A Non-Realistic Approach for Natural Languages

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Abstract

The structure of natural languages is usually studied from three major different but interconnected points of view: syntax, semantics, and pragmatics. If we consider that the main purpose of natural languages is communication, we should consider another dimension for languages, which deals with the influence of internal states of communicating individuals on meanings. Such a dimension we refer to as *internalism*. Within this context, internalism cannot be confused with psycholinguistics, in the same way pragmatics cannot be confused with sociolinguistics. In particular, we argue, language is tied to its systematic use. This view leads us to a non-realist perspective on linguistics. We analyze the role of natural languages into dialogues, by comparing our proposal to the dialogical approach to logic, which considers a dialogue as a game. Within our approach, there is no way to guarantee that two parties involved in a dialogue are playing the same game, due to unavoidable (and frequently hidden) differences in their respective internal states. Another contribution of this paper is to argue that semantics plays a more fundamental role than syntax in the cognitive acquisition of languages.

Key words: semantics, pragmatics, syntax

1 Introduction

In order to understand the structure of natural languages, it is usual to split their components into three major dimensions, namely, syntax, semantics, and pragmatics. But other aspects play an important role into the structure of a language, such as those studied in phonetics, phonology, and morphology. Sociolinguistics, psycholinguistics, dialectology, neurolinguistics, ethnolinguistics, historical linguistics, and computational linguistics refer to specialized studies for the understanding of the ways in which languages relate to other disciplines in addition to linguistics.

Nevertheless, before stating the fundamental components that define the structure of a language, it is important to be clear about the philosophical point of view about linguistics that is adopted. Otherwise, we are condemning ourselves to fragile methodological and epistemological grounds for linguistics. The delicate equilibrium between linguistics, as a social endeavor of scientific character, and its epistemological grounds has been a motivation for disturbing discussions about, for example, "psychological reality" [14, 15, 9].

A realist perspective, for our purposes, considers that the existence of a natural language, defined by syntax, semantics, and pragmatics, is independent of any individual's belief. And a non-realist perspective considers that a language can exist if and only if there is at least one conscious individual that believes to grasp a minimal content about such a language (enough for the identification of some of its central features). That means that a language is defined by its user.

In this paper we adopt a non-realist standpoint for linguistics. After all, without communicating agents, there can be no language at all. Moreover, we argue throughout the paper, there is no guarantee that two individuals share the same perceptions and beliefs about the meaning of utterances. Finally, there is a huge variation at all levels of linguistic organization [21], which allows us to be quite skeptical about the existence of linguistic universals. In other words, any claim that a natural language is an

emerging social phenomenon that exists by its own merit is unsustainable, at least from a non-realist perspective about linguistics. A good example that illustrates our thesis is the statement "You know what I mean" (and its cousin "Oh, come on"), so common in everyday discussions. On our view, the use of language requires a state of the mind that may generate the impression that there is an emerging linguistic phenomenon common to all individuals from a specific group. It is unclear that a natural language can exist without at least one individual who effectively believes in its existence and tries to use it for communication purposes, either successfully or not, at least from the point of view of that individual. Therefore, internal states (such as psychological mental states) should be taken into consideration if we are trying to understand a human and natural language. The fact that all natural languages are supposed to be equipped with a semantic counterpart, according to both common sense and the specialized literature, emerges from a ubiquitous psychological trait, namely, the compulsory need for meanings to express something [12].

Since we claim that a language can exist if and only if there is at least one conscious individual that believes to grasp such a language, we are forced to admit that there is exactly one - and one alone - individual that believes to grasp such a language. Otherwise, we would be forced to admit that two individuals may share the same language, an hypothesis that contradicts our statement that a language is defined by its user (even in the case where there is a shared vocabulary). And there is no way to guarantee that two individuals share the same internal state in order to unavoidably attribute the same meaning for a given string of that language. Different communicating individuals may eventually share one single vocabulary. But vocabulary is not enough to define a language, even in the case where syntax is provided.

Consider the case of mathematics, in which it is sometimes argued that meanings are irrelevant—a view that is often, albeit not very accurately, attributed to David Hilbert ([20]). It is, of course, difficult to understand mathematics when one sees no meaning in the mathematical concepts stated by mathematical languages. And mathematics is easier to understand when one realizes its applicability to the real world, a world that helps users to see the rich meanings involved. Even pure mathematicians, who often develop their mathematical theories quite independently of any application, communicate their ideas by using natural languages. No mathematical paper and no mathematics lecture makes use of formal languages alone without the support of natural languages. So, meaning is unavoidable in both cases.

Our non-realist view of natural languages is opposed to Saussure's distinction between *langue* (a socially shared collection of conventions) and *parole* (the particular instruments used by a speaker deploying a language) [34]. After all, Saussure's view about linguistics was affected by his own particular internal states. More generally, linguists talking about natural languages, by using natural languages, are unavoidably trapped into a particular logical ambush, subject to their own particular internal states and their own personal perceptions about allegedly shared perceptions on languages and the world. Of course, the authors of this paper face the same problem. So, for the sake of consistency, only *parole* is considered real (with some adjustments), while *langue* is not.

Chomsky's realist view, on the other hand, is related to his notion of I-language [6, 7], which, based on Otto Jespersen's ideas [23], is individual, internal, and intentional. I-language denotes linguistic knowledge, a particular mental or psychological state. The problem this view faces, however, can be found, e.g., in the following passage [6], p. 22:

> Taking language to be I-language, the grammar would then be a theory of the I-language, which is the object under investigation. And if, indeed, such a "notion of structure" exists, as Jespersen held, then questions of truth and falsity arise for grammar as they do for any scientific theory".

