped by the feature or the relation that remains transferable from the earlier meaning, such as height, direction, or function. *Alembik* and *Zenit* exemplify two different forms of this trajectory. Metaphorical shift, in *Alembik*, develops from the function associated with the instrument, which became the basis for later abstract meanings of refinement or purification. On the contrary, *Zenit* develops through a spatial relation. Its source meaning is connected with direction or the highest point above the observer, and this vertical relation is later transferred into an abstract meaning of peak or maximum degree. Metaphorical shift, then, depends on a traceable relation between the earlier meaning and the later abstract use.

Based on the observed outcomes, semantic change can be best understood as both a process of recontextualizations and a result of the interaction between lexical transmission and the scientific knowledge systems into which Arabic loanwords were incorporated.

6. Conclusion

This study has addressed the limited research on the semantic change of Arabic loanwords in German within the domain of scientific terminology. It examines and analyses the process of semantic change in forty loanwords across four domains: Medicine/Pharmacology, Chemistry, Mathematics, and Astronomy. The findings reveal that the most notable types of change were semantic broadening and narrowing, followed by retention, while metaphorical shifts were observed in a smaller proportion of loanwords. As for semantic broadening, loanwords were integrated into more general scientific and industrial contexts and adapted to meet new technological and conceptual demands. Conversely, other terms underwent narrowing because of the nature of scientific discourse that usually requires precision and specialization. Retention, on the other hand, attests to the linguistic stability of terms rooted in enduring scientific and cultural practices. While less common, metaphorical shifts were present in domains like astronomy and chemistry due to cultural reinterpretation in forming symbolic and figurative meanings. Additionally, words that underwent amelioration tended to gain prestige

as they became associated with advanced scientific or technological practices, whereas pejoration occurred when terms lost their original scholarly value or became part of the German colloquial lexicon. The absence of metonymy in the data suggests that meaning extension in scientific vocabulary favours systemic conceptual precision over context dependent associative meanings. These findings suggest that in specialized domains such as science, semantic change operates under certain limitations of standardization and definitional stability, which limits the role of pragmatic or associative reinterpretation typical of metonymic processes. In addition, the semantic trajectories observed in the corpus suggest that Arabic loanwords were adapted to the classificatory, functional, conceptual, and referential needs of the receiving domains, which helps explain the different semantic outcomes identified in the study.

The study suggests that future research might investigate the influence of contemporary migration, globalization, and digital communication on the integration and semantic change of Arabic loanwords in German.

Endnotes

- ¹ **“Benzin,”** in Wolfgang Pfeifer et al., *Etymologisches Wörterbuch des Deutschen* (1993), digitized and revised version in *Digitales Wörterbuch der deutschen Sprache*, <https://www.dwds.de/wb/etymwb/Benzin> (accessed 25 November 2024).
- ² **“Sirup,”** in Wolfgang Pfeifer et al., *Etymologisches Wörterbuch des Deutschen* (1993), digitized and revised version in *Digitales Wörterbuch der deutschen Sprache*, <https://www.dwds.de/wb/etymwb/Sirup> (accessed 25 November 2024).
- ³ **“Borretsch,”** in Wolfgang Pfeifer et al., *Etymologisches Wörterbuch des Deutschen* (1993), digitized and revised version in *Digitales Wörterbuch der deutschen Sprache*, <https://www.dwds.de/wb/etymwb/Borretsch> (accessed 25 November 2024).
- ⁴ **“Harmel,”** in Nabil Osman (ed.), *Kleines Lexikon deutscher Wörter arabischer Herkunft*, 8th ed. (Munich: C. H. Beck, 2010), 59. (Original work published 1992).
- ⁵ **“Alchemie,”** in Wolfgang Pfeifer et al., *Etymologisches Wörterbuch des Deutschen* (1993), digitized and revised version in *Digitales Wörterbuch der deutschen Sprache*, <https://www.dwds.de/wb/etymwb/Alchemie> (accessed 25 November 2024).
- ⁶ **“Alkohol,”** in Wolfgang Pfeifer et al., *Etymologisches Wörterbuch des Deutschen* (1993), digitized and revised version in *Digitales Wörterbuch der deutschen Sprache*, <https://www.dwds.de/wb/etymwb/Alkohol> (accessed 25 November 2024).
- ⁷ **“Borax,”** in Wolfgang Pfeifer et al., *Etymologisches Wörterbuch des Deutschen* (1993), digitized and revised version in *Digitales Wörterbuch der deutschen Sprache*, <https://www.dwds.de/wb/etymwb/Borax> (accessed 25 November 2024).

