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Are categories' cores more isomorphic than their peripheries?

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Isomorphism holds that, ideally, a single meaning is expressed by a single form. However, despite long-standing support, the theoretical viability of the isomorphic principle has been called into question. There is widespread recognition that the coexistence of (near-) synonymous expressions—variation—is actually very common in language. In this study, we explore a possible path toward reconciling the theoretical notion of isomorphism with the observable fact of variation. To this end, we adopt an analogy to tool use inspired by Zipf (1949). Tools largely monopolize their core functional domains (e.g., for cutting, knives are overwhelmingly preferred over screwdrivers) but compete over more peripheral functions (for puncturing, knives and screwdrivers have more equal chances of selection). In the same way, we hypothesize forms can code a prototypically organized network of senses, whereby they largely monopolize the core but are more likely to come into competition with other forms in the periphery. To test this hypothesis, a case study is conducted on variation in the use of two prepositions: *at* and *with*. For each, a semantic core and periphery are established. Using a corpus consisting of parallel translations of the same source text, it is then tested whether translators are more likely to converge on the same preposition to express one of that preposition's core senses than to express one of its peripheral senses. This is the pattern one would expect if isomorphic pressure is stronger for semantic cores than for peripheries. The results are promising but inconclusive. They confirm that the sense most prone to competition is arguably the most peripheral but also reveal a surprisingly high level of competition for the spatial core use of *at*.

KEYWORDS

variation, isomorphism, prepositional semantics, core, periphery

1 Introduction

Isomorphism—the idea that languages will tend to code a single meaning using a single form—is a long-established principle in linguistics, with roots in Saussurean structuralism and widespread adoption as a central working assumption in more recent theoretical work, where it takes the form of a 'no synonymy' rule (e.g., Bolinger, 1977; Clark, 1987; Langacker, 1987: 39; Wierzbicka, 1988; Goldberg, 1995: 3, Goldberg, 2006: 95; Nuyts and Byloo, 2015). From this point of view, variant expressions as in (1), where *at* and *with* are at least roughly interchangeable as markers of the object of anger, must be assumed to convey (subtly) different meanings.

(1) a. Do not be angry ***at*** me. (BNC).
b. You're not angry ***with*** me? (BNC).

However, this line of thinking is not without challenge. Variationist work, in particular, has shown languages to abound with expressions that are at least semantically similar enough to enter into competition (Sankoff and Thibault, 1981; Sankoff, 1988; Mair, 2003; Noël, 2003; Bresnan and Nikitina, 2009; Torres Cacoullos and Walker, 2009; Thornton, 2011, 2012; Tagliamonte, 2012; Lečić, 2016; Parker, 2022). In that light, the variation in (1) is just one example out of many where language naturally provides a range of roughly equivalent coding options. The observed abundance of variable contexts in language use inevitably casts some doubt on isomorphism. For example, Poplack (2018) dismisses the isomorphic principle, labeling it the "Doctrine of Form-Function Symmetry," which she argues is flatly contradicted by the data of actual usage. Even authors working within a broadly cognitive-functionalist framework have begun to question the concept of isomorphism (Van de Velde, 2014; De Smet et al., 2018) or have formulated less stringent versions of what 'no synonymy' really means (Laporte et al., 2021; Leclercq and Morin, 2023).

At first glance, the discussion could be set aside as one over descriptive granularity and focus. Arguably, proponents of isomorphism choose to explore the finer shades of meaning that distinguish variant expressions, whereas its detractors are more inclined to focus on the relation of communicative equivalence that allows one variant to be used instead of the other across lects and registers. However, a compromise along those lines remains an uneasy truce. The different positions carry more profound implications regarding the forces that shape language systems and, hence, our understanding of language change. Adoption of the isomorphic principle typically comes with a view of language change as (potentially) restorative. As Dik puts it:

> No one is perfectly happy. Yet 'human happiness' is an important explanatory principle for human behavior, because much behavior can be interpreted in terms of the pursuit of happiness. 'Happiness', seen in this way, is a guiding principle, a driving force of human behavior. In a similar way, no language is perfectly isomorphic. Nevertheless, isomorphism is an important explanatory principle, because many language changes can be interpreted in terms of the 'pursuit' of a state of isomorphism. In this respect, isomorphism could be thought of as one of the guiding principles or driving forces of language change. (Dik, 1988: 98–99, our translation).

Rejection of isomorphism, in contrast, leaves less room for internally motivated change driven by the organizational principles of language, and more room for accident, as it shifts the emphasis to external and less deterministic forces. After all, if variation is "socially situated and motivated," then it is "always potentially unstable" (Montgomery, 2007: 111). In sum, views on isomorphism reflect a fundamental opposition between basic guiding intuitions about the nature of form-meaning mapping in language and of language change.

In this study, we do not seek to elevate one of these views over the other. Rather, we aim to explore one possible path toward reconciliation.[1] To this end, we draw inspiration from the tool-use analogy developed by Zipf (1949). In his words:

> The forms and meanings of words represent merely a special case of tools that perform jobs (Zipf, 1949: 10).

