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## INFERENCES AND INTERFACES: VALIDITY AND RELEVANCE

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***Abstract:** The Ancient Greeks, since the sophists' texts represented threats to legitimate reasoning anchored in the notion of truth, tried to examine the relationship among valid, informal and fallacious arguments. Aristotle distinguished mainly formal ways of abstractions from the daily practical uses, addressing the relationships between the logical forms and the interferences of content. This paper, motivated by this script of insights, investigates problems concerning logical operators, relations of sense, probability, entailment and their properties in natural language, constituted as inferences in the logical-cognitive-communicative interface. For that, foundations of classical—propositional—logic are brought closer together with the ones from semantics, pragmatics and an inspiring notion of relevance.*

***Keywords:** Inferences. Interfaces. Logic. Validity. Relevance.*

### 1 INTRODUCTION<sup>1</sup>

Since Aristotle (1938) made the distinction between demonstrative (*apodeíxeis*) and dialectic arguments, an investigation script has been opened concerning the interface between logic and natural language. In fact, the matter of validity, essential property of an argument, can be designed free from specific context at the level of logical form, or within context in dialogical debates. The former represents the perspective of theoretical discourse, whereas the latter characterizes communicative or practical rationality. It is possible and desirable to investigate both dimensions of reasoning via language when, for example, there are conflicts in the interface between them. The argument, whose premises “if this is a rose, then it is a flower,” and “it is a rose,” lead conclusively to “it is a flower,” is valid;

$P \rightarrow Q$ ,  $P$  then  $Q$  (*modus ponens*)

However, the argument with the first premise and the second “it is not a rose” does not validly lead to “it is not a flower,” being then a classical fallacy.

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$P \rightarrow Q, \neg P$  then  $\neg Q$  (fallacy)

It can be supposed, now, that an argument of the same logical form of the previous one, i.e., with the negation of the antecedent, be built thus: “If this is a flower, then it is a rose,” and “it is not a flower,” then “it is not a rose.” Such argument can be designed as acceptable even if its logical form is rendered invalid, as the aforementioned fallacy. It is a conflict in which the semantic notion of entailment leads from “rose” to “flower,” seeming to validate the argument. In a similar way, the following argumentative context: “If this is an artificial flower, then it is not technically crafted very perfect,” “it is technically crafted very perfect,” “then it is not an artificial flower”:

$P \rightarrow \neg Q, P$  then  $\neg Q$  (*modus ponens*)

$P \rightarrow \neg Q, Q$  then  $\neg P$  (*modus tollens*)

The argument seems logically valid by the negation of the consequent, even though its conclusion seems inconsistent.

This text examines properties of daily language within the perspective of the logical-cognitive-communicative interface, especially the complex relationships that involve formal inferences, semantic inferences and pragmatic inferences. In section 2, the idea of interfaces is introduced as a descriptive and explanatory model for an interdisciplinary approach; in section 3, following Sperber and Wilson, basic principles for the approach via interfaces that rest on the idea of relevance are presented, notion that is at the same time intuitive and technical; in section 4, cases that illustrate the logical-cognitive-communicative interface are analysed for the contextualization of multimodal inferences; finally, in section 5, pertinent and relevant matters are considered.

## 2 INTERFACES, INFERENCE AND INTERDISCIPLINARITY

Campos (2007) defends the idea that interdisciplinary investigation, organized via an approach of interfaces, can be supported as valid and relevant in relation to the traditional theoretical framework. Historically, Saussure builds a Linguistics with its own methodology and object, but inserted in Semiology and Social Psychology, what is in the interdisciplinary perspective per area; Chomsky, in the same way, considers theory of language as cognitive theory, or even biolinguistics, inserting the investigation in the interdisciplinary scope of natural sciences; Bloomfield also has roots in his behavioural psychology perspective and, even Montague considers the studies of human language analogue to the ones within the formal and mathematical area. This implies that, even before the explicit interdisciplinary proposals, there had already been built a context for the emergence of interdisciplinarity.