- ⁸ “**Markasit**,” in Nabil Osman (ed.), *Kleines Lexikon deutscher Wörter arabischer Herkunft*, 8th ed. (Munich: C. H. Beck, 2010), 86. (Original work published 1992).
- ⁹ “**Naphtha**,” in Wolfgang Pfeifer et al., *Etymologisches Wörterbuch des Deutschen* (1993), digitized and revised version in *Digitales Wörterbuch der deutschen Sprache*,
<https://www.dwds.de/wb/etymwb/Naphtha> (accessed 25 November 2024).
- ¹⁰ “**Athanor**,” in Nabil Osman (ed.), *Kleines Lexikon deutscher Wörter arabischer Herkunft*, 8th ed. (Munich: C. H. Beck, 2010), 33. (Original work published 1992).
- ¹¹ “**Alembik**,” in Nabil Osman (ed.), *Kleines Lexikon deutscher Wörter arabischer Herkunft*, 8th ed. (Munich: C. H. Beck, 2010), 22. (Original work published 1992).
- ¹² “**Amalgam**,” in Wolfgang Pfeifer et al., *Etymologisches Wörterbuch des Deutschen* (1993), digitized and revised version in *Digitales Wörterbuch der deutschen Sprache*,
<https://www.dwds.de/wb/etymwb/Amalgam> (accessed 25 November 2024).
- ¹³ “**Algebra**,” in Wolfgang Pfeifer et al., *Etymologisches Wörterbuch des Deutschen* (1993), digitized and revised version in *Digitales Wörterbuch der deutschen Sprache*,
<https://www.dwds.de/wb/etymwb/Algebra> (accessed 25 November 2024).
- ¹⁴ “**Algorithmus**,” in Wolfgang Pfeifer et al., *Etymologisches Wörterbuch des Deutschen* (1993), digitized and revised version in *Digitales Wörterbuch der deutschen Sprache*,
<https://www.dwds.de/wb/etymwb/Algorithmus> (accessed 25 November 2024).
- ¹⁵ “**Aldebaran**,” in Nabil Osman (ed.), *Kleines Lexikon deutscher Wörter arabischer Herkunft*, 8th ed. (Munich: C. H. Beck, 2010), 22. (Original work published 1992).
- ¹⁶ “**Fomalhaut**,” in Nabil Osman (ed.), *Kleines Lexikon deutscher Wörter arabischer Herkunft*, 8th ed. (Munich: C. H. Beck, 2010), 52, 95. (Original work published 1992).
- ¹⁷ “**Algol**,” in Nabil Osman (ed.), *Kleines Lexikon deutscher Wörter arabischer Herkunft*, 8th ed. (Munich: C. H. Beck, 2010), 23. (Original work published 1992).
- ¹⁸ “**Zenit**,” in Wolfgang Pfeifer et al., *Etymologisches Wörterbuch des Deutschen* (1993), digitized and revised version in *Digitales Wörterbuch der deutschen Sprache*,
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Selsabil Ayache (PhD Candidate) – Corresponding Author
 Doha Institute for Graduate Studies, Doha, Qatar
 ORCID ID: 0009-0000-7151-9270
 Email: say001@dohainstitute.edu.qa

Mohamed Mohamed Yunis Ali (Associate Professor)
 Doha Institute for Graduate Studies, Doha, Qatar
 ORCID ID: 0009-0000-7130-2928
 Email: mohamed.ali@dohainstitute.edu.qa

