The Unity of Sentence Understanding and the Limits of the Linear Model

(Ladder Understanding of Language: How to Understand a Sentence)

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Abstract

Language is expressed consecutively, and it is natural to assume that understanding follows the same linear order. This paper argues that this assumption is mistaken. Although sentences are expressed in a linear way, they are not understood in the same way. When we reach the end of a sentence, we arrive at a single, unified understanding that cannot be explained as the mere accumulation of word-by-word meanings. This paper introduces the concept of entwined understanding units, which are understanding units larger than individual words that form during comprehension. The formation of these units introduces a vertical axis into language understanding, which the linear model cannot account for. To explain how and why these units form, the paper draws on the concept of mental work, grounded in our natural tendency toward less mental effort. The result is the ladder model of sentence understanding, proposed as an alternative to the linear model.

Keywords: Language understanding; Linearity of language; Ladder model; Mental work.

1. Introduction

Words are expressed consecutively over time. Saussure (1915: 70) calls this the second principle of semiotics and the linear nature of the signifier. Time is linear, and therefore language is linear too. Words are inevitably expressed one after another, on a horizontal axis. To understand a sentence, we follow the words in order until the sentence is complete.

It seems obvious that we understand the meaning of a sentence only by following the words one after another.[2] Sentence understanding is linear in the same way that sentence expression is. That is,

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[2]Some phrases provide a counterexample to this claim. For instance, when hearing idioms or very common phrases, we can often anticipate what is coming after only the first few words.

understanding also proceeds consecutively, and linearity is a common feature of both expression and understanding.

This claim is supported by strong intuition. When we hear a sentence, we understand it only after hearing it in full. Consider: "Yesterday, Sara arrived late to work." When do we understand this sentence? The natural answer is that we understand it completely only when the last word, "work," is spoken. As long as the sentence is not complete, we cannot have a complete understanding of it.

The main goal of this paper is to challenge this claim by showing that sentence understanding does not proceed in a linear way. Beyond challenging linearity, the paper also aims to introduce an alternative model of sentence understanding. This idea was inspired by the work of Behin Arbabi (2007; 2010), who focuses on how things, including language, are understood, and presents a ladder model to explain language understanding.

In the first and second sections, we challenge the idea that language understanding is linear, with the central argument focusing on the role of understanding units larger than individual words. In sections three and four, the ladder model is introduced as an alternative to the linear model. Section five explains the concept of mental work, which is the basis for the ladder model. Finally, some objections to these ideas are considered and addressed.

2. Linearity of Language

Wittgenstein asks in *Philosophical Grammar* (1974: 50): does sentence understanding occur in a linear way, consistent with sentence expression? If the answer is yes, then sentence understanding must be completely consistent with the order in which words are heard. Otherwise, the assumption of linearity is called into question.

Linearity of sentence understanding means that we understand words consecutively until the sentence ends. If this sequence is disrupted in some way, then sentence understanding is not linear. Consider the sentence: "Yesterday, Sara arrived late to work." If understanding this sentence does not follow the order of its words exactly, that is, if "late" is not understood after "arrived" and before "to work," then the sentence cannot be said to be understood in a linear way.

It is difficult to imagine that the words of a sentence are not understood in their order of appearance. When we move from one word to the next, we understand each word automatically. Crispin Wright (2001: 170-213) writes that we understand a word as soon as we hear or say it, instantly. He continues (2001: 177): we know the meaning of words we hear non-inferentially, immediately, and effortlessly. We understand words as soon as we encounter them.

So when we see or hear a word, we understand it instantly, and we cannot understand a later word before the earlier one. In other words, understanding the words of a sentence follows the same order in which they are expressed. On these grounds, one cannot argue that sentence understanding is non-linear simply by claiming that it is not consecutive. But it is still possible to show that understanding the words and phrases of a sentence is different from merely hearing them.

Language is linear, like a graph with only a horizontal axis. But sentence understanding cannot work in the same way, because we arrive at a unified understanding of the whole sentence when we reach its end. This means that all parts of the sentence have played a role in that final understanding. If this description is accurate, then the assumption of linearity in sentence understanding is genuinely challenged.

