The Image Schema VERTICALITY: Definitions and Annotation Guidelines

Lennart Wachowiak[1,†], Dagmar Gromann[2,†] and Chao Xu[3,†]

[1]King's College London, United Kingdom
[2]University of Vienna, Austria
[3]Shanxi University, China

Abstract

Definitions of image schemas have generally been found to be underspecified in image-schematic literature, which is particularly true for the image schema VERTICALITY. A frequently adopted approach to address this issue is to provide formal definitions. The use of image schemas in natural language is one central source of evidence for their existence, but spatial language is highly flexible and rarely contains explicit disambiguated spatial information. Thus, applying formal definitions that require non-linguistic spatial properties for the annotation of linguistic manifestations of image schemas is problematic. In this paper, we propose an interdisciplinary review of definitions and suggest annotation guidelines for the image schema VERTICALITY in natural language, including an annotation experiment with three experts.

Keywords

Image Schemas, Cognitive Linguistics, Conceptual Metaphors, Verticality, Up-Down

1. Introduction

As basic sensorimotor-informed cognitive structures [1, 2], image schemas are believed to shape higher level cognition, including natural language. An image-schematic cognitive linguistic analysis of language has been subjected to the same criticism as many cognitive linguistic theories, namely to suffer from circularity. Language analysis represents a means for forming inferences about the mind, body and its interrelations, the results of which then motivate different arguments on linguistic phenomena [3, p. 245-246]. Thus, natural language might not provide evidence on the origin of image schemas. However, its analysis can foster an understanding of image schema existence and usage in natural languages [4], which is a challenging endeavor due to underspecified definitions. To start addressing this issue, we propose to derive annotation guidelines for the image schema VERTICALITY from interdisciplinary definitions and related annotation procedures, especially the Metaphor Identification Procedure (MIP) [5], which we refine by means of an annotation experiment.

While spatial relations vary widely across languages and cultures, the complexity and diversity can be analyzed and explained with an underlying set of universal image schemas. In other

The Seventh Image Schema Day (ISD7), September 2, 2023, Rhodes, Greece
[†]These authors contributed equally.
lennart.wachowiak@kcl.ac.uk (L. Wachowiak); dagmar.gromann@univie.ac.at (D. Gromann); chao.xu@sxu.edu.cn (C. Xu)

words, VERTICALITY might be used differently in a specific language but with the same basic configuration, also in its metaphoric use. Accounts to formalize image schemas attempted to counteract the vagueness of image schema definitions [6, 7], however, "providing a natural language semantics directly in terms of a non-linguistic external representation turns out to be problematic"[8]. Besides, as a cognitive theory, image schemas do not naturally rely on formal representations or logic. Taking a different route, we seek to provide an operational and experimentally validated annotation procedure exemplified for VERTICALITY. We are interested in the spatial commitment of an utterance without overcommitting to interpretations of the description of spatial properties not directly provided by the linguistic context. To this end, we provide a set of linguistically motivated configurations of and rules for VERTICALITY to aid the decision if a specific linguistic context affords annotating this image schema or not.

Thus, this paper establishes annotation rules and configurations that can easily be reused by other annotation projects to identify image schemas in a transparent and reproducible manner, even in other languages apart from the word class-specific rules. Our guidelines can increase trust in text-based image schema analyses, whose methodology might otherwise be labeled as "alchemy" or "a matter of interpretive ingenuity" [9]. Image schema annotation has many interesting applications, ranging from investigating how the use of image schemas differs across languages and cultures [10, 11], how the language of children with spatial impairments differs [12] or which image schemas occur in various literary works [9]. Ultimately, analysing image schemas in text corpora also contributes to image schema theory which investigates how we think and talk about abstract concepts.

2. Related Work on Image Schema Annotation

In terms of manual evaluation, subjective experience when encountering a word has been investigated. Gibbs et al. [13] first asked people to rate which image schemas relate to experiences of physical standing, with VERTICALITY being one of the most related. Moreover, they created image-schematic profiles for metaphorical uses of *to stand* to explain semantic similarities. Similarly, Richardson et al. [14] asked participants to relate action verbs to the spatial primitives UP-DOWN and LEFT-RIGHT. Participants chose vertical representations for concrete words such as *lifted* and *sank* as well as for abstract words such as *succeeded* and *increased*. In a crowdsourcing experiment, Gromann and Macbeth [15] asked participants to assign one, several, or no image schema to natural language sentences to also test for their collocation, however, without considering VERTICALITY.

