
| RESEARCH ARTICLE

The Semantics of Stative Locative Events in Vietnamese: A Spatial Exploration

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| ABSTRACT

This study investigates stative locative event semantics in Vietnamese using mathematical formalism, categorizing events as bijective or surjective based on Figure-Ground argument mapping. Building on Figure/Ground semantics (Talmy, 1975), event structure (Jackendoff, 1990), and predicate syntax (Nam, 1995), bjectives denote one-to-one argument mappings while surjectives permit one argument to map to multiple others. Through analysis of Vietnamese sentences, the study shows bjectives unambiguously localize Figures and Grounds in a one-to-one manner, contrasting with the flexibility of surjectives allowing single Figures to map onto multiple Grounds. This novel bijective/surjective distinction advances understanding of locative event typologies and provides an explanatory model for cross-linguistic analysis. Scrutinizing Figure-Ground mapping as bijective/surjective functions elucidates fundamental differences in stative locative semantics, furthering comprehension of how language encodes static spatial relations through the complex interplay of verbal semantics and argument structure. This integrated formal semantic approach combining predicate logic, set theory and lexical syntax has significant applications in theoretical and computational linguistics, and cognitive science.

| KEYWORDS

Stative locatives, bijective events, surjective events, figure and ground, formal semantics

| ARTICLE INFORMATION

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1. Introduction

In the domain of linguistic inquiry, the investigation of stative locative events assumes a pivotal role in elucidating the intricate interplay between language, cognition, and spatial representation. This line of study is principally concerned with scrutinizing the semantics inherent in the specific combinations of stative locative prepositions (hereinafter referred to as SLPs) and verbs (abbreviated as Vs), drawing from a body of literature that includes works by Keenan and Faltz (1985), Crow (1989), Nam (1995), Kracht (2004), and Gehrke (2008). As an initial step in examining **stative locatives**, Keenan and Faltz (1989: 33) expound that stative locatives can be understood as isomorphic to the set of intersective functions that relate properties to properties. Concurrently endorsing Keenan and Faltz's assertion, Crow (1989:163) provides an informal definition of stative locatives, characterizing them as locative expressions that define a property jointly satisfied by individuals (which could encompass objects, events, or states) simultaneously conforming to both a predicate and a locative modifier. To elucidate, consider the example of the statement *is sleeping in a tree*, which applies to individuals who are both in a state of slumber and situated within a tree's vicinity.

In the context of stative locative events, it is imperative to gain a comprehensive understanding of the foundational constituents of events themselves. The term **event** assumes diverse roles within the existing literature. In event semantics, verbal predicates are construed as denoting sets of events, a perspective that aligns with Davidson's postulations in 1967. Within this framework,

the argument structure of a verbal predicate encompasses not only nominal arguments but also an event argument. Furthermore, the concept of an event is invoked in the event-state dichotomy, as expounded by Jackendoff (1983), wherein events are generally characterized as situations involving dynamism or temporal processes. This perspective further nuances the concept of events into two distinct categories: unbounded, atelic processes and bounded, telic events, as established by scholars like Back (1981), Verkuyl (1972, 1993), and Talmy (2000). Building upon Talmy's (2000) formulation, an event is conceived as a delimited portion of reality, circumscribed by the human mind's cognitive faculties. According to this conception, human perception or conception is capable of delineating boundaries around segments of a continuum, be it in the domains of space or time. This demarcation results in the ascription of a unified entity status to the contents encapsulated within this defined boundary (Talmy, 2000b: 215).

From the vantage point of the properties associated with stative locatives and events, a stative locative event can be defined as a linguistic expression that delineates a static state or condition of being situated within a particular spatial locus. Such linguistic events underscore a lack of dynamic action or alteration in position, placing a predominant emphasis on the unchanging nature of the described state. For instance, expressions like *đang ngồi ở trên ghế* (is sitting on the chair) or *đang đứng bên cạnh cửa* (is standing by the door) typify static locative events, conveying a state of being fixed in a specific spatial location without any indication of motion or positional change.

This scholarly discourse serves as an endeavor to explore the foundational components that underpin the construction of stative locative events within the framework of language. It underscores the pivotal role of comprehending the lexical semantics of SLPs and verbs Vs in isolation, positing them as the elemental building blocks from which the complex tapestry of stative locative events is woven. Notably, the spatial semantics conveyed by prepositions such as *trên* (on) and the stationary attributes associated with verbs like *ngồi* (to sit) constitute indispensable constituents of this linguistic architecture. These foundational elements coalesce and interact within verb phrases, governed by established semantic composition principles, with the notable inclusion of event identification as a salient process in this context. This discourse furnishes a theoretical framework for apprehending the mechanics through which language effectively communicates information pertaining to stable spatial relationships and states of being.

The overarching purpose of this scholarly endeavor, which delves into the intricacies of lexical semantics and their amalgamation, is to provide valuable insights into the intricate process of linguistic construction of stative locative events. Through the deconstruction of the individual meanings ascribed to SLPs and Vs, this text sets forth a foundational understanding of how these lexical elements collectively contribute to the overall semantic import of a sentence. Such comprehension is of paramount significance to the field of linguistic research, as it unveils the underlying mechanisms that underlie the linguistic expression of spatial relationships and states of being. Furthermore, it furnishes a critical underpinning for studies that delve into the realms of syntax, semantics, and the multifaceted interplay between language, cognition, and spatial representation.

The significance of grasping the semantics of static locative events extends far beyond the confines of academic exploration. It holds profound implications for both theoretical linguistics and practical applications, offering key insights into the manner in which humans mentally conceive and navigate physical space while also shedding light on the intricate nexus between language and cognition. Moreover, this inquiry carries notable pertinence within the context of Vietnamese linguistics, facilitating cross-linguistic comparisons and making substantive contributions to the broader sphere of cognitive linguistics. Despite a plethora of the prior studies having paved the way for an understanding of stative events, a distinct void persists in the specific manifestation of these constructs in the Vietnamese language. Through this holistic investigation, the authors aspire to advance the comprehension of spatial representation, thus yielding invaluable contributions to both theoretical linguistics and cognitive science. However, these studies just ceased at the examination of the semantics of linguistic elements contributing to constructing expressions denoting locatives, there had hardly been studies which investigate stative locatives as an event with the combination of prepositions and verbs. This research endeavor constitutes a semantic exploration into SLEs as they manifest in Vietnamese linguistic constructs, as exemplified by the following sentences.

- | | | |
|-----|---|---|
| (1) | a. Nam ở trong vườn. | <i>Nam is in the garden.</i> |
| | b. Bọn trẻ đang bơi ở trong hồ. | <i>The children are swimming in the pool.</i> |
| | c. Tôi nhìn thấy cô ấy ở trong vườn. | <i>I saw her in the garden.</i> |
| | d. Anh ấy kéo lê tôi trước cái xe hơi. | <i>He dragged me in front of the car.</i> |

2. Literature Review

The literature reviewed underscores the multifaceted nature of locative expressions, emphasizing their pivotal role as linguistic vehicles for expressing spatial relations. Vietnamese, with its rich spatial vocabulary, emerges as a fertile ground for exploring the semantics of locative expressions. Cultural and environmental influences, as well as variations in proficiency and exposure, add layers of complexity to the study. This extensive literature review provides a robust foundation for the present investigation into the semantics of locative expressions in Vietnamese.

2.1. Figure and Ground

It was just as Talmy was the first to lay the theoretical groundwork for this study. In his seminal work, Talmy (1975) directs his attention towards the centrality of conceptual organization within the framework of sentence structure. Within this purview, he introduces a pivotal cognitive-semantic dichotomy, denoted as **Figure** (*F for short*) and **Ground** (*G for short*), originating from the realm of visual perception.

The figure object is a moving or conceptually movable point whose path or site is conceived as a variable the particular value of which is the salient issue.

The ground object is a reference-point, having a stationary setting within a reference -frame, with respect to which the figure's path or site receives characterization.