When we say that language is linear, we mean that words are expressed one after another, so that when a given word is expressed, the previous one has already been expressed and is no longer present. We argue that although understanding also proceeds consecutively, the previously understood words remain present in the final understanding of the whole sentence. Linearity, therefore, cannot explain how a unified understanding of the whole sentence is possible once the sentence is complete.

3. Understanding of the Whole Sentence

If we can show that a single and complete understanding of the whole sentence is indeed reached, we can then argue that language understanding is not linear. We know from experience that when we hear a sentence, we understand the whole of it, not just its final word. We also respond to the whole sentence, not to isolated parts of it. Consider an example: you are asked to close the door, but you know the speaker actually wants you to leave the room, so you leave. In this case, none of the individual words of the sentence matched your reaction, yet you understood the whole message and acted accordingly. You arrived at an understanding of the whole despite the fact that the full intention was not explicitly stated.

In short, if sentence understanding were linear like sentence expression, then arriving at a single unified understanding at the end of a sentence would be in conflict with linearity. When we hear the consecutive words of a sentence, we understand each of them; and when the sentence ends, we arrive at an understanding of the whole. At that final moment, do we have an understanding of the last word or of the whole sentence? We have certainly understood the individual words, but it is not possible to hold two separate understandings at the same time, one of the whole sentence and one of its last word, because conscious experience is unified at any single moment. According to the theory of the unity of consciousness proposed by Bayne and Chalmers (2003), any set of conscious states belonging to a subject at a given time is necessarily unified.

Given that we face a phenomenon like understanding a whole sentence in a single moment, sentence understanding cannot be linear in the way sentence expression is. In what follows, we try to show how different parts of a sentence contribute to the understanding of the whole. The aim is to show that arriving at a unified understanding of the whole sentence depends on forming understandings of parts larger than individual words. If this can be shown, the linearity of sentence understanding is refuted, and an alternative can be proposed.

4. Ladder Understanding of Language

Consider the sentence: "Sara has a broken chair." The terms "Sara", "has", "a", "broken" and "chair" are expressed consecutively and understood in the same order, until a final understanding of th e whole sentence is reached. This paper argues that although words are expressed consecutively, they are not understood in a purely word-by-word fashion. Understanding units larger than individual words are formed during the process of understanding a sentence, and it is these units that make a unified final understanding possible.

We form understandings of entwined phrases within a sentence. We can develop an understanding even when we hear a sentence fragment or an incomplete sentence. This understanding may be vague, but it is present and plays a role in the final understanding of the whole sentence. For example, imagine hearing: "... a long and dark road leading ..." You develop an understanding of this fragment. Now, when you hear the full sentence, "It was a long and dark road leading to an old castle covered with moss," it is reasonable to suppose that the understanding you had of the fragment is also present within the understanding of the whole sentence.

If we look closely at the situation in which a sentence is suddenly cut off, we can see that we have understood the whole fragment, not just the last word. We grasped the phrase "a long and dark road leading" as a unit, without consciously attending to each word in isolation. This shows that larger understanding units are formed within the process of hearing a sentence.[3]

When we hear a sentence, it is not the case that words are understood one by one and nothing more. If that were so, how could a single unified understanding of the whole sentence arise at the moment the last word is spoken? At any single moment, we can have either an understanding of the last word or an understanding of the whole sentence. Intuitively, when we hear a sentence, we arrive at an understanding of the whole, not merely of the last word.

The parts of a sentence contribute to understanding the whole. But we need to distinguish between sentence expression and sentence understanding. A sentence is expressed progressively, so that when the last word

[3]Given that at any single moment we can only have one unified conscious state.

is spoken, the earlier words are no longer present. Yet the listener has arrived at an understanding of the whole sentence. This shows that the linearity found in expression is not found in understanding, because if it were, it would be impossible to hold an understanding of the whole sentence at the end of it.