In terms of automating the annotation process, Gromann and Hedblom [16] used an unsupervised clustering approach to group verb-preposition pairs with related nouns and co-occurrence frequencies as feature vectors by image schema. Wachowiak and Gromann [17] used a supervised approach utilizing large pre-trained language models to classify sentences into eight different image schemas, including VERTICALITY, for which the model reached an F1-score of 0.81. However, the examples used to train the model are annotated at sentence-level and consist of short sentences collected from image schema literature. To get information about the individual words indicating an image schema, the researchers used the explainability method LIME [18] that identifies the words the model relied on to make its prediction.

In comparison to these existing ways of annotating image-schematic language, we rely on real-world language use and not examples gathered by introspection, expert annotators rather than laypeople or the crowd, and annotation on text- rather than sentence-level to provide annotators with sufficient context to interpret the meaning of lexical units.

3. On Specifying the Image Schema VERTICALITY

In initial annotation experiments, we found definitions of image schemas, in particular VERTICALITY, to be insufficiently specific to provide clear guidelines on which lexical units to annotate. To start, we select VERTICALITY and seek to answer the question whether specific instances of linguistic sequences, such as *This book crowned his career as a writer* or *She sits at the head of the table*, where in the latter case the vertical axis is tipped over to the horizontal one, should be annotated or not.

3.1. Perspectives and Definitions

One important notion for image schemas in general and for VERTICALITY in particular are affordances, i.e., properties that the environment provides to living beings [19]. For instance, stairs afford climbing, which is an important notion for linguistic annotations, since not all linguistic mentions of stairs do indeed focus on this property, e.g. *These are interesting stairs* does not. Johnson defines VERTICALITY as emerging from our tendency to employ an UP-DOWN orientation in picking out meaningful structures of our experiences [2] and states that we conceptualize quantity in terms of VERTICALITY in the metaphorical projection of MORE IS UP/LESS IS DOWN. In general, experiences with gravity are connected with this image schema. Martínez et al. [20] use a more restrictive definition when analyzing the enaction of image schemas in infant–parent interactions, only considering dynamic, that is, going up or down activities, as related to VERTICALITY.

Brugman and Lakoff [21] offer a more detailed analysis by discussing VERTICALITY within the context of the distinct senses of the preposition *over*. Deane [22] nicely summarizes this analysis by identifying the following predominant characteristics that co-occur with the preposition *over* as: Verticality, Boundary-Traversal, Surmounting, Covering, Potential Interaction, and Contact. While several of these potentially co-occur, the one characteristic that interests us the most is VERTICALITY, for which the following examples are provided:

a. The lamp hangs over the table.
b. The plane flew over the city.
c. He jumped over the wall.
d. He walked over the hill.

While Example a relates purely to VERTICALITY, Example b and d are also boundary-traversal, and Example c represents a case of surmounting. For us, this means collocation with other image schemas, that is, every occurrence of path-traversal and path relate to the image schema SOURCE-PATH-GOAL. However, collocation is not considered in this experiment.

Ekberg [23] analyzes linguistic manifestations of VERTICALITY in English and Swedish and proposes five principles of transformations of the prototypical VERTICALITY image schema. First,

a vertical axis can be transformed to a horizontal one by 'tipping' it over, e.g. the Swedish *upp* (up) and *ner* (down) can be transformed to the horizontal plane in *Han gick upp och ner i korridoren* (He walked up and down the corridor). Second, an end-point focus can be introduced to index the location along a vertical trajectory, e.g. *Hon bodde en trappa upp* (She lived one floor up). Third, the metaphorical projection of time into space and as a mover along a vertical path in the Western world can be considered related to this image schema, e.g. *tankar som når upp i vår egen tid* (thoughts that reach up into our own time). Fourth, a zero-dimensional entity can be transformed to a path towards a one-dimensional extended entity, e.g. *Klänningen nådde ner till anklarna* (The dress reached down to the ankles). Zero-dimensional here refers to the construed trajectory for an entity that is in fact one-dimensional, i.e., a point in space rather than a line. A dress in the above example is considered a point in space rather than a line and thus, the trajectory of having a starting point and an end point is construed. Finally, inanimate objects can acquire characteristics of the human body, such as *Han satt längst upp vid bordet* (He sat at the head of the table).