A good criticism of this I-language doctrine is offered in some works by Michael Devitt, referred to above [14, 15]. In what follows, we provide a brief analysis from our non-realist perspective (which, thus, differs from Devitt's realism). The very notions of truth and falsity rely on meanings, which are treated by Chomsky as being independent of anyone's beliefs. They are often taken to be unavoidable and inherent to any scientific theory. Indeed, on certain views, the notions of truth and falsity guide large portions of the scientific enterprise [28]. But there are other possible semantic values that can be used even in the experimental sciences, such as the notion of partial truth [11]. Furthermore, in the case of formal logic, even the classical propositional calculus is not restricted to only two possible semantic values, but its formulas may be interpreted in a multi-valued semantics that has nothing to do with truth or falsity [26]. And returning to the experimental sciences, there are many well-known limits to interpretation in quantum mechanics [1]. In particular, depending on the interpretation given to quantum mechanics,

different quantum states may be simultaneously associated with the same physical system. In other words, Chomsky's interpretation to the string "scientific theory" is different from ours. And different semantics entail different natural languages. That is an example of how difficult it is to communicate ideas through dialogues. More than that, we show here how difficult it is to even understand what a natural language is.

The success of language as an instrument of exchange of ideas along thousands of years of human civilizations reinforces everyone's beliefs on the existence of collective beliefs, such as languages, commonly treated as emerging social phenomena. That entails a conundrum! Suppose Mary says to John that, no matter what they say to each another, they are never talking the same language. If John unconditionally agrees with Mary (granting she is right), then he is providing evidence that Mary is wrong. After all, both of them seem to understand language the same way, since the understanding of what a language is depends on a semantic value attributed to the string "language". And, if John strongly disagrees with Mary (stating she is wrong), then he is providing evidence that Mary is right. After all, they seem to understand language in different ways. Besides, if Mary believes that they are not talking the same language, why is she talking to him anyway? A possible solution to this epistemological problem is provided in section 3.

Nevertheless, despite all the successes of language, the very existence of multiple interpretations for the same text (such as in the case of philosophical exegeses, so common in literature) reveals that something odd may be going on with natural languages. Even the traditional tripartite analysis of knowledge as justified true belief is strongly supported by subjective perceptions about knowledge: belief is an introspective state, including the belief on justification and truth. So, within our perspective about this traditional view, knowledge is a belief supported by other beliefs. Within this context, one could ask: Why is the tripartite analysis of knowledge a problem about language rather than a problem about the concept of knowledge (since the tripartite analysis requires belief but not necessarily belief in justification and truth)? Our answer is this: any problem about the concept of knowledge is a problem which depends on the language used to formulate such concept. Otherwise, there wouldn't be so many interpretations on the philosophical literature about concepts like truth and justification. That is why in this paper we examine both successes and failures of dialogues within the very same framework.

In addition to non-realism, we adopt the philosophical point of view that there are interferences on meanings associated with utterances, caused not just by context, but also by unknown elements lurking among those who communicate. A mathematician may understand the meaning of the string "mathematics" in a rather different way than a person who does not have any formal training in mathematics. That's because the internal state of a mathematician is different from the internal state of a non-mathematician. More than that, the internal state of a mathematician may be a complete mystery for, e.g., a lawyer. And that is a very relevant feature on the effective use of languages, supported by solid evidence, as we shall see along the paper. An example much less radical than this (a quite simple dialogue about the safety of a car) is provided in section 3 to illustrate such interferences.

In this sense, we consider that internal states of communicating individuals (which include previous personal experiences and even psychological traits) are indispensable components of natural languages, due to its effects on the interpretations attributed to utterances. Internal states interfere on semantics. That is the rationale that explains why we prefer to split natural languages into four dimensions: syntax, semantics, pragmatics, and internalism.

Pragmatics is the study of the ways in which context contributes to meaning. Contexts interfere on meanings and interpretations of uttered strings help to develop social contexts. So, pragmatics is entangled with semantics. Nevertheless, even in the case of shared experiences (stimuli), people understand contexts in different ways, according to their internal states, which depend on previous personal experiences, cognitive capabilities, and emotional skills and states. One good example is the movie "Small Time Crooks", written and directed by Woody Allen. The main character is known as "Brain" among his former cellmates. This character understands his nickname as a compliment, although his friends were just ironic about that. The audience laughs because their internal state differs from Woody Allen's character. Without the internal counterpart of languages we propose, there would be less humour in the world, maybe none. So, we are taking jokes very seriously here.

We adopt an empiricist view about the physical world, in the sense that we admit the existence of a real world formed by the environment and communicating agents, independently on their beliefs. That is why we are keeping the pragmatic dimension of natural languages. Contexts are real and may be physically and emotionally felt. But languages emerge from individual internal states, stimulated by social contexts, nothing else. Languages rely on individual internal states that can be physically manifested

by communicating individuals who produce sounds, inscriptions and signals in general, including body language. But the interpretation of those sounds and inscriptions has nothing to do with any natural language if there is no one to interpret them. And if there is no interpretation, then there is no semantics. If there is no semantics, there is no natural language.

Since communication is paramount in our framework for natural languages, we have no choice but to discuss concrete dialogues (dialogues in natural languages). And dialogues are usually treated as a game, within a dialogical approach to logic [30]. Our main point is that there is no systematic way to guarantee that two interlocutors engaged in the same dialogue are playing the same game, due to the introspective character of natural languages. Nevertheless we are still able to endow natural languages with epistemological grounds by means of a *convergence principle for meanings*. The idea is quite simple, although extremely general. The longer an uttered string, the narrower is its corresponding set of possible meanings. If an interlocutor feels that any hope for convergence of meanings is impossible, then a new dialogue should get started.

In the next section we recall and discuss some basic mathematical concepts which are necessary for the development of our proposal. The syntax of a natural language may be mathematically provided by means of algebraic concepts which may be considered common to two or more interlocutors. That is why we need this mathematical discussion. In section 3 we introduce our non-realistic approach for natural languages, with special emphasis on *the principle of convergence for semantics*. We analyse our ideas from the perspective of dialogical logic principles applied to concrete dialogues, which are mathematical tools briefly discussed in section 2, as pre-requisite. In section 4 we show how syntax is built from semantics. In section 5 we justify why natural languages are successful on everyday usage and how they can be a frustrating failure when two interlocutors have considerable differences in their respective internal states. In the last section we close this paper with final remarks and some open problems.