Consider the sentence: "Last night my heavy antique table was stolen." According to the principle of linear expression, "night" is spoken before "my." But from the perspective of understanding, "night" is not placed next to "my." There is first the understanding of "last night," and this understanding then combines with "my heavy antique table." If we do not acknowledge that understanding units larger than individual words are formed, we cannot explain how a unified understanding of the whole sentence is arrived at. When we hear the verb phrase "was stolen" at the end, we can only have an understanding of the whole sentence up to that point if an understanding of the preceding fragment, "my heavy antique table," has already been formed, and if that understanding together with "was stolen" has produced the final unified understanding.[4]

In other words, if "night" were simply placed next to "my" with no intermediate understanding units, one might argue that we could hear the last word of the sentence without yet having an understanding of the whole. In that scenario, every word would have its own understanding and would only later play a role in an understanding of the whole. But we know intuitively that this is not how understanding works.

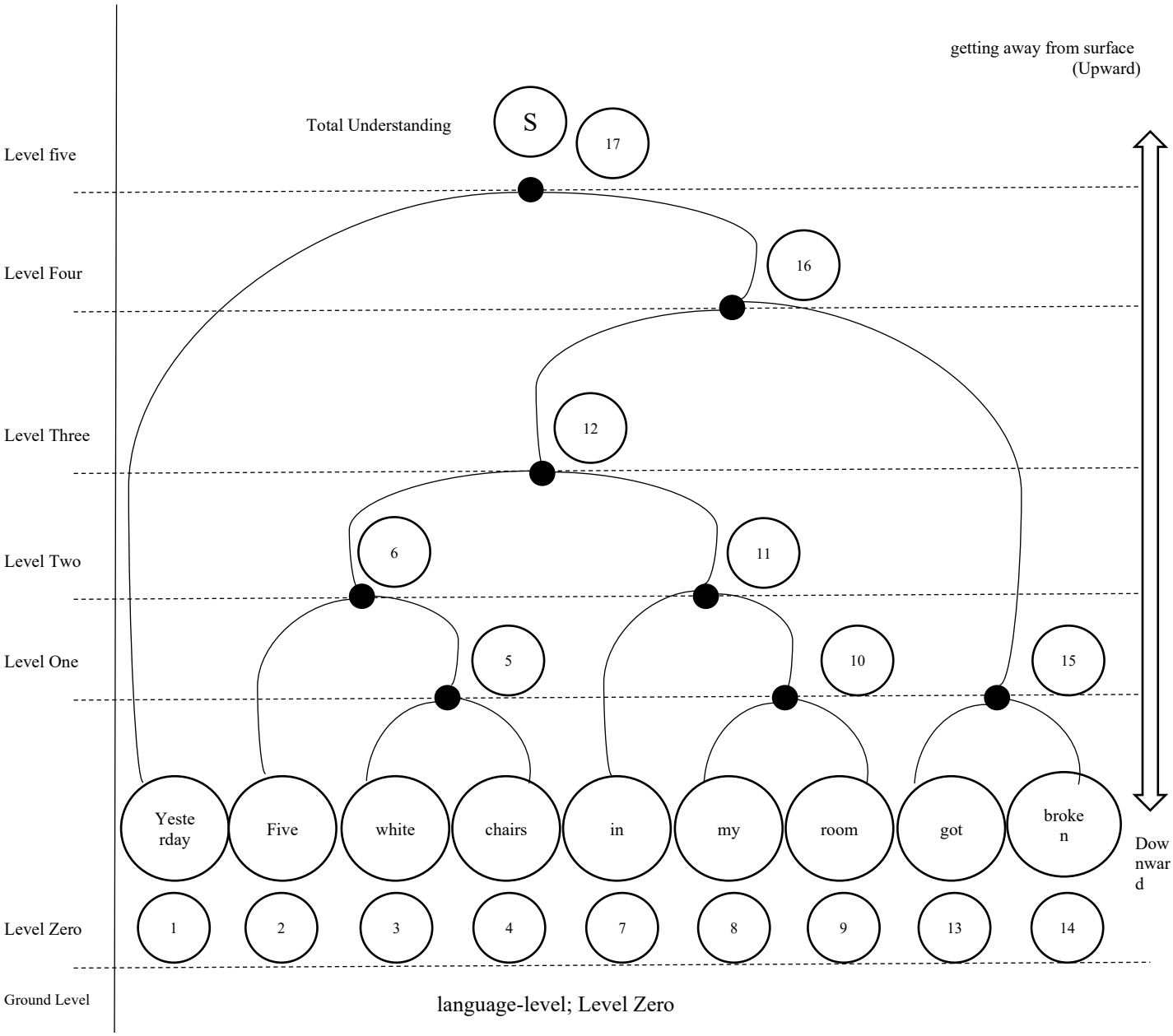
If we accept that fragments within a sentence are understood in addition to individual words, we can explain the role of a word like "heavy" in the final understanding of the sentence above. This word plays a role in the formation of a new understanding of "heavy antique table." This understanding is separate from the understandings of "table," "antique," and "heavy" in isolation. We are faced with a third and new understanding, and it is by recognizing the formation of this kind of understanding unit that we can explain how sentence parts contribute to the final understanding of the whole.