In this direction, it is possible to design two levels of interface: the external one, in which the interdisciplinary bases are established, for example, between Linguistics and Cognitive Psychology, and the internal level, or intradisciplinary, in which interface relations between subtheories such as syntax, semantics and pragmatics are, for

example, established. Of relevance is the fact that a way of perspectivism is being adopted, in which the research object is internally built within the theory under construction.<sup>2</sup> Thus, if one is in an interface among linguistics, logic and communication, for example, the intersection between them is not within the same perspective of the one established among linguistics, computation and cognition.

Taking into consideration the notion of inference, traditionally investigated, one can find that such concept is complex in relation to its nature, from classic to recent times. The notion of inference, indeed, refers to an object that can be built under varied perspectives, or disciplinarily, in the context of only one theory. For example, from the logical point of view, it is the centre of the classical activity of argumentation, established by the Aristotelian syllogism, by the Stoics' contribution to propositional logic and manipulated by the interests of the sophists; in interdisciplinary times, it can be considered a process to be investigated in tandem from many angles. Currently, even if the logical tradition remains the starting point, one can shape inference according to the interface between the different areas—it can be a cognitive process that warrants the acquisition of new knowledge (through the association of new propositions with memory), as it can be a communicative process that involves meaning in use. Thus, inference can be characterized as a basic inter/intradisciplinary object, for it would warrant the construction of different interfaces, as logical-linguistic, logical-communicative, logical-cognitive or, even, logical-linguistic-cognitive-communicative. Therefore, one can guarantee the proposal's interdisciplinarity, for it is possible to reconcile the basics from deductive logic with the descriptions of natural meaning inherent to Semantics and Pragmatics.

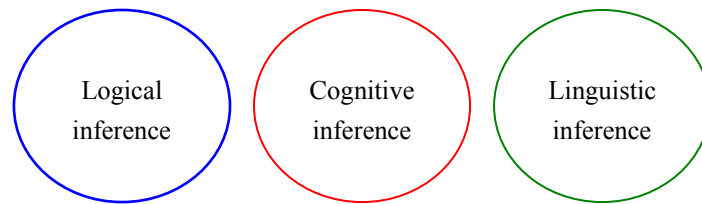
Such interdisciplinary property of inference can be illustrated in the following way:

- a) In *Classical Logic*, there is a formal inference, in which a process of the type  $P \rightarrow Q$  is assumed,  $P$  then  $Q$ , assuming the importance of form in warranting or not the validity of the arguments.
- b) In *Cognitive Science*, one can speak of a relevant-cognitive inference, in which there is a new proposition *Dilma was booed in the opening ceremony of the Cup* that relates to the memory *The World Cup was in Brazil, Brazil is going through a period of political instability*, to infer something like *Dilma is not popular in Brazil*. It is necessary to note that, if an interface with Linguistics is established, we could have illustrated the discipline with an example that would not use words, but only images or feelings—concerning ampler inferences.
- c) In the *Sciences of Language*, we have the linguistic inference, that is built within the internal interfaces of the linguistic study, phonology, morphology, syntax, semantics, pragmatics. In the case of a semantic/pragmatic intradisciplinary relation, the inference will be part of our communicative process, involving sentence meaning and speaker meaning.

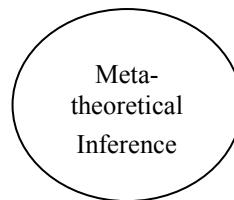
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<sup>2</sup> One of the major modern thinkers on philosophy of science is Giere (2006), who constructs a contemporary model of perspectivism, relying on classical ideas of Kant and Nietzsche. He assumes that the nature of scientific knowledge is not absolute, since it is influenced by historical, cultural and social perspectives on who is observing reality and constructing theories.

If we would consider graphs, we would have three distinct concepts:



However, in the moment of interface, we have a new object that it is neither the logical, cognitive, nor the linguistic one, but it is a fourth, which involves properties of all other areas, as shown in the graph below. (It is important to remember as well that it is not only an intersection or an approximation among the areas, but a fourth, built, object).