2 The Mathematics of Natural Languages

There are many mathematical models and theories for the study of natural languages [3, 4, 5, 16, 19, 38]. But we are particularly interested on two mathematical proposals. Our starting point for the understanding of natural languages is the formal language of a set theory, for example, NBG [26]. Let A be a finite set, called *alphabet*. The set of all *words*, or strings (finite sequences) of elements of A, is denoted by A^*. A *set-theoretical language* L on A is any non-empty subset of A^*. We can understand the juxtaposition of words as a binary operation $+$ on A^*, such that $+$ is associative. In this sense, A^* endowed with $+$ is a free semigroup, where the empty word $\emptyset$ (the empty word always belongs to L) is the neutral element with respect to $+$. For the sake of abbreviation, if there is no risk of confusion, we say that L is a set-theoretic language if there is an alphabet A such that L is a set-theoretic language on A.

In a very broad sense, a semantics of any set-theoretic language L is a correspondence from all strings of L to subsets of elements of a non-empty domain Δ such that the intersection $L \cap \Delta$ is empty. In other words, a semantics of L is a function $s : L \to \wp(\Delta)$, where $\Delta \neq \emptyset$, $L \cap \Delta = \emptyset$, and $\wp(\Delta)$ is the set of all subsets of Δ. Usually, s is not surjective. s is the *semantic function* and Δ is the *domain of all possible meanings*.

For example, consider a set-theoretic language L such that $\emptyset$, "delicious", "green", "apple", "greenapple", and "deliciousgreenapple" belong to L. In this case,

$$\text{green} + \text{apple} = \text{greenapple},$$

due to the way $+$ is defined, as a juxtaposition of words. And

$$\text{delicious} + (\text{green} + \text{apple}) = (\text{delicious} + \text{green}) + \text{apple} = \text{deliciousgreenapple},$$

due to the associativity property of $+$.

This algebraic model for set-theoretic languages is quite interesting from a historical point of view. The history of written languages confirms that most ancient European texts were written in *scriptura continua* (continuous script), without spaces between words. That was the usual practice from The Iliad to religious manuscripts of the seventh century. Exceptions may be found among ancient Hebrew manuscripts and the earliest Greek papyri. But on those cases, separation between words was a practical issue, since those texts have words with no vowels [33].

The introduction of spacing between words, capital letters, punctuation, paragraphs, itemization, apostrophe, and other auxiliary symbols for clarifying meaning was a social practice evolution that contributed to the common belief that languages are emerging social phenomena that may exist by their own merit. Nevertheless, such a social evolution establishes only that natural languages are much more than just set-theoretic languages.

Natural languages can be affected by social contexts. That's because social contexts affect individual beliefs, while individual beliefs less frequently affect social contexts throughout the use of natural languages. One good example is the fact that one single individual's belief on unicorns (in the sense of interpreting the string "unicorn" as a real horse with a single large, pointed, spiraling horn projecting from its forehead) does not necessarily entail that a whole community will interpret the string "unicorn" in the same way.

Concerning semantics, if α is a string from L, then $s(\alpha) \subseteq \Delta$, where s is the semantic function defined above. This means that $s(\alpha)$ is the set of all possible meanings that an individual is able to accept for string α, according to its internal state. In this paper we use the symbols $\subseteq$ and $\subset$ to denote subset and proper subset, respectively. For example, consider the string "bed" from the set-theoretic language L associated with English. The word "bed" may be interpreted as any real bed that existed, exists or will exist. Actually, the word "bed" may be interpreted even as an imaginary bed, such as the plastic bed where Alexander, the Great, slept every night during a military campaign (plastic was invented in the 19th century and Alexander, the Great, died more than two thousands years before that). Furthermore, the word "bed" may be interpreted as the abstract category of all beds and even as a bed in a extended sense, such as a bedrock. This quite simple example illustrates just partially the magnificent ambiguities in natural languages. That is another reason to approach such languages from a non-realist perspective. Different individuals have different internal states. They may believe that they share a particular belief. And if two individuals engaged in a dialogue believe that both share the same natural language, they may eventually believe that they agree with each another (or disagree). But there is no guarantee that such beliefs are true, since there is no third party (a meta-judge) that knows all about their respective internal states. In order to narrow possible interpretations for a given string α, new strings are supposed to be juxtaposed to α, thus forming longer strings.

When any individual I either receives or transmits a string α, in a dialogue situation, one single element from $s(\alpha)$ is chosen by I, according to its internal state. That choice may be changed as long the dialogue proceeds. But that change will just replace one element from $s(\alpha)$ for another element from $s(\alpha)$ in the case of a dialogue that provides no learning experience. And more than that, dialogues may eventually allow either a new possible meaning for α to be added to $s(\alpha)$ or an old possible meaning for α to be removed from $s(\alpha)$. That is a learning experience. Learning is a particular process of belief change.

At this point it is worth to remark that our proposal cannot be confused with the notion of *alternative semantics* rooted in the work of Charles Leonard Hamblin [8]. It is true that the semantic value of a string, in Hamblin semantics, is a whole set of objects. Nevertheless, Hamblin work was motivated by uttered questions in a language, like English. And our proposal considers a much bigger set $s(\alpha)$ of all possible meanings (recognizable by a communicating individual) associated to any string α of an individual's natural language. Thus, in a way, our ideas are considerably more radical than Hamblin's.

Since, for every utterance α, internal states define $s(\alpha)$ as well the choice of a specific element of $s(\alpha)$ (for dialogue purposes), a lot of investigation is required to understand how internal states actually work.