Not only do we form third understandings of two or three word fragments, but other entwined understandings are formed at various levels on the way to the final understanding. Consider: "Yesterday, five white chairs in my room got broken."[5] The entwined understandings formed in arriving at the final understanding of this sentence are illustrated in the graph below.

[4]This is comparable to musical notation or arriving at the final result of a complex mathematical formula. For example, the final result of the following formula, as a complex expression consisting of larger units, equals S: (((x+y)*z)/(x2*(y+z))/6)=S

[5]The graph was adopted from *Multiplication of Understandings* (Arbabi, 2010: 408).

Ladder understanding diagram for "Yesterday, five white chairs in my room got broken."



As shown in the graph, in addition to individual words, other understanding units are formed during the process of understanding a sentence. In this example, understanding units at levels 5, 6, 10, 11, 12, 15, and 16 all contribute to the understanding of the whole sentence. When we speak of the role of entwined understanding units in arriving at a final understanding, we are referring to understanding units at different levels, as shown in the graph.

Therefore, similar to sentence expression, sentence understanding occurs over time. But unlike expression, which proceeds only along a horizontal axis, understanding also has a vertical axis. It is this vertical axis that explains how a single, unified final understanding of the whole sentence becomes possible. This is why the model is called ladder understanding of language.

5. Understanding Levels and the Vertical Axis

To show how and on what basis understanding units are formed within a sentence, we can try to simulate the reverse process: starting from a final understanding of a sentence S and dividing it into smaller understanding units until we reach the most basic ones.[6] Imagine that you are the speaker of the sentence. The speaker already has an understanding of what she intends to express, and this understanding is analogous to the single, final understanding that the listener will arrive at. A physicist, for example, has an initial understanding of a physics concept and breaks it down into smaller units in order to convey it to a listener.

The speaker's understanding of the whole sentence, as she works to express it, ultimately leads to what we call words at the base level. These basic units are what I call level-zero or language-level understandings, that is, the horizontal axis in the graph presented above. The reason we treat words as the primary understanding units at this level is that words are the units available at the language level that, unlike larger units requiring a third or composite understanding and greater mental work, are already accessible and understood by the listener with minimal effort. Words are treated as the standard units of sentence understanding.

This is clearly a relative concept. It depends on who the listener is, on the kind of relationship between speaker and listener, and on how familiar each is with the other's language. But here we assume a standard case. In *Philosophical Investigations* (1958: 197), Wittgenstein uses the example of a mason and his assistant to illustrate a language game. When the assistant hears the word "slab," they understand each other without any mental work. But if the mason wanted to explain "slab" to someone unfamiliar with

[6]For a fuller account of this division-based idea, see Arbabi (2010: 382-407).

construction terms, he would need to break down the concept into other words, and it would matter a great deal whether the listener knew the relevant vocabulary or not. The situation would be different again if he were explaining it to a child.

We therefore assume a level zero consisting of words that are already available at the language level and require minimal mental work to understand. Not every single word qualifies as a unit at this level. What we are assuming is a level zero made up of words we already know. Standard words are treated as the final, basic understanding units.[7]

These words are easily accessible and understood with minimal effort. For example, if we had "FWC" instead of "five white chairs" at the primary level of language, we could say: "Yesterday, FWC in my room got broken." But because "FWC" is not available at the language level, we need a phrase, which requires a higher level of mental work to understand. The term "slab" functions similarly for the mason and his assistant: it is not available to other users of the language in the same sense, yet for them it can be understood with minimal effort.