3.2. VERTICALITY in Conceptual Metaphors

Conceptual metaphors represent a cognitive mechanism that enables the projection of conceptual structures from a source to a target domain [24], where the former can be recurring physical experiences and the latter an abstract domain [2]. In a literature review, Cian [25] summarizes different dimensions of VERTICALITY in the context of conceptual metaphors. Five dimensions are identified: (i) an object's verticality, (ii) a viewer's verticality, (iii) imagined verticality, (iv) vertical associations, and (v) abstract domains. He finds that MORE IS UP from a power and valence perspective. In addition, lower positions are considered more concrete, heavier, given our experience with gravity, and related to emotion, e.g. *falling in love*, whereas higher positions are related to rationality. He also finds that an upright position is associated with more self-esteem and positive thoughts and that the MORE IS UP even applies to imagined or construed VERTICALITY. This was even found to apply to cardinal directions, e.g. a once good situation goes bad or *goes south*. In MetaNet [26] many such metaphors confirm these notions, e.g. MORALITY IS UPRIGHTNESS.

Borneto [27] looks at how the German verbs *stehen* (to stand) and *liegen* (to lie) are used to describe physical and abstract situations. He finds that in the physical world, *stehen* usually requires the subject to be in a vertical position, whereas *liegen* requires the subject to be in a horizontal position or one lacking dimensionality. For example, to say that a book is (upright) on a shelf, one can say *Das Buch steht im Regal.* On the other hand, when a book is in a horizontal position on a table, one can say *Das Buch liegt auf dem Tisch.* Moreover, he identifies patterns in the metaphoric usage of *stehen*. For instance, it can be used to describe extract entities as if they were standing like a human to describe their level of stability, e.g. *Die Bank steht fest auf eigenen Beinen* (The bank is firmly on its own two feet). Overall, Borneto comes to distinguish four main semantic types of VERTICALITY in regards to the verb *stehen*: (1) human verticality, i.e., the human body being in an upright position as in the example before; (2) geometric verticality, i.e., there being a vertical axis in geometrical space; (3) saliency verticality, i.e., something rises and, thereby, stands out ;(4) gravity verticality, an object falling downwards. Here, geometric verticality is the most static, and gravity verticality is the most dynamic. We specify our own

definition based on these details in Section 4.2.

4. Annotation Guidelines

We derive annotation rules to be considered when annotating linguistic sequences with the image schema VERTICALITY from: (1) the above discussion on different perspectives of VERTICALITY, and (2) annotation experiments in which we discussed and compared our annotations of various natural language examples. Before introducing the VERTICALITY-specific rules, we present some general annotation guidelines that are also applicable to other image schemas.

4.1. Annotation Procedure

Step-wise general instructions for the annotation procedure closely relate to that proposed by the Metaphor Identification Procedure (MIP) [5] and are as follows:

1. Read the entire sentence to obtain a general understanding of its meaning.
2. Determine the lexical units of the sentence.
3. For each lexical unit
    a) establish its meaning in context and its relation to other lexical units in the sentence.
    b) consult the annotation rules for each image schema
    c) determine whether the lexical unit and its related units directly describe a physical event or configuration that affords image schemas
        i. if yes, classify the sequence as "non-metaphoric" image schema
        ii. if no, determine whether the lexical unit has a more basic, underlying meaning that is jointly evoked in the sentence; basic meaning here refers to physical, sensorimotor experiences (evoking a sense of see, hear, feel, smell or taste or of a physical experience, e.g. getting up, walking)
            A. if yes, annotate as "metaphoric" image schema

When annotating a word or phrase as image schematic, we decided to annotate the units that led to the classification as well as all units contributing to VERTICALITY. For instance, from our annotation experiment and corpus, the lexical unit *trouser-rousing* describing men getting excited over nude pictures in a magazine alone describes the image schema. However, *crawled* alone might not necessarily describe a vertical axis, but only in the combination *crawled under rocks*. Since consciously construing all potential interpretations of a lexical unit is a challenging task, we recommend consulting dictionary definitions in order not to accidentally overlook more basic meanings of abstract units and additionally consider potential transfers across word classes (see Section 4.2).

