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Article

Beyond the Semantic Web: Towards an Implicit Pragmatic Web and a Web of Social Representations

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Abstract: Motivated by the distinction between semantics and pragmatics as sub-disciplines of linguistics, shortly after Tim Berners-Lee introduced the Semantic Web in 2001, there have been works on its extension to the “pragmatic level”. Twenty years later, the Semantic Web is more popular than ever, while little has been achieved in extending it into a Pragmatic Web. Social representations introduced by Serge Moscovici in the 1960s seem totally ignored by the information technology community even though they are strongly related to research on opinion mining and representation in social media. We, thus, recall the major results of academic research on the Pragmatic Web, followed by our proposal for an Implicit Pragmatic Web inspired by various sub-domains of the discipline of pragmatics. We further recall the basics of the social representations theory and discuss their potential implementations in a Web of Social Representations and thus their potential contribution towards at least a part of the future internet.

Keywords: Semantic Web; Pragmatic Web; implicatures; presuppositions; social representations

1. Introduction

In the eyes of its creator, Tim Berners-Lee, the Semantic Web can assist the evolution of human knowledge as a whole. ([1] p. 43)

However, what is knowledge in the first place? Is it just a collection of facts and rules, as methods based on formal semantics seem to imply? What about opinions, values, impressions, and culture? Let us compare the incipits of two Wikipedia pages on an event that occurred on July 20th, 1974, in Cyprus. Here is the incipit of the Greek Wikipedia page (https://en.wikipedia.org/wiki/Greek_Wikipedia, accessed on 6 July 2023), with its translation into English:

Η Τουρκική εισβολή στην Κύπρο το 1974 ήταν τουρκική στρατιωτική εισβολή στην Κυπριακή Δημοκρατία.

The Turkish invasion of Cyprus in 1974 was a Turkish military invasion of the Republic of Cyprus.

and here is the incipit of the Turkish Wikipedia page (https://en.wikipedia.org/wiki/Turkish_Wikipedia, accessed on 15 April 2023), with translation into English:

Kıbrıs Harekâtı, 20 Temmuz 1974'te Türk Silahlı Kuvvetlerinin Kıbrıs'ta başlattığı askerî harekât.

Cyprus Operation, the military operation launched by the Turkish Armed Forces in Cyprus on July 20, 1974.

(the two sentences have been translated by DeepL (<https://www.deepl.com>, accessed on 6 July 2023) to avoid partiality in the choice of vocabulary). The first sentence mentions an *invasion* of a *State* (the “Republic of Cyprus”), the second sentence mentions a *military operation* that took place in some *location* (“Cyprus”). We witness here two different representations of the same event by two geographically neighboring and culturally close communities of people. If we compare the two representations, both agree on the fact that



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there has been a military operation (an invasion being a special case of a military operation). Still, the Turkish one does not refer to the ethical or legal aspects of that operation, and as all military operations are not invasions, the omission of this qualification aims to legitimize the operation.

To describe the previous paragraph's event in the Semantic Web frame, one would consider it as an instance of the class of military operations. However, this covers only a part of the description of the event, and clearly, there are at least two communities with conflicting opinions on whether it was legitimate or not. As this event has changed many people's lives, the issue goes way beyond a simple opinion: both sides have built distinct *representations* of the event, with their own narratives, value systems, and emotional loads. As the Semantic Web is based on description logics, which are truth-conditional, monotonic, and infeasible [2], it would be unable to model and communicate two *partially contradictory* representations of the same event.

Every human being is shaped by their DNA and their history (past, present, but also their perception of their future). This history is built through education, amidst one or more societies and cultures. It is because of this multiplicity of origins and cultures that we advocate the creation of an additional Web layer, a Web of Social Representations, which would contain social representations of events, situations, and artifacts by various communities at various time periods.

We also recommend creating a part of the Pragmatic Web that will deal with implicit information, such as implicatures, presuppositions, etc. There have been many proposals for the extension of the Semantic into a Pragmatic Web. For example, on a very basic level, many authors underline the necessity of keeping data on a Web page author's identity and authorship conditions. Indeed, if we consider a Web page as an utterance, then identifying the who, when, where, why, and how of this utterance is the pragmaticist's first instinct. Someone unfamiliar with the workings of the Semantic Web may find this curious: why is the Semantic Web not taking care of such basic metadata? Another concern, a technical one, is the question of the interoperability of the Semantic Web [3].

Because the Semantic Web's resources do not live in the same place as Web pages, they do not share any properties with them. RDF triples (an RDF triple is a subject, a predicate, and an object, expressed as unified resource identifiers or as literals) live in overcrowded triplestores. The page <https://www.w3.org/wiki/LargeTripleStores> (accessed on 6 July 2023) enumerates about 18 such stores, of a capacity ranging from 10 million to 1.08 trillion (!) RDF triples.

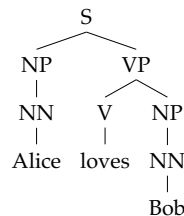
The Pragmatic Web we imagine—be it a Pragmatic Web of metadata on Web pages or an Implicit Pragmatic Web of implicatures, presuppositions, and the such, as we suggest—must be firmly connected with the Web pages of the “Syntactic Web”.

Furthermore, we imagine the Web of Social Representations as a Wikipedia-like structure where one can store observed social representations of given communities at given periods over given subjects. When reading, e.g., the Wikipedia page of the wolf, the reader should be able to learn about the social representations of the wolf, be it today or in the past. It is time for the hidden aspects of human social life to be exposed to the whole light. The purpose of this article is twofold. On the one hand, we compare the different types of Web (syntactic, semantic, pragmatic) with the corresponding linguistic sub-disciplines (syntax, semantics, pragmatics), taking into account both Tim Berners-Lee's initial proposal and subsequent proposals appearing in the literature. On the other hand, we develop our own proposals for both a Pragmatic Web of implicatures and a Web of Social Representations. For this reason, the structure of this article is ternary: an introduction to the linguistic notions involved (Section 2); in Section 3, a description of the different types of Web in the light of the linguistic notions of Section 2; and finally, in Section 4, our proposal.

2. Semantics, Pragmatics, Social Representations

The linguistics of the second half of the 20th century is marked by Noam Chomsky's generative (and, later, transformational) grammar [4]. The tools he invented (formal gram-

mars, etc.) were intended for natural language but have also been used heavily in computer science [5]. At first, Chomsky focused on syntax, providing the necessary tools to assert the grammaticality of an essential fragment of English and other natural languages. To give a simplistic example, the English sentence “Alice loves Bob” is grammatical because its syntax tree

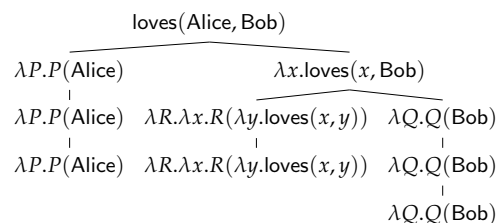


can be obtained by the rewrite rules

- $S \rightarrow NP VP$
- $NP \rightarrow DET N$
- $VP \rightarrow V NP$
- $N \rightarrow \text{“Alice”} \mid \text{“Bob”}$
- $V \rightarrow \text{“loves”}$

which are part of some grammar of English considered as a formal language.

In the 1960s and early 1970s, Richard Montague set about the task of applying mathematical logic to language, namely to describe the meaning of sentences by logical formulas [6]. Montague’s approach is based on the compositionality principle, which states that the meaning of a sentence can be obtained from the meaning of individual words and the sentence’s syntax. Applied to the same example, we obtain a semantic tree with the same structure as its syntax tree:



The root of this semantic tree is the first-order logic formula loves(Alice, Bob), where loves is a binary predicate and Alice and Bob are logical constants. Other nodes of the tree use a formalism based on lambda calculus and first-order logic. This sounds very nice and gives very good results for paradigmatic sentences such as “Alice loves Bob”. Furthermore, it is indeed helpful for machines to “understand” text in natural or in controlled language.

But Chomsky and Montague failed to deal with some essential aspects of human communication, such as the importance of context (a sentence such as “the train leaves in five minutes” may have a completely different meaning whether it is uttered inside the train, in front of the railway station, or in a traffic jam a few miles away from it), ambiguity, implicit knowledge, etc., not to mention speech acts (language that is not declarative). As a reaction to these shortcomings of Chomsky’s and Montague’s approaches, the discipline of pragmatics was born.

For a theory, being born as a reaction to another theory becomes a handicap in the long run. Theories that arrived after Chomsky’s transformational grammar and Montague’s formal semantics, such as cognitive linguistics [7], do not favor a distinction between semantics and pragmatics. However, Chomskyan linguistics are still there and are still part of the linguistics curriculum, so pragmatics is in a permanent existential crisis, searching for clearly established boundaries with semantics. This task may very well be in vain.