In breaking understandings down into smaller parts, the aim is to reach a point where entwined and composite understandings are formed with minimal mental work. Similarly, in the higher levels of the graph, new units are formed that are understood with progressively less mental work. The basic constituent units are those understood with the least work, because they are at the language level. Higher understanding units, by contrast, are formed with more mental work. The amount of mental work required depends on factors such as the context of the conversation, the listener's familiarity with the vocabulary, and familiarity with relevant grammatical patterns. All of these factors influence how much mental work is needed to form larger understanding units.

6. Mental Work in Sentence Understanding

In this paper, mental work serves as the central concept for explaining the ladder model as an alternative to the linear model. The "law of least mental effort"[8] is useful for explaining how sentence understanding is organized around sentence parts. This principle indicates that we tend to choose strategies that require less effort (see Kool et al., 2010).

We know intuitively that different levels of mental work are required to understand phrases like "a green apple" and "a handsome apple." The first is more familiar and is understood more easily than the second. Van Petten and Kutas (1990) and Smith and Halgren (1987) have shown that sentences consisting of

[7]The word "slab" exists in the language, but not in the specialized sense the mason and his assistant use it.

[8]The law of least mental effort states that, everything else being equal, the brain tends to minimize mental effort during task performance by avoiding decisions that require greater cognitive demand (Patzelt et al., 2019).

commonly used word combinations are understood more quickly. For example, "John saw a heavy stone" is understood more quickly than "John saw a happy stone."[9] This can be explained by accessibility. "A heavy stone" is a familiar phrase; "a happy stone" is not. Different levels of accessibility correspond to different recognition times.[10]

We also notice intuitively that different phrases are understood differently. For example, "table and chair" is understood more easily than "table and cup," and "a green apple" is understood more easily than "a happy apple." Both phrases in each pair can eventually be understood, but the familiar one requires less mental work.

As used in this paper, mental work refers to a relatively simple phenomenon: the more familiar and accessible the words and phrases within a sentence are, the less mental work is required to understand them; the more novel and unfamiliar they are, the more mental work is required. This can be illustrated with everyday examples.

Imagine preparing a meal like pizza. The less available the necessary ingredients are, the more effort is required to make it. If you buy a pre-made pizza, you simply warm it, and this requires far less effort than making one from scratch. Similarly, a physics formula is understood much more easily by a physicist who already knows the relevant concepts than by someone with no background in the field. The same principle applies to sentence understanding.

As noted earlier, when we hear a sentence, we arrive at a final understanding of the whole. This final understanding is related to the understanding of the sentence's parts. Entwined understanding units formed from combinations of words and phrases contribute to the final understanding. The level of mental work required depends on how familiar the relevant words and phrases are. The more familiar they are, the less mental work is required.

Several explanations for this have been proposed. Saussure, for instance, explained it through what he called agglutination: when two or more language units that are essentially separate are used together frequently, they come to form "an absolute unit that is hard to analyze." When a compound expression has been formed through a very common string of meaningful units, the mind takes a shortcut, skips analysis, and treats the whole string as a simple unit (Saussure, 1915: 175-6). Steinberg (1993: 124) similarly notes that commonly used phrases are stored in memory like single words. Speakers treat familiar phrases as single units when

[9]According to these studies, the average recognition time for commonly used phrases is around 400 ms, which is taken as the standard baseline.

[10]Other studies have shown that words that are semantically close, such as doctor-nurse, are also understood more quickly. For further examples, see Kutas et al. (1984), Bentin and Wood (1985), and Holcomb and Neville (1990; 1991).

expressing or understanding them, without applying grammatical rules each time. The more frequent a word or phrase, the more accessible it is.

Grammar is another important factor that facilitates sentence understanding. Nouns and adjectives, for example, frequently appear together, and we have heard them together many times. Each time we encounter them together, we expect them to play the familiar role they have always played. As a result of this expectation, which need not be conscious, we understand phrases more quickly and with less mental work. Consider phrases such as "the room's white chair," "her beautiful dress," "the big house by the beach," and "Grandpa's farmiloo library." We recognize, based on our knowledge of grammar, that a noun and adjective belong together; additional, larger understanding units are also formed on that basis. Although we have never heard the word "farmiloo" before, a composite understanding of "farmiloo library" is still formed, followed by a larger understanding of "Grandpa's farmiloo library." This shows that grammar facilitates understanding through the operation of less mental work.