Another mathematical aspect that is relevant in this paper can be found in the historically traditional view of logic as the systematic study of dialogues, which has given birth to dialogical logic. Modern dialogical logic uses concepts of game theory in order to provide a semantics for a wide range of logical systems. Dialogues are simply games where what is at stake is a formula, a string in a formal language. Based on these historical roots, dialogues (in a purely formal framework) are useful instruments for studying, comparing, and combining different formal logics [32]. But in addition to the use of game-theoretic concepts for studying formal logics, there has been an effort to use similar ideas in concrete dialogues that occur in natural languages. One of these attempts is due to Henry Prakken [30], which provides a good review of previous literature dealing with dialogue games, from medieval times to artificial intelligence.

Prakken follows a way similar to L. Carlson [2] and others, by assuming coherence. Coherence refers, simply put, to the goal of a dialogue. In other words [30]:

> [T]he principles governing the meaning and use of utterances should not be defined at the level of individual speech acts but at the level of the dialogue in which the utterance is made.

This justifies why most work on argumentation dialogues, like Carlson, takes a game-theoretic approach to dialogues, where speech acts are viewed as moves in a game and rules for their appropriateness are formulated as rules of the game.

But Prakken himself recognizes that his approach may "be less suited for dialogues where the focus is more on investigation or deliberation than on settling a conflict of opinion".

The point we make here is that any assumption of coherence in dialogues implicitly entails a realist view of natural languages. And that assumption is something we intend to avoid. It is hard to square realism with linguistic matters, since there hardly are universals in linguistics [21]. Even in conflicts of opinion, it is not difficult for any of us to recall hopeless discussions among intransigent people. Emotions and other internal states play a substantial role on how people understand what they hear and even what they say.

3 An Alternative Approach: Internalism

Our proposal is the introduction of internalism as a fourth dimension in natural languages, in addition to syntax, semantics and pragmatics. Internalism is the study of the ways in which internal states of communicating individuals contribute to meaning. More explicitly, we have:

1. A *quasi-natural language* is an ordered triple $\mathcal{L} = \langle L, \Delta, s \rangle$, where L is a set-theoretic language, and Δ and s are the concepts discussed in Section 2.

2. If someone believes that a quasi-natural language $\mathcal{L}$ may be used for communication purposes (in an intuitive sense), then $\mathcal{L}$ is a *natural language*. In order to an individual believe that a quasi-natural language $\mathcal{L} = \langle L, \Delta, s \rangle$ may be used for communication purposes, it is necessary and sufficient that $s(\alpha) \neq \emptyset$ for any α that belongs to L. In other words, all strings of a natural language have meanings.

3. Natural languages are created by individuals for the purpose of communication (concrete dialogues), although they may be used for introspective and solitary activities, such as monologues.

4. Meaning is an introspective process in which an individual develops its own semantic function s. In this sense, the semantic function may change as time goes by.

5. Meaning depends on the internal state of the interlocutor in a dialogue. That internal state is defined by previous personal experiences, cognitive capabilities, and emotional skills and states.

How does the dynamics of a concrete dialogue work between two individuals I and J?

Steps Every dialogue is defined by *steps*. A step starts with an utterance α transmitted from interlocutor I to interlocutor J and stops with the response β uttered by interlocutor J. The next step starts with β previously uttered by J and ends with the response γ uttered by I, and so on. Each utterance is a string of a set-theoretic language associated with a natural language, which is particular to each interlocutor. As long as the dialogue proceeds, those steps have a cumulative effect, generating new strings $\alpha + \beta + \gamma$ that are bigger or equal in size, compared to the previous step $\alpha + \beta$. The size of a string is defined by the number of occurrences of elements of the vocabulary of the individual's set-theoretic language. If both I and J share the same set-theoretic language L, then there is no problem to juxtapose strings uttered by different communicating individuals. Nevertheless, if I and J do not share the same set-theoretic language L, there can be a problem. Within our approach, the operation $+$ is defined for a particular set-theoretic language. So, if I utters α and J responds β, in a situation where β does not belong to the set-theoretic language L_I of I, then I changes its set-theoretic language L_I in order to accommodate β as an element that can be juxtaposed to α, but $s_I(\alpha + \beta) = \emptyset$, i.e., α is meaningless for I. This means that the quasi-natural language $\mathcal{L}_I = \langle L_I \cup \{\alpha\}, \Delta, s \rangle$ is not the natural language of interlocutor I. In that case, the dialogue ends and I and J should start a new dialogue (in a way that either both I and J avoid β or I grants non-empty meanings $s_I(\beta)$ and $s_I(\alpha + \beta)$.

Meanings Each string α transmitted by I and received by J during a concrete dialogue between I and J (we are ignoring communication noise) is unconsciously associated with vast domains of

possible meanings $s_I(\alpha)$ and $s_J(\alpha)$, respectively. $s_I(\alpha)$ and $s_J(\alpha)$ work as data banks that provide all possible meanings to α, according to the internal states of I and J and to the ways they both perceive the shared social context during the dialogue. Such personal experiences concatenated to social context help to build internal states. Nevertheless only one possible meaning $m_I \in s_I(\alpha)$ is consciously chosen by I and only one possible meaning $m_J \in s_I(\alpha)$ is consciously chosen by J, during a step of a concrete dialogue. If $m_I = m_J$, then we may have grounds for believing that both interlocutors are talking similar (in some sense) natural languages. Nevertheless, within a non-realist view of natural languages, there is no unquestionable way to guarantee that $m_I = m_J$. The most we can do is to believe that both I and J believe to be talking similar languages and about the same thing. A more refined view of our proposal should consider the possibility that m_I and m_J are sets of objects (proper subsets of $s_I(\alpha)$ and $s_J(\alpha)$, respectively), like what happens in Hamblin semantics [8]. But that is a task we prefer to explore in the future.

