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SUMMARY

Marianna Bolognesi's book "Where Words Get their Meaning" deals with profound issues. The subtitle "Cognitive processing and distributional modelling of word meaning in first and second language" gives us important information about her approach, which is informed by distributional modelling and studies on first and second language learning. The book is divided into three parts, "Word meaning construction and representation in the human mind" (Chapters Two to Four), "Word meaning construction and representation in the artificial mind" (Chapters Five to Seven), and "Converging evidence in language and communication research" (Chapters Eight to Ten).

The first chapter of the book is called "Word power". In it, Bolognesi briefly discusses the effects of word choices, but it is, above all, an overview of what is to come. Bolognesi summarizes her topics in the form of three questions (p. 8): "How do the word-to-world and word-to-word associations contribute to the construction of word meaning in our mental lexicon? How do children and adult

language learners learn new word meanings? And what can the latest endeavors in machine learning and AI contribute to our understanding of the structure and functioning of the human mental lexicon?"

In the first part of the book, Bolognesi focuses on the question of how people learn new words. The second chapter is titled "Word meaning mental representation", and it takes a developmental perspective. Bolognesi begins with pointing out four biases in the learning of concrete nouns. The whole object bias suggests that a new encountered noun refers to an entire object. The taxonomic bias suggests that when a new word is spoken in the same context with an old one, the two words belong to the same taxonomic category (e.g. animal). The basic level bias suggests that a new word refers to an everyday, basic level item; and the mutual exclusivity bias suggests that each single word denotes a single object of its own. On this premise, which she points out is insufficient to explain word meaning acquisition, Bolognesi introduces cross-situational learning whose idea is that children are able to deduce meanings of words on the basis of encountering them in different new situations and making comparisons between these situations. This is easiest in transparent situations where both the word and the object it refers to are present. Bolognesi suggests that children may associate concrete things even with abstract nouns but continues to explain that abstract nouns can above all be learned via language. In other words, in some situations language learners infer the meaning of a word from the physical context, while in others they infer it from the linguistic context.

In Chapter Three, "Word meaning extension: Deriving new meanings from old ones", Bolognesi discusses some common mechanisms through which words acquire new meanings. These comprise polysemy, metonymy and metaphor. In this chapter, she defines the term 'mental lexicon' as follows (p. 34): "--- I refer to mental lexicon as a virtual (rather than physical) architecture that collects all the knowledge and information (derived from language and from experience) about a word and allows the different streams of information to interact, combine and inhibit one another, depending on the context and the task conditions in which the speaker is involved."

Bolognesi does not only discuss the phenomenon of polysemy but also Word Sense Disambiguation (WDS) and computer programs aimed at detecting different senses of words. She seems at the same time skeptical and hopeful of unsupervised methods in this respect. As regards the discussion of metonymy, she introduces two psycholinguistic models. According to one of them, people primarily access the literal senses of words, whereas figurative senses are accessed indirectly. According to the other model, neither the literal nor figurative senses of words are systematically prioritized, but "contextual and lexical information determine the intended meaning" (p. 42). She continues with the topic of literal versus figurative senses in the subchapter on metaphor where she also suggests that metaphors violate Grice's maxim of quality by not being true. Moreover, she continues to ponder computer programs that would automatically identify metaphorically used words and analyze them. She tells us that the "problem of automatic metaphor identification is very challenging" (p. 49) but continues to evaluate some existing work. She also asks to what extent computer programs correspond to what occurs in the human mind.