There are many factors that can facilitate sentence understanding along the lines of less mental work, and a full discussion of them is beyond the scope of this paper. The central point is that sentence understanding can be explained through the concept of mental work, and that this concept is what drives the formation of entwined understanding units within a sentence.

The level of mental work required, which varies depending on the knowledge of the speaker and listener, their backgrounds, and the context of the conversation, is the main factor explaining why and how entwined understanding units are formed. It is precisely because of the operation of less mental work that one particular third understanding, and not another, is formed at each level.

7. Objections and Replies

One possible objection to the argument presented here is that we do not consciously notice the formation of entwined understandings when we hear a sentence.

This objection is, in part, correct. We do not seem to be consciously aware of each entwined understanding as it forms. However, this does not mean that entwined understandings are not formed. It shows, rather, that we are so familiar with common phrases in our language that we do not need much mental work to understand them. The level zero of language, as described above, often includes not only individual words but also common phrases. Many phrases are understood like single words, with minimal mental work. For example, understanding "white chairs" is similar to understanding a single word, because it is a very common phrase. One might argue that when we hear "white chairs," two separate understandings and a third composite understanding are not formed; rather, a single understanding of "white chairs" is accessed directly, as if it were at the level zero of our language. If we compare this with "honest chair," we can

intuitively feel that the latter requires more mental work, and that a third composite understanding is formed that is distinct from the understandings of "honest" and "chair" in isolation.

Furthermore, the less mental work required to arrive at an understanding, the closer that understanding is to the language level. For example, "naughty boy" consists of two words placed in sequence, but because it is a very common phrase, it is not the case that "naughty" and then "boy" are understood separately, followed by a composite understanding. We are simply faced with a single understanding of "naughty boy," which functions like a single word at the zero level of language. Although two words are heard, and one might expect two understandings followed by a third composite one, from the perspective of meaning, we have only one understanding of "naughty boy." This again shows that understanding a phrase is not the same as expressing it.

Here we can also speak of the relativity of the language level. When we are very familiar with a phrase and have encountered it many times, less mental work is required to understand it, the zero level of language begins from a higher point on the ladder, and fewer entwined understandings are formed. When we are unfamiliar with a phrase, or when it has an unusual structure, more entwined understandings are formed at more levels.

It is also worth noting that we are sometimes not consciously aware of understanding a sentence at all. We may hear "Yesterday, it rained heavily" without paying any conscious attention to our understanding. But if we hear "Yesterday, the rainfall was heavily happy," we are likely to notice our understanding of this sentence, and perhaps revisit the previous one. So sometimes we do not notice our understanding of a sentence or the entwined understandings within it, not because they do not exist, but because we are not paying attention to them. It is when we encounter unusual or unfamiliar combinations like "happy stone" that our attention is drawn to the process of understanding.

Another objection is that the model depends on a level zero at which no mental work is required, while we know intuitively that some level of mental work is always required, even for the most familiar words and phrases.

The level zero introduced in this paper does not exist as an empirical reality. Some degree of mental work is always required. The language level with zero mental work is a theoretical construct, introduced for the purposes of argument. Despite this idealization, the overall argument remains valid.

This is also consistent with the earlier point that the level zero may include phrases larger than single words. The closeness of a word or phrase to the level zero does not mean that its understanding is always consciously noticed. We consciously attend to understanding when the required mental work is high, that

is, when the word or phrase is very unfamiliar or unexpected. The minimal level of mental work that is always present does not itself bring understanding into conscious attention.

8. Conclusion

The main aim of this paper was to show that the common assumption that sentence understanding follows a linear pattern is not correct. Although sentences are expressed in a linear way, they are not understood in the same way. Sentence understanding is better explained by the ladder model than by the linear model.