As for computers, they definitely adopted the formal semantics approach to language, and the current Semantic Web is still based on it. This explains why issues studied by

pragmatics have one thing in common: they are notoriously difficult to be processed by machines. It suffices to consider the notion of *implicature*, introduced by Grice [8]. An implicature is an implicit knowledge or information, not literally expressed in an utterance. Implicatures are challenging to be detected and included in reasoning processes by computers.

This is very nicely illustrated in the following. Reboul and Moeschler, authors of a renowned (French) introduction to pragmatics [9], conclude their book with a tasty anecdote written by the famous French author Stendhal [10]:

Le curé n'était point vieux; la servante était jolie; on jasait, ce qui n'empêchait point un jeune homme du village voisin de faire la cour à la servante. Un jour, il cache les pincettes de la cuisine dans le lit de la servante. Quand il revint huit jours après, la servante lui dit: "Allons dites-moi où vous avez mis les pincettes que j'ai cherchées partout depuis votre départ. C'est là une bien mauvaise plaisanterie." L'amant l'embrassa, les larmes aux yeux, et s'éloigna.

The parish priest was by no means old; the servant girl was pretty. People gossiped. This, however, did not prevent a young man from a neighboring village from courting the girl. One day he hid a pair of kitchen tongs in the girl's bed. Eight days later, when he returned, the girl said to him: "Come now, tell me where you put my tongs. I've looked everywhere for them since you went away. That's a very poor joke." With tears in his eyes the lover embraced here—and walked away.

According to the authors of [9], the machine is not even close to grasping what happened and why the young man went away heart-broken, even though this is clear to most, if not all, French readers. To make the text accessible to readers from other cultures, some background is needed: he or she should be an adult or at least a teenager, and he or she must be aware of specific cultural facts such as the celibacy of Catholic priests, sexual exploitation of female servants in the 19th century, etc.

In Section 4, when we detail our proposal, we will give a short description of some currently studied issues by pragmatics, which we consider appropriate to include in an "Implicit Pragmatic Web". Let us turn now to the second part of our proposal, namely, social representations.

One of the main concepts of cognitive science is mental representations. Mental representations occur in our minds, we can attempt to communicate them, but they essentially remain in the sphere of our flow of conscience. In our social life, we are confronted with a different kind of representation, namely *social representations*. These are systems of beliefs, values, or practices that enable coherence and communication among the members of groups or communities. As we will see below (Section 4.2.1), the concept was introduced in Paris, in 1961, by a young political refugee from Romania, Serge Moscovici. In his published Ph.D. thesis, he dealt with a very sensitive subject, namely, the reception of psychoanalysis in the relatively conservative society of France in the 1950s. It has been theorized later that social representations have a structure consisting of a central core, which is normative and stable, a functional periphery, which fluctuates and allows divergence of opinions [11], and sometimes even a hidden zone that becomes apparent when people are asked not what they believe, but what they think some other group believes.

Guimelli and Deschamps [12] describe a study on the social representations of gitanos (gypsies) in France. They used the word association method on two groups of subjects (psychology students, as is often the case in psychological experiments): they asked the first group to produce word associations on their beliefs on gypsies. They asked the second group to produce word associations on "what an average Frenchman believes on gypsies". The differences were spectacular regarding negative terms: in the first group, 19 subjects called them "thieves," and 4 subjects called them "dirty"; in the second group, it was 46 and 11, respectively. The interpretation given by the authors is that there is a social pressure not to utter these stereotypes, which vanishes when the subject is "speaking in the name of somebody else".

Social representations play an essential role in our life, and in particular in our social life since they underlie our membership in various groups and communities. Similarly to implicatures and other phenomena studied by pragmatics which we will describe in

Section 4, social representations are implicit. People in a given community consider them as granted and do not write them down as if they were factual information. They, nevertheless, are an essential part of human culture. This is why we propose the creation of a Web of Social Representations (Section 4.2).

3. The Various Kinds of Web

3.1. The “Syntactic” and the Semantic Web

3.1.1. HTML and Its Evolution

People usually connect the invention of the Web by Tim Berners-Lee with his internal CERN memo released in March 1989 [13]. However, the process started quite some time earlier with the invention of the generalized markup language (GML) by Charles F. Goldfarb in 1969 [14]. GML later became SGML (S for “standard”), and still, later, XML. SGML, and, therefore, also its application HTML (hypertext markup language), is profoundly rooted in Chomskyan tradition. In SGML and HTML, a document is considered as a (formal) word in a (formal) language, the (formal) grammar of which is contained in a part of the SGML document called the DTD (document-type definition). An SGML document is a set of “elements” endowed with a tree structure based on the inclusion relation. At the leaf level of the tree, we have either empty elements (potentially with attributes) or text fragments. An HTML document, the basic unit of the first version of the worldwide Web, is an SGML document with a fixed DTD containing 18 element types (in its first version). The semantics of these elements represent a standard document structure (sections of various levels, paragraphs, tables, lists, images), typographical styles (italics, bold, underlined, etc.), hypertext links, etc. To be called an “HTML document”, a document had to be *well-formed*, in the sense of respecting SGML syntax, and *valid*, in the sense of being a (formal) word in the formal grammar described by HTML’s DTD. Usual actions on HTML documents were checking their validity, displaying them in a Web browser’s window, and navigating through them.

As the explicit structure of HTML documents was mainly syntactic, the original WWW was later called the “Syntactic Web” ([15] p. 5). Before we close this section on the “Syntactic” Web and move on to the Semantic Web, let us mention three features of the Syntactic Web that belong to the realm of the implicit:

1. The `alt` attribute of the `img` tag (for inserting images), which was introduced in HTML v2 ([16] p. 34) (1995). This attribute was used to contain a hidden description of the image, described as follows:

text to use in place of the referenced image resource, for example, due to processing constraints or user preference.
2. The `acronym` and `abbr` elements, introduced in HTML v4 (1999) ([17] Section 9.2.1). The `title` attribute of these elements is meant to contain the expanded version of the abbreviation or acronym (the distinction between abbreviation and acronym was irrelevant; therefore, the `acronym` tag became obsolete in HTML v5, while the `abbr` is still valid today). The part of the specification that justifies the existence of these elements is as follows:

Marking up these constructs provides useful information to user agents and tools such as spell checkers, speech synthesizers, translation systems, and search-engine indexers.
3. The `ruby` element, introduced in HTML v5 (2011) ([18] Section 4.6.19). This element is useful for sinographic languages and adds an annotative layer above or next to sinograms (cf. [19] p. 822). When this layer is hidden through CSS code, annotation (or the main text layer) becomes implicit information in the Web page code.

Finally, of course, since HTML is interpreted by Web browsers, any SGML or XML comment included in the Web page’s code becomes implicit information, available only to those previewing the code.

3.1.2. The Semantic Web

Tim Berners-Lee, who in the meantime had become the director of the WWW Consortium, introduced a “new form of Web content that is meaningful to computers will unleash a revolution of new possibilities” and which, “properly designed, [...] can assist the evolution of human knowledge as a whole” ([1] pp. 35, 43). He acknowledged the shortcomings of the “Syntactic Web” as follows:

Most of the Web’s content today is designed for humans to read, not for computer programs to manipulate meaningfully. Computers can adeptly parse Web pages for layout and routine processing—here a header, there a link to another page—but in general, computers have no reliable way to process the semantics ([1] p. 36)

From a mathematical point of view, the Semantic Web is a collection of graphs, the nodes of which are concepts (“classes”) or instances (“individuals”) of concepts and the edges of which are relations (“roles”) between instances, plus description logic formulas to define classes and roles in elegant ways. From a data-oriented point of view, the Semantic Web is a vast amount of RDF triples, the elements of which belong to specific namespaces. Query languages such as SPARQL are used to access these triplestores, and reasoners are used to take advantage of the logical structure, perform inferences, and thereby access “knowledge”.

As we mentioned in the introduction, the Semantic Web is somehow “invisible” to the average Web user since triples live in gigantic triplestores. Recently, in 2022, a blog’s author even announced and argued for the “death of the Semantic Web” [20]. This is, of course, an exaggeration, but it shows that the Semantic Web is probably too esoteric or conceptually too far away from the ordinary Web. This has to change, and perhaps our proposal of returning to the original Web pages through a Pragmatic Web and shedding light on human social life through a Web of Social Representations can also contribute to rehabilitating the Semantic Web.