In Chapter Four, "The bilingual mind and the bilingual mental lexicon", bilingualism enters the scene. Bolognesi begins it by introducing Kroll and Stewart's (1994) Revised Hierarchical Model for bilingual lexicon, according to which second/foreign language learners first translate each word they encounter into their first language and are then able to access its conceptual representation. As their fluency in the new language grows, this strategy gradually falls out of use. According to Bolognesi, the merit of this model was that it distinguished between the mental representations of words and concepts, but she continues to report newer, brain imaging studies. These show not only overlap and divergences between L1 and L2 but also that bilingual brains seem to function differently from monolingual brains. Again in this chapter as well as in the previous ones, Bolognesi calls for a dynamic, bottom-up approach to language learning. She compares word associations in native speakers and language learners and proceeds to talk about incidental vocabulary learning. Incidental vocabulary learning occurs when a person encounters the same word several times in similar enough contexts to be able to deduce its meaning. Bolognesi points out that this is a good way to learn a new language provided that the texts the learner reads are on just the right level of difficulty. She then proceeds to also pointing out that incidental learning is a form of statistical learning. The main message of the chapter comes towards its end, where Bolognesi emphasizes that pattern detection is a hallmark of human cognition. She discusses pattern detection in detail,

dividing it into world-to-world, word-to-world and word-to-word associations. She further divides these associations into syntagmatic and paradigmatic, distinguishing between the company an item keeps and items that occur in similar contexts. This takes her directly to the second part of the book where she discusses the artificial mind.

Chapter Five is titled “Distributional models and word embeddings”. It contains a wireframe model of how we can calculate conceptual distances between various words based on the contexts in which they occur. This is illustrated with the help of images and tables. The chapter also contains mathematical equations used to produce distributional models. The focus is on Latent Semantic Analysis (LSA). Bolognesi explains how vectors can be used to describe the positions of different words in conceptual space. She briefly covers different macro types of distributional models when she discusses structured and unstructured models, explicit and implicit vectors, and compares frequency-based models with word embeddings.

Such basic information having been provided for, Bolognesi directly continues to “Evaluating distributional models” in Chapter Six. The measure by which she evaluates the models is how well they correspond to human cognitive functioning. After talking about synonym tests and conceptual priming, she critically discusses Pavlov’s dogs, pointing out that it is not only positive associations that count, but also the things that do not happen (Rescorla 1988). In other words, learners evaluate both positive and negative evidence, presence and absence. This helps us to understand that foreign language learners rely more on linguistic cues than embodied situational evidence, since the former is more available to them. In this chapter, Bolognesi discusses two of her own studies in detail, illustrating differences between language learners and native speakers (2011, 2016). The chapter contains six figures showing similarity scores, word maps and a Zipfian distribution illustrating her data. In this chapter, Bolognesi also takes up the topic of Searle’s (1980) Chinese Room Argument, in which he imagines himself in a room receiving messages in Chinese slipped under the door. He suggests that he can answer these messages simply by manipulating the Chinese characters according to certain rules, without learning or understanding Chinese. The question is if this is what a computer does when it processes language and what the relationship of the Chinese room is to the human brain.

Also in Chapter Seven, “Distributional models beyond language”, Bolognesi discusses her own previous research (2014, 2017). The point of the research is to acquire an understanding of associations between words and images. Bolognesi studies Flickr® images and their tagsets in order to understand the perceptual side of concepts. She is interested in what kind of features of concepts are tagged by the users and how the concepts represented by Flickr® data cluster. In this chapter, she also returns to world-to-world modelling, describing, among other things, the challenges encountered by the MIT AI lab in the seventies when they started working on computer vision. The chapter ends with a summary of what has been discussed so far. The idea is that Bolognesi will return to each topic thread in the third and last part of the book.

The title of the eighth chapter coalesces with the title of the entire book, “Where words get their meaning”. The chapter starts from category formation, which, as stated earlier in the book, occurs when a person associates an object with another object, or an object with a word, or a word with another word. Bolognesi underlines that this is also a cline of abstraction. This inspires her to delve into the differences between concrete and abstract concepts and eventually to return to L1 and L2 learning, the latter being more language-based than the former. In this chapter, she discusses behavioral and neuroscientific evidence related to abstract concepts and language learning.