In brief: when we hear a sentence, we arrive at a unified understanding of the whole, and we recognize this understanding directly. The parts of the sentence contribute to this final understanding. We examined what role those parts play. When we hear a sentence, we understand the whole. When we hear a fragment of a sentence, we also understand what we have heard. Given that we cannot have two different understandings at the same moment, we can either have an understanding of the last word or of the whole sentence, not both simultaneously. This means that our understanding of a sentence is different from our understanding of its isolated parts. Therefore, when we hear a sentence, other understandings are also formed along the way, and these contribute to the final understanding. If entwined understandings are not formed during sentence comprehension, the role of sentence parts in the final understanding of the whole cannot be explained. The formation of these entwined understandings is explained by the ladder model, which is grounded in the principle of less mental work.

Even if one were to reject the explanation in terms of mental work, the main claim still stands: understanding the whole sentence requires forming understandings of its entwined parts. If we accept that understandings other than those of consecutive individual words are formed when we hear a sentence, that is, if we accept a vertical axis in the language understanding graph, then the idea of linearity in language understanding is decisively challenged. Language is expressed in a linear way, but linearity cannot adequately explain language understanding. Language understanding cannot be fully explained without assuming a vertical axis, and the ladder model provides the framework for that explanation.

References

Arbabi, Behin, 2010, *Multiplication of Understandings* (in Persian: Zarbefahmha), Tehran: Arbabi.

Arbabi, Behin, 2007, *Language of Understandings, Language of Things* (in Persian: zaban-e fahmha, zaban-e chizha), Tehran: Arbabi.

Bentin, S., McCarthy, G., and Wood, C. C. (1985). Event-related potentials associated with semantic priming. *Electroencephalography and Clinical Neurophysiology*, 60, 343-355. https://doi.org/10.1016/0013-4694(85)90008-2

Chalmers, D., and Bayne, T. (2003). What is the unity of consciousness? In *The Unity of Consciousness: Binding, Integration, and Dissociation*, 23-58.

Holcomb, P. J., and Neville, H. J. (1991). Natural speech processing: An analysis using event-related brain potentials. *Psychobiology*, 19(4). https://doi.org/10.3758/BF03332082

Holcomb, P. J., and Neville, H. J. (1990). Auditory and visual semantic priming in lexical decision: a comparison using event-related brain potentials. *Language and Cognitive Processes*, 5, 281-312. https://doi.org/10.1080/01690969008407065

Kool, W., McGuire, J. T., Rosen, Z. B., and Botvinick, M. M. (2010). Decision making and the avoidance of cognitive demand. *Journal of Experimental Psychology: General*, 139(4), 665. https://doi.org/10.1037/a0020198

Kutas, M., Lindamood, T. E., and Hillyard, S. A. (1984). Word expectancy and event-related brain potentials during sentence processing. In S. Kornblum and R. J. (Eds.), *Preparatory States and Processes* (pp. 217-237). Hillsdale: Erlbaum. https://doi.org/10.4324/9781315792385-11

Patzelt, E. H., Kool, W., Millner, A. J., and Gershman, S. J. (2019). The transdiagnostic structure of mental effort avoidance. *Scientific Reports*, 9(1), 1-10. https://doi.org/10.1038/s41598-018-37802-1

Saussure, Ferdinand, 1915. *Course in General Linguistics*, trans. by Wade Baskin. New York: McGraw-Hill.

Smith, M. E., and Halgren, E. (1987). Event-related potentials during lexical decision: Effects of repetition, word frequency, pronounceability, and concreteness. *Electroencephalography and Clinical Neurophysiology*, Supplement 40, 417-421.

Steinberg, Danny, 1993, *An Introduction to Psycholinguistics*. London: Longman.

Van Petten, C. and Kutas, M. (1990). Interactions between sentence context and word frequency in event-related brain potentials. *Memory and Cognition*, 18(4), 380-393. https://doi.org/10.3758/BF03197127

Wittgenstein, L. (1974). *Philosophical Grammar: Part I, The Proposition, and Its Sense, Part II, On Logic and Mathematics*. Blackwell: Oxford University Press.

Wittgenstein, Ludwig, 1958, *Philosophical Investigations*. Oxford: Blackwell.

Wright, C. (2001). *Rails to Infinity: Essays on Themes from Wittgenstein's Philosophical Investigations*. Harvard University Press.