Within this complex frame of definitions for the nature of inference, many theorists have made approximations to explain the phenomenon. Plato, for example, was disturbed by the arguments brought forward by the sophists, which used language tricks to win arguments. Aristotle, in his turn, founded logic because he comprehended clearly the difference between the debates among philosophers and daily discussions (COSTA, 2009). The Greeks already recognized, overall, the difficulty and the importance of differentiating the logical, scientific nature of the argument from the one used in daily situations. Centuries afterwards, the traps of natural language are again within the focus of analysis, in which the notion of inference is amplified to give room to practical reasoning also in a communicative-cognitive level. Arguments in natural language and their relation to validity, persuasion and correction have been treated by the unfolding of Pragmatics in its relationship with Philosophy of Language, with the works of Strawson (1952), Austin (1962), Searle (1983), Grice (1989), and Sperber and Wilson (1986/1995). At the same time, from the point of view of logic, a discipline called Informal Logic comes into existence, which is an attempt at developing a logic that can analyse natural language arguments (GROARKE, 2013). According to Groarke, the criteria to consider an argument good are reduced to two points: (i) the acceptability of the premise and (ii) the conclusion that follows from the premises. The second criterion is understood in terms of relevance and sufficiency, making it so that the good argument has premises that are relevant to the conclusion and sufficient to establish it as acceptable. Walton (2007) also seeks to explain and describe the relationship between logic and natural language through a dialogical theory, which aims at showing the nature of rationality, that would not be guided only by deductive rules, but whose argumentation should be considered within the context of dialogs.

Let us illustrate what has been said, bringing closer together areas that investigate language to an interdisciplinary research, looking for connections between the arguments that have been determined by the logical operators or connectives, and the impact of the cognitive-communicative uses of such arguments in their practical dimension. Taking as an example the connective and/ $\wedge$  it could be possible for one to build the interface as specified in the figure 1.

**Figure 1: The Construction of the Inter/intradisciplinary Object**

External Interface (interdisciplinary)	Linguistics, Classical Logic, and Cognitive Sciences
Internal Interface (intradisciplinary)	Lexical-syntactic-semantic-pragmatic/propositional calculus
Inter/intradisciplinary object	Logical-linguistic-cognitive-communicative inferential operator

In order to characterize this perspective in which logic, cognition and communication represent an inter/intradisciplinary approach, let us take into consideration the connective  $\wedge$ . From a logical point of view, ' $\wedge$ ' represents an operator from propositional calculus within Classical Logic, articulated with truth conditions in which  $P \wedge Q$  only is true if both are true and both deduction rules, the  $I_{\wedge}$ , by which it is introduced, and the  $E_{\wedge}$  by which it is eliminated. Given  $P$  and  $Q$ , in isolation, one can deduce  $P \wedge Q$  and, given  $P \wedge Q$ , one can deduce  $P$  and  $Q$ , in isolation. As it is the case with the other connectives, the role of  $\wedge$  is of articulation of deductive inferences. It is to be noted that the commutative property goes for  $\wedge$ , i.e.,  $P \wedge Q = Q \wedge P$ . From the linguistic point of view, on the other hand, 'and' is a lexical entry of English, a coordinating conjunction that adds a  $P$  sentence to a  $Q$  sentence, commonly built as establishing pragmatic connections between antecedents and consequents, as in "John fell and fainted," being the former the cause for the latter (cause). Consequently, the commutativity between the antecedent and the consequent is problematic for the 'and' in practical communication, once that "fell and fainted" is not equivalent to "fainted and fell."<sup>3</sup>

According to Costa (2006, p. 292),

until the contrary is proven, natural language connectives are different from their logical counterparts only due to the fact that they are situated in both aforementioned interfaces, different in nature. The first has as its core the inferential process in monotonic arguments—in the direction of scientific languages—whereas the second has as its core the communicative discourse—in the direction of daily language. In this perspective, one can build a semantics/pragmatics, in the interface with logic, and a semantics/pragmatics in the interface with communication. They would have formal interests in the first hypothesis and, for example, social-communicative interests in the second. Obviously, both connections are relevant to the theory of meaning in natural language, and this heavy weight is to be carried

<sup>3</sup> The relation of logical connectives and natural languages is at the centre of the elaboration of Grice's theory of conversational maxims (1989, p. 22, 44-85), where he debates on the *borderline between semantics and pragmatics*. His discussion starts from the comparison between three basic logical operators  $\wedge$ ,  $\vee$ ,  $\rightarrow$  and the corresponding connectives in natural languages, 'and', 'or' and 'if'. Levinson (2000) also works with the logical connectives in natural languages via I-heuristics (What is said in a simple (unmarked) way represents a stereotypical situation).