3.2. The Pragmatic Web: 2002–2020

3.2.1. Pioneers

The first mention of the *Pragmatic Web* appeared in the May/June 2002 issue of the journal *IEEE Internet Computing*, in a short note by the Editor in Chief, Munindar P. Singh [15] (which is a shortened version of the workshop paper [21]). His terminology is a bit outdated as it relies on William Morris’s 1938 classic *Foundations of the Theory of Signs*, the very book where the term “pragmatics” was coined:

The Web is a symbolic system, and its symbols are Web page content and markups. Normally, browsers and human users interpret these symbols. For machines to exploit information on the Web, we must consider the meanings of symbols explicitly. *Semiotics*, the study of symbolic systems, has three parts: *Syntax*, or structure; *Semantics*, or structure-based meaning; *Pragmatics*, or context-based meaning. ([15] p. 4)

Nowadays, one would consider syntax, semantics, and pragmatics sub-disciplines of *linguistics* rather than *semiotics*. In [15], Singh uses an example related to part inventories and inventory dates and times or processes affecting inventory size for information of a pragmatic nature that can complement the information of a semantic nature. The example is suboptimal but the intention is clear: if the list of parts is considered as an utterance, then the time and date of this utterance is not part of its semantics but indeed of its pragmatics. Singh further mentions Web service composition, description discovery, and interaction. He concludes with three principles for “designing and linking pragmatically sound Web services”, namely, “user before provider”, “process before data”, and “interaction before representation”.

Only two months later, in the framework of the 10th International Conference on Conceptual Structures that was held in Bulgaria, Aldo de Moor et al. [22] provided a more

detailed discussion of the emerging notion of the “Pragmatic Web” in a paper entitled “Towards a Pragmatic Web”. We quote:

Admittedly, the Semantic Web is a necessary step from the syntax (HTML) level to the semantics (meaning) level. However, still one crucial level is lacking: that of pragmatics: what is the *purpose* of the information? How do we use it, and change it, as we use it? ([22] p. 237)

This proposal encompasses the purpose, method of use, and dynamic change. They continue, saying:

We, therefore, also propose the development of a Pragmatic Web. In this Web, essential pragmatic processes are carefully defined and automated where possible. In this way, human beings can focus on their unique qualities of creative thinking, balancing options, and wisely using their unlimited supplies of tacit knowledge. ([22] p. 238)

As seen in this excerpt, their focus is on “pragmatic processes” that can be defined and automated. “Tacit knowledge” is mentioned, but not to become explicit but rather to be used by the processes. In the major part of the paper, they describe such a process, a col-laboratory called PORT (Peirce online resource testbed), based on Peirce’s logical analysis of inquiry in three steps [23]: abduction, deduction, and induction. This system aims to be a pragmatic method for community information systems development.

A year later, Ahti-Veikko Pietarinen presented a short paper entitled “The Semantic + Pragmatic Web = The Semiotic Web” at the International WWW / Internet Conference 2003 in Portugal [24]. According to him,

First and foremost, this narrow understanding of semantics lacks the semiotic components of the *utterers* and the *interpreters* of the data, indispensable in pragmatic approaches to inquiry. And so, one still needs to understand how the meta-data, such as one provided by the schema of Resource Description Framework (RDFS) or its ilk, will be connected to the interpreters and objects of data. This connection defines the *pragmatic* meaning of data. ([24] p. 982)

By interpreters, he means both humans and agents. Indeed, he states that the “Pragmatic Web challenge may be brought into life” by using multi-agent systems, in which agents become *quasi-utterers* and *quasi-interpreters*. Once agents start interacting, we enter the cycles of Peirce’s dialogical semiosis.

In 2005, Aldo de Moor presented a quite extensive Pragmatic Web proposal [25] at the 13th International Conference on Conceptual Structures in Kassel (Germany). His paper raises the point of the wide range of pragmatic contexts in the real world and advocates that one should only model pragmatic constructs essential to reach specific joint objectives. He introduces the notion of *pragmatic patterns*. As there will always be conflicts in the definition and granularity of ontologies, de Moor proposes

to make a strict conceptual separation between modeling and using ontologies, to identify meta-patterns, i.e., *pragmatic patterns* that can be used in meaning evolution processes in communities of users in order to make existing ontologies more useful and easier to change. ([25] p. 8)

Here are some core pragmatic patterns he mentions:

- *Pragmatic context*: a pattern that defines the speakers, hearers, type of communication, and identifiers of the individual and common contexts of a community.
- *Individual context*: a pattern that defines an individual community member, individual context parameters, and an identifier of the individual context ontology.
- *Common context*: a pattern that defines the common context parameters and an identifier of the common context ontology of a community.

- *Individual pragmatic pattern*: a meaning pattern relevant to an individual community member. An individual context ontology consists of the total set of meaning patterns relevant to that individual.
- *Common pragmatic pattern*: a meaning pattern relevant to the community as a whole. The common context ontology consists of the total set of common meaning patterns relevant to the community.

Pragmatic patterns can be used in meaning negotiation and other meaning evolution processes, such as meaning representation, assignment, selection, and alignment.

Finally, in May 2006, Mareike Schoop, Aldo de Moor, and Jan L.G. Dietz published a short note in the *Communications of the ACM*, entitled “The Pragmatic Web: A Manifesto” (the words “A Manifesto” in 71-point type!) [26]. This paper re-orientates the Pragmatic Web idea: instead of agents, the focus is now on ontology evolution and negotiation. According to them,

The most problematic assumption [of the Semantic Web] is that context-free facts and logical rules would be sufficient. [...] However, it is not necessary to reach for context-independent ontological knowledge. Most of the ontologies used in practice assume a certain context and the perspective of some community. [...] Ontologies are not fixed but co-evolve with their communities of use. Communication partners have to agree continuously on what they can assume to be the shared background. [...] An ontology is an agreed-upon conceptual specification used for making ontological commitments. The crucial question is: how do human agents commit and renegotiate their meaning commitments? ([26] pp. 75–76)

The authors quote Singh [21]:

The best hope for the Semantic Web is to encourage the emergence of communities of interest and practice that develop their own consensus knowledge on the basis of which they will standardize their representations. ([21] p. 2)

In this excerpt, representations are mentioned, but not in the sense of implicit, subconscious representations as in social representation theory, but rather as knowledge domains made explicit via consensus, i.e., ontologies. We have here a first mention of the link between ontologies and social representations (of a specific kind). The paper concludes with an invitation to the First IPWC (International Pragmatic Web Conference). Below, we discuss papers presented at the three IPWC conferences.

3.2.2. First International Pragmatic Web Conference

The First International Pragmatic Web Conference was held in Stuttgart (Germany) in September 2006. The *Proceedings*, published by the German Computing Society, contain 14 papers.

The paper by Mark Aakhus [27] tackles the relationship between the Pragmatic Web and the discipline of pragmatics. It gives a list of the topics or phenomena of interest in pragmatics, taken from [28]:

- (1) Deixis: The way the relationship between language and context is reflected in the structures of languages (e.g., the meaning of ‘this’).
- (2) Conversational Implicature: Pragmatic inference based on assumptions about the cooperativeness of the conversational participants, not the semantic inferences drawn from the meanings of words, phrases, or sentences (e.g., how it is possible to mean more than what is said).
- (3) Presupposition: Pragmatic inferences that depend in part on semantics but that interact with contextual factors.
- (4) Speech acts: Inferences about the meaning of actions performed with words and how people convey and understand that meaning using content and rules about actions (e.g., using words to make promises, requests, bets, invitations).
- (5) Discourse structure: The relationship between the organization of conversa-

tion and utterance meaning. The sequential order of an utterance plays a role in what that utterance means. ([27] p. 11)

This is the first paper that clearly bases its vision of the Pragmatic Web on the discipline of pragmatics. It states that the main point is *communication design*, which is a set of abstract principles that people employ to devise communication strategies and practices that solve the puzzles of meaning, action, and coherence in face-to-face interaction ([27] p. 12)

and that the Pragmatic Web should focus on the designability of communication via technology. It concludes with the statement that the agenda of the Pragmatic Web lies in developing a meta-language for talking about the pragmatic layer of the Web and in applying that meta-language to describe the relationship among people, their tools, and the activities in which they engage. ([27] p. 20)

The paper by S.J. Buckingham Shum [29] introduces the concept of *sensemaking*: The world, indeed our lives, make sense to the extent that we can sustain a coherent narrative about who we are and why we matter. If the story fragments, our identity crumbles if we cannot re-integrate it into our narrative. When we are confronted by breaches in normality, Karl Weick [30] draws our attention to *sensemaking* as literally “the making of sense”: sharing interpretations using different representations of the situation. ([29] p. 24)

Once again, there is mention of representations, this time focusing on the share of interpretations resulting from different representations. It then moves on to argumentation, hypermedia discourse, and a tool for discourse modeling called “compendium”, exemplifying, as the author says, aspects of the Pragmatic Web.

The paper by Stalker and Mehandjiev [31] presents a special kind of ontologies, called “devolving ontologies”, as “a structure to facilitate ontological and semantic alignment among communicating entities”. Such an ontology comprises a core ontology and a number of extensions of this into peripheral and inter-application domain ontologies. The goal is to have agents negotiate concepts to evolve the ontology. As in [26], the pragmatic aspect lies in the collaborative evolution of ontologies.