In the next, ninth chapter, Bolognesi returns to distributional modelling. The name of the chapter is “The cognitive foundations of the distributional hypothesis”. Here, Bolognesi suggests that even if the human mind does not function exactly like a computer program, successful computer modelling can give us important insights about how the mind works. She says that we should thus leave Searle’s Chinese room behind us and reach towards such insights. She returns to the topic of abstraction and, quoting the APA Dictionary of Psychology, suggests that there are at least two kinds of abstraction since abstraction can refer both to categorical abstraction (specific to generic) and conceptual abstractness. In the specific to generic type of abstraction we infer common properties of, for example, tables, to arrive at a generic understanding of what a table is. It is different from, for example, our understanding of “goodness” or “beauty”. (VandenBos 2007.) Bolognesi is of the opinion that metaphors can be understood in a similar way, as instances of taxonomic

categorization. She also applies the distributional hypothesis to metonymy, and concludes that metaphors function in the domain of paradigmatic similarity, while metonymy functions in the domain of syntagmatic contiguity. Her main point in this chapter is that distributional modelling can help us understand various kinds of meaning.

In the tenth and last chapter "Conclusions and outlook" Bolognesi finally brings together the topical threads that she has been handling throughout the book. She again emphasizes that behavioral scientists can learn about the mind through AI modelling and vice versa. She is of the opinion that we have arrived at a point where it is necessary to consider both kinds of evidence. In this chapter, she discusses human creativity, first language acquisition, and foreign language teaching, pointing out what we can learn by marrying behavioral sciences with AI research. Lastly, she predicts that we will understand much more in the near future.

EVALUATION

On the outside, this book looks relatively thin, and when you read it, it is deceptively simple. It is in fact a very intense book full of information. It has been a challenge to attempt to summarize what it is about. On the one hand, it is about how neural networks in AI can help us understand human cognition. However, at the same time, it is about first and second language learning. In her quest to combine insights from psycholinguistics and AI, Bolognesi has to explain several complex issues in a rather limited space. When she writes, for example, about world-to-world, word-to-world and word-to-word associations, these are easy to imagine, but at the same time, she continuously adds information that is more challenging to understand, such as characteristics of computational modelling. She is quite deft at handling the two and more threads of the work from the beginning to the end. The book is like a plait where its author brings together linguistics (e.g. polysemy), psycholinguistics (language acquisition) and AI (e.g. Latent Semantic Analysis). Or, Bolognesi could be considered a juggler throwing several balls in the air. The book is indeed built so that the author introduces or mentions a topic, then moves on to another topic, then returns to a previous topic. It is cumulative so that on each round, we learn something more about each topic. It is also like a

jigsaw puzzle where we are first introduced to one piece after another, and then later see how they fit together, one by one.

The answer, then, to the question where words get their meaning, is at the same time simple and complex. Word learning is equated with language learning which occurs when the learners encounter new objects that have names, or texts that include new words, and in the course of time learn to associate the right words with the right referents, both on the basis of positive and negative evidence. This general mechanism can be accounted for in relatively simple terms but a further description of the process requires rigorous statistical modelling. Also, not all words relate in the same way to other words but somewhat different descriptions are required, for example, concerning metaphor and metonymy.

The main argument of the book, that we can understand where words get their meaning if we combine insights from psycholinguistics and AI, is presented boldly, and the author deserves credit for being able to maintain the simple argument through all the complex issues she has dealt with in the book. At the same time, I cannot escape the sense that there is still much to unveil in these matters. The author herself points to a future where we will know more, provided we walk the path she is suggesting. Perhaps this is just how a good scientific book should end: the reader is left to wonder what more there is to the matter. Curiosity has been roused.

I can recommend this book to anyone who is interested in word meaning. It is a well-researched book with plenty of references to further studies. It could also work as an advanced course book at the university, compact as it is and covers many relevant issues in a readable format.

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ABOUT THE REVIEWER

Dr. Heli Tissari currently works as a university lecturer of English philology at the University of Helsinki. Her own research mainly concerns English words for emotions and their metaphors since Late Middle English, but she is also more generally interested in the history of the English language, semantics and cognitive linguistics, as well as interdisciplinary research. At the moment, she is involved in a research project studying people's reported experiences of the music of digital games.