by the ones that try to use the second one as argument against the construction of the first, of justifying the (theoretical?) desire of emptying the semantics/pragmatics of natural language of a minimal logical basis as a support to rationality and to the expansion of meaning itself that is rich; but, for some reason, non-chaotic.<sup>4</sup>

In an approach via logical-linguistic interfaces, the deductive-formal inference and its counterpart, the deductive-natural one, constitute themselves as the centre of the argumentative process. As to the cognitive matter, one needs to identify the way that people accept and share inferential processes moved by basic tendencies of the human mind/brain. Sperber and Wilson's (1986/1995/2005) relevance theory, for example, relies on two principles, one cognitive and the other communicative, in which the former defends the idea that human cognition tends towards a notion of relevance, and the latter in which, in ostensive communication, the most relevant can be defined by an optimal cost-benefit relation. In the example of  $\text{and}/\wedge$  inferences in terms of order of  $\text{P}\wedge\text{Q}$  arise, as the most relevant interpretation adds the proposition P to the proposition Q, and an inference, for example, of cause, when P is the cause of Q. A few additional examples involving other connectives might be illustrative:

- (1) John is a teacher and the Earth is round.
- (2) John drank a litter of whisky and then went home driving.
- (3) John was washing the car and singing.
- (4) John fell and came running.
- (5) If you wash my car, then you get ten dollars; you do not, therefore you do not get ten dollars.
- (6) The mother or the father killed the son.

In (1) *John is a teacher and the Earth is round*, the pragmatic intuition is that the conjunction does not make sense, at least not obviously. Why? Well, there are two sentences that are connected by the 'and' and two propositions conveyed by them. This means three syntactic units, the antecedent, the 'and' and the consequent. What is the role of the conjunction? Let us compare it with (1') *John is a teacher and makes little money*. In this case, there are two sentences with two propositions, but there is, in (1'), a possible inference that the teacher makes little money. Then, (1) and (1') may be compared in the sense that (1') is more informative than (1) and the latter seems strange regarding common sense. If this is correct, then, possibly, our cognitive tendency is to optimize the informative process. We seek a connection, in case of (1), between the

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<sup>4</sup> In the original: "até prova em contrário, os conetivos da linguagem natural diferem de suas contrapartes lógicas apenas pelo fato de que se situam nas duas interfaces recém-citadas, diferentes em sua natureza. A primeira tem como centro o processo inferencial em argumentos monotônicos – na direção de linguagens científicas – enquanto a segunda tem como centro o discurso comunicativo – na direção da linguagem cotidiana. Nessa perspectiva, pode-se construir uma semântica/pragmática, na interface com a lógica, e uma semântica/pragmática na interface com a comunicação. Elas teriam interesses formais na primeira hipótese e, por exemplo, interesses sócio-comunicativos, na segunda. Obviamente, ambas as conexões são relevantes para a teoria do significado em linguagem natural, e cabe o pesado ônus, aos que tentam usar a segunda como argumento contra a construção da primeira, de justificar o desejo (teórico?) de esvaziar a semântica/pragmática da linguagem natural de uma base lógica mínima como suporte da racionalidade e da própria expansão de sentido que é rica, mas, por algum motivo, não-caótica."

propositions and the connective, and we find awkwardness, but we find such connection in (1'), what would allow us to say that the latter is more relevant than the former. Actually, (1) equals three syntactic units to two propositional units, and (1') equals three syntactic units to two propositional ones (*John is a teacher* and *John makes little money*) plus an inference that *teachers make little money*.

In (2) *John drank a litter of whisky and then went home driving*, the problem at hand brings up the matter of the order of the sentences connected by 'and'. In the form of (2), John was extremely reckless to drink and drive; in the form of (2'), *John drove home and drank a litter of whisky*, to drink at home does not seem something awful. The complexity, in the case of the interface with logic is that, in this one, commutativity goes, since  $P \wedge Q$  and  $Q \wedge P$  are utterly equivalent. In fact, our