Convergence The bigger the string α, the narrower is its corresponding set $s(\alpha)$ of all possible meanings for α, provided that $s(\alpha)$ is never empty. Eventually either I or J may reconsider the choice for $m_I \in s_I(\alpha)$ and $m_J \in s_J(\alpha)$, as long m_I and m_J belong to $s_I(\alpha)$ and $s_J(\alpha)$, respectively. So, as a concrete dialogue evolves through its steps (by accumulating bigger strings, according to the first item Steps), less options are available for possible meanings. We call this *the principle of convergence for semantics*. That is a feature that is supposed to be common to all natural languages. In a non-realist view of language, as we propose, a convergence principle is fundamentally needed, since the main goal of natural languages is to allow communication among individuals, by narrowing possible meanings for a given string α. The main purpose of natural languages is to develop individual beliefs into a collective belief. Otherwise, the purpose of communication would be hopeless. If there is no convergence for either I or J, then we have no dialogue at all. In this case, all we have is a sequence of utterances.

Here is an example of a hypothetical concrete dialogue between one of us (the authors) and you (the reader). Let us say that I say out loud the string "Mother" to you, by employing usual English pronunciation. What is the first meaning that crosses your mind, when you hear "Mother"? Now consider a longer string, let us say, "Mother of Hitler". What do you make of this new string? What does it mean for you? Finally, consider the new longer string "Mother of Hitler is the name of my dog".

When you first heard the phrase "Mother", in this hypothetical dialogue, you probably thought about your own mother. If you are a mother yourself, it is even probable that you thought about yourself. I seriously doubt you consciously thought about, e.g., Albert Einstein's mother. But when you read the longer string "Mother of Hitler", you reconsidered your interpretation to something else. It is possible that you thought of Adolf Hitler's mother, even if you do not know who Klara Pölzl was. That's because $s_{\text{reader}}(\text{Mother})$ allows the possibility that I was talking about the mother of Hitler. You may have not thought about this before. But you admitted the possibility, at least unconsciously. That is because you believe, by means of your internal state, that even Adolf Hitler had a mother. Nevertheless, when I finally completed my sentence with the cumulative string "Mother of Hitler is the name of my dog", a new meaning pops up in your mind. Now you probably believe that the string "Mother of Hitler is the name of my dog" has little or nothing to do with your mother or yourself. But one thing is for sure: if you ever admitted the possibility that I never heard the name "Hitler" before, now that interpretation for anything I say in the future is simply eliminated. So, the set $s_{\text{reader}}(\text{Mother of Hitler is the name of my dog})$ has less elements than the set $s_{\text{reader}}(\text{Mother})$. That's the principle of convergence for semantics in action.

Now let us consider an example of concrete dialogue previously examined by Prakken [30]. We are keeping the parenthesis with observations made by Prakken himself.

Paul: My car is very safe. (making a claim)

Olga: Why is your car safe? (asking grounds for a claim)

Paul: Since it has an airbag, (offering grounds for a claim)

Olga: That is true, (conceding a claim) but I disagree that this makes your car safe: the newspapers recently reported on airbags expanding without cause. (stating a counterargument)

Paul: Yes, that is what the newspapers say (conceding a claim) but that does not prove anything, since newspaper reports are very unreliable sources of technological information. (undercutting a counterargument)

Olga: Still your car is not safe, since its maximum speed is very high. (alternative counterargument)

According to Prakken, the persuasion dialogue given above "illustrates that players may return to earlier choices and move alternative replies". That statement is grounded on the idea that "in the course of a dialogue the participants implicitly build a logical structure of arguments and counterarguments relevant to the dialogue topic". This common logical structure is, for Prakken, a nonmonotonic logic. It is worth to recall that a nonmonotonic logic is a kind of logic in which interlocutors draw risky but plausible conclusions, reserving the right to retract them in the light of further information. We consider here that the very notions of a "common logic" between interlocutors and of a "dialogue topic" are unsound, from a non-realist perspective about natural languages. After all, Olga could be just determined to be against any idea of Paul. And that kind of reasoning could entail a monotonic logic associated to her, according to her own beliefs. Besides, while Paul could be talking about his car, Olga could be meaning Paul instead, even when she explicitly talks about Paul's car. This kind of masquerade is not unusual among arguing people.

What really happened in the dialogue exemplified by Prakken? Well, we have no idea. But we can point a couple of possibilities out, based on our non-realistic view for natural languages. In this case we have a five steps dialogue.

Scenario I For abbreviation sake, we denote Paul's statements as α_1, α_2 and α_3. Olga's statements are denoted by β_1, β_2 and β_3.

Step 1: No matter what, Paul believes his car is very safe (since it has an airbag system that none of his previous cars ever had) and states that belief in a way he believes it is faithful to what he thinks about his car. The first claim is α_1, namely, "My car is very safe". Olga hears Paul's statement α_1 and she chooses one single possible interpretation, extracted from a vast myriad of possible interpretations: "Paul believes that his car is safe". That interpretation can be partially explained by means of a social context! That is pragmatics in action, since it is not just the sentence that is taken into account for interpretation purposes, but also who said that. Then Olga's internal state and α_1 trigger her memory. Olga recalls that her notions about safety are more rigorous than Paul's (based on previous discussions with him), and she decides to ask grounds for his claim. She states a string she believes to be faithful to what she wants to show him (not about Paul's car, but about Paul's notions on safety). The first string uttered by Olga is β_1. The topic of conversation is a car's safety, for Paul, but it is Paul's view about any car's safety, for Olga. There is no common topic in dispute here. Hence, they are not playing the same game. Nevertheless, they are both players. Moreover, $s_{Paul}(\alpha_1)$ unconsciously admitted the possibilities that Olga may doubt him, that Olga may unconditionally believe him and that Olga may believe him if he provides some grounds. When Olga uttered β_1, then we have $s_{Paul}(\alpha_1 + \beta_1) \subset s_{Paul}(\alpha_1)$. That's because $s_{Paul}(\alpha_1 + \beta_1)$ has at least one less element than $s_{Paul}(\alpha_1)$. The missing element in $s_{Paul}(\alpha_1 + \beta_1)$ is at least the interpretation that "Olga believes him with no doubt whatsoever". And the missing element in $s_{Olga}(\alpha_1 + \beta_1)$ (by comparing to $s_{Olga}(\alpha_1)$) is at least the interpretation that "Paul learned something about cars safety since their last discussion about this topic". That is the convergence principle in action.

Step 2: Paul hears Olga's question β_1 and keeps his unconditional belief on his car's safety, since his reasoning about the safety of his car has a monotonic character. Paul does not realize that it is his particular standards of safety that are being questioned by Olga. But he realizes that α_1 was not informative enough, due to Olga's question β_1. That happens because his internal state is strongly focused on his car. By keeping the exact previous component of internal state (concerning his car) he had in the beginning of this concrete dialogue, Paul simply adds a new string α_2 that he consciously believes should be enough to guarantee the convergence of the first statements juxtaposed, in a way he considers to be obviously true. The new string α_2 is "Since it has an airbag". That is clearly an additional information that is supposed to narrow possible interpretations for his first statement (α_1) juxtaposed to Olga's inquiry (β_1). In other words, $s_{Paul}(\alpha_1 + \beta_1 + \alpha_2)$ is a proper subset of $s_{Paul}(\alpha_1 + \beta_1)$. $s_{Olga}(\alpha_1 + \beta_1 + \alpha_2)$ is also a proper subset of $s_{Olga}(\alpha_1 + \beta_1)$. The missing element in $s_{Olga}(\alpha_1 + \beta_1 + \alpha_2)$ is at least that "now Paul thinks carefully before answering to critical questions about any car's safety". That is the principle of convergence for semantics in action again.

Step 3: But Olga's internal state also searches for a convergence of meanings of her own. Her monotonic internal logic is still focused on Paul's views about safety. That's why she remembers about newspapers recently reporting on airbags malfunction. That memory is part of her internal

state. So, she states β_2: "That is true, but I disagree that this makes your car safe: the newspapers recently reported on airbags expanding without cause". Olga is not conceding any claim about safety, since she believes that airbags are not enough to guarantee safety. She is conceding the claim that Paul's car has an airbag. Olga is determined to show that Paul does not know what he is talking about. The missing element in $s_{Paul}(\alpha_1 + \beta_1 + \alpha_2 + \beta_2)$ is at least the interpretation that "Olga is careful about newspapers reports on technology", and the missing element in $s_{Olga}(\alpha_1+\beta_1+\alpha_2+\beta_2)$ is at least the interpretation that "Paul reads newspapers reports about airbags and he believes in such reports". One could argue that one missing element in $s_{Olga}(\alpha_1+\beta_1+\alpha_2+\beta_2)$ should be that "Paul is aware of newspapers reports about airbags". That possible interpretation could even be a conscious belief from Olga. Nevertheless, her personal experience, in this first scenario, defines an internal state that admits the possibility that Paul is aware of such reports, but he does not care for them. So, conscious beliefs are not enough to probe internal states.

Step 4: Paul hears Olga's claim about newspapers but he believes that that information adds nothing to their discussion. She could be talking about elephants in Africa for all that matters. That is because Paul does not believe in any newspaper, when the subject is technology. So, Paul utters β_2: "Yes, that is what the newspapers say but that does not prove anything, since newspaper reports are very unreliable sources of technological information". In other words, Paul is enchanted enough by his car to the point that his internal state guarantees that $s_{Paul}(\alpha_1+\beta_1+\alpha_2+\beta_2+\alpha_3) \subset s_{Paul}(\alpha_1 + \beta_1 + \alpha_2 + \beta_2)$. The missing element in $s_{Paul}(\alpha_1 + \beta_1 + \alpha_2 + \beta_2 + \alpha_3)$ is at least the interpretation that "Olga was aware that he does not care about newspapers reports on technology". And the missing element in $s_{Olga}(\alpha_1 + \beta_1 + \alpha_2 + \beta_2 + \alpha_3)$ is at least the interpretation that "Paul can learn about airbags from a newspaper".

Step 5: Olga draws her last card to convince Paul that his vision on safety is too relaxed for her taste. She utters β_3: "Still your car is not safe, since its maximum speed is very high". Paul consciously interprets $\alpha_1 + \beta_1 + \alpha_2 + \beta_2 + \alpha_3 + \beta_3$ as "My car is safe because it has airbag. But Olga talks nonsense and she thinks I like to drive at maximum speed." In other words, $s_{Paul}(\alpha_1 + \beta_1 + \alpha_2 + \beta_2 + \alpha_3 + \beta_3) \subset s_{Paul}(\alpha_1 + \beta_1 + \alpha_2 + \beta_2)$. There are convergence of meanings for both Paul and Olga, although they are both stubborn and do not agree with each another. All respective missing elements mentioned above, and much more, are unconsciously present in both $s_{Paul}(\alpha_1)$ and $s_{Olga}(\alpha_1)$.

Scenario II For the sake of shortness we present a less detailed scenario here, just in order to illustrate another possibility for internal states.

Step 1: Paul believes, for the moment, that his car is safe. So, he claims α_1. Olga hears it and she gets intrigued. That is because Olga wishes to know if she should buy a car like Paul's. So, she replies β_1.

Step 2: Paul understands how vague is α_1 and interprets $\alpha_1 + \beta_1$ as "my car is safe and she is interested in a car like mine". In other words, $s_{Paul}(\alpha_1 + \beta_1)$ is a proper subset of $s_{Paul}(\alpha_1)$. He decides to help her, and then he replies α_2. That is a moment where both Paul and Olga are talking about the same topic, namely, "Olga wishes to decide if a car like Paul's is safe for her".

Step 3: Olga hears α_2 but she is not convinced, since she remembered about reports on airbags malfunction. This means that $s_{Olga}(\alpha_1 + \beta_1 + \alpha_2) \subset s_{Olga}(\alpha_1)$. Since she seeks for a convergence of her own, she utters β_2.

Step 4: Paul interprets $\alpha_1 + \beta_1 + \alpha_2 + \beta_2 + \alpha_3$ in a way that $s_{Paul}(\alpha_1 + \beta_1 + \alpha_2 + \beta_2 + \alpha_3) \subset s_{Paul}(\alpha_1 + \beta_1 + \alpha_2 + \beta_2)$. The missing element in $s_{Paul}(\alpha_1 + \beta_1 + \alpha_2 + \beta_2 + \alpha_3)$ is that "Olga was aware that he does not care about newspapers reports on technology". So, he replies α_3.

Step 5: Olga is offended, since she started to work at a newspaper. She replies β_3. Paul consciously interprets $\alpha_1 + \beta_1 + \alpha_2 + \beta_2 + \alpha_3 + \beta_3$ as "My car is safe because it has airbag. But Olga talks nonsense because she likes to drive at maximum speed."

Many other scenarios could be illustrated. But the pictures we illustrated here should be enough to show that convergence is a natural, but unconscious, phenomenon in a concrete dialogue. If convergence on meanings (to a non-empty meaning) is felt impossible by any interlocutor, then a new dialogue should get started. That happens when one of the interlocutors reaches some inconsistency such that the set of all possible meanings for a string is empty. In that case the string is meaningless.

So, what is our solution to the Mary and John conundrum stated in section 1? If Mary and John have some personal linguistic experiences in common, they may eventually believe to share similar languages. That is what allows them to juxtapose strings in a dialogue, like the example given above, of Olga and Paul. So, it is even possible that two parties involved in a dialogue converge their personal meanings to the same interpretation. If $s_{Mary}(\xi) = s_{John}(\xi)$, for some cumulated string ξ in a dialogue, and $m_{Mary} = m_{John}$ (where $m_{Mary} \in s_{Mary}(\xi)$ and $m_{John} \in s_{John}(\xi)$), then we have a guaranteed agreement between Mary and John, without any apparent paradox. But besides the fact we cannot guarantee such equalities, there is the problem that the string ξ corresponds to just a small fraction of their respective languages. On the other hand, if $s_{Mary}(\xi) = s_{John}(\xi)$, for some cumulated string ξ in a dialogue, and $m_{Mary} \neq m_{John}$, then we have a partial or conditional agreement between Mary and John. If $s_{Mary}(\xi) \neq s_{John}(\xi)$, for some cumulated string ξ in a dialogue, and $m_{Mary} = m_{John}$, then we have a complete agreement between both, but for different reasons. If $s_{Mary}(\xi) \neq s_{John}(\xi)$, for some cumulated string ξ in a dialogue, and $m_{Mary} \neq m_{John}$, we have total disagreement. If $s_{Mary}(\xi) \cap s_{John}(\xi) = \emptyset$, for some cumulated string ξ in a dialogue, then we have mutual misunderstanding between both. That is the case where two people have grounds to believe not to be talking the same language at all.

So, the natural principle of convergence for semantics is a deep motivation for people searching a collective convergence of meanings during a dialogue. And this search for convergence reflects the intrinsic desire to be understood and to understand. It is a desire which presents some remarkable features from a psychological point of view. One of them is the use of gestures to speak. Most people gesture during a dialogue. Even congenitally blind people gesture when they speak [22]. That's because the need for gestures is intrinsic among people. We interpret that as an intrinsic recognition from all of us that spoken natural languages are not enough to allow mutual understanding, to guarantee convergence. The special symbols used in written languages and mentioned in section 2 (capital letters, punctuation, itemization and so on) are the equivalent of gestures in spoken natural languages: they are tools to improve convergence of meanings, with the intrinsic hope that the same convergence applies to each and every individual involved in a concrete dialogue.

4 Syntax and Semantics

Within our approach, semantics is more fundamental than syntax. That goes against the mainstream concept of Universal Grammar (in the sense of an innate knowledge of grammar), where its followers claim that the use of grammar is the most essential of all human qualities [6, 27, 29]. Criticisms to this view may be found, e.g., in [15, 36]. Actually, the search for hard evidences for the Universal Grammar hypothesis has reached genetics [18]. Nevertheless, such evidences are still inconclusive [39, 24, 35]. Our proposal is more consonant with Wolfram Hinzen's view about linguistics [21]:

> Throughout its long history, the project of a science of grammar has always been an inherently philosophical one, in which the study of grammar was taken to have special epistemological significance. I ask why 20th and 21st century inquiry into Universal Grammar (UG) has largely lost this dimension, a fact that I argue is partially responsible for the prevailing controversy around UG, relating to its formulation, scope, and biological basis.

According to Hinzen "There are no linguistic universals: universal grammar is refuted by abundant *variation* at all levels of linguistic organization, which lies at the heart of human faculty of language".

Children give their first steps into dialogues by learning very specific words, like "dad", "mom", "food", "dog", and "toy". They hear those strings, and the social context (pragmatics) associated to their internal state (internalism) helps them to reason in an inductive fashion (it is an abstraction process in action) in order to associate meanings to strings: "dad" corresponds to dad and "mom" corresponds to mom. If the child says "mom dad", the social context defined by mom and dad will eventually correct the child by saying "mom and dad". And so the child is able to learn two new linguistic concepts: the meaning of "and" and some syntax. If the child says "mom dad and", her parents will reply: "mom and dad". From a purely grammatical point of view, there is nothing wrong with "mom dad and". The connective "and" may be understood as an operator that can be applied to strings, allowing us to get new strings. So, the syntax of the use of "and" is quite arbitrary, and not universal. Consider, for example, the case of a Hewlett-Packard calculator, which employs the reverse Polish notation (RPN) for basic operations between numbers. According to RPN, if we want to add 2 and 3 we write this as "2 3 +". In the usual notation, we simply say "$2 + 3$". If syntax is arbitrary, so is grammar. After all, one single

language may be generated by as many grammars as we wish [37]. So, when the child's parents correct her by saying "mom and dad" instead of "mom dad and" or "and mom dad", this correction is not in the sense that "mom dad and" and "and mom dad" are false statements or wrongly said. Rather than that, those strings are simply meaningless in dad's and mom's natural languages. So, mom and dad hope their child develops a natural language where those same statements are meaningless as well. That's how semantics builds a natural language's syntax! That happens by means of a close relationship between internal states and stimuli (pragmatics).

The human ability to cope with natural languages certainly has genetic grounds [24], but not in the sense of a universal grammar gene programmed by millions of years of evolution. The grammar gene hypothesis is simply unnecessary and even unsound, at least in a non-realist perspective for natural languages. Human unique skills to use natural languages have more to do with memory (people store and, more or less, retrieve information regarding personal experiences, feelings, vocabulary and meanings), juxtaposition of strings (in a recursive way), stimuli, and the principle of convergence for semantics stated in section 3.

5 Successes and Failures of Concrete Dialogues

From a social point of view, the success of natural languages, as useful tools for communication, can be partially explained through the process of language acquisition illustrated in the last section. Children naturally trust their parents and so they develop natural languages similar to their mom and dad natural languages. And mom and dad live in a social environment where they need to feel included, for survival purposes. So, it is the human need (an intrinsic desire) for sociability that helps to develop individual natural languages with so much in common, at the point to make it believable that there is indeed one single natural language common to all people from a given community. And this search for social inclusion works with minor problems for very basic everyday needs, like food, shelter, safety, health, and even entertainment.

Major problems arise when one single individual (or a little group) tries to interfere with other people ways of perception about more complex and less familiar issues, like what happens in religion, politics, science, education, arts, literature, philosophy, and history studies. That's where natural languages more frequently fail as communication tools. How can we guarantee that two players in a dialogue are playing the same game? One well known example that the dialogical approach to dialogues is inadequate is the Azande, an ethnic group of North Central Africa, whose beliefs in witchcraft have been motive for debate (see [10] and references). The Azande do not revise their beliefs on witchcraft even when they are confronted by contradictions that are pointed out to them. One possible approach to this problem is to admit that Zande (adjective for Azande) reasoning is a paraconsistent logic [10]. Another way to cope with this problem is to recognize that natural languages are grounded on pragmatics and internalism. Social contexts and inner states define semantic values. And when natural languages are used by religious leaders in a social group with little contact to other cultures, this social group develops a way of its own to understand utterances and reason about them. It is rather difficult to guarantee mutual agreement between a Zande witch and a western researcher, if the subject is witchcraft. The possible meanings for logical operators like conditionals, among Azande, may be quite different from the possible meanings for conditionals among western researchers. In order to anyone be able to talk and reason like an Azande it is necessary to practically become an Azande.

The very notions of falsity and truth are historically built in natural languages of most human cultures, and are commonly mistaken as agreement and disagreement, respectively. Since any natural language is a state of the mind, when an individual says that a given statement (string) is true, that means that this individual agrees with whoever (even itself) uttered such a sentence. That is why so many people still claim that the Earth is flat! Indeed, there are hard evidences against a flat Earth hypothesis. But there is no hard evidence that all people understand the same claim the same way. One thing is to talk about the Earth. Another thing is to talk about the languages we use to talk about the Earth. Without natural languages there would be neither truth nor falsity. The physical world exists independently of any natural language. The notions of truth and falsity depend on a fundamental level on natural languages.

But there are worst situations that illustrate the limits of natural languages. Quantum mechanics is an excellent example. It is not easy for most people to understand what does it mean to say that Schrödinger's cat is dead and alive [17]. A sentence like that is neither true nor false, for most people. It is just meaningless. And even quantum physicists work with this kind of natural language with some

difficulty.

Jane Austin (Pride and Prejudice) wrote "It is a truth universally acknowledged, that a single man in possession of a good fortune, must be in want of a wife". This famous quotation summarizes our view in a poetic form. Man and wife look for a convergence of meanings, through language, at a point to believe in some kind of universal truth. And even so, man and wife are still struggling for mutual understanding. Jane Austin seemed to understand that quite well. After all, the cited quotation has an ironic and playful tone during the reading of her famous novel.

6 Final Remarks

Since syntax rules may be derived from semantics, it seems reasonable to consider only three dimensions for natural languages, once provided an alphabet: semantics, pragmatics and internalism. People talk because they wish to be understood, they wish to achieve a convergence into a specific non-empty meaning. That convergence naturally happens in the mind of who talks and is wished to be achieved in the mind of whoever is listening.

Nevertheless, we recognize that this paper presents a vast myriad of fundamental problems to be solved:

1. How precisely do internal states work in the development of natural languages as tools for concrete dialogues? The answer to that question depends on answering the next one.

2. How can we get reliable information about all internal states of a communicating individual without depending on dialogues with such an individual? Nowadays people talk to machines (like, for example, the one provided by www.cleverbot.com) without knowing their softwares. Any approach to understand the internal states of a talking machine must go beyond simple conversations. And an analogous remark can be done with regard to talking people.

3. Is it possible to conceive a natural and useful language that guarantees the same convergence for two or more individuals' semantics?

4. Our principle of convergence for semantics, stated in section 3, is too general. A much more refined principle is demanded if we want to fully understand our approach in a testable way. Nevertheless, in order to achieve this goal, we need first to answer questions 1 and 2.

5. There have been reported experimental evidences that some neurons in the temporal cortex of the human brain are highly selective for object categories such as faces and hands [13] and even specific people [31]. Such results inspired the creation of a software capable to build high-level, class-specific feature detectors from unlabeled images [25]. The main result in [25] was that such a software was able to identify (from a database of images) cat faces and human bodies without the need for any programmer to label which images were supposed to contain faces or bodies. In other words, machines are potentially able to create object categories, just as the human brain does. According to the terminology of the authors in [25], their software "learns the concept of faces". Such object categories can be partially identified with internal states of either human beings or even machines. Nevertheless, there is an important difference between people and computers. A human being internal state is far richer and more sophisticated than the internal state of a machine, by including information with no visual appeal and even emotions. Nevertheless, we question if it is not possible to conceive machines that learn to talk by following some constrained version of our proposed principle of convergence for semantics. In other words, can a machine learn that the word "cat" may be associated to the object category "cat", without human intervention?

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