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Appendix

Table 1. Loanwords in the domain of medicine/pharmacology

Loanword (Arabic Word)	Type of Semantic Change	Semantic Change
Alkanna Alhanna الحِنَّاء (al-ḥinnā')	Retention	Meaning retained
Amber عنبر ('anbar)	Narrowing and Amelioration	Medicinal and perfumery uses → primarily luxury and perfumery contexts; shift toward a more prestigious association
Behennufi البَّانُ (al-bān)	Narrowing	Broad multifunctional use → specialized perfumery use
Benzin لُبَّان جَلَوِي (lubān jāwī)	Broadening	Resin → broader industrial uses
Berberitze البَرْبَارِيس (Al-barbarīs)	Narrowing	General Medical uses → narrow culinary use.
Borretsch أَبُو عَرَق (abū 'araq)	Narrowing	General Medicinal uses → narrow culinary use.
Bezoar بازهر (bāzahr)	Broadening and Pejoration	Specific therapeutic antidote → broader pathological category (negative connotation)
Galgant هَالَنْجَان (halanjān)	Narrowing	Broad therapeutic applications → specialized medicinal use
Harmel حَرْمَل (harmal)	Retention	Meaning retained
Kampfer كَافُور (kāfūr)	Broadening	Medicine/incense → broader medical and industrial uses
Karve كَرَاوِيَا (karāwiyā)	Broadening	Specific Medicinal use → broader medicinal and culinary uses
Sennesbaum سَنَا (sanā)	Retention	Meaning retained
Sumach سُمَّاق (summāq)	Retention	Meaning retained
Sirup شَرَاب (sharāb)	Broadening	Medicinal drink → general syrup
Zitwer زَدَوَار (zadwār)	Narrowing	Broader medicinal, antidotal, and culinary meaning → narrower meaning excluding the antidotal function

Table 2. Loanwords in the domain of chemistry

Loanword (Arabic Word)	Type of Semantic Change	Semantic Change
Alchemie الكيمياء (Al-kīmiyā')	Broadening	Mystical/alchemical practice → broader scientific discipline
Alembik الإنبيق (al-inbīq)	Broadening and Metaphorical Shift	Distillation apparatus → broad technical and figurative use
Alkali القلوي (al-qāly)	Broadening	Specific potash substance → general class of basic compounds
Alkohol الكحل (al-kuhl)	Broadening	Specific cosmetic powder → broader chemical substance/alcohol
Amalgam عمل الجماعة ('amal al-jamā'a)	Metaphorical Shift	Concept of union → chemical mixture → figurative combination
Antimon الإثميد (itmid)	Broadening	Specific antimony compound → general chemical use
Athanor التتور (at-tannūr)	Narrowing	General oven/furnace → specialized alchemical furnace
Azur لازورد (lāzaward)	Broadening	Specific blue stone → general bright-blue colour
Borax بورق (būraq)	Broadening	Specific alchemical material/use → wider industrial applications
Elixir الإكسير (al-iksīr)	Broadening and metaphorical shift	Specific alchemical substance → broader restorative preparation → figurative sense of a powerful or beneficial remedy
Markasit المرقشيتا (marqāšīta)	Narrowing	Broad class of sulfide minerals → specific mineral (FeS ₂)
Natron النطرون (naṭrūn)	Broadening	Specific sodium carbonate → broader range of sodium compounds/uses
Soda سواد (suwwād)	Broadening	Soda-producing plant → chemical substance with wider industrial uses
Talk طلق (talq)	Narrowing	General mineral reference/use → specific cosmetic use

Table 3. Loanwords in the domain of mathematics

Loanword (Arabic Word)	Type of Semantic Change	Semantic Change
Algebra الجبر (al-jabr)	Broadening	Specific mathematical operation → entire mathematical discipline
Algorithmus الخوارزمي (al-Khwarizmi)	Narrowing	Mathematician's name → specific systematic computational procedure
Ziffer صفر (ṣifr)	Broadening	Specific numeral “zero” → any numerical digit

Table 4. Loanwords in the domain of astronomy

Loanword (Arabic Word)	Type of Semantic Change	Semantic Change
Aldebaran الدبران (ad-dabarān)	Narrowing	General meaning of “The follower” → one specific star in Taurus
Algol الغول (al-ghūl)	Metaphorical Shift and Amelioration	Mythological “ghoul” → astronomical star name through symbolic association; negative connotation → more prestigious scientific designation
Almagest المجسطي (al-majisṭī)	Retention	Meaning retained
Almukantarāt المقنطرات (al-muqantarāt)	Retention	Meaning retained
Deneb ذنب (dhanab)	Narrowing	General noun “tail” → specialized proper name of a specific star
Fomalhaut فم الحوت (fumm al-ḥūt)	Retention	Meaning retained
Nadir نظير (naẓīr as-samt)	Retention	Meaning retained
Zenit / Zenith سَمْت (samt)	Narrowing and Metaphorical Shift	General “direction/path” → astronomical zenith → figurative “peak”