The paper by Weigand and van den Heuvel [32] deals with SOAs (service-oriented architectures). According to the authors,

the Pragmatic Web aims at improving human collaboration, and its central object, therefore, is the (social) action. Currently, social actions are performed by humans. The Pragmatic Web challenge is that agents can effectively support humans in performing their social actions. To achieve that, agents must be able to enter meaningful conversations and get at agreements. ([32] p. 61)

Here, the focus is on social actions, which is illustrated by Table 1, showing a perfect duality between the Semantic Web and the Pragmatic Web, according to the vision of the authors of [32].

Table 1. Taken from [32] (p. 61).

Semantic Web	Pragmatic Web
Information exchange	Collaboration
Document	Action
Agents can analyze documents	Agents can perform delegated actions
Semantic descriptions	Conversations and agreements
Ontologies	Communities
Description logic, knowledge representation	Communication theory, multi-agent systems
Finding services	Composing, adapting services

This is probably the most radical vision of the Pragmatic Web, in which all ingredients of the Semantic Web are replaced by ingredients based on multi-agent systems.

The paper by Harry Delugagh [33] goes in another direction: the main focus is on reasoning. Indeed, the author states that

the ability to reason (in any form) about information gives it the status of “knowledge”. This aspect of the Web has been called the Semantic Web. ([33] p. 67)

In addition to reasoning, Delugagh advocates the use of models, and not just any models but “both dynamic (i.e., always changing) and interactive (i.e., able to autonomously interact with their environment)” models. In logic, a model is an interpretation of a logical formula in which the latter is true. Delugagh uses the phrase “pragmatic interpretation” that

encompasses all of the semantic, social, and cultural knowledge relevant to the use of the model. ([33] p. 70)

First-order logic is extended in an active (=dynamic) and non-monotonic framework. The dynamicity of the model induces its awareness to the user’s environment: physical location, occupation, level of expertise in their present activity, accepted norms, and their goals in pursuing the activity. Interestingly, shortly before the release of the first iPhone in 2007, the author imagines

that each participant [in an activity] is supported by a knowledge assistant that maintains a conceptual graph representation of their current context, goals, mental state, etc. These graphs are exchangeable with other participants’ assistants in order to communicate and collaborate. Such a system has not yet been built; however, there are several current efforts to support such environments. ([33] p. 73)

This goes far beyond the Web and anticipates the notion of the digital twin, going as far as modeling the user’s mental state using conceptual graphs.

The paper by Razafimbelo et al. [34] is dedicated to a very specific task, namely, the optimization of search engines. It concentrates on three issues:

- How data contained in the Web pages can be used to allow more efficient searches;
- How can we make sure that the data analyzed in the page is contextually the one the user expects/wants;
- How can we make sure that even if the data belongs to the correct ‘context,’ the content was not tampered with in a bid to highly rank the pages. ([34] p. 82)

To solve these issues, the authors refer to Stamper’s semiotic ladder [35], which we display in Figure 1. This ladder goes in the same direction as our argument for using social representations as a further step of the Pragmatic Web: beyond the pragmatic level of intentions, communications, etc., it places the “social world”, consisting of beliefs, expectations, etc. The paper adapts Stamper’s ladder to the problem of search engine optimization by defining three layers:

Social layer	Trust of the source of information (identification of source), social ranking–popularity, social Impact on the identity of the site AND on the users to visit it
Pragmatic layer	Usage determination of the context of the search
Semantic layer	Meaning using Standards such as XML, RDF or OWL ([34] p. 85)

In this case, the pragmatic layer is just a collection of metadata allowing disambiguation of the terms found on the page. The social layer is about trust (the integrity of the information on the page) and popularity. Interestingly, the site’s popularity is used to determine the social impact on the site’s identity and the users visiting it. The paper concludes by emphasizing that the pragmatic and social layers need input by users (in the spirit of Web v2, a term institutionalized by Tim O’Reilly in 2005) to be fully accomplished.

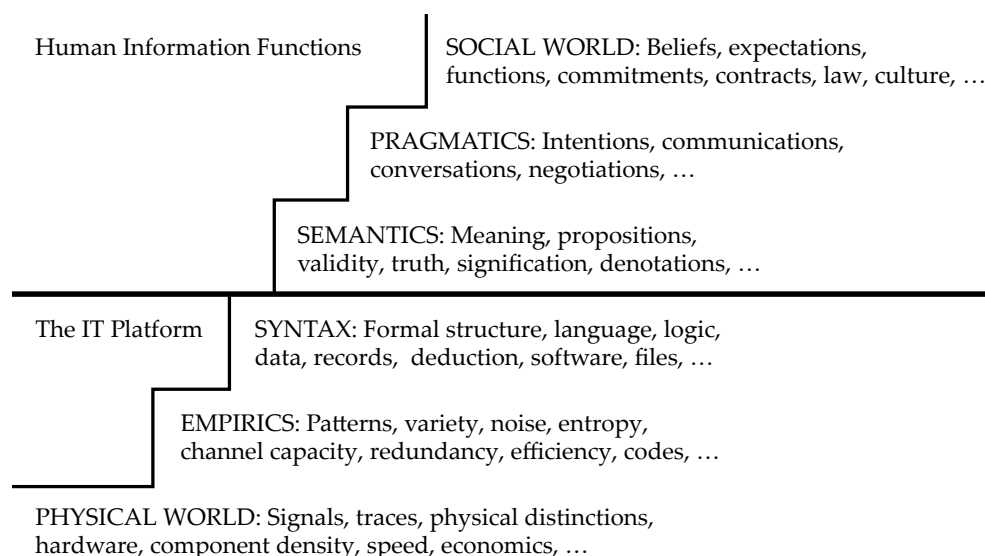


Figure 1. Stamper's semiotic ladder, inspired by [35].

3.2.3. Second International Pragmatic Web Conference

The Second IPWC was held in Tilburg (The Netherlands), in 2007. The *Proceedings*, published by ACM, contain eight long and two short papers.

The paper by Paschke et al. [36] considers the Pragmatic Web as being a collaborative human–computer network where “semi-automated RuleML-based agents, with their individual contexts, decisions and actions form virtual organizations.” An agent of such an organization consists of a syntax layer, a semantic layer (ontologies of shared concepts) and

[a] pragmatic and behavioral/ decision layer which consists of the organizational norms and values (e.g., deontic norms, needs, avoidance), the joint goals/interests/ purposes (beliefs/wants/desires), the strategies and decision logic (deductive logic and abductive plans), the behavioral reaction logic, and the used negotiation and coordination interchange patterns with the community members but also with external agents. ([36] p. 19)

By the interaction of these agents, a Pragmatic Agent Web is defined. The remainder of the paper describes the technical aspects of the three core parts of its architecture: the rule markup language, the enterprise service bus, and platform-independent rules engines.

The paper by Delugach [37] considers a very specific case, namely, the one of Web-based bug tracking tools, such as Bugzilla, Trac, and SourceForge. It proposes the inclusion of *intentions* (why a particular role would be given a particular assignment) not as mere metadata but as part of the system's semantics, so that reasoning about roles and their legitimacy becomes possible. At first sight, this means just adding additional entities to the architecture of the system, but in fact, it is pragmatic if we consider assignments as utterances, the context and purpose of which are taken into account.

The paper by Falkman et al. [38] applies de Moor's notion of pragmatic patterns [25] to clinical knowledge management. Following a consultation request, they define a consultation pattern, communication patterns, information patterns, task patterns, memory patterns, and community memory patterns.

De Waard [39] presents an approach to model the argumentation of research articles. She claims that rhetorical relations belong to the Pragmatic Web since these exceed the mere semantics of text and belong to the context of the use of sentences.

Cahier et al. describe in [40] (which is a shortened version of [41]) not a “Pragmatic Web”, but a “Socio-Semantic Web”. The authors claim that

the use of formal semantics in the higher strata of the Web's semantic cake covers only a small part of the semiotic contents, especially when these depend on cultural factors and/or are subject to debate. [...] In these situations, it is necessary to use approaches other than those of referential languages and to use the rhetorical/hermeneutic approach [by François Rastier] instead. ([41] p. 216)

3.2.4. Third International Pragmatic Web Conference

The Third IPWC was held in Uppsala (Sweden), in 2008. The *Proceedings*, published by ACM (in the framework of the Hypermedia and The Web SIGWEB), contains ten research papers.

The paper by Allwood [42] considers the various definitions of the Semantic and Pragmatic Web and comes to the conclusion that there is an overlap between their characterizations in various sources. Furthermore, the author claims that the distinction between semantics and pragmatics has evolved during the 20th century and given rise to two subtly different tasks for pragmatics:

- (i) pragmatics as the study of the use and context-dependent meaning of signs;
- (ii) pragmatics as the study of the use and the context of signs. ([42] p. 36)

According to the author, contributions to the first task are concepts such as presuppositions [28] and implicatures [8], while contributions to the second task are speech acts [43,44], language games [45], and social activities [46] or politeness [47]. In the first task, pragmatics has a close relation to logic and semantics, and, therefore, to the Semantic Web. In the second task, pragmatics is closer to psycholinguistics, sociolinguistics, and, therefore, has implications for the Pragmatic Web.