4.2. Annotation Rules for VERTICALITY

In this section, we present specific annotation rules for (not) annotating VERTICALITY in linguistic sequences that derive from the above definitions and our experiences trying to systematically annotate this image schema in natural language. In fact, starting from existing definitions and

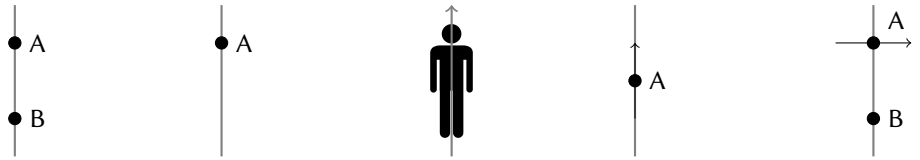

Figure 1: Static and dynamic instances of VERTICALITY (from left to right):
1: *A is over B* (static)
2: *A is high up* (static)
3: *A is in an upright position* (static)
4: *A is rising* (dynamic)
5: *A flies over B* (dynamic)

descriptions of VERTICALITY configurations, we iteratively refined our annotation rules in several annotation experiments on different datasets, describing the last experiment after finalizing the annotation rules in this paper.

General: The main notion is an UP-DOWN orientation that the meaning of lexical units in a sequence affords in a specific context, where, however, the vertical axis can potentially be tipped to a horizontal plane, e.g. *walking up and down a corridor*. The main dimensions for this image schema are a vertical orientation or positioning of an entity or viewer, a vertical association between entities as well as instances of imagined or construed VERTICALITY. The main configurations of this image schema are depicted in Fig. 1, which distinguishes between static and dynamic descriptions. Positioning is frequently static, e.g. *She is higher up the hierarchical ladder than him*, including instances of being upright, e.g. *standing tall*, and adjectives, such as *high* or *deep*. Vertical associations are generally dynamic, e.g. *She is climbing the career ladder*. For each sequence, the meaning of lexical units should be analysed to evaluate whether their meaning in context represents one of the above static or dynamic configurations and ultimately affords VERTICALITY.

Fictive Motion: The question whether to annotate fictive or construed motion is a very central one in image schema annotation. Egorova et al. [28] describe fictive paths as figurative rather than metaphoric language that describe geospatial location rather than motion. Ekberg [23], however, argues that relating a static entity or "meaning of a lexeme" to a dynamic one shows our ability to mentally construe a path and thus, dynamic VERTICALITY, e.g. *The dress reached down to the ankles*. We decided to annotate such instances of fictive or construed motion.

Verbs: Some verbs are more prototypical for the image schema VERTICALITY than others, e.g. *climbing* or *falling*. Other verbs, such as *nodding* or *shrugging*, caused long discussions on whether they evoke VERTICALITY or not. If the meaning of the verb in context relates to one of the vertical configurations depicted in Fig. 1, it should be annotated. Vertical head and shoulder movement in nod and shrug would be annotated if used in this meaning, physically or metaphorically. Verbs can also be static as in being in an upright position, e.g. *standing*. In contrast, *stand back* does not relate to an upright orientation and would not be annotated.

Verbs combined with prepositions, i.e., phrasal verbs, are not automatically annotated when containing *up* or *over*, since their connection to a vertical axis is not evident, e.g. *make up*.

Nouns: Nouns indicating that an entity is at a specific point on a vertical axis are annotated, for example, *peak* or *level*. Nouns can also indicate dynamic movement along a vertical axis, e.g. *descent* or *ascension*. Body parts, especially *head* and *feet*, are frequently related to VERTICALITY, however, not always. For instance, *head of the company* implies someone is at the highest point of the vertical axis describing the company's hierarchy, whereas *best foot forward* focuses on forward motion rather than on a vertical motion or position.

Transfer Across Word Classes: At times, a word in a specific word class strongly resonates or directly derives from another word class with a very specific physical meaning. The authors of the MIP method [5] make the same observation in relation to the metaphoricity of lexemes, where the noun might have a physical meaning only, however, used as a verb might obtain a metaphoric meaning. In our case, many nouns directly relate to adjectives and verbs, often in combination, e.g. *high-rise*, or an adjective component might relate to a vertical axis, e.g. *underground* and *highlands*. Verbs can also be transferred to adjectives, e.g. *the low-hanging fruit*. Even though only the dictionary definition of the related, original word class explicitly relates to VERTICALITY, we included such transfer across word classes in our annotation procedure. As a counter-example, the verb *understand* resonates of *under* and *stand*, however, has lost its etymological relation to the now remote physical meaning.