(Leonard Talmy, 1975: 419)

Subsequently, Talmy extends the application of this conceptual construct to the domain of linguistic analysis, positing it as an instrumental analytical tool. In elucidating this theoretical framework, he advances the proposition that the figure-ground distinction, fundamental in perceptual contexts, is equally salient in the realm of linguistic expression. In language, the figure refers to the information that is in focus or foregrounded, while the ground pertains to the background against which the figure is highlighted. He posits that these categories are assignable within a motion event where one object is moving and the other is stationary, but they might be thought to be merely a restatement of the fact of movement and locatedness. By illustrating how these elements contribute to the overall meaning and coherence of the sentence by manipulating the conceptual organization of information, Talmy highlights the importance of cognitive processes in sentence comprehension, emphasizing how the arrangement of figure and ground influences the mental representation of the events or situations described in a sentence. Talmy (1975: 182) points out that there is a noticeable difference between the Figure and Ground.

Table 1. Characteristics of Figure and Ground

Figure	Ground
- Has spatial variables to be determined	- Acts as a reference object with known spatial characteristics
- More moveable	- More permanently located
- Smaller	- Larger
- Conceived as geometrically simpler	- Taken to have greater geometric complexity
- More salient	- More backgrounded
- More recently on the scene/ in awareness	- Earlier on the scene/ in memory

Jackendoff (1983) adopted Talmy's conceptual framework to analyze spatial prepositional phrases (PPs for short). He argued that PPs can be decomposed into the ontological categories, namely PLACE and PATH, and functions such as TO, FROM, VIA, or IN, ON, UP as in (2).

- (2) a. In the room: [_{Place} IN ([_{Thing} ROOM])]
 b. Into the room: [_{Path} TO ([_{Place} IN ([_{Thing} ROOM])])]
 c. Through the cheese: [_{Path} VIA ([_{Place} IN ([_{Thing} CHEESE])])]

and Figure and Ground relations as in (3).

- (3) a. John_F hung the paintings_F on the wall_G.
 b. The children_F travelled to school_G.

In the realm of adpositional research, the foundational semantic concepts of Figure and Ground, also referred to as trajector and landmark in the cognitive linguistic frameworks of Lakoff (1987) and Langacker (1987), will be employed consistently throughout this paper. Nam (1995) notably disassembled the conceptual structures of prepositional phrases into two distinct components: a **locative** (Place) and a **directional** (Path) segment. This decomposition has exerted a significant influence on linguistic analyses of spatial expressions, and such differentiation is echoed, in various forms, across a majority of approaches to the syntax and semantics of spatial PPs. In the context of this paper, expressions associated with Place functions will be denoted as stative **locative events**, focusing on the semantic intricacies of specific combinations of spatial prepositional phrases and various verb types.

2.2. Stative locative events

According to Leonard Talmy, an event is a segment of reality that is perceptually or conceptually delineated or circumscribed by the human mind. Events are not objectively divided units of reality, but rather cognitive constructions that carve out portions of what would otherwise be continuous expanses of space and time. The human mind has the capacity to take a stretch of spatial or temporal continuity and cognitively bound part of it, thus forming a unified and discrete event. It is this very act of mentally bounding or delineating a portion of reality that gives it the quality of being an identifiable event - a cohesive unit that is perceptually or conceptionally set apart from the undifferentiated flux of space and time. In other words, the mind imposes boundaries that distinguish events as unified wholes within the ongoing stream of reality. Events are therefore not pre-existing divided segments, but rather cognitively constituted delineations that the mind constructs from spatial or temporal continuity. This is, in essence, Talmy's perspective on the nature of events and how the human cognitive system gives rise to them as perceived occurrences.

Ray Jackendoff (1990) proposed a detailed taxonomy for classifying different types of events. He divided events into ontological categories such as **actions**, **processes**, and **states**. Actions are bounded events involving an intentional actor, while processes unfold over time without set endpoints. States, on the other hand, persist over time and represent static conditions. These events can be defined formally as follows:

- (4) a. [Event GO ([], path $\left[\begin{array}{l} \text{FROM} ([] \\ \text{TO} ([] \quad) \end{array} \right]$)]
 b. [State BE ([], [place])]
 c. [Event STAY ([], [place])]

Jackendoff further distinguished between bounded and unbounded events based on whether they have fixed start and end points. He categorized events along semantic dimensions including dynamism, punctuality, volitionality, causation, and aspect. To represent their conceptual structure, Jackendoff developed hierarchical structures and primitives for different event types. His goal was to link the syntactic and semantic properties of events to their underlying conceptual representations.

Drawing upon seminal conceptualizations of event cognition (Talmy, 2000b) and fine-grained event typologies (Jackendoff, 1990), a stative locative event can be defined as follows:

Stative locative events constitute a subtype of state events that encode the persistent spatial configuration between an entity or figure and its reference ground or landmark. As predicates characterizing unchanging relational configurations between participants, stative locatives contrast with dynamic actions that trace the same semantic roles across space.

While dynamic events capture motion through space or resultant end-states, stative locatives denote enduring spatial relations that conceptualize the scene as a static backdrop. Formally, stative locative events can be represented as:

- (5) [SLEs ([Figure], [Ground])]

In analyzing the argument structure of predicate constructions, Nam (1995) delineates two subtypes - **predicate modifiers** and **predicate extensors**. Predicate modifiers are functions that map n-ary relational predicates to other n-ary relational predicates. That is, they take an n-place predicate as input and yield a semantically modified n-place predicate as output (ibid:23). For instance, locative prepositional phrases may serve as predicate modifiers when combined with single-place predicates, restricting the predicate's domain of localization without augmenting its valency. As an example (6), in the Vietnamese construction *đi bộ trong công viên* 'to walk in the park', the locative PP *trong công viên* 'in the park' modifies the monotonic one-place predicate *đi*

bô 'to walk', specifying its localized context. Therefore, locative modifiers provide spatial grounding for predicates without increasing their arity - a crucial distinction from predicate extensors that expand argument structure.

- (6) Bọn trẻ con **đi bộ** trong công viên.
'The boys walked in the park.'

In contrast to predicate modifiers, Nam (1995) defines predicate extensors as functions that map n -ary relational predicates to $(n+1)$ -ary predicates. That is, predicate extensors take an n -place predicate as input but yield an $(n+1)$ -place predicate as output, extending the original predicate's valency. As such, prepositions functioning as predicate extensors are classified as intersective predicate modifiers, augmenting the predicate's argument structure by allowing an additional argument slot to be saturated. For instance, in the Vietnamese construction:

- (7) Hưng đặt cuốn sách ở trên bàn.
'Hưng put the book on the table.'

The preposition *trên* 'on' acts as a predicate extensor, increasing the valency of the two-place predicate *đặt* 'to put' to incorporate a third argument, the table. Therefore, unlike predicate modifiers which leave argument structure intact, predicate extensors intersectively introduce an extra participant role into the predicate relation.

Based on Nam's (1995) syntactic properties of argument construction, this study categorizes stative locative events into two mathematical types: **bijjective events** and **surjective events**. A bijjective event refers to a one-to-one mapping process where a single argument is mapped onto another single argument as in Figure 1a. In contrast, a surjective event denotes a mapping process where one argument is mapped onto one or more other arguments as in Figure 1b. This concept can be formally represented as follows:

Definition of bijjective event

Let X and Y be two sets representing syntactic arguments. A bijjective mapping $f: X \rightarrow Y$ satisfies the condition that for every element y in Y , there exists exactly one element x in X such that $f(x) = y$. This represents a one-to-one correspondence between the sets X and Y .

Definition of surjective event

On the other hand, a surjective mapping $f: X \rightarrow Y$ satisfies the condition that for every element y in Y , there exists at least one element x in X such that $f(x) = y$. Here, the mapping covers or surjects onto the entire set Y .

This conceptualization is illustrated in Figure (1).