According to Zipf, just as an artisan will shape and arrange her tools in such a way as to minimize the effort expended in their use, so a speaker will organize the expressions of language to communicate with maximal efficiency. Zipf draws on this analogy to explain why, for instance, frequent words tend to be shorter, or shorter words tend to be more polysemous (Zipf, 1949: 66). Drawing on the same analogy, we speculate here that in the efficient artisan's workshop, principles akin to variation and isomorphism may well both have their place. For a recurrent job, it pays to have a dedicated tool optimally adapted to its function, and once such a tool is available, it will tend to be the tool of choice for that particular job. This is the equivalent of isomorphism—a one-to-one mapping between form (tool) and meaning (job). In contrast, the more exceptional a job, the greater the chance the artisan will improvise and choose to repurpose a tool.[2] However, as repurposed tools are less optimally adapted to the task at hand, openness to alternative solutions becomes more sensible. Such openness eventually results in the equivalent of variation—a many-to-one mapping between form (tool) and meaning (job). For example, knives are dedicated tools for cutting food and, as a result, can largely monopolize that particular portion of functional space; knives can also be used for puncturing balloons but then are more likely to face competition with scissors, screwdrivers, needles, etc. Ultimately, these asymmetric tool-job mappings reflect an imbalance in the demand for either job: There is generally much more cutting to be done than puncturing.

The tool analogy is not perfect as tool-job relations lack the arbitrariness characteristic of form-meaning relations. Even so, we see good reason to suspect that at least some aspects of the analogy are matched by linguistic reality. The grammaticalization literature has promoted a view of language as constantly evolving to "code best what speakers do most" (Du Bois, 1985: 362–363). In other words, grammatical (but by extension, also lexical) forms can be thought of as primarily coding the portions of semantic space linked to speakers' most salient communicative needs.[3] Yet when it comes to the more neglected portions of semantic space, repurposing is the go-to solution. Such repurposing is the essence of semantic extension and is what allows forms to accumulate different yet related senses. Those senses are organized into networks emanating from a prototypical

1 Another such path has been explored by De Smet (2019) and Cai and De Smet (2024), who argue that the emergence of near-synonyms is sometimes functionally motivated simply by each variants' internal semantic development.

2 Zipf (1949: 22) recognizes these diverging pressures on the organization of form-meaning mappings, speaking of 'diversification' for the situation where a single tool is dedicated to a single job (isomorphism) and 'unification' for the situation where the same tool is used for multiple jobs (polysemy).

3 Just what determines the salience of a communicative need and thereby drives lexicalization and grammaticalization remains a tantalizing question. The likely answer includes frequency (which is the aspect we have highlighted above), but also perceptual biases (e.g., humans are hard-wired to attend to other humans, recognize objects as objects, keep track of their position in space, perceive time as passing, be aware of their own and others' emotions, be mostly unaware of the workings of organs like the liver, kidneys, gal bladder, etc.), as well as cultural biases (e.g., the need to recognize sins and differentiate between them will be driven by a particular religious world view), and linguistic constraints (e.g., a language is only likely to have a dual if it also has a plural).

core (Brugman, 1981; Lakoff, 1987; Geeraerts, 1997; Tyler and Evans, 2003). Those cores have been characterized as "more stable" than peripheries (Geeraerts, 1997: 23), such that, in line with our analogy, the prototypical organization meets "the joint requirements of structural stability and flexible adaptability" (Geeraerts, 1997: 113). Consequently, if there is such a thing as isomorphic pressure at work over linguistic structure, the place to find it must be in the core meanings coded by formal categories. Conversely, it is in semantic peripheries of forms that variation has the best chance of creeping in.

The remainder of this study is meant to test this idea. To do so, we exploit parallel translations of a single source text to establish the prevalence of variation in the expressions of core and peripheral meanings. Parallel translations have been used previously in typological and cross-linguistic work (Altenberg and Aijmer, 2002; Cysouw and Wälchli, 2007; Aijmer and Lewis, 2017; Aijmer, 2020) to describe form-meaning relations while keeping meaning approximately constant. Here, this strategy is adapted to the study of variation within a single language. In this way, we will test our hypothesis against the use of Present-day English prepositions, which are renowned for their complex semantic networks. Below, Section 2 documents the data and methods. Section 3 offers semantic analyses of two prepositions, *at* and *with*, to establish their core and peripheral senses. Section 4 discusses the findings from the translation corpus. The results are summarized in Section 5.

2 Data

Our quantitative analysis draws on data from a parallel translation corpus, compiled by the second author, consisting of the original Spanish texts of Miguel de Cervantes' *Don Quijote* and eight English translations. Cervantes' *Don Quijote* was published in two parts, with the first part released in 1605 and the second in 1615. The translations in the *Don Quijote Corpus* (DQC) range from 1612 to 2003 and cover the Modern and Present-day periods of the history of English. For current purposes, use is made only of the four most recent translations in the corpus, which appeared in 1949 (by Samuel Putnam), 1950 (by J.M. Cohen), 1999 (by John Rutherford), and 2003 (by Edith Grossman). The translations average approximately 412,000 words each. In what follows, we regard them as contemporary and representative of Present-day English.

The great advantage of having parallel translations of the same source text is that we get a sense of where language users converge on the same linguistic choices and where they diverge. Perfect convergence across translations suggests that the target language strongly favors a single resource to convey a given meaning expressed in the source text. The divergence between the translations, in contrast, reveals that a given meaning from the source text can be conveyed by a range of alternative strategies. For example, in (2) all translators converge on the same preposition *at*, suggesting that in this particular context, it is the only available option or at least stands out as an obvious choice. In (3), *at* alternates with *with* and the complex preposition *because of*, indicating that in this case the English translators had several options to choose from, and that *at* is in competition with other prepositions.

(2) *Yo, señores, por mis pecados, he estudiado Cánones en Salamanca* (1605–15, DQC).
I, gentlemen, for my sins, have studied canon law ***at*** Salamanca (1949, DQC).
I, sirs, for my sins have studied canon law ***at*** Salamanca (1950, DQC).
I, sirs, for my sins, studied canon law ***at*** Salamanca (1999, DQC).
I, Senores, for my sins, have studied canon law ***at*** Salamanca (2003, DQC).