Examples For Orientation: Lastly, we want to introduce some prototypical literal and metaphorical examples, counterexamples, and boundary cases, i.e., borderline examples that caused discussions but in the end were annotated, covering a substantial amount of our rules. This overview allows annotators to judge new samples more efficiently and reliably by allowing for direct comparisons.

a. **Prototypical Literal**:
   (i) *He is climbing the mountain.* (vertical movement)
   (ii) *The lamp hangs over the table.* (static vertical configuration)
   (iii) *The train goes under the bridge.* (movement (non-vertical) + static vertical configuration)
b. **Prototypical Metaphorical**:
   (i) *I feel down/low today* (static vertical configuration without explicit reference point)
   (ii) *It was like a guardian angel had come down.* (vertical movement)
   (iii) *The comedian escalated the jokes.* (vertical movement)
   (iv) *The joke went over my head.* (movement (non-vertical) + vertical configuration)
c. **Counterexample**:
   (i) *Put your best foot forward* (dynamic, but no vertical configuration)
d. **Boundary cases**:
   (i) *He is suppressing the urge to kill.*
   (ii) *The time is standing still.*

4.3. Reporting Guidelines for Ensuring Reproducibility

One of the main arguments for establishing annotation rules for image schemas is to make image schema text analyses more transparent, comparable, and reproducible. To ensure this goal is met, we urge to report all important decisions taken when analyzing — similar to the suggestions by the authors of the MIP [5]. Such decisions include the dictionary used to find more basic word meanings, what image schemas were annotated (if more than VERTICALITY), and if additional inclusion/exclusion decisions were made regarding specific word classes that diverge from the presented recommendations. Additional information that should be reported for any type of linguistic annotation include, among others, the number of annotators, the number of passes through the text, how disagreements were resolved, the inter-annotator agreement, and how/if annotators were trained or instructed.

5. Example Annotation

To test the reliability and usability of our annotation rules, the three authors of this paper annotated natural language texts. This annotation experiment was conducted after finalizing the guidelines. Thus, it is entirely distinct from the annotations done to derive any rules. We chose the Open American National Corpus (OANC)[1] as it is freely available, has a permissive license allowing transparent modification, and contains coherent texts of different genres. These coherent texts allow us to understand each word's meaning in its full context, which is crucial when identifying the metaphoricity of a word and its potential connection to more basic physical usages. Furthermore, the texts contain complex sentences that use domain-specific language. In previous work on metaphor annotation [29], we found that such complex and naturally occurring language is much more difficult to annotate for humans and machine learning models than the thought-up, unambiguous examples in datasets such as the Image Schema Database [30] or Lakoff's Metaphor List[2].

From the OANC, we annotated 19 texts belonging to the journal category. Each annotator read the texts once and used Merriam-Webster and the Cambridge Dictionary for word definitions. Overall, this resulted in 451 annotated sentences. In 88 of those sentences, at least one annotator identified the image schema VERTICALITY. We compared annotations after the first nine texts to resolve disagreements and misunderstandings regarding the guidelines. The initial inter-annotator agreement as measured by Fleiss' Kappa for these first nine texts is 0.40. After this round of discussion, the agreement increased to 0.49 for the following 10 texts. One reason for the rather low score is that identifying VERTICALITY needs very thorough reading, especially when the basic meaning is found only in a sub-component of a compound word. Thus, the annotators sometimes missed instances of VERTICALITY even though they did agree to the annotation when brought up during discussion. Other times it is difficult to come to an agreement, for instance with phrasal verbs like *wind up*, where the relation of *up* to its VERTICALITY-related meaning is debatable.

[1] https://anc.org/data/oanc/

[2] http://www.lang.osaka-u.ac.jp/sugimoto/MasterMetaphorList/metaphors/index.html

6. Discussion and Conclusion

In this paper, we presented the first steps towards guidelines for annotating image schemas in natural language in a systematic, transparent, and reproducible fashion. While some rules apply to image schemas in general, as of now, we primarily focused on the image schema VERTICALITY, as it especially suffered from underspecification. We provided a thorough discussion and definition of VERTICALITY based on literature and annotation experiences, highlighting the schema's main dimensions and configurations. The resulting guidelines were tested with three annotators applying them to 451 sentences.