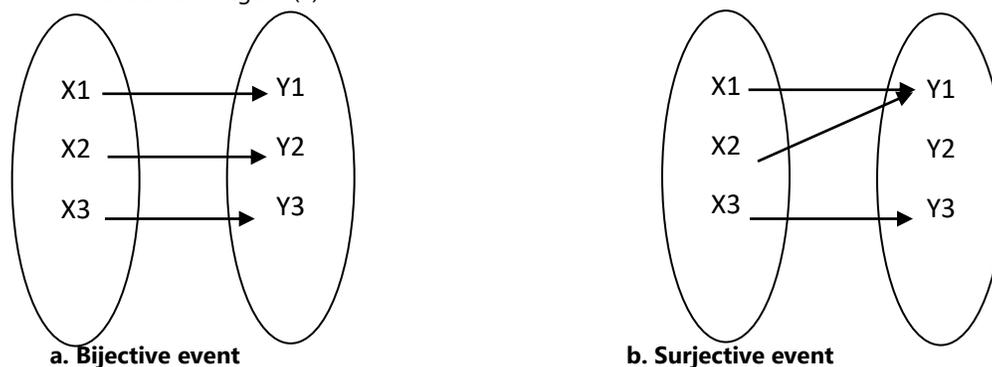


Figure 1. Stative locative events

This study has formally defined stative locatives as state events encoding enduring figure-ground relations. Adopting Nam's predicate semantics, two mathematical categories are proposed - bijjectives as one-to-one argument mappings and surjectives as one-to-many mappings. This theoretical groundwork enables analyzing compositional semantics of stative locatives cross-linguistically.

2.3. Previous work on stative locatives

This section reviews foundational formal semantic analyses of locatives by Creary et al. (1989) and Nam (1995) to identify limitations that motivate developing an integrated framework. While these seminal treatments proposed unified and Boolean semantic models capturing key properties, they have shortcomings regarding explanatory scope. The goal is to situate this work within existing literature while revealing gaps that call for a new model, synthesizing insights across theories to account for

complex locative semantics. This analysis provides background and justification for a novel framework integrating contemporary perspectives to address limitations of previous approaches.

2.3.1. Creary et al. (1989)

Jackendoff (1983) made foundational observations about parallels between locatives and nominals, including establishing discourse referents. Building on this, Creary et al. (1989) proposed a unified semantic analysis of locatives as denoting regional entities. This approach accounted for locative-nominal parallels like anaphoric "there" while using modern formal semantics. However, it did not capture locatives' lack of scope ambiguities compared to nominals. Still, Creary et al. advanced understanding of how locatives denote spatial regions and function referentially.

Additionally, aligning with Jackendoff, Creary et al. argued locatives should be treated as arguments rather than adjuncts. Based on this, they proposed that iterative locatives conjoin to jointly modify a single event. This contrasted with an adjunct analysis which would allow iterative readings. The argument analysis better explained the semantics of iteration.

However, Creary et al.'s approach has limitations. Their analysis focused only on static locatives, without considering time-dependence essential to spatial semantics. Moreover, modeling locatives as denoting singular regions fails to fully capture their semantic complexity. For three reasons, the present work disputes that locatives are universally arguments: 1) their omissibility; 2) verbs taking multiple locative types; and 3) their standard intersective semantics suggesting adjunct status. Though some non-intersective uses as arguments do occur.

In summary, analyzing locatives as time-dependent sets of regions, and recognizing their primary adjunct status, allows greater explanatory scope. While foundational, Creary et al.'s framework does not encompass key insights from modern locative semantics, including time-dependence and syntactic variability. Their work must be expanded through integrating contemporary perspectives.

2.3.2. Nam (1995)

Extending the influential boolean semantic framework for analyzing locative expressions originally proposed by Keenan and Faltz (1985), Nam (1995) provided robust new evidence for the intersective semantics of static locatives. Through in-depth syntactic analyses, Nam demonstrated that static locatives (e.g. "in the garden" in "John is walking in the garden") serve to intersect with the verb phrase to delimit a subtype of the event denoted by the verb. His extensive data showed that the locative combines compositionally with the verb via boolean semantics to yield the full semantics of the clause. This builds substantially on Keenan and Faltz's groundbreaking application of boolean semantics to capture the compositional semantics of locatives.

However, Nam's work also uncovered limitations in Keenan and Faltz's notion of orientation - the idea that locatives exclusively serve to locate the subject. Using insightful examples like "John sees Mary in the garden", Nam revealed that locatives can locate either subjects or objects. In this case, "in the garden" locates the object Mary, not the subject John. Through such examples, Nam demonstrated systematically that Keenan and Faltz's simpler orientation model fails to capture all semantic complexities.

In addition, Nam broke significant new ground by extending boolean semantic analysis to directional locatives for the first time. Drawing on lexical semantic theory, he discovered consistent semantic verb type constraints on orientation patterns. For instance, stative psychological verbs like "see" disallow subject-only orientation of directional locatives in their complement clauses. This evidenced inherent semantic restrictions in the lexical semantics of verbs governing possible locative orientations. Nam's integration of boolean and lexical semantics thus generated important new theoretical insights.

In sum, Nam significantly expanded on pioneering boolean semantic analyses using cutting-edge syntactic theory and lexical semantics. Both his qualitative syntactic findings and quantitative lexical semantic results revealed deeper complexities in locative semantics than captured in previous models. His integrated approach addressing prior limitations substantially advanced the formal semantic analysis of locative expressions

4. Methodology

This study utilizes a mixed methods approach combining corpus analysis and experimental elicitation tasks to investigate stative locative event semantics in Vietnamese.

4.1. Corpus analysis

A diverse corpus of authentic Vietnamese textual data spanning multiple genres is compiled and annotated with information about locative constructions. Quantitative analysis examines the distributional frequencies of different locative expressions, prepositions, and lexical verbs. Qualitative analysis conducts close readings of corpus examples to uncover nuanced spatial semantics.

4.2. Participant recruitment

Native Vietnamese speakers across proficiency levels, dialects, and exposure to different linguistic communities are recruited as participants. Demographic factors including age, education, region of origin, and language background are collected.

4.3. Experimental tasks

Participants complete controlled comprehension and production tasks designed to elicit specific locative constructions in various contexts. Reaction time and eye-tracking are used to capture real-time cognitive processing.

4.5. Data analysis

Corpus analysis utilizes computational methods to identify significant linguistic patterns. Experimental data is analyzed using statistical methods like regression to uncover effects of demographic variables on locative semantics. Qualitative analysis of elicited constructions supplements quantitative findings.

This mixed methods approach integrating corpus linguistics and experimental psycholinguistics provides comprehensive data to study how stative locative semantics in Vietnamese arise from the interaction of lexical verbs, prepositions, argument structure constructions, and cognitive processes. The combination of data sources, participant groups, and analysis techniques allows robust investigation of this complex linguistic phenomenon.

5. Stative locative prepositions in Vietnamese

An examination and classification of locative prepositions in the Vietnamese language is undertaken by employing the two theoretical frameworks: (i) frames of reference as expounded by Talmy (1983); and (ii) the arguments of predicates proposed by Nam (1995).

5.1. Frames of reference

This framework is central to the analysis of how languages delineate spatial relationships and how speakers cognitively represent and articulate the relative placements of objects within a given spatial context. Table 2 provides a succinct summary of the stative locative prepositions found in Vietnamese, along with their respective semantic attributes. To be more convenient, these prepositions are provided in the two versions including in Vietnamese and the equivalence of English.

Table 2: Classification of SLPs in terms of frames of reference

Intrinsic frame of reference		Relative frame of reference	
Vietnamese	English	Vietnamese	English
Trên	On	Phía trên	Above
Trong	In	Phía dưới	Under
		Phía trước	In front of
		Phía sau	Behind

5.1.1. Intrinsic frame of reference

The intrinsic frame of reference of stative locative prepositions, namely *trên* and *trong*, which pertains to understanding spatial relationships within the Vietnamese linguistic context. The identification of semantic properties of these prepositions relied on the inherent attributes and properties of objects to delineate their relative positions. In this paradigm, spatial arrangements are

defined by the innate characteristics of the objects themselves, devoid of external reference points. Examine the following example.

- (8) Cuốn sách ở **trên** bàn.
'The book is on the table.'