(3) *quedé confusa y pensativa, y casi fuera de mí con el nuevo acaecimiento* (1605–15, DQC).
I was pensive and bewildered, almost beside myself ***with*** what had just happened (1949, DQC).
I was troubled and anxious, and almost beside myself ***at*** this strange event (1950, DQC).
I was confused and pensive and almost beside myself ***at*** what had just happened (1999, DQC).
I was confused and pensive and almost beside myself ***because of*** this new turn of events (2003, DQC).

In this way, we can hope to pinpoint which senses of *at* and *with* are subject to formal variation and which are monopolized by just a single form.

Needless to say, the method is not perfect. Translation effects may interfere with the results as translated texts are known to be biased toward target language structures that resemble the source language (e.g., Cappelle and Loock, 2013). It has further been found that translations are often more normative than non-translated texts (e.g., Delaere et al., 2013). Moreover, the translations in our data come from only four translators, who are each uniquely situated in lectal space, not to mention the personal idiosyncrasies they inevitably bring in as well. Because of its nature and size, then, the data from the DQC are not suitable to investigate the lectal and diatypic factors that are undoubtedly relevant to variation. To complicate matters still, it is clear that the translations may not be fully independent of one another (e.g., several translators indicate that they undertook their translation out of dissatisfaction with previous translators' works but also that they relied on previous translations to solve difficult translation problems). All those issues notwithstanding, the use of corpus data here supports easy replicability and shows us usage in a natural setting, giving us a unique window on naturally occurring variation.

Notice that translations sometimes diverge in intricate ways, making it difficult to pinpoint any exact equivalence between the translators' choices. In (4), for instance, the Spanish adverbial *a este instante* is closely translated by *at that instant* in the 1949 translation and *at that moment* in the 2003 translation, but the 1950 and 1999 translations have no time adverbial. Instead, they select the more colorful lexical verbs *broke in* and *exclaimed* (as opposed to the very neutral *dijo* 'said' in the original) to convey the abruptness and agitation that is implied by the adverbial and marked word order in the Spanish source text. Divergence here is not between *at* and some other preposition, but at a level higher up in the translators' decision tree. This, too, of course, is variation, but because the variation is dependent on other choices, it may be of more passing relevance to the use of English *at*.

(4) *-No ha de ser así- dijo a este instante don Quijote* (1605–15, DQC).
At that instant Don Quixote spoke up. "No," he said, "that is not the way it is to be." (1949, DQC).

TABLE 1 Structure of the data set of *at* and *with*.

	1949	1950	1999	2003	Total without parallel texts	Total with parallel texts
At	49	67	42	42	200	800
With	68	41	42	49	200	800

> 'That is not the way,' broke in Don Quixote. (1950, DQC).
> 'No, that is not the way' Don Quixote exclaimed. (1999, DQC).
> "It should not be this way," said Don Quixote ***at*** that moment (2003, DQC).

In light of this, we have to distinguish three types of relationships between translations: (i) formal equivalence, (ii) syntactic equivalence, and (iii) pragmatic equivalence. For our purposes, formal equivalence means that another translator chooses the same preposition with the same meaning and so resorts to exactly the same form, as is the case in all of the parallel renderings in (2). Syntactic equivalence means that another translator selects a prepositional phrase with roughly the same meaning but uses a distinct preposition, as is seen twice in (3), when *at* corresponds to *with* (1949) and *because of* (2003). In that case, the translators vary between syntactically equivalent formal alternatives. Pragmatic equivalence is when translators opt for more radically different solutions to convey the same message, as seen twice in (4).

To collect our data, the DQC was first queried to collect a 5% sample of all occurrences of *at* and *with* in the four selected translations. Some contexts were removed prior to semantic annotation because they represented semantically/syntactically non-compositional phrases. These included the negative polarity item *at all*, the complex preposition *with regard to*, and a variety of other fixed phrases such as *at first*, *at least,* and some prepositional verbal idioms such as *go on with* or *have (nothing) to do with*. It is difficult to formulate precise criteria for non-compositionality. The expressions we excluded, however, were listed as fixed combinations in the *Oxford English Dictionary* and, in addition, either do not introduce a noun phrase (e.g., *at first*) or are semantically too opaque to convincingly classify into one of our semantic categories (e.g., *go on with*). In case of attestations that happened to parallel each other (e.g., two instances of *at* in different translations but translating the same source passage), only one was retained. Following this round of clean-up, a total of 200 randomly selected attestations of each preposition were retained for semantic analysis. Their distribution over the four translations is shown in Table 1. Then, each attestation was aligned to its three parallel renderings in the other three translations, resulting in a data set of 200 attested 'target' instances per preposition, each of which is accompanied by three parallel renditions of the same passage. The final data set for analysis consists of 1,600 observations in total. It is the parallel renditions that inform the quantitative analyses below, as we analyzed how many of them converge on or diverge from the initially retrieved target instance.

3 The semantics of *at* and *with*

Prepositions, with their notoriously complex polysemies, have been a favorite testing ground for radial network analyses (e.g., Brugman, 1981; Lakoff, 1987; Cuyckens, 1991; Tyler and Evans, 2003, to name just a few). Some problems notwithstanding (e.g., Sandra and Rice, 1996; Gilquin & McMichael, 2018), these analyses have shown that prepositional semantics can be insightfully described in radial network terms, revealing the motivational relations that hold between senses and their overall organization into a semantic core and periphery.[4] The following offers our own radial network analyses for *at* and *with*, which we will use as a basis to classify our corpus data. We must emphasize that, contrary to most of the preceding literature on this topic, our purpose is not to provide a fine-grained classification or perfectly panoramic picture of the historical extensions of the two prepositions in question. Instead, our analysis is merely meant to offer a workable framework to annotate our own corpus data. To this end, it must distinguish between broadly defined core and peripheral senses and cover the main senses observed in our DQC data. To establish plausible connections between senses, the analyses are additionally informed by the sense distinctions, examples, and diachronic information in the relevant *Oxford English Dictionary* (OED) entries. In line with the above literature, we assume that prepositions have relational meaning, situating one entity (the Trajector, or T) with respect to another (the Landmark, or L) (Langacker, 1987).

Figure 1 presents our proposed semantic network for *at*.[5] The primary and core meaning of *at* is its spatial use. It involves a prototypical association between T and L, which consists of a place or position that can be conceptualized as a topographical point, describing 'position in space' (A), as in (5a). When the spatial relation between T and L is metaphorically extended to the temporal domain, *at* is used to express a 'position in time' (A1), as

4 As one reviewer rightly points out, ideas from the prototype literature, which typically focuses on the organization of conceptual categories (e.g., BIRDS), may not translate directly to the organization of polysemy networks, where each individual sense could be taken to correspond to a conceptual category in its own right. For example, when *feather* means 'bird', as in *Your Setting-Dog must … love naturally to hunt Feathers* (OED s.v. *feather* n., I.4), the sense 'bird' presumably corresponds to the conceptual category BIRD but is at the same time a very peripheral metonymic extension in the radial network of a *feather*. Our choice to treat radial networks as prototypically organized is, however, by no means unique to the present study, as the literature on radial networks clearly drew inspiration from the work on prototypical organization. It is further worth pointing out that sense individuation must be recognized as an analytical idealization (Geeraerts, 2015) so that the line between polysemy and the prototypical organization of a conceptual category is blurry at best. Finally, recursive application of the same structuring principles in cognition is commonly assumed elsewhere (see, e.g., Ellis, 2017 on chunking or De Smet forthc. on analogy).

5 Though less detailed, the network is essentially in line with the analyses proposed by Cuyckens (1985: 55), Tyler and Evans (2003: 178), and Brenda (2015: 28). It adds some detail to the network we earlier used in Cai and De Smet (2024).

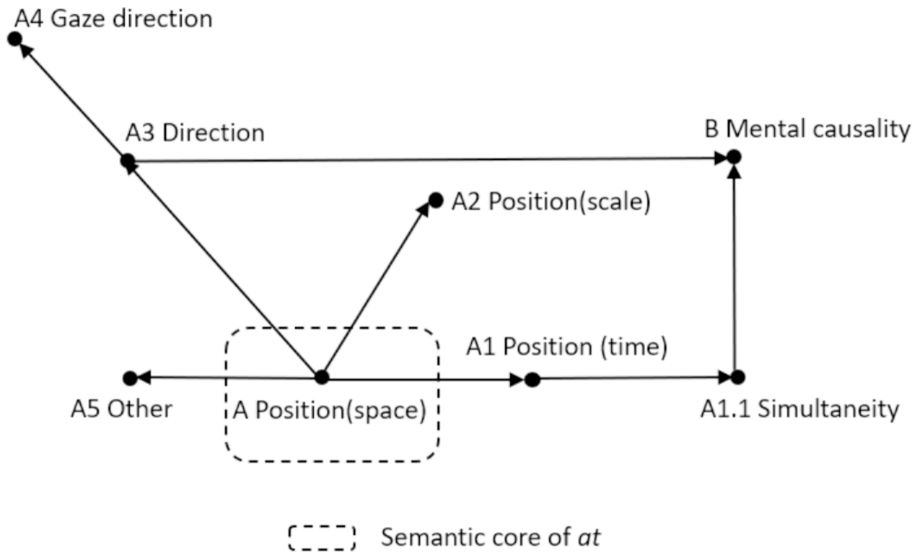

FIGURE 1
Semantic network of *at*.

illustrated in (5b). The 'position in time' sense subsumes 'simultaneity' relations (A1.1), as in (5c). The 'position in scale' sense (A2) of *at* arises through another metaphorical link, when the core spatial sense is extended to the scale domain. *At* then locates T as a point on a scale or gradient, as in (5d). Where motion is involved, *at* can express direction toward L (A3), as in (5e), a likely metonymic derivation from the core 'position in space' sense. As a metaphorical counterpart to directed action, *at* can mark the direction of gaze (A4), as in (5f). Finally, *at* may mark the cause of emotion (B), as in (5 g). This last sense can be plausibly derived from either the simultaneity sense or the 'direction of action' sense.[6]

(5) a. if truth be told, what I eat, even if it's bread and onion, tastes much better to me in my corner without fancy or respectful manners, than a turkey would ***at*** other tables where I have to chew slowly, not drink too much, wipe my mouth a lot (2003, DQC)
b. if I had had, ***at*** the right time, those twenty ducats your Grace is now offering me, I'd have greased the notary's quill and freshened up the attorney's wit with them (1949, DQC).
c. They took it off quickly, and the lackey's face was plainly revealed, ***at*** which sight Dofta Rodriguez and her daughter cried out aloud. (1950, DQC).
d. who charged toward his enemy the instant he heard it, ***at*** the fastest speed that Rocinante could manage. (1999, DQC).
e. [that] a storm of stones was raining down on him, and that he was threatened by a thousand crossbows pointing ***at*** him, and by no fewer muskets. (1999, DQC).
f. The Knight of the Wood, upon hearing the Knight of the Mournful Countenance speak in this manner, could only stare ***at*** him long and hard, surveying him from head to foot (1949, DQC).
g. I am amazed, Sancho, ***at*** the insensibility of your nature. I believe you are made of marble or brass, and have no emotion or feeling in you. (1950, DQC).

Figure 2 presents the semantic network for *with*. The historically primary sense of *with* concerns a spatially opposite position (A), locating T against or opposite L. By figurative extension, T and L can be in a relation of conflict, rivalry, or antagonism. In fact, in our data set, these figurative uses are the only traces of the historically oldest meanings of *with*, as in (6a). A 'proximity' sense (A1) portrays spatial adjacency between T and L, as in (6b), and is plausibly derived from the historical 'opposition' sense.

(6) a. The Gentleman in the Green Coat would have liked to stop him, but he was not as well-armed, and he did not think it prudent to fight ***with*** a madman (2003, DQC)
b. The fault therefore lies not ***with*** the public that asks for silly pieces, but with those who do not know how to put on anything else. (1949, DQC).

Via metaphorical transfer, the 'proximity' sense of *with* gives rise to the 'comitative' meaning (A2) as a T and L in physical proximity can be perceived as a companion to each other and are likely to be in close association. For instance, in (7a), *she went off with her father* illustrates a 'companion schema' where the accompaniment relationship of two humans is coded through the use of *with*. In contrast, *with* in (7b) expresses comitative meaning,

6 Senses of *at* under 'other' (A5) are only marginally attested in our data, including a position in the field (e.g., *skill at fencing*), circumstance (e.g., *at the cost of a good whipping*), abstract position (e.g., *stretch myself at ease*), etc. Because these senses are too infrequent in our data, they are not elaborated on in this study.

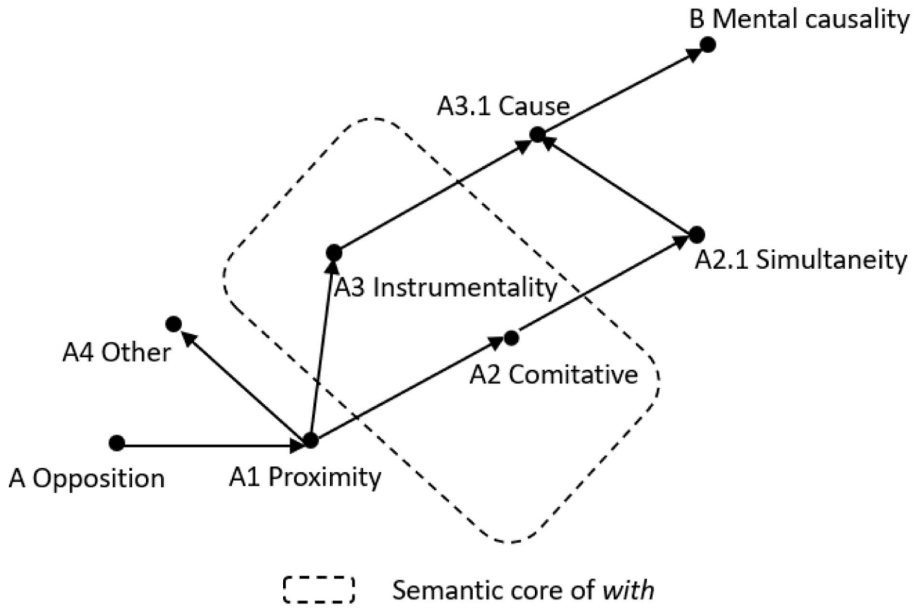

FIGURE 2
Semantic network of *with*.

presenting a 'part-whole' schema where *its four turrets and its pinnacles* play the role as appurtenances or figurative companions of the *castle*. Another non-spatial sense that invokes a metaphorization of 'proximity' is the 'instrumentality' sense (A3) in which entities in spatial proximity are conceptualized as accompaniments associated with specific functions. This sense indicates the instrument, means, or manner of an action. For example, in (7c) *with my sword* specifies the concrete instrument by which an action—*make him acknowledge this*—is accomplished. Similarly, *with so much violence* in (7d) depicts the manner of the attack.[7]

(7) a. With this I said goodbye to them both, and she went off ***with*** her father looking as if her soul was being tom out of her. (1999, DQC)
b. When he caught sight of the inn, it at once became a castle ***with*** its four turrets and its pinnacles of gleaming silver. (1949, DQC).
c. I swear by my gospel-oath that I will make him acknowledge this ***with*** my sword, at length and *in extenso*. (1999, DQC).
d. He jumped up from the ground where he had been lying and attacked the man closest to him, ***with*** so much violence and so much anger. (2003, DQC).

Like *at*, *with* also has the 'simultaneity' sense (A2.1), which marks the coexistence of two events. We take it to be derived from the 'comitative' sense when the companion schema is applied to the non-human domain (Radden, 1998: 279), emphasizing the proximity of actions in time. As an example, *with these words he left the printing-house* in (8) delineates two events happening in approximate simultaneity or immediate sequentiality.

(8) ***With*** these words he left the printing-house, with some signs of annoyance. (1950, DQC)

Both the simultaneity and instrumentality senses can give rise to the 'cause' sense of *with* (A3.1), marking T as the source that engenders change in L. For instance, in (9a), *with* is used to relate a physiological reaction expressed by *jumping* and its cause presented by *joy*. In its 'mental causality' sense (B), *with* marks the source of an emotion or a mental state, as in (9b). It is assumed that this sense of *with* may arise by metaphorical mapping from the 'cause' sense when it is extended to mark the cause of psychological reactions.

(9) a. The canon and the priest were laughing fit to burst, the peace-officers were jumping ***with*** joy. (1999, DQC)
b. Don Quixote, meanwhile, was not wholly satisfied ***with*** the performance that had just been given. (1949, DQC).

Although the relevance of prototypical organization to semantic categories has been firmly established, no fixed set of criteria exists to easily distinguish core senses from peripheral senses (Gilquin and McMichael, 2018). In the case of *at*, we propose that its semantic core is comprised of a single sense, the 'position in space' sense, with other senses in the semantic network constituting the periphery. The 'position in space' sense is one of the historically earliest attested according to the OED; it generates other extensions, as seen in Figure 1; and it is highly frequent as well as diachronically

7 The sense group labeled as 'other' (A4) covers senses of *with* in relatively marginal use, such as familiarity (e.g., *not familiar with the rules*), consistency (e.g., *not agreeing with me*), skill (e.g., *skill with the sword*), etc. They rarely occur in our data set and will not be elaborated on in our study.

stable (Cai and De Smet, 2024). For *with*, we assume that the 'instrumentality' sense and the 'comitative' sense constitute its semantic core. This reflects the fact that the original spatial senses of *with* have largely been lost, as documented in the OED and as apparent from our own data. In our data, the instrumental and comitative uses make up more than three-quarters of all attestations (161 of 200 instances in our data set)—as such, the frequency difference between core and periphery is much more pronounced for *with* than for *at*. The core senses of *with* are the likely sources for diverse semantic extensions, as seen in Figure 2, further supporting their core status.

4 Results

Using the parallel translation data and our semantic classification of senses, we can now assess whether there is a relation between the meaning a form expresses and the degree to which it is subject to competition with other forms. The expectation is that a form that is used to express its core sense is subject to lower levels of competition, while higher levels of competition are expected where a form expresses a peripheral sense. We focus here primarily on competition with alternative prepositions, including preposition-like expressions that are known grammaticalization sources of prepositions (e.g., complex prepositions like *because of* or participles like *using*). For each of the major senses of *at* and *with*, Figures 3, 4 show the share of parallel renderings with formal equivalence (i.e., another selection of *at* or *with*, respectively) as opposed to syntactic equivalence (i.e., selection of a different preposition). Renderings with pragmatic equivalence are not included in the figures. Before proceeding, let us stress that even in parallel translations of the same source passage, the use of different prepositions need not mean that those prepositions express exactly the same meaning. We merely assume here that occurrence in syntactically equivalent contexts implies that prepositions are semantically similar enough to generate competition.

As Figures 3, 4 show, the sense most prone to variation is the 'mental causality' sense in *at*. Going by our own analysis as well as that by Brenda (2015), this sense is decidedly peripheral, as it is itself derived from non-core senses, does not give rise to any further semantic extensions, and is relatively infrequent (at 15% of instances of *at* in our sample). The share of formal equivalence in the 'mental causality' sense of *at* differs from that in the 'position (space)' use at statistical near-significance ($p = 0.051$, $chi^2 = 3.79$). As one of the main competitors of *at* in its 'mental causality' sense is *with* (compare example (3)), it is not entirely surprising that 'mental causality' also shows the lowest incidence of formal equivalence for *with*, yet due to the smaller number of attestations, the difference to the instrumental and comitative core senses of *with* is not even close to significant ($p = 0.41$, $chi^2 = 0.61$). Though short of the significance threshold, the data in this respect fall in line with the hypothesis.

In other respects, the picture is more complicated than expected. Other senses that we had classed as peripheral enjoy low levels of competition. Most strikingly, the share of formal equivalence in the peripheral 'gaze direction' sense of *at* is significantly higher than in the spatial core sense of *at* ($p = 0.03$, $chi^2 = 4.82$) so that it appears that *at* largely monopolizes this particular function. Along the same line, and again counter to expectation, the share of formal equivalence in the spatial core sense of *at* appears to be relatively low—significantly lower, in fact, than the share of formal equivalence in the instrumental and comitative core senses of *with* ($p = 0.02$, $chi^2 = 5.25$).

While it is possible that these findings partly stem from operational choices in our research design, they also point to some potentially relevant (albeit *post-hoc*) insights. First, it stands to reason that vulnerability to competition does not have to lead to actual competition. As such, it is to be expected that some corners of semantic space can be monopolized by a single preposition despite the fact that they are peripheral to the preposition's semantic structure, as perhaps seen in the 'gaze direction' sense of *at*. The tool analogy supports this possibility. For instance, olive oil can be used to condition hair, and in some areas of the world could monopolize this functional niche for a long time, even though haircare would have never constituted its core job.

Second, the relatively low rate of formal equivalence for the spatial core sense of *at* may be less surprising than appears at first sight. It is interesting to note that, for this particular sense, the high rate of syntactic equivalence is entirely offset by a low rate of pragmatic equivalence, compared both to the non-core senses of *at* and to the core senses of *with*. The rate of pragmatic equivalence (in relation to formal equivalence) is only 28% for 'position (space)'. 'Direction (gaze)' and 'direction (action)' have slightly higher rates, at 30 and 34%, respectively. For 'position (time)' and 'mental causality', pragmatic equivalence is far more prevalent in our data, at 52 and 50%, respectively. For the core senses of *with*, the rate is as high as 46% for 'comitative' and 38% for 'instrument'.

The relevance of pragmatic equivalence to competition and isomorphism in *at* and *with* is hard to assess, because instances of pragmatic equivalence typically involve divergence in more ways than one, and the alternative coding options involved differ considerably across senses. All the same, the finding is consistent with the idea that marking spatial relations is the core job of English prepositions in general. Consider the relatively high rates of pragmatic equivalence for 'comitative' and 'instrumentality' in *with*. The high rates betray that these functions lie somewhat outside the usual functional range of English prepositions. In many cases, the alternative renderings recode the *with*-marked phrase as a verb argument, as shown in (11) (where *with* marks an instrument) and (12) (where it is used as a comitative).

(11) *Llegaba adonde solía tener la puerta, y tentábala con las manos* (1605–15, DQC).
Going up to where the door had been, he ***ran*** his hands over the wall (1949, DQC).
Finally he went to the place where the door used to be, and felt for it ***with*** his hands (1950, DQC).
He kept going up to the place where the door used to be, and feeling for it ***with*** his hands (1999, DQC).
He went up to the place where the door had been, and he felt it ***with*** his hands (2003, DQC).

(12) *se ofreció a tenerme compañía, como él dijo, hasta el cabo del mundo.* (1605–15, DQC).
offered to ***accompany*** me—to the end of the world as he assured me. (1949, DQC).

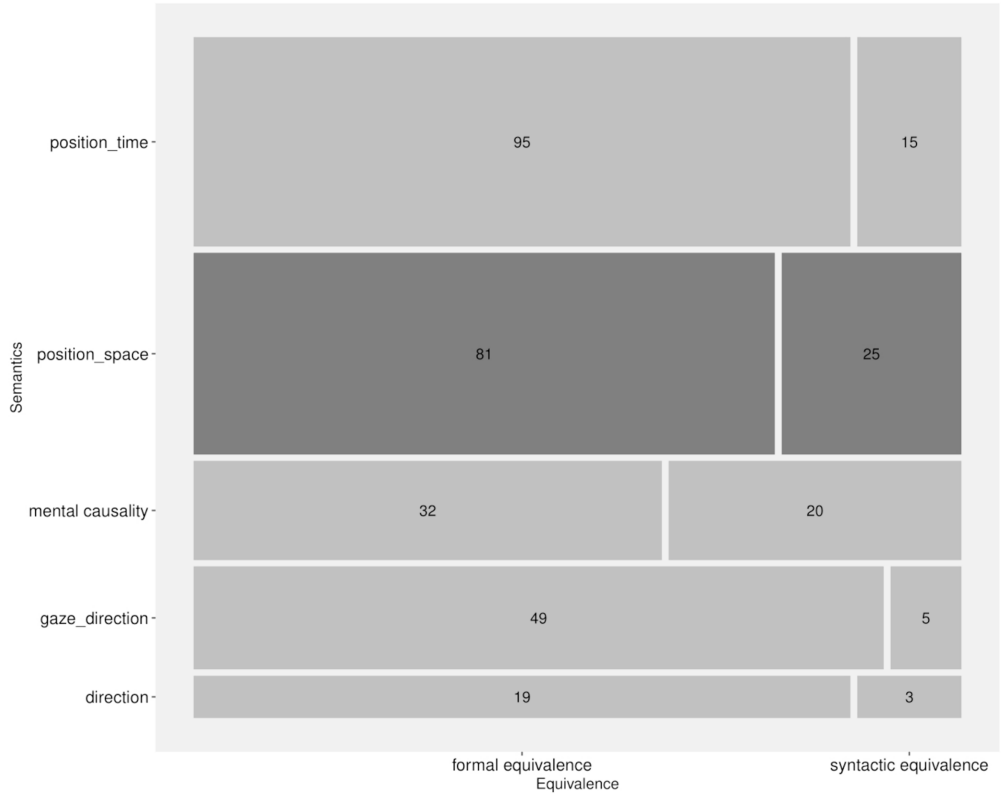

FIGURE 3
Distribution of formal and syntactic equivalence in senses of *at*.

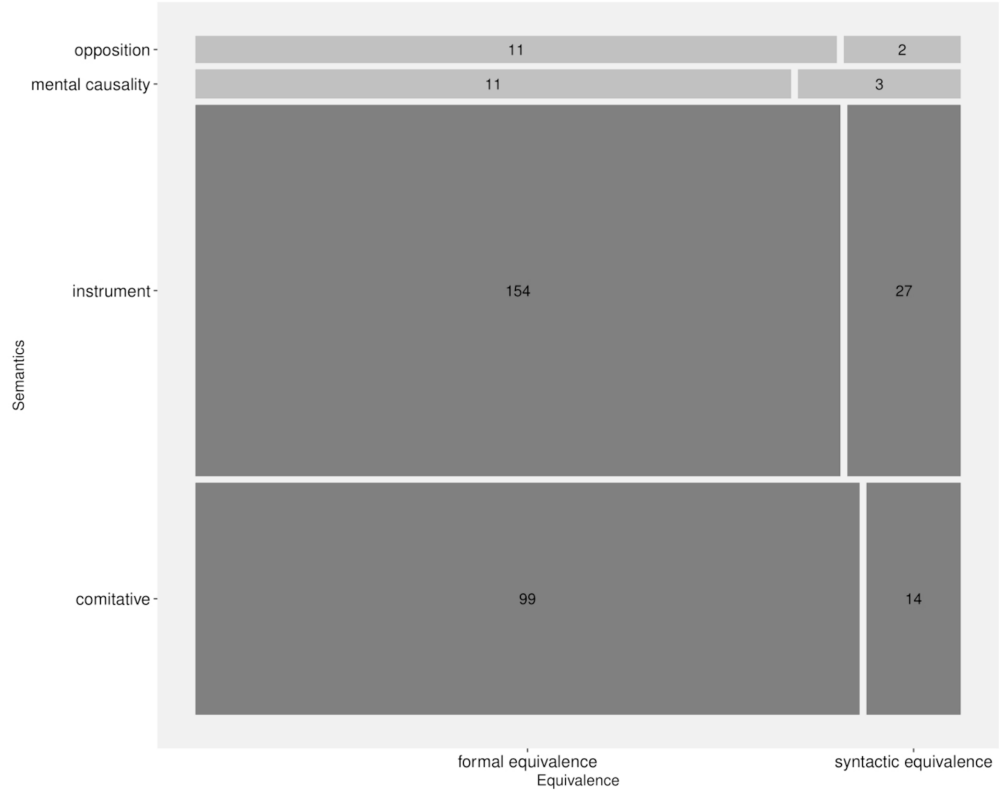

FIGURE 4
Distribution of formal and syntactic equivalence in senses of *with*.

he offered to ***accompany*** me, as he said, to the end of the world. (1950, DQC).
he offered to go ***with*** me to the end of the world, as he put it. (1999, DQC).
and offered to ***keep*** me ***company***, as he called it, to the ends of the earth. (2003, DQC).

Conversely, with regard to 'space (position)' in *at*, the combination of low pragmatic equivalence with relatively high syntactic equivalence may be interpreted as evidence that prepositions have specialized to mark finer shades of meaning in the domain of spatial relations than they do elsewhere. The result is that even slight modifications in how T and L are construed can motivate the selection of different prepositions in our data. Example (13) illustrates this: in Present-day English, *crossroads* reliably patterns with *at* (and *on* as a distant second), which is what we see in the 1950 translation. However, the parallel renderings nevertheless have *in* and *along* due to minor changes to the spatial construal of L. No such level of finesse is seen in non-spatial uses—the prepositional object of *gaze*, for instance, can be pretty much any nominal referent without necessitating a change of preposition. These fine-grained construal effects also work in the opposite direction. In (14), it is the choice of preposition that determines the construal of L; *at*, *in,* and *on* specify a locational relation, but only *at* additionally construes *market-places* as socially institutionalized venues. In terms of the tool analogy, jobs that are in higher demand will see higher levels of specialization in the dedicated tools. For example, although knives are for cutting, the more cutting someone does (think of a cook or craftsperson), the more different kinds of knives they will tend to use. In sum, it cannot be assumed that semantic granularity is constant across semantic domains.

(13) *de algunos días a esta parte, he considerado cuán poco se gana y granjea de andar buscando estas aventuras que vuestra merced busca por estos desiertos y encrucijadas de caminos* (1605–15, DQC)
for some days now I have been thinking how little gain or profit there is in your Grace's going in search of adventures ***in*** these wasteland and crossroad places (1949, DQC).
for several days lately I've been thinking how little profit is gained from wandering after the adventures which your worship seeks in these wastes and ***at*** these crossroads (1950, DQC).
for some time now I've been thinking about how precious little there is to be got out of going around like this looking for these adventures of yours in these wastes and ***along*** these remote roads (1999, DQC).
for the past few days I've been thinking how little gain or profit there is in looking for the adventures that your grace looks for ***in*** these deserted places and crossroads (2003, DQC).

(14) *porque lo que no se hace ni concierta en las plazas, ni en los templos, ni en las fiestas públicas, ni estaciones […], se concierta y facilita en casa de la amiga o la parienta de quien más satisfación se tiene.* (1605–15, DQC).
for while it may be difficult to arrange a clandestine meeting ***in*** the market place, in church, at public festivals, or in connection with private visits to religious shrines […], these things are readily managed in the house of a trusted female friend or relative. (1949, DQC).
For what is not done or arranged ***in*** market-places and churches, or at public shows or church-goings […] is often managed and facilitated at the house of that very woman friend or relative in whom he has most confidence. (1950, DQC).
because that which is not arranged and indeed put into effect ***at*** market-places, churches, public festivities and devotions […], is arranged and put into effect in the houses of the wife's most trusted friends and relatives. (1999, DQC).
because those things not done or arranged ***on*** open squares, or in temples, or at public festivals, or on devotional visits to churches […] can be arranged and expedited in the house of her most trusted friend or kinswoman. (2003, DQC).

5 Conclusion

Variation and isomorphism still stand in a poorly understood relation. As concepts, both are prominent in current thinking on language and language change; both have strong theoretical underpinnings; and both are supported by empirical evidence. However, they also seem contradictory. If variation is the norm, then isomorphism is not, and vice versa. In this study, we have attempted to resolve the conflict by hypothesizing that variation and isomorphism may stand in a functional relationship and, therefore, predominantly apply to different areas of form-meaning mapping. Forms have core functions but—through semantic extension—may be repurposed to also fulfill additional peripheral functions. We hypothesized that variation can arise when several forms are repurposed for the same function, even as isomorphism holds sway over the core functions of same forms.

The hypothesis was tested against the English prepositions *at* and *with*, and their use in a corpus of parallel translations, exploiting divergence between translations as a proxy for variation, and convergence for isomorphism. The results confirm that levels of variation differ across senses. In line with expectations, variation in our data is most strongly associated with one of the most peripheral senses of *at*. The picture is complicated, however, by the fact that other peripheral senses in *at* and *with* appear to escape variation and that the spatial core sense of *at* is relatively prone to variation. The latter finding may be explained by higher levels of fine-grained semantic specialization, in particular domains of meaning for particular classes of items—such as the marking of spatial relations by prepositions. In conclusion, the hypothesis developed here is not irrevocably contradicted by the data and is even partly confirmed, yet without question also needs further refining and much more extensive testing.

Data availability statement

The data analyzed in this study is subject to the following licenses/restrictions: The data set consists of translations of Don Quijote that are still under copyright. Requests to access these datasets should be directed to hendrik.desmet@kuleuven.be.

Author contributions

YC: Formal analysis, Visualization, Writing – original draft. HDS: Conceptualization, Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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