Checking Basic Meanings. In the annotation process, it is important to evaluate all meanings of a lexical unit. Direct interpretation and understanding of meaning might lead to overlooking more basic, physical underlying meanings. Thus, we recommend consulting definitions for most lexical units to ensure that no metaphoric projections are accidentally omitted. For instance, the word *approach* might directly be interpreted as purely abstract. However, when considering the physical meaning of the (noun-related) verb to come near, there is an underlying physical experience. This example also relates to the transfer across word classes, where a word class with a purely abstract meaning derives from another word class with a metaphoric meaning. For instance, *high-rise* as a noun clearly relates to the corresponding adjective *high* and verb *rise*, two prototypical examples of VERTICALITY. In this annotation procedure, we included and recommend considering transfer across word classes. However, as this rule requires examining the metaphorical projections among different meanings of a lexical unit, this can be particularly challenging for non-native speakers. In general, identifying more basic meanings can be difficult for non-native speakers as it requires a firm grasp of the usage and semantics of the word in question. This difficulty can be also seen as a limitation of our annotation experiment in Section 5, with all three annotators being non-native English speakers.

Image Schema Collocation. Collocation of image schemas, even within the same lexical unit, is a common phenomenon, which represents future work to extend the proposed procedure to all commonly proposed image schemas. Within this annotation experiment, we noticed that, besides collocation, clearly delimiting image schemas is at times challenging. In particular, SUPPORT and CONTACT frequently occur with similar prepositions as VERTICALITY, especially *on* and *over*. If an entity A is on another entity B, A is vertically higher than B but represents a prototypical example of SUPPORT. Thus, in our view, these instances afford SUPPORT rather than VERTICALITY. To *pour the juice over ice* implies a vertically higher juice being poured over a vertically lower ice for the liquid to flow. However, *spread the mustard over the chicken* refers to covering the surface of the chicken with mustard without an evident relation to VERTICALITY. It is open for discussion whether annotating the former example with this image schema already represents an instance of overcommitting to interpreting a presumed underlying scenario.

Languages Beyond English. All our discussions and example annotations are based on English language samples. While we assume that the basics of our annotation rules are transferable to other languages, any word class-related rules and some of the more fine-grained

discussions will not apply to other languages. For instance, our discussion of how to annotate body parts, such as *head*, was based on how it is used in English. Looking at the Mexican language Mixtec, Regier [31] and Brugman [32] found that body parts are used as a standard way to describe spatial configurations. To describe the configuration of a stone under a table one says *yuù wã híyaà čìì-mesá (stone the be-located belly-table)*. Similarly, being above something can be described as being at something's *head* if the lower object is vertically extended or *animal's back* if it is horizontally extended. Interestingly, Mixtec makes no difference between being on something or above something, thus, not allowing the clear separation into the image schemas VERTICALITY and SUPPORT we described in the paragraph before. Another example of this sometimes blurred line between vertical configurations with and without contact is Japanese, where *ue ni* can be used for describing configurations where something is *on* or *above* an object [31].

References

[1] G. Lakoff, Women, Fire, and Dangerous Things. What Categories Reveal about the Mind, The University of Chicago Press, 1987.

[2] M. Johnson, The Body in the Mind: The Bodily Basis of Meaning, Imagination, and Reason, The University of Chicago Press, Chicago and London, 1987.

[3] R. W. Gibbs Jr, H. L. Colston, The cognitive psychological reality of image schemas and their transformations., Cognitive linguistics (1995).

[4] E. Dodge, G. Lakoff, Image schemas: From linguistic analysis to neural grounding, From perception to meaning: Image schemas in cognitive linguistics (2005) 57–91.

[5] P. Group, Mip: A method for identifying metaphorically used words in discourse, Metaphor and symbol 22 (2007) 1–39.

[6] M. M. Hedblom, O. Kutz, T. Mossakowski, F. Neuhaus, Between Contact and Support: Introducing a logic for image schemas and directed movement, in: Proceedings of the 16th International Conference of the Italian Association for Artificial Intelligence, 2017.

[7] B. Bennett, C. Cialone, Corpus guided sense cluster analysis: a methodology for ontology development (with examples from the spatial domain), in: 8th International Conference on Formal Ontology in Information Systems (FOIS), volume 267, IOS Press, 2014, pp. 213–226.