In Vietnamese, the preposition *trên* 'on' encapsulates the intrinsic frame of reference. Here, the concept of *trên* is intricately tied to the physical attributes of both the book and the table, underscoring the profound influence of intrinsic characteristics in spatial descriptions. This cognitive framework permeates spatial language in Vietnamese, contributing to the unique linguistic expression of spatial relationships in the culture.

Likewise, the preposition *trong* 'in' is a fundamental locative term in Vietnamese, denoting containment or inclusion within a defined spatial area. It is used to express that an object or entity is situated inside or within another object or space. When *trong* is employed in a sentence, it conveys the idea of being enclosed or contained within a particular entity, whether it be a physical object, a place, or an abstract concept. This preposition is integral in expressing various spatial relationships, such as being inside a room, container, or a larger conceptual framework. To illustrate this point, considering the following example.

- (9) Cô ấy đang ở **trong** phòng.
'She is in the room.'

In this example, *trong* is used to indicate that the subject *cô ấy* is located within the defined space of the room. Also, the preposition *trong* emphasizes the containment of the subject within the spatial boundaries of the room.

5.1.2. Relative frame of reference

The relative frame of reference of locative prepositions in Vietnamese such as *phía trên*, *phía dưới*, *phía trước*, *phía sau* helps understand how spatial relationships are conceptualized and communicated. In this frame, spatial arrangements are determined by the position of one object in relation to another. Specifically, it emphasizes the observer's perspective as a crucial factor in defining spatial relationships.

The preposition *phía trên* signifies a position or direction that is higher in relation to an object or a surface. Furthermore, it is used to describe something situated at an elevated position as in (10a). Meanwhile, *phía dưới* denotes a location or direction that is lower in relation to an object or a surface and signifies something positioned beneath or at a lower level as in (10b).

- (10) a. Cái hộp đặt **phía trên** bàn.
'The box is placed above the table.'
b. Con mèo đang nằm **phía dưới** giường.
'The cat is lying beneath the bed.'

Next, *phía trước* pertains to a location or direction that is positioned ahead or in front of a particular object. This preposition signifies something situated in the forward direction as in (10a). Conversely, *phía sau* refers to a location or direction that is situated behind or at the rear of an object or a surface and signifies something positioned in the backward direction as illustrated in (10b).

- (11) a. Cậu bé đứng **phía trước** lớp học.
'The boy is standing in front of the classroom.'
b. Ngôi nhà nằm **phía sau** hàng cây.
'The house is behind the trees.'

5.2. Spatial relationships

This section examines the stative locative prepositions in the spatial relationships, which are grouped into two subcategories such as **topological locatives** and **orientational locatives**. Topological locatives describe properties unaffected by transformations, providing a stable framework for spatial descriptions. Orientational locatives offer insights into how language communicates direction in relation to fixed points. Together, these concepts illuminate the fundamental principles guiding the linguistic expression of spatial information. Table 3 summarizes the classification of stative locative prepositions in terms of spatial relations.

Table 3. Classification of SLPs in terms of spatial relationships

Spatial relationships	Prepositions		Quantity	Frequency
Topological invariants	Tại	At	4	257
	Trên	In		
	Trong	On		
Orientational locatives	Phía trước	In front of	6	185
	Phía sau	Behind		
	Phía trên	Above		
	Phía dưới	Behind		
	Phía phải	On the right of		
	Phía trái	On the left of		

5.2.1. Topological locatives

The topological locatives in Vietnamese are grounded in fundamental geographical concepts and properties, constituting a vital component within the semantics of spatial expressions. These locatives exhibit distinctive characteristics by denoting elemental relations between spatial regions, aligning with the concept of topological invariants – those aspects of spatial relations that remain unaltered despite topological transformations. In the Vietnamese linguistic framework, three prominent topological locatives, namely *tại*, *trên*, and *trong*, take precedence. Each of these locatives encapsulates distinct spatial relationships, respectively embodying the notions of intersection, inclusion, and tangential association. This linguistic differentiation enables speakers of Vietnamese to precisely articulate nuanced spatial configurations and relationships within their linguistic discourse. In Vietnamese, it is noteworthy to observe the existence of three prominent topological locatives. Notably, these locatives exhibit a noteworthy prevalence within various Vietnamese genres and textual compositions.

5.2.1.1. *Tại*

Tại serves as a topological locative within the Vietnamese linguistic system, signifying a binary intersecting relation between distinct spatial regions. This relation is contingent upon the intersection of two entities, denoted as Figure and Ground, wherein an absence of an empty region shared by these entities indicates their intersecting state. Subsequently, the topological locative *tại* conveys a spatial relationship predicated on the proximity of a region situated between the aforementioned Figure and Ground. This spatial concept is formally defined as follows:

Definition:

$$\langle F G \rangle \in \parallel \mathbf{t\grave{a}i} \parallel \text{iff } \mathbf{p} [F] \subseteq \mathbf{PROX} [G]$$

(11) Hoa ở **tại** cơ quan của cô ấy.

'Hoa is at her office.'

This example exhibits the spatial relationship between the Figure (Hoa) and the Ground (her office). The symbol $\langle F G \rangle$ encapsulates the spatial relationship subsisting between the Figure and the Ground. The stative locative preposition is conventionally denoted by the symbol \parallel , while the variable \mathbf{p} designates the positional attribute ascribed to each respective object or event. The symbol \subseteq signifies the inclusivity of the Figure within the spatial domain defined by the Ground. Additionally, the notation $\mathbf{PROX} [G]$ conveys that the Figure maintains a proximate spatial relation in relation to the Ground.

5.2.1.2. *Trong*

Trong functions as a stative locative term in the Vietnamese language, signifying a spatial relationship characterized by inclusion. This specific relationship is characterized by its asymmetric nature, signifying the presence of two distinct regions, one of which is entirely encompassed within the interior of the other as determined by specific spatial parameters. Noteworthy alternatives for expressing this inclusion relationship encompass terminologies like *bên trong* 'within', *phía trong* 'inside', and *phía ngoài* 'outside'. These alternatives provide nuanced expressions for the inclusion dynamic within diverse spatial contexts.

Definition:

$$\langle F G \rangle \in \parallel \mathbf{trong} \parallel \text{iff } \mathbf{p} [F] \subseteq \mathbf{INTER} [G]$$

(12) Bọn trẻ đang ở trong vườn.

'The children are in the garden.'

In this particular context, the locative term *trong* assumes paramount importance in elucidating the intricate spatial relationship between the Figure, represented by *bọn trẻ* 'children', and the Ground, identified as *vườn* 'garden'. Specifically, it signifies that the designated point *p* within the Figure constitutes an internal component of the broader spatial entity, the Ground. This delineates a relationship characterized by containment, with the Ground enveloping and encircling the Figure. Beyond a mere static spatial descriptor, *trong* conveys a nuanced relational disposition, providing a linguistic tool to articulate not just the Figure's location, but also its interplay with the encompassing Ground. This precise usage of the locative term *trong* establishes a sophisticated framework for understanding the intricate spatial dynamics at play in this instance.

5.2.1.3. *Trên*

The stative locative *trên*, denoting on in Vietnamese, comprises a multifaceted semantic dimension. It encompasses the notion of tangentiality or contiguity, a characteristic feature that remains unaltered even under conditions of continuous elastic deformation. Specifically, when employed in spatial contexts, *trên* denotes a state where one entity lies in direct contact with the surface of another, exhibiting a contiguous relationship that persists despite potential deformations. This locative thereby embodies a composite of both geometrical contiguities, signifying the immediate adjacency of entities, and physical support, implying that the entity situated above relies on the surface beneath for stability or sustenance. This intricate interplay underscores the nuanced and resilient nature of *trên* as an essential component within the lexicon of Vietnamese locative events.

Definition

$\langle \mathbf{F} \mathbf{G} \rangle \in \parallel \mathbf{trên} \parallel \text{iff } p[\mathbf{F}] \subseteq \mathbf{TANG}[\mathbf{G}]$

(13) Con mèo ở **trên** hàng rào.

'The cat is on the fence.'

In this illustrative instance, the locative *trên* assumes critical significance in explicating the intricate spatial relationship between the Figure, represented by *con mèo* (the cat), and the Ground, characterized as the *hàng rào* (fence). Specifically, *trên* denotes a state of tangentiality, signifying that the Figure maintains direct contact with the surface of the Ground. This condition is indicative of a contiguous relationship, where the Figure and the Ground share an immediate and unbroken adjacency. Moreover, the term delineates that the designated spatial point within the Figure constitutes a tangential component of the broader spatial entity, the Ground. This dual perspective underscores the nuanced and resilient nature of the locative term *trên* within the lexicon of Vietnamese spatial expressions, providing a precise framework for comprehending the intricate spatial dynamics at play in this particular scenario.

5.2.2. *Oriental locatives*

The orientational locatives in the Vietnamese linguistic framework assume a pivotal role in establishing spatial orientation, encompassing *trước/sau*, *phải/trái*, and *trên/dưới*. These locative expressions serve as fundamental linguistic constructs employed to delineate directional relationships within a given spatial context.

5.2.2.1. *Trước/sau*

The orientational locatives *trước* and *sau* in Vietnamese provide a clear and distinct means of establishing anterior and posterior spatial orientations. *Trước* pertains to the anterior orientation, denoting the frontward position of an object or entity in relation to another. Conversely, *sau* designates the posterior orientation, indicating the position behind a reference point. This pair of orientational locatives is particularly significant in scenarios necessitating precise spatial description or navigation, such as giving directions or describing the arrangement of objects in a given context. The juxtaposition of *trước* and *sau* not only aids in specifying the relative positioning of entities but also contributes to the linguistic richness and sophistication of Vietnamese spatial semantics. Moreover, their binary nature allows for a clear differentiation between front and back orientations, thereby enhancing the language's capacity to convey detailed spatial information effectively.

Definition:

$\langle \mathbf{F} \mathbf{G} \rangle \in \parallel \mathbf{trước/sau} \parallel \text{iff } p[\mathbf{F}] \subseteq \mathbf{EXTER}[\mathbf{G}, \mathbf{ANTER/POSTER}]$

(14) a. Cây bàng ở **trước** trường của tôi.

'The banyan tree is in front of my school.'

b. Cây bàng ở **sau** trường tôi.

'The banyan tree is behind my school.'

This pattern elucidates the spatial correlation between the Figure, denoted as *cây bàng*, and the Ground, designated as *trường tôi*, signified by the notation $\langle F G \rangle$. This correlation is contingent upon the condition that the position, denoted as 'p', of the Figure must occupy an external position in relation to the Ground, situated either anteriorly or posteriorly in comparison to the Ground's location.

5.2.2.2. Bên phải/ bên trái

The orientational locatives *bên phải* and *bên trái* in Vietnamese serve to establish lateral spatial orientations, specifically indicating rightward and leftward positions, respectively. *Bên phải* denotes the rightward orientation, signifying the side or direction to the right of a given reference point. Conversely, *bên trái* designates the leftward orientation, indicating the side or direction to the left of the reference point. This pair of orientational locatives is highly pertinent in contexts requiring precise spatial descriptions or directions, such as giving instructions for navigation or specifying the arrangement of objects. The distinction between *bên phải* and *bên trái* enables clear and unambiguous communication of lateral positioning. This binary nature enriches the Vietnamese language's capacity to convey detailed spatial information effectively, contributing to its linguistic sophistication. Furthermore, the pair underscores the language's capacity to articulate nuanced spatial relationships, thereby enhancing its utility in various practical scenarios.

Definition

$\langle F G \rangle \in \parallel$ **bên phải/ bên trái** \parallel iff $p [F] \subseteq \text{EXTER} [G, \text{RIGHT/LEFT}]$

- (15) a. Những người lính ở **bên phải** chiếc xe tải.
'The soldiers are on the right of the lorry.'
b. Những người lính ở **bên trái** chiếc xe tải.
'The soldiers are on the left of the lorry.'

The spatial configuration, designated as $\langle F G \rangle$, elucidates the positional alignment between the Figure, represented as *Những người lính*, and the Ground, characterized as the *chiếc xe tải*. Within this relational framework, the Figure possesses the flexibility to assume a placement either to the right or the left of the Ground. In adherence to this relational construct, the specific location denoted as 'p' pertaining to the Figure is required to manifest as an external facet. This implies that it must be situated in such a manner that it exists distinctly apart from the Ground. Furthermore, 'p' must be positioned either to the right, indicated as option (15a), or to the left, designated as option (15b), in relation to the Ground for the stipulated relation to be considered valid.

5.2.2.3. Phía trên/ phía dưới

Phía trên and *phía dưới* are Vietnamese orientational locatives that convey essential information about vertical spatial relationships. *Phía trên* denotes a configuration where the Figure is positioned at a higher elevation compared to the Ground. This term is invaluable in describing the vertical arrangement of objects or points within a given space. Conversely, *phía dưới* refers to a spatial relation where the Figure is located at a lower level or position relative to the Ground. It serves as a crucial linguistic tool for articulating the depth or height of elements within a particular spatial context. These locatives play a fundamental role in various contexts, from giving directions to discussing architectural configurations, enabling precise communication about the relative positioning of objects or entities.

Definition

$\langle F G \rangle \in \parallel$ **phía trên/ phía dưới** \parallel iff $p [F] \subseteq \text{EXTER} [G, \pm \text{VERT}]$

- (16) a. Bức tranh ở **phía trên** cửa sổ.
'The picture is above the window.'
b. Bức tranh ở **phía dưới** cửa sổ.
'The picture is under the window.'

In Vietnamese, the orientational locatives *phía trên* and *phía dưới* are characterized by their spatial relationship between the Figure (referred to as *bức tranh*) and the Ground (referred to as *cửa sổ*), denoted as $\langle F G \rangle$. To be classified as such, this relationship must adhere to specific criteria. Firstly, the location "p" of the Figure must pertain to its external aspect in relation to the Ground. Secondly, both *phía trên* and *phía dưới* locatives convey the vertical orientation between the Figure and Ground.

Nevertheless, *phía trên* designates the upper vertical section relative to the Ground, whereas *phía dưới* pertains to the lower portion relative to the Ground.

6. Stative locative events in Vietnamese

This section classifies stative locative constructions in Vietnamese into bijective and surjective event types based on the mapping between Figure and Ground arguments. The mathematical conceptualization reveals differences in determinism, ambiguity, and multiplicity in the localization relationships denoted. By examining argument mappings as formal bijective or surjective functions, this analysis uncovers key semantic distinctions encoded in the spatial language. Table 4 provides a comprehensive overview of Vietnamese verbs and their frequencies, along with subcategories indicating serialization capability with linguistic elements for stative locative events (+) or incapability (-).

Table 4. Verb classifications in Vietnamese

Types of verbs		Stative locative events	Quantity	Frequency
Placement		+	6/6	29
Judgment		+	3/6	13
Intention		+	5/5	71
Psychology		+	2/5	64
Communication		+	3/3	54
Housing		+	7/7	91
Attaching		+	3/3	42
Position		+	5/5	71
Entertainment		+	14/14	128
Sports		+	26/26	215
Dative	Goal	+	21/21	54
	Source	-	0/9	18
Perception	Vision	+	8	27
	Hearing	+	1/1	11
	Smell	+	1/1	9
	Taste	-	0/1	13
	Touch	+	2/2	21
Motion	Path	-	0/38	76
	Manner	+	224/ 224	342
	Cause	+	88	124

6.1. Bijective stative locative events

Definition:

A bijective event refers to a locative construction that denotes a one-to-one mapping between two sets of syntactic arguments, a Figure (X) and a Ground (Y). Formally, this can be defined as follows:

Let X and Y be sets representing distinct syntactic arguments in a clause. A locative mapping $f: X \rightarrow Y$ is bijective if:

1. f maps each element x in X to exactly one element y in Y .
2. For each element y in Y , there exists exactly one element x in X such that $f(x)=y$.
3. There is a one-to-one correspondence between elements in X and elements in Y under the mapping f .

This means a bijective locative event unambiguously maps a single Figure to a single Ground. There is no surjectivity or multiplicity in the mapping.

In Vietnamese, lexical verbs license bijective locative constructions including placement, judgment, intention, psychology, communication, housing, attaching, position, entertainment, and sports often denote bijective events. Consider sentence (17):

(17) Tôi bơi ở trong hồ.

'I swim in the lake.'

Let $X = \{\text{tôi}\}$ represent the set of Figure arguments, containing the single element 'Tôi'.

Let $Y = \{\text{trong hồ}\}$ represent the set of Ground arguments, containing the single element 'ở trong hồ'.

The locative preposition 'ở' at/in' denotes a function f that maps elements of set X to elements of set Y :

$$f: X \rightarrow Y$$

This function f has the following properties that characterize a bijective mapping:

- f is injective: Each element of X maps to a unique element of Y . There are no two distinct elements x_1 and x_2 in X such that $f(x_1) = f(x_2)$. This is satisfied because X contains only a single element 'Tôi'.
- f is surjective: For each element y in Y , there exists at least one element x in X such that $f(x) = y$. This is satisfied because for the single element 'ở trong hồ' in Y , there exists a corresponding element 'I' in X that maps to it under f .
- f is one-to-one: Each element of X is mapped to exactly one element of Y . The single element 'I' maps to a single element 'ở trong hồ'.
- f is onto: Each element of Y has exactly one element of X mapping to it. There are no unfilled elements in the range Y .

Therefore, the locative preposition 'ở' denotes a bijective mapping between the sets X and Y in this example. It unambiguously maps the Figure 'Tôi' to the Ground 'Hồ' in a one-to-one correspondence. There is no surjectivity or multiplicity in the mapping. This provides a formal semantic analysis of the deterministic, unambiguous locative relationship denoted by the preposition in this simple sentence. The bijectivity captures the precise localization of the Figure relative to the Ground.

6.2. Surjective stative locative events

Definition

A surjective event refers to a type of locative construction in which a Figure argument (set X) maps surjectively onto one or more Ground arguments (set Y).

Formally, this can be defined as follows:

Let X and Y be syntactic argument sets representing the Figure and Ground. A locative mapping $f: X \rightarrow Y$ is surjective if:

1. For each element y in set Y , there exists at least one element x in set X such that $f(x)=y$.
2. The mapping f covers or surjects onto the entire set Y .

This means a single Figure argument can map ambiguously to multiple Ground elements under a surjective mapping. The localization relationship expresses multiplicity rather than a one-to-one correspondence. In Vietnamese, the verbs of dative, intension, attaching, social interaction, co-motion and perception denote this event. we can analyze the example sentence as follows:

(18) Tôi nhìn thấy anh ấy ở trong vườn.

'I saw him in the garden.'

Let $X = \{\text{Tôi, anh ấy}\}$ be the set containing the Figure arguments 'Tôi' and 'anh ấy'.

Let $Y = \{\text{vườn}\}$ be the set containing the single Ground argument 'vườn'.

The locative preposition 'ở' establishes a mapping f from X to Y :

$$f: X \rightarrow Y$$

f maps:

$$f(\text{Tôi}) = \text{vườn}$$

$$f(\text{anh ấy}) = \text{vườn}$$

This satisfies the definition of a surjective mapping:

- For the single element 'garden' in set Y , there exist two elements 'Tôi' and 'anh ấy' in set X that both map to 'vườn' under f .
- The mapping f surjects onto the entire set Y .

Therefore, similar to the previous example, the locative expression establishes a surjective mapping between the Figure set X and the Ground set Y . Both 'Tôi' and 'anh ấy' map ambiguously to the single Ground element 'vườn'. The surjectivity arises from the multiplicity of having two Figures localize to the same Ground. This introduces ambiguity in the semantic mapping denoted by the preposition 'ở'. The analysis demonstrates the flexibility of surjective locative constructions in Vietnamese.

5.1.2. Concept-oriented stative locative events

This section elucidates a pivotal semantic attribute inherent to locative expressions in the Vietnamese language. Within this framework, locative expressions manifest as functions pertaining to the conceptual categories, which are located, wherein they facilitate the identification of the spatial placement of said conceptual categories. This process of ascertaining the locational attributes of conceptual categories is largely contingent upon the linguistic attributes of verbs and prepositions. Table encapsulates a summary of expressions denoting conceptual categories in a state of being located within the Vietnamese linguistic context. A general definition of this expression is given in Table 4.

Table 4. Argument orientations of SLEs

Linguistics elements	Argument orientations of stative locative events			
	Figure	Ground	Figure-Ground	Figure and Ground
	Bijective events		Surjective events	
Verbs	judgement, position, entertainment, sports, manner, motion	cause, motion, placement, communication, psychology, housing,	dative	intension, attaching, social interaction, co-motion, perception
Total	5	5	1	5
Prepositions	trên, trong, phía trên, phía dưới, phía trước, phía sau	trên, trong, phía trên, phía dưới, phía trước, phía sau	trên, trong, phía trên, phía dưới, phía trước, phía sau	trên, trong, phía trên, phía dưới, phía trước, phía sau

5.1.2.1. Figure- oriented stative locative event

This pattern delves into a linguistic phenomenon specific to the Vietnamese language known as a figure-oriented stative locative event. The pattern of this event focuses on elucidating the stationary position or location of a designated object or entity, referred to as the Figure. This determination of location is accomplished through the utilization of stative locative prepositions, which are employed to pinpoint the Figure's position within a given context. There are five distinct groups of verbs in Vietnamese denoting this event: judgement, position, entertainment, sports, and manner motion.

(19) Ông chủ trì trích nhân viên mình trước đám đông.

'The boss criticized his employees in front of the crowd.'

Example exemplifies the concept of a figure-oriented stative locative event in Vietnamese. In this instance, the sentence portrays a scenario where the Figure, represented by the Ông chủ 'the boss', takes on the role of presiding over a gathering, indicated by trước đám đông 'in front of the audience'. This underscores the linguistic pattern's focus on elucidating the stationary position or location of the Figure in relation to its surroundings. While the specific stative locative prepositions are not explicitly mentioned, the context implies their presence, as the boss is positioned in front of a crowd. The verb trì trích 'presiding over' falls under the category of position, highlighting the Figure's specific action and position of authority. This example vividly showcases how Vietnamese employs this linguistic structure to precisely convey static positions or locations of objects or entities, demonstrating the language's capacity for nuanced spatial descriptions.

5.1.2.2. Ground- oriented stative locative event

In contrast to previous event types, ground-oriented stative locatives encode the location of the Ground or landmark argument within the relational predicate. That is, ground-oriented functions uniformly treat sets of coordinates in binary relations as specifying the spatial context of the ground element.

For instance:

(20) Anh ấy đặt quả bóng trên bàn.

'He put the ball on the table',

The locative prepositional phrase *trên bàn* 'on the table' exemplifies a ground-oriented stative locative. It identifies the location of the ground argument *bàn* 'table' in relation to the figure *quả bóng* 'ball'. Crucially, this ground-oriented locative entails that the table holds a particular spatial configuration within the relation, rather than simply modifying the action of ball placement. Therefore, ground-oriented stative locatives encode the localization of the reference object or landmark itself, contrasting with figure-oriented locatives that specify the position of the located entity. In Vietnamese, there are five miscellaneous types of verbs denoting this event including cause motion, placement, communication, psychology and housing,

5.1.2.3. Figure and Ground -oriented stative locative event

Stative locative prepositional phrases in Vietnamese specify the location of both a Figure and a Ground participant independently. There are four major lexical classes of verbs that license this type of construction: intention, attachment, social interaction, and co-motion. For example:

- (21) Lan gặp Hùng trong cơ quan.
'Lan met Hung in the office.'

The locative prepositional phrase *trong cơ quan* 'in the office' in (21) expresses the location of both the Figure (Lan) and the Ground (Hùng) simultaneously. This yields a surjective semantic interpretation, as demonstrated by the decomposed clauses in (22):

- (22) a. Lan ở trong cơ quan.
'Lan is in the office.'
b. Hùng ở trong cơ quan.
'Hung is in the office.'

The stative locative *trong cơ quan* 'in the office' relates both the Figure and Ground to the same spatial Ground (the office) independently, rather than expressing motion or directionality. The surjective nature of the locative construction in (1) arises compositionally from the ground-locating function of the preposition *trong* 'in' applied to two discourse referents. Thus, the lexical semantics of certain stative verbs in Vietnamese interact with the semantics of locative prepositional phrases to allow independent and simultaneous spatial predication of Figure and Ground. This demonstrates the complex interplay between a language's lexical classes, verb semantics, and function of spatial particles in giving rise to particular locative event types.

5.1.2.4. Figure- Ground oriented event

The Figure-Ground oriented locative event expressed in example (23) demonstrates surjective semantics, as the stative locative prepositional phrase *ở Hà Nội* 'in Hanoi' refers to the location of three distinct arguments - the Figure *Tôi* 'I', the secondary Figure *cái áo khoác* 'the coat', and the Ground *anh ấy* 'him'.

- (23) Tôi mua cho anh ấy cái áo khoác ở Hà Nội.
'I bought him a coat in Hanoi.'

The surjectivity arises because the ground-locating PP potentially expresses two distinct situational meanings:

Interpretation 1: The PP locates both the Figure *Tôi* and the secondary Figure *cái áo khoác* in relation to the spatial Ground *Hà Nội*, as in (24):

- (24) a. Tôi ở Hà Nội.
'I am in Hanoi.'
b. Cái áo khoác ở Hà Nội.
'The coat is in Hanoi.'

Interpretation 2: The PP locates the secondary Figure *cái áo khoác* and the intended recipient Ground *anh ấy* in Hanoi, as in (25):

- (25) a. Cái áo khoác ở Hà Nội.
'The coat is in Hanoi.'
b. Anh ấy ở Hà Nội.
'He is in Hanoi.'

The ambiguity arises from the stative semantics of the verb *mua* 'to buy' and the ground-locating function of the preposition *ở*. The surjectivity demonstrates how a single PP in Vietnamese can locate multiple arguments in a clause independently, arising from the complex interaction between lexical semantics and locative syntax. Further research could investigate what factors determine the contextual interpretation of the locative semantics in examples like (25) - whether it is determined by information

structure, plausibility, or other pragmatic principles. This phenomenon highlights the importance of understanding the mapping between semantic roles and syntactic expression in explaining locative event types cross-linguistically.

6. Conclusion

In conclusion, this study has proposed a novel mathematical formalization of stative locative events in Vietnamese using the concepts of bijective and surjective mappings. Through exemplary analysis of authentic sentences, the classification of locative constructions based on Figure-Ground argument mapping reveals clear semantic differences between bijective and surjective events. The findings demonstrate how bijective locatives unambiguously map arguments one-to-one, while surjective locatives permit flexible many-to-one mappings between a Figure and multiple Grounds. This novel typology based on mapping surjectivity provides valuable insights into the determinism, ambiguity, and multiplicity encoded in Vietnamese spatial language. By scrutinizing locative semantics through the lens of mathematical functions, this study elucidates the complex interplay between a language's lexical classes, verbal semantics, function of prepositions, and argument structure constructions in yielding spatial meanings. The integrated formal approach combining predicate logic, set theory, and syntax holds promise for future cross-linguistic analysis of static locative events. In summary, the proposed bijective/surjective distinction significantly enriches understanding of stative locative event types and their syntactic-semantic composition. The findings open fruitful avenues for further exploration of how natural languages geometrically conceptualize and linguistically encode enduring spatial relationships and configurations between entities.

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APPENDIX

Types of Verbs in Vietnamese

Types	Verbs
Placement	đặt (to place), sắp xếp (to arrange), lắp đặt (to install), để (to leave), sắp đặt (to set up), định vị (to position)
Total	6
Judgment	chỉ trích (to criticize), phàn nàn (to complain), tôn trọng (to respect), cảm ơn (to thank), xỉ nhục (to insult)
Total	5
Intension	tìm kiếm (to search), tìm (to find), lục lọi (to rummage), truy tìm (to pursue), đề cập (to mention)
Total	5
Psychology	yên mến (to cherish), thờ phụng (to worship), nhớ (to remember), coi thường (to look down on), ngưỡng mộ (to admire)
Total	5
Communication	gọi (to call), viết (to write), gửi tin (to send a message)
Total	3
Housing	cho ở (to accommodate), đón tiếp (to welcome), chứa (to contain), cho ngồi (to provide seating), cho ngủ (to provide accommodation), lưu lại (to keep), phục vụ (to serve)
Total	7
Attaching	sửa (to repair), buộc (to tie), gắn (to bandage)
Total	3
Position	ngồi (to sit), tựa (to lean), nằm (to lie down), đứng (to stand), quỳ (to kneel)
Total	5
Entertainment	hát (to sing), đọc sách (to read books), nấu ăn (to cook), mua sắm (to go shopping), xem tv (to watch tv), cắm trại (to go camping), nhảy (to dance), hội họp (to have a meeting), trình diễn (to perform), vui chơi (to have fun), xem kịch (to watch a play), múa (to dance), mua sắm (to go shopping), vẽ tranh (to paint)
Total	14
Sports	chơi (to play), tập (to practice), tham gia (to participate), thi đấu (to compete), trình diễn (to perform), huấn luyện (to train), chạy (to run), bơi lội (to swim), nhảy xa (to long jump), nhảy cao (to high jump), ném cừu vật (to throw), đá bóng (to kick a ball), đánh bóng chuyền (to play volleyball), đánh bóng rổ (to play basketball), đá cầu 93ong (to play badminton), đánh tennis (to play tennis), đá golf (to play golf), đua xe (to race), đi xe đạp (to cycle), leo núi (to climb mountains), chơi cầu 93ong (to play badminton), chơi bóng chày (to play baseball), chơi bóng rổ nước (to play water polo), chơi cờ vua (to play chess), thi đua (to compete), trượt tuyết (to ski), những động từ này mô tả các hoạt động thể thao khác nhau, từ các môn thể thao đội nhóm đến các môn thể thao cá nhân.
Total	26
Social interaction	gặp (to meet), hẹn (to make an appointment), ôm (to hug), cưới (to marry), đánh nhau (to fight), thăm (to visit), cãi nhau (to argue)
Total	8
Dative	Goal
	gửi (to send), mang (to carry), cầm (to hold), đem (to bring), khiêng (to lift), đưa (to give), chuyển (to transfer), phát (to distribute), viết (to write), đưa (to bring), tặng (to give as a gift), trao (to give, to pass on), trả (to return), bán (to sell), dạy (to teach), kể (to tell), bảo (to tell), hỏi (to ask), trình (to present), báo cáo (to report),

		truyền (to transmit)
	Total	21
	Source	mua (to buy), nhận phát (to receive), thu (to collect), tranh (to avoid), lấy (to take), ăn cướp (to steal), mượn (to borrow), vay (to lend)
	Total	9
Total		30
Perception	Vision	nhìn (to look), quan sát (to observe), thấy (to see), chú ý (to notice), ngắm (to gaze), ngó (to peek), theo dõi (to follow), canh chừng (to watch over)
	Total	8
	Hearing	Nghe (to hear)
	Total	1
	Smell	Ngửi (to smell)
	Total	1
	Taste	Nếm (to taste)
	Total	1
	Touch	sờ (to touch), đụng (to bump/come into contact)
	Total	2
Total		14
Motion	Path	biển khỏi (to depart) bỏ xa (to distance) cập (to approach) chúm (to gather) co (to curl) chụm (to cluster) cúi (to bow) co quắp (to huddle) dạo (to stroll) doãi (to approach) đến (to arrive) đến gần (to approach) đi (to go) đi đầu (to lead) đi khỏi (to leave) đột kích (to raid) ghé (to visit) gục (to collapse) hạ cánh (to land) khép (to close) khuynh (to bow) khuỵu (to bow) lại (to return) lên (to ascend) lùi (to retreat) ngả (to lean) nhập cư (to immigrate) qua (to pass) ngoảnh (to turn) quay (to turn) ra (to go out) tản cư (to emigrate) theo đuổi (to pursue) tới (to arrive) trèo (to climb) trở lại (to return) trốn thoát (to escape) vào (to enter) xuống (to go down) uốn (to curl)
	Total	40
	Manner	bành (to flatten) bay (to fly) bay bổng (to soar) bay lượn (to glide) bay nhảy (to flutter) bay vèo (to dart) bật (to jump) bèn mảng (to crawl) bệt (to be secluded) biến (to transform) bò (to crawl) bơi (to swim) bơi ếch (to frog swim) bơi xuồng (to row) bước (to step) bỏ (to abandon) buột (to jump) bung (to open) cập bến (to reach the shore) cất cánh (to take off) chành (to waddle) chảy (to flow) chạy (to run) chạy bay (to sprint) chạy bền (to jog) chạy bộ (to jog) chạy đua (to race) chạy lao đi (to rush off) chạy lung tung (to run recklessly) chạy mau (to run fast) chạy nhốn nháo (to scramble) chạy mất (to run away) chạy nước rút (to sprint) chạy theo (to chase) chạy thoát (to escape) chạy trốn (to flee) chạy trước (to run ahead) chạy tung tăng (to run around) chạy xô (to rush) chạy việc dã (to do errands) chèo thuyền (to row a boat) chìa (to extend) chìm (to sink) choài (to hunch) chồm (to sneak) chui (to crawl) chuồn (to dart) chuyển (to transfer) cúi (to stoop) cúi (to bow) cuốn (to roll) cút (to flee) dao động (to oscillate) dạo (to stroll) dạo chơi (to hang around) dạt (to drift) dậm (to step on) dậm dờn (to trample) di chuyển (to move) diễu hành (to parade) duỗi (to stretch) đạp (to pedal) đập (to beat) đi ca nô (to go canoeing) đắm (to drown) đâm (to stab) đi bộ (to walk) đi câu (to go fishing) đi chập chững (to stagger) đi chợ (to go to the market) đi chùa (to go to the temple) đi học (to go to school) đi khệnh khạng (to wobble) đi làm (to go to work) đi lòng vòng (to go around in circles) đi nước kiệu (to parade) đi cà kheo (to go stealthily) đi la cà (to go sneaking) đi lạc (to get lost) đi lạch bạch (to go astray) đi

	<p>lảo đảo (to go staggering) đi lang thang (to wander) đi ống ẹo (to walk with a limp) đi phà (to take a ferry) đi rón rén (to sneak) đi thành hang (to explore caves) đi theo (to follow) đi thơ thần (to walk in a daze) đi xe buýt (to take a bus) đi xe đạp (to cycle) đi khập khiễng (to hobble) đi xe máy (to ride a motorbike) đi xe taxi (to take a taxi) đi xe trượt tuyết (to go skiing) đi xe ngựa (to ride a horse) đi xe đồ (to take a tram) đi thuyền (to go boating) đổ (to pour) đung đưa (to sway) đuổi theo (to chase) đưa đẩy (to shuttle) gạt (to swipe) gật đầu (to nod) giang (to swing) giạng (to stretch) giãn (to extend) giẫm (to step on) giẫm (to trample) gục (to collapse) hạ cánh (to land) hụp (to cringe) khép (to close) khuấy (to stir) kiễng (to suspend) khúm núm (to crouch) kiệu (to parade) lan truyền (to spread) lái xe (to drive) lan (to spread) lách (to weave) lang thang (to wander) lẳng (to dangle) lánh (to avoid) lao (to rush) lảo đảo (to sway) loạng choạng (to totter) lắc (to shake) lắc lư (to oscillate) lăn (to roll) lật (to overturn) len (to creep) lén (to sneak) leo (to climb), lê (to saunter) liệng (to dawdle) loạng choạng (to sway) lò cò (to waddle) lồi (to bulge) lộn (to flip) lộn nhào (to somersault) luân chuyển (to circulate) lúc lắc (to wobble) lùi (to retreat) lượn (to soar) lượn lờ (to glide) lướt (to skim) mò (to grope) mọc (to sprout) múa (to dance) múa ba lê (to ballet dance) múa lân (to lion dance) múa sạp (to pole dance) múa máy (to dance mechanically) mưa (to rain) nặn (to squeeze) ngả (to lean) ngã (to fall) ngẩng (to raise) ngoảnh (to turn) ngồi (to sit upright) ngồi (to sit) ngồi xổm (to sit cross-legged) ngoe (to stick out) nguẩy (to bend) nhảy (to jump) nhảy cẫng (to jump hurdles) nhảy dây (to jump rope) nhảy dù (to parachute) nhảy đầm (to jump in puddles) nhảy múa (to dance) nhảy nhót (to hop) nhảy lò cò (to hop on one leg) nhảy lồng (to jump in a cage) nhảy phóc (to leap) nhảy rào (to jump fences) nhảy sào (to pole vault) nhảy sạp (to jump on a bench) nhảy vòng (to jump rope) nhảy vọt (to vault) nhảy xa (to leap) nhảy xà (to jump) nảy (to jump) nổi (to float) nội súi (to flow inward) phất phới (to flutter) phóng (to launch) quanh (to go around) quấn (to coil) quay (to spin) ra khơi (to sail) rảo bước (to strut) rẽ (to turn) rơi (to fall) rũ (to shake off) run (to shake) rung (to vibrate) rượt (to chase) sà (to step on) sập (to collapse) sụp (to collapse) sụt (to sink) toài (to stagger) thoát (to escape) tong (to toss) trào (to gush) trèo (to climb) trèo đèo (to climb hills) trôi (to drift) trườn (to crawl) trượt (to slide) tuôn (to pour) tuột (to slip) tụt (to drop) uốn (to curl up) va (to bump) văng (to throw) vẫy (to wave) tay (to wave) vòng (to circle) vọt (to dart) vỗ (to clap) vung (to swing) vụt (to throw) vượt (to surpass) xoắn (to twist) xoay (to turn) xô (to push) xông (to rush)</p>
Total	224
Cause	<p>Chất (to load, to put), chêm (to stab), chỉ (to direct), cho phép (to allow), cắm (to plug), cuộn (to roll), duỗi (to stretch), hất (to push), yêu cầu (to request), giúp đỡ (to help), cản lại (to block), vẫy tay (to wave), thổi (to blow), mang (to carry), khuân (to carry on a pole), vác (to carry), nạp (to load), đuổi (to chase), nhồi nhét (to stuff), ném (to throw), lôi (to drag), kéo (to pull), tung (to throw), dòn (to push), nén (to compress), hất (to push), phóng (to launch), búng (to toss), thả (to release), chỉ đạo (to instruct), đập (to hit), ném mạnh (to throw forcefully), giữ (to hold), đá (to kick), hạ (to lower), chèn (to insert), khóa (to lock), ra lệnh (to command), lồng (to cage), mời (to invite), dẫn (to lead), khiêng (to carry), lao (to rush), phóng (to launch), đổ (to pour), lôi (to drag), xô (to push), kéo (to pull), đẩy (to push), nâng (to lift), phóng thích (to release), bỏ (to abandon), tách (to separate), lăn (to roll), vác (to carry), chia ra (to divide), gửi (to send), rung lắc (to shake), nạp (to load), nhét (to stuff), nhấn chìm (to press down), giật (to jerk), chớp (to grab), phà hơi (to blow up), xoay</p>

		(to rotate), bắn (to shoot), phun (to spray), bơm (to pump), rắc (to sprinkle), rải (to spread), vắt (to squeeze), đâm (to stab), bịt (to cover), hút (to suck), đưa (to give), ném (to throw), ấn (to press), vật ngã (to knock down), quăng (to throw), bấm (to press), nhổ (to pull out), thuyết phục (to persuade), buông (to let go), vẫy (to wave).
	Total	84
	Co-motion	đuổi theo (to chase), dẫn theo (to lead), h dẫn đầu (to lead), hộ tống (to escort), theo (to follow), đi theo (to accompany)
	Total	6
Total		350