Furthermore, the author states that semantics is by no means context-independent: reference and truth conditions can often not be determined with contextual information (see, e.g., deictic terms such as "I", "you", etc.); *conventional* meaning is supposed to be context-independent, but it does nevertheless depend on cultural factors; furthermore, *literal* meaning is supposed to be context-independent, but literal meaning can be (at least) two things: the greatest common denominator of all uses of a word, which relies on the context of the word to assign meaning, and a prototypical representative of the word's meaning, which again needs context to select the appropriate prototype.

The paper by Carpenter et al. [48] is very interesting because it takes another direction: the one of shared mental models in a team. Two types of shared mental models are investigated: taskwork (whatever is related to the task, the necessary skills, procedures, tools, and criteria for evaluation) and teamwork (whatever is related to the team, communication patterns, and perceptions of how these occur). Besides the quality of these models and the efficiency of the team, what is measured is also its *entitativity* (the extent to which a group is perceived as being a real entity), its organization-based self-esteem, and the emergent team-level emotions. The paper gives a thorough overview of team efficiency evaluation but unfortunately no direct application to the Pragmatic Web. Nevertheless, one cannot help but see social representations taking shape behind the paper's shared mental models.

3.2.5. Subsequent Work

In a paper at the conference I-SEMANTICS 2010 [49], Pohjola considers the linguistic metaphor between linguistic sub-disciplines and various Web types anew. He states that the Pragmatic Web should be considered a hybrid system constituted by humans and technology. According to him, in addition to context, an important Pragmatic Web issue is the change of practices, where a practice is defined as a sequence of actions that remains the same through a certain period of time and is carried out by more than one person.

A year later, at the Human-Computer Interaction Conference in Orlando (Florida), Hornung and Baranauskas [50] present their own vision of the Pragmatic Web as being a space of people, services, and content, with context and customization as orthogonal dimensions. In this space, interaction is based on intentions, materialized by actions. The example given is the one of a school teacher who has private and professional photos on

the Web and expects the system to take the difference into account and act accordingly, independently of the provider and of technicalities.

In an article in the journal *Int. J. on Metadata, Semantics, and Ontologies*, Aaberge et al. [51] consider the Pragmatic Web as an augmentation of the Semantic Web with virtual agents exploiting Web content on behalf of human contractors:

The Pragmatic Web thus consists of the tools, like virtual agents, practices and theories describing why and how people put, retrieve and use information on the Web; it is broadly speaking about social interaction via the Web. ([51] p. 75)

The paper aims to provide agents with the ability to learn new languages by introducing a method of automated translation between formal languages with overlapping domains of discourse. The method is based on an intensional formal semantics, i.e., a semantics that conceives the structure of the language to be determined via the truth-conditional model of the domain. The connection with the Pragmatic Web lies in the adaptation of the agents: “we may not speak the same formal language, but we are able to communicate nevertheless”, in which the choice of language is considered as being part of the context of communication.

In 2012, Weigand and Paschke presented their own vision of the Pragmatic Web (which they called “Web 4.0”) at the RuleML conference [52]. The authors built upon de Moor’s definition of the Pragmatic Web as being a set of pragmatic contexts [25], as well as upon practices and norms according to Stamper’s ladder. It is norms that relate them to the subject of the conference, namely, rule-based systems:

This extends the Semantic Web to a rule-based Semantic-Pragmatic Web [15], which puts the independent micro-ontologies and domain-specific data into a pragmatic context, such as communicative situations, organizational norms, purposes, or individual goals and values. ([52] p. 186)

In addition to contexts, the authors emphasize the fact that the Pragmatic Web should be a Web of events based on event-driven architectures and ubiquitous computing. Figure 2, which concludes their paper, shows their vision of a Pragmatic Web 4.0 that applies no more to humans but to intelligent agents and smart things.

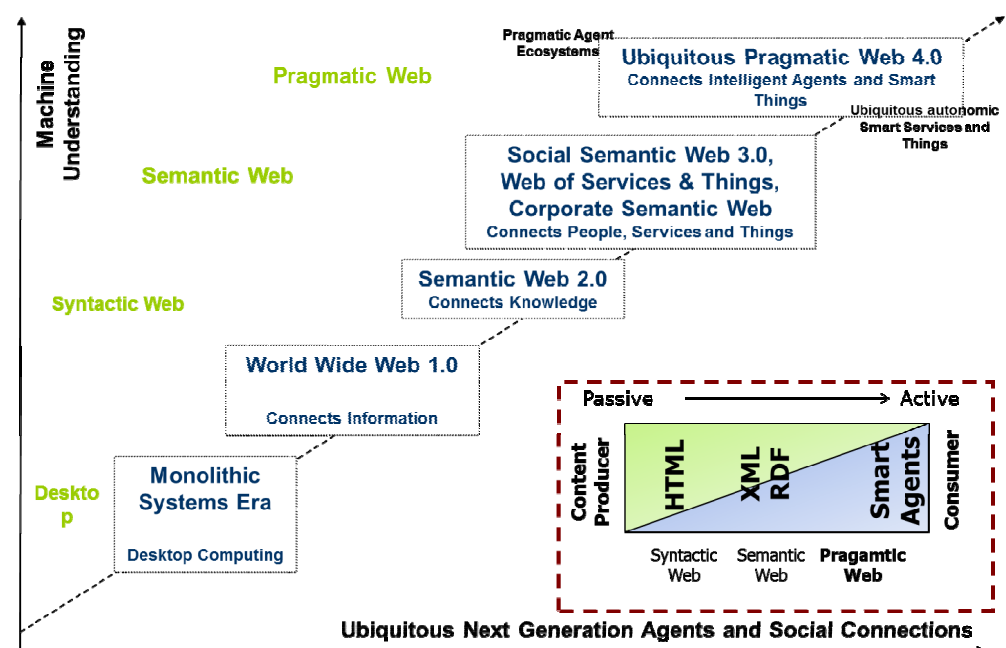


Figure 2. The vision of a ubiquitous Pragmatic Web 4.0 by the authors of [52].

In 2013, Lolli presented a short paper [53] at the 2nd International Symposium on Language and Communication, in İzmir, Turkey, in which he related the Pragmatic Web

to voice assistants such as Apple's Siri (<https://www.apple.com/siri/>, accessed on 6 July 2023) (introduced two years earlier) or Google Voice (<https://voice.google.com/u/0/about>, accessed on 6 July 2023). The author concludes by giving the example of the Google search "My daughter is a fox", that has led to results about (real) foxes and people called Fox, such as Fox Mulder of the *X-Files*. Google missed the metaphorical use of "fox" (in fact, when we performed the same Google query in 2023, the first two links we obtained referred to a story with that title, published in the UK, and the third link pointed to the article [53] by Lolli, a very nice example of the application of Heisenberg's uncertainty principle, where observation can change the phenomenon observed), while a platform called Evi (which later became part of Amazon Alexa (<https://alexa.amazon.com/>, accessed on 6 July 2023)) was able to grasp the meaning of the question "Where is Elvis?" by recognizing the reference to Elvis Presley and answering that Elvis is dead and buried in Graceland.

In 2015, in his Ph.D. thesis [54], Ribeiro Mota gives a nice overview of the Semantic vs. Pragmatic Web issue and concludes with examples of contextual modeling for the Pragmatic Web. His examples cover quotations, document sources, keywords, and extended information about the documents' authors.

Finally, in 2020, R.H. Jones authored a very interesting text on the "Rise of the Pragmatic Web" [55], published as a chapter of the collective *Message and Medium*. He starts by recalling the 2018 Cambridge Analytica scandal, where data on the behavior of 87+ million Facebook users was used to support Donald Trump's campaign and the Brexit vote. The data that contributed the most to inferring voting intentions were not textual utterances but "likes", which are speech acts and therefore belong to the domain of pragmatics and hence to the Pragmatic Web.

Jones argues that even though from an academic research point of view the Pragmatic Web has not (yet?) really taken off, we *do* live already in a Pragmatic Web world without being aware of it, when we consider algorithms that are the heart of search engines (Google), recommender systems (Amazon), and filtering systems (Facebook).

According to Jones, we have witnessed the birth of a new kind of pragmatics, *algorithmic pragmatics vs. analogue pragmatics*:

Analogue pragmatics gives us a toolkit for understanding how people manipulate features of text and context to design interactions in ways that influence the direction and outcomes of communication. Algorithmic pragmatics, rather than focusing on closed systems of usually dyadic communication, sees pragmatic norms as operating within open complex systems in which information circulates and inferences are formed on multiple levels, in multiple contexts, based on multiple logics that both exploit and defy the forms of reasoning characteristic of human-to-human communication. Understanding it requires asking how algorithms form inferences based on people's actions, how they create context and construct identities for people, and how they coerce behavioral change. Whereas analogue pragmatics is about how people "do things with words", algorithmic pragmatics is about how algorithms "do things" with people. ([55] p. 25)

Considering speech acts [43], Jones claims that while natural language has varying degrees of performativity ("I now pronounce you husband and wife" is an example of maximal performativity when pronounced in the proper context), algorithms are *purely performative*. Furthermore, every word we type or every one of our clicks is monitored and becomes information that coerces algorithms to act on us. Therefore, the system is indeed a web of actions, where any of our actions induces actions by the algorithms.

Jones's paper is interesting because it reverses the deal: instead of planning a future Pragmatic Web he claims that we already live in it, with situations reminiscent of the *Black Mirror* series.

3.2.6. Conclusion on the Pragmatic Web

The Pragmatic Web started as a reaction to Berners-Lee's Semantic Web, it incorporated many technological tendencies (SOA, multi-agent systems, etc.) and appealed to

various philosophical theories. Nevertheless, the frontier between the Semantic Web and Pragmatic Web is just as indefinable as the one between semantics and pragmatics. Some authors advocated an entirely new perspective (based on contexts, patterns, or actions), and other authors contributed by some method or tool to facilitate the awaited Pragmatic Web. Finally, after [52] had predicted the ubiquitous Pragmatic Web 4.0 in 2012, [55] claimed in 2020 that it has already arrived and that, at least partly, we already live in it.

In the following two sections, we present our proposal for enriching the Semantic Web with information belonging to the pragmatic spectrum and our proposal for a Web of Social Representations.

4. Our Proposal for an Implicit Pragmatic Web and Web of Social Representations

4.1. An Implicit Pragmatic Web

As a discipline, pragmatics covers a large spectrum of topics, such as speech-act theory, implicatures, figurative language, and politeness. In this section, we will consider some aspects of pragmatics that can be applied to the Web, as a sketch of a tentative Pragmatic Web.

4.1.1. Speech Act Theory

Introduced by Austin [43] and refined by Searle [44], speech act theory examines the intentions of the utterer (the *illocutionary act*) and the effects of an utterance on its listeners/readers (the *perlocutionary act*). The “Syntactic Web” is based on written language, therefore, the possible speech acts are those compatible with the written modality of language. Such acts involve promising, apologizing, requesting, and asserting ([56] p. 248). Annotating pages with speech acts can be useful to clarify the intention of the author, especially since these are realized in different ways from culture to culture and these differences may result in communication difficulties [57].

4.1.2. Reference Assignment and Disambiguation

Reference assignment is a basic inferential process used both by humans and machines. Most of the time this process is straightforward (as in the sentence the reader just read: is there any doubt on which process we mean by saying “this process”?) but it can sometimes be problematic, as in “the prime minister visited the psychopathic killer in his cell—he confided that he felt remorse for his actions,” who is ‘he’ in this case?

It would be a waste of storage space and of CPU to tag the referents of all references of all Web pages, but it would be helpful to perform it for ambiguous cases, this would also facilitate translation between languages since languages with gender and cases use morphological markers for references and, therefore, the ambiguity of gender-free languages must be lifted in gendered languages.

The same also goes for lexical or syntactic ambiguity. As ([56] p. 31) asserts it, disambiguation is a *pragmatic* task, since the meaning of a lexical unit or of the choice of a syntactic construction depends on the context of the utterance. As for now, natural language processing (NLP) has used only part of this context for disambiguation, namely, the neighboring utterances, the text surrounding the ambiguous unit. One can hardly do otherwise since most of the remaining part of the context, the part that makes it an utterance, is unavailable when processing a given sentence. Therefore, it can be helpful to add contextual information through the Pragmatic Web, once again only in case of ambiguity.

Semantic ambiguity resulting from lexical or syntactic ambiguity can also occur across languages and be a perturbing factor in translation [58].

4.1.3. Implicit Meaning: Implicatures

The founder of this field is Grice [8], who distinguishes what is *uttered* from what is *implicated*. The latter is whatever meaning is communicated beyond meaning decoded from verbal content, reference assignment, and disambiguation. His theory was then refined by

Horn [59], Levinson [60], and finally, Sperber and Wilson [61], who introduced *relevance theory*.

According to relevance theory, communication is ruled by relevance, and relevance depends on two factors: cognitive effects (to what extent the cognitive environment of the hearer/reader is modified after the communication act) and the processing effort required by the reader to grasp the meaning. Relevance increases when the cognitive effects are greater, or the processing effort is smaller.

Sperber and Wilson distinguish two intentions: the *informative intention* (the intention to inform an audience of something) and the *communicative intention* (the intention to inform an audience of one's informative intention). If both are missing, we have an accidental information transmission. If there is an informative intention but not a communicative one, we have a covert intentional information transmission. When we have both kinds of intention, we have an *ostensive communication*, and this is most often the case with Web pages.

A hearer/reader will follow a path of least effort in deriving cognitive efforts in order of accessibility until they reach relevance that conforms to their expectations, which is sufficient relevance to justify the processing effort.

We use *implicatures* when we want to achieve more cognitive effects than those corresponding to the literal meaning of the sentence used, and we rely on the hearer to use contextual assumptions in order to build inferences and arrive at the implicated conclusion. According to Sperber and Wilson, besides implicatures we also use *explicitures*, which are propositions explicitly communicated by the utterer, plus reference assignment, disambiguation, and sometimes even inferences. In other words, there is a parallel process between what is said, and inferences applied to what is said, on the one side, and contextual assumptions and what is implicated, on the other side.

Here is an example, taken from an interview given by Barack Obama in 2020, transcribed on the Web. We should note that this interview was aired on 15 November 2020, two weeks after the 2020 elections, at which time the victory of Biden was denied by Trump, a denial that led to the attack of the Capitol, on 6 January 2021.

Scott Pelley: *How do we overcome where we are today?*

Barack Obama: *There's no American figure that I admire any more than Abraham Lincoln, but he did end up with a civil war on his hands. I think we'd like to avoid that.* ([62] 08:33)

Taken literally, Obama's answer is not an answer to the question. To access the real answer, the hearer/reader must go through a number of contextual assumptions and intermediate implicated conclusions:

INPUT

In Lincoln's time, conditions for civil war were met

Lincoln was the best president ever

Lincoln was not able to avoid a civil war

CONTEXTUAL ASSUMPTION

What the best president cannot do, another president can do even less

IMPLICATED CONCLUSION

No president can stop civil war when conditions are met (1)

INPUT (None)

CONTEXTUAL ASSUMPTIONS

When the populace is divided and/or polarized, conditions for civil war are met

(1) No president can stop civil war when conditions are met

IMPLICATED CONCLUSION

When the populace is divided and/or polarized, civil war is unavoidable (2)

INPUT

Civil war is a disastrous potential outcome

CONTEXTUAL ASSUMPTIONS

Disastrous potential outcomes must be stopped at all costs

(2) When the populace is divided and/or polarized, civil war is unavoidable

IMPLICATED CONCLUSION

Actions must be taken to stop division and/or polarization of the populace, at all costs (3)

INPUT

The current president divides/polarizes populace

CONTEXTUAL ASSUMPTIONS

(3) Actions must be taken to stop division and/or polarization of the populace, at all costs

FINAL IMPLICATED CONCLUSION

The current president must be stopped, at all costs

Well understood, this is just an interpretive hypothesis, we will never know for sure whether Obama intended to implicate this conclusion and whether he followed the given reasoning path to it. However, it is a plausible hypothesis. The Implicit Pragmatic Web should make it possible to store information on implicatures and display it on demand. Furthermore, as there is a subjective factor, it should allow multiple versions of this kind of information.

4.1.4. Figurative Language

Figurative language includes methods such as metaphors, irony, sarcasm, etc.

Metaphors

Metaphors [63] involve a translation from one frame (in the sense of [64,65]) into another, so that various concepts of the first frame get mapped to contexts in the second. Let us take an example from the blog [20] that we mentioned in the introduction:

[...] the Semantic Web was on life-support since its inception, and it continued to survive only with the medical intervention of academic departments

In this excerpt, the metaphor maps the concept of computer network (domain A: information technologies) to the concept of human (domain B: life/death, health). "Life-support", "survive", and "medical intervention" belong to frame B, and although the word "inception" still belongs to frame A, it is lexically close to the word "conception", which is paradigmatic of frame B. Metaphors have been extensively studied, and data resources are available, such as the database *MetaNet* (<https://metanet.arts.ubc.ca/>, accessed on 6 July 2023), hosted by the University of British Columbia. In this database, we find a metaphor "computers are people", going from the frame "person" (with roles: person, body, body parts, actions, objectives, and with superframes: animate entity and sentient entity) to the frame "computer" (with roles: computer whole, computer parts, computer function, computer purpose, computational process, hardware, software, computer user, power source, and with superframe: machine). When an NLP algorithm encounters "life-support" and "survive", while the context is that of computers, it will search for metaphors, find "computers are people", and consequently replace "life-support" by "bad condition" and "survive" by "remain operational". This is by no means trivial, and, indeed, "life-support" and "survive" are not (yet) explicitly provided as frame elements in *MetaNet*.

Furthermore, metaphors are culturally-dependent [66]. For example, in the domain of depression, ([67] p. 170) mention the metaphoric theme "depression is darkness" ("a dark cloud", "rainy day", etc.) while ([68] p. 272), in a study of Hebrew metaphors, relates the metaphoric theme "depression is body parts smashed to the ground" ("belly stuck to the ground", "liver spilled to the ground").

Including the information on the specific metaphors used in a separate Implicit Pragmatic Web layer can allow both a human and a machine to avoid semantic opacity or misunderstanding of metaphorical content.

Irony and Sarcasm

Detection of irony is an increasingly popular NLP task (see, e.g., [69]). In Obama's interview we used above, there is an instance of irony, referring to the question of whether the outgoing president Trump would continue the tradition of being present at the inauguration of the new president and congratulating him:

Whether Donald Trump will do the same thing, we'll have to see. So far, that's not been his approach, but hope springs eternal. There's a promised land out there somewhere. ([62] 12:23)

The quote "hope springs eternal", from Alexander Pope's poem *An Essay on Man*, applied literally would mean that there is always hope that the attitude of the outgoing president may change at the last moment. However, as is hinted at by Obama's intonation, the quote is meant ironically. It, therefore, means the opposite of its literal meaning, namely, that there is no hope that the attitude of the outgoing president may change. The ironic intention is confirmed and further underlined by two elements in the sentence "There's a promised land out there somewhere" that follows. First, this is a reference to Obama's book *The Promised Land*, for which he previously said, "I titled it the promised land because *even though we may not get there in our lifetimes*" ([62] 03:40), i.e., the promised land is a place we will not reach in our lifetimes, and, by analogy, so is the outgoing president's change of attitude. Second, the "promised land" is a reference to the Bible and, therefore, is generally perceived as an abstract notion—by saying that it is "out there somewhere", and thereby contradicting the notion's abstractness, Obama builds a second layer of irony.

This example shows that in elaborate texts, irony may be more challenging to detect and interpret than in textbook examples such as "What beautiful weather!" (while it is raining). Introducing a layer that would annotate irony would significantly enhance understanding both by humans and machines.

Explicitly annotating intention is not a new idea. After all, it is the role of some punctuation marks, such as the exclamation mark or the question mark. In 1668, already ([70] Section 11.1) the philosopher John Wilkins used an irony point as an inverted exclamation mark. In 1841, a different irony point (an inverted question mark) was introduced in a Belgian newspaper, together with points for sympathy, antipathy, affliction, and satisfaction ([71] p. 51). In 1966, Hervé Bazin ([72] p. 142) introduced five other punctuation marks: the love point, the conviction point, the authority point, the acclamation point, and the doubt point. Nowadays, the irony point has entered Unicode, but without carrying the semantics of irony (its name is reversed question mark). These ludic inventions may never have been used, at least systematically. Still, they witness the desire of annotating communicative intention well before the computer and the Web.

The function of explicitly annotating irony and other communicative intentions initiated by Wilkins in the 17th century has been indirectly taken over by *emojis*. Emojis mimic facial expressions and, therefore, are subject to interpretation. It seems [73] that the upside-down face emoji (U+1F643) is conventionally used to express irony. A neurolinguistic study [74] has shown that the brain processes ironic emojis in the same way as verbal irony. Emojis can be considered as pragmatic enrichment but do not constitute an explicit annotation. They complement but do not replace the Implicit Pragmatic Web layer of our proposal.

4.2. A Web of Social Representations

In 2020, a highly-ranked computer science journal published a paper entitled "Learning social representations with deep autoencoder for recommender system" [75]. In this paper, the term "social representation" appears 24 times (not counting the title and abstract). Still, nowhere in the paper or in the bibliography is there the slightest hint about

what a social representation actually is. Of course, one could argue that in a scientific paper, there is no need to define the obvious: the term “social network” also appears in the paper and, naturally, does not need to be defined. However, this is not the case with the term “social representation”: a search on Google gives 215 million hits for “social network” but only 85 (units, not millions!) for “social representation”.

4.2.1. History of Social Representation Theory

While Google gives only 85 hits for the term “social representation”, the amount of hits for the French version of the term, “représentation sociale”, rises to 170 thousand. Indeed, social representation theory originated in France in 1961, when Serge Moscovici published his thesis: *Psychoanalysis, its image, and its public*, [76], a book translated into English 47 (!) years later [77]. The subject of psychoanalysis was very well chosen since the three main blocks in French society of the 1950s had adopted different behaviors and viewpoints on the subject of psychoanalysis: liberals cautiously dealt with it in relative neutrality; Catholics adapted it to their belief system by evacuating everything related to sexuality; and communists refused it as a tool of the decadent bourgeoisie. Moscovici presented social representations as having two aspects: a static aspect, in which social representations are beliefs, images, and behaviors concerning some entity, idea, or event, and the dynamic aspect “which has to do with communication and discourse where social representations emerge, develop, change and are used among members of a given group” ([78] p. 6).

Their double aspect makes social representations difficult to grasp: they have an internal structure that can be studied, but they can also evolve in the very short term so that a given study may easily be outdated. As if this was not enough, Moscovici noticed a process that he called *cognitive polyphasia*: individuals use different and sometimes even contradictory discourse about the same issue depending on their social setting. Indeed, social representations are related not to individual opinions but to the behaviors of social groups. They are not truth-conditional and may often be irrational.

Moscovici’s students, and his students’ students, worked on various subjects: on Charlie Hebdo and the Muslim community [79], on drugs and cannabis [80], on psychiatric outpatients [81], on health [82–85], on AIDS [86], on violence in schools [87], on sexual relations of young Greeks in the 1990s [88], on eating [89], on immigrants [90], on Benetton advertisement campaigns [91], on the Euro in Austria [92], on the electronic purse in Austria [93], on the European Community [94], on the ideal group of people [95], on collective memory and history [96], on mutations in food practices [97], on gitanos [12], on speed in car driving [98], on men’s and women’s work [99], on values [100,101], on hazards [102], on higher education [103], on the environment [104,105], on natural medicine [106], on suicide [107–110], on craftsmen and craftsmanship [111], on banks [112,113], on hunting and nature [114], on socio-professional categories [115], on tax avoidance [116], on intelligence [117], on African Americans [118], on money [119], on the financial crisis [120], on the marketing of wine [121], on car brands [122], on the informational implementation [123], and on many other subjects. Social representations have even been used in a study about the concepts of the American Western and the ideology of American exceptionalism through popular culture in the *Star Trek* television series ([124] Ch. 9).

4.2.2. Structure of Social Representations and Methodologies for Extracting Them

According to Abric ([125] p. 59), social representations have a three-fold structure:

1. A central core, which is linked to collective memory, defines the homogeneity of the group, is diachronically stable, coherent, rigid/undefeasible, generates the signification of the social representation, and determines its organization. The core consists of elements and relations between elements. Abric ([126] p. 59) emphasizes the importance of relations: he gives the example of a study about the theme of work in two different groups of young people, the first group consisted of qualified individuals with high degrees, and the second group of unqualified individuals. In the first case, he gathered the three elements “make a living”, “personal fulfillment”, and “social

recognition"; in the second case, he gathered the elements "make a living", "constraints", and "financing leisure time". The same cognitive element "make a living" is related to the other elements in very different ways: in the first case, it is a personal or social value; in the second case, it means to satisfy individual needs.

2. A periphery, which permits the integration of individual experiences and past histories, supports the group's heterogeneity, is flexible and bears contradictions, allows adaptation to concrete reality, and protects the central core.
3. A mute zone (which can again be subdivided into a central core and periphery). In certain contexts, there is a mute zone of social representation for particular objects. This mute zone comprises elements of the representation not verbalized by the subjects with the traditional collection methods. The example given by [126] is J.-M. Le Pen's second position at the presidential elections of 2002, contradicting all pollsters: he hypothesizes that Le Pen voters were ashamed to declare their voting intentions to pollsters, even anonymously.

After describing the structure of social representations, let us see how they can be obtained. Moscovici used questionnaires and qualitative analyses of interviews and press articles to pinpoint social representations concerning psychoanalysis. His students used various methods, among which was free word associations. Apostolidis [88] stated that using a single method may produce biased results and that to obtain social representations, several methods should be used in conjunction and triangulated.

An important method for studying social representations is the method of *basic cognitive schemes*, introduced by Guimelli and Rouquette [127,128]. This method investigates relations between *cognemes* (elementary units of cognition). Starting with a given cogneme A, the subject is asked to supply five additional cognemes B_1, \dots, B_5 by association. Then, 28 paradigmatic relations between A and each B_i are proposed to the subject, who has to mark them as *true*, *false*, or *unrelated*. These relations, called *basic cognitive schemes* (a reference to Bartlett's schemata in psychology [129]), correspond to synonymy, antonymy, definition, inclusion, inverse of inclusion, co-inclusion (both included in a superset), meronymy ("is part of"), inverse of meronymy, co-meronymy (both parts of a whole), doing, inverse of doing, acting on, inverse of acting on, using, inverse of using, having an incidence on, inverse of having an incidence on, using as tool for an action, inverse of using as tool for an action, tool used upon, inverse of tool used upon, frequent characteristic, occasional characteristic, normative characteristic, evaluative characteristic, cause/origin/factor, and consequence/effect/goal. For example, the following basic cognitive schemes came out from a study about the social representation of the ideal group: an ideal group has the fact of having the same opinions as a frequent characteristic, jealousy as an occasional characteristic, egalitarianism as a normative characteristic, pleasantness as an evaluative characteristic, etc.

4.2.3. Our Proposal of a Web of Social Representations

As Aimé and Arnould [130] point out, the method of basic cognitive schemes is reminiscent of the process of building ontologies. Ontologies model a knowledge domain built by a community of experts in the domain through a consensus. There are shared conceptualizations, in the sense that a group of individuals has confronted their choices of concepts and relations and has come to an agreement. Ontologies model common knowledge. Social representations are shared beliefs, images, and opinions. They can be extracted using methods that bear a superficial resemblance to ontology construction. In social representation extraction, no compromise is sought. The diversity of answers to basic cognitive scheme questionnaires is important as it can determine the position of a given cogneme in the central core or in the periphery of a social representation.

As we see, the Semantic Web cannot be directly applied since social representations are neither truth-conditional nor logically consistent. However, we can use its methods to model social representations under two conditions: (a) to attach pragmatic information

on time and community identity to each cogneme and cogneme relation, and (b) to allow contradiction and vagueness. We call such a structure a *Web of Social Representations*.

Here is the structure of this Web: as can be seen in Figure 3, an instance of social representation R is connected:

- to a subject, the central theme of the social representation;
- to one or more communities in the network of human communities. It has geographic components (the inhabitants of a given town or region) but also other criteria, such as profession, hobby / fandom, religious beliefs, political orientation, age, etc. Community detection in social networks can also provide input for such a network which, of course, evolves in time;
- to the “contents” of the social representation, which can be represented, e.g., by RDF triples in an ontology. These triples should ideally be classified according to their belonging to some structural part of the social representation, for example, the periphery, the central core, or the mute region;
- to a time interval $[T_0, T_1]$, on which both the community and the social representation depend. Time is very important since a current event and especially a high-profile event can change social representations drastically;
- to a source: social representations must be established scientifically. Therefore, the source of every such data structure must be given. Otherwise, any political party or corporation could invent social representations to suit its needs.

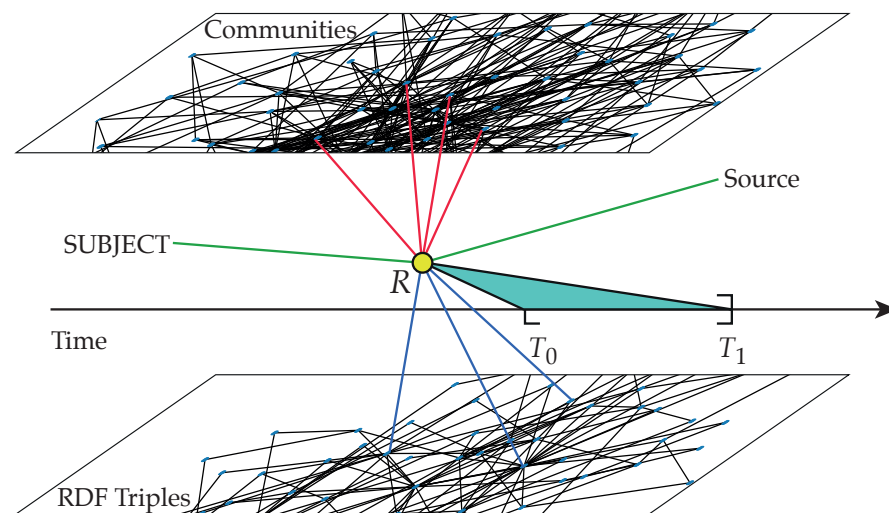


Figure 3. A representation of the structure of an elementary instance R of social representation in the Web of Social Representations

4.2.4. An Example: Suicide in Brittany and Alsace

Let us give an example based on [107]. This paper deals with the social representation of suicide. It is a comparative study of social representations in two anti-diametrical French regions: Alsace (culturally and geographically close to Germany) and Brittany (a culturally Celtic region). Kopp-Bigault et al. used not the method of basic cognitive schemes described above, but a method of word associations introduced by [119]: the participants were asked to provide ten words (the restriction to words instead of cognemes is unfortunate, but made statistical calculations easier) associated with the question “For you, suicide is?”. Once the data was collected, both the average rank and the frequency of words were calculated: those with high rank and frequency were considered to belong to the central core, and those with high values for one of the two dimensions were considered to belong to the inner periphery, and finally, those with low rank and frequency, to the outer periphery. Taking only the first five words, the results obtained can be seen in Table 2.

Table 2. Word associations for the social representation of suicide in Brittany and Alsace ([107] p. 5).

	Highly Ranked	Low Ranked
Brittany		
High Frequency	Suffering, despair, death, unhappiness, collective trauma	Solitude, sadness, depression
Low Frequency	Relief, cowardice, solution	Incomprehension, giving in, deadlock, end
Alsace		
High Frequency	Suffering, despair, death, unhappiness, depression	Solution, collective trauma
Low Frequency	Escape, cowardice	Solitude, relief, call for help, incomprehension, deadlock

The central core is “suffering, despair, death”. Even though it is clear that “despair” is a cause of suicide and “death” is its result, the word association method may be ambiguous, so we do not know whether the subjects meant “suffering” as felt by the victim or by their surroundings (Kopp-Bigault is in favor of the former [131]). Similarly, the term “solution” is ambiguous: it is highly ranked (1.78) in Brittany but of low frequency (7%), while it is of lower rank in Alsace (2.23) but of higher frequency (11%). Maybe these differences result from a different meaning given to the term when used by the two populations.

As can be seen in the table, the central core is the same for the two regions, except for the fifth term, which is “depression” for Alsace and “collective trauma” for Brittany. In addition, there is a term “call for help” in the outer periphery of Alsace, but not in any level of the social representation in Brittany. Kopp-Bigault et al. interpret these differences as follows:

it may be that the Alsace population has a more global view of the nature of depression and of some of its symptoms: sadness, despair, unhappiness, suffering. As a consequence, we could postulate that Alsatian population is more ready to identify depression, which might facilitate access to healthcare services for people suffering from depression. This hypothesis is supported by the presence of the item ‘call for help’. ([107] p. 7)

The authors continue on the differences between the two regions (Brittany has the highest suicide in France, namely 25 suicides per 100,000 inhabitants, while Alsace had a suicide of 10.7 / 100,000, as of 2015) and conclude with recommendations on an optimal way of achieving suicide prevention, adapted to each region. This is a beneficial application of social representations: to address a population or community efficiently, you need to know how it thinks, and social representations provide a solid account of shared beliefs, very often unconscious and sometimes surprising.

The data of the above example would be encoded as follows in a Web of Social Representations:

- Subject: Suicide (node Q10737 of Wikidata, and code CUI C0038661 of the Diseases Database (http://www.diseasesdatabase.com/umls_cui_home_plus.asp?strCUI=C0038661, accessed on 6 July 2023));
- Communities: Inhabitants of French region Brittany (Wikidata Q12130) and French region Alsace (Wikidata Q1142);
- Contents: the original triples are “Suicide is Suffering”, “Suicide is Despair”, “Suicide is Death”, etc. After interpretation by experts (in this case, psychiatrists and psychologists) the triples may have more elaborate predicates, such as “Suicide results from Suffering” (or “Suicide results in Suffering”, depending on the interpretation), “Suicide is caused by Despair”, “Suicide results in Death”, etc.

Depending on the method used, these triples may be more or less precise and may leave room for more or less interpretation by the conductor of the study;

- Time: February 2015 ([131]);
- Source: [107], a paper in a renowned international journal in social psychiatry.

5. Conclusions

After a survey of Pragmatic Web proposals and initiatives, we have presented a two-fold extension of the Semantic Web: an Implicit Pragmatic Web, incorporating implicatures, metaphors, and other implicit information, and a Web of Social Representations, where social representations become encoded objects, linked to communities, context, RDF triples, time, and source.

As was noted by the reviewers of this paper, the implementation of an Implicit Pragmatic Web and of a Web of Social Representations would require significant technical and social challenges, such as developing new standards and protocols, addressing issues of privacy and security, and ensuring the participation and representation of diverse communities. These issues should of course be considered in the near future.

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