[8] J. A. Bateman, Language and space: a two-level semantic approach based on principles of ontological engineering, International Journal of Speech Technology 13 (2010) 29–48.

[9] M. Kimmel, Analyzing image schemas in literature, Cognitive Semiotics 5 (2009) 159–188.

[10] S. Choi, M. Bowerman, Learning to express motion events in english and korean: The influence of language-specific lexicalization patterns, Cognition 41 (1991) 83–121.

[11] A. Papafragou, C. Massey, L. Gleitman, When English proposes what Greek presupposes: The cross-linguistic encoding of motion events, Cognition 98 (2006) B75–B87.

[12] L. Lakusta, B. Landau, Starting at the end: The importance of goals in spatial language, Cognition 96 (2005) 1–33.

[13] R. W. Gibbs Jr, D. A. Beitel, M. Harrington, P. E. Sanders, Taking a stand on the meanings of stand: Bodily experience as motivation for polysemy, Journal of Semantics 11 (1994).

[14] D. C. Richardson, M. J. Spivey, S. Edelman, A. J. Naples, "Language is spatial": Experimental

evidence for image schemas of concrete and abstract verbs, in: Proceedings of the Annual Meeting of the Cognitive Science Society, volume 23, 2001.
[15] D. Gromann, J. C. Macbeth, Crowdsourcing image schemas., in: TriCoLore (C3GI/ISD/S-CORE), 2018.
[16] D. Gromann, M. M. Hedblom, Kinesthetic mind reader: A method to identify image schemas in natural language, in: Advancements in Cogntivie Systems, 2017.
[17] L. Wachowiak, D. Gromann, Systematic analysis of image schemas in natural language through explainable multilingual neural language processing, in: Proceedings of the 29th International Conference on Computational Linguistics, 2022, pp. 5571–5581.
[18] M. T. Ribeiro, S. Singh, C. Guestrin, " Why should I trust you?" Explaining the predictions of any classifier, in: Proceedings of the 22nd ACM SIGKDD, 2016.
[19] W. Kuhn, An Image-Schematic Account of Spatial Categories, in: Spatial Information Theory, Springer, 2007.
[20] I. C. Martínez, S. A. Español, D. I. Pérez, The interactive origin and the aesthetic modelling of image-schemas and primary metaphors, Integrative Psychological and Behavioral Science 52 (2018) 646–671.
[21] C. Brugman, G. Lakoff, Cognitive topology and lexical networks, in: Lexical ambiguity resolution, Elsevier, 1988, pp. 477–508.
[22] P. Deane, Multimodal spatial representation: On the semantic unity of over, in: From Perception to Meaning, De Gruyter Mouton, 2008, pp. 235–284.
[23] L. Ekberg, The mental manipulation of the vertical axis: How to go from 'up' to 'out', or from 'above' to 'behind', Lexical and syntactical constructions and the construction of meaning (1995) 69–88.
[24] G. Lakoff, M. Johnson, Metaphors we live by, University of Chicago press, 1980.
[25] L. Cian, Verticality and conceptual metaphors: A systematic review, Journal of the Association for Consumer Research 2 (2017) 444–459.
[26] E. K. Dodge, J. Hong, E. Stickles, Metanet: Deep semantic automatic metaphor analysis, in: Proceedings of the Third Workshop on Metaphor in NLP, 2015, pp. 40–49.
[27] C. S. Borneto, Liegen and stehen in German: A study in horizontality and verticality, Cognitive linguistics in the redwoods (1996).
[28] E. Egorova, L. Moncla, M. Gaio, C. Claramunt, R. S. Purves, Fictive motion extraction and classification, International Journal of Geographical Information Science 32 (2018) 2247–2271.
[29] L. Wachowiak, D. Gromann, Does GPT-3 Grasp Metaphors? Identifying Metaphor Mappings with Generative Language Models, in: Association for Computational Linguistics: ACL, 2023.
[30] J. Hurtienne, Image Schema Database (ISCAT), 2017. URL: http://zope.psyergo.uni-wuerzburg.de/iscat.
[31] T. Regier, The human semantic potential: Spatial language and constrained connectionism, MIT Press, 1996.
[32] C. Brugman, The use of body-part terms as locatives in Chalcatongo Mixtec, in: Survey of California and Other Indian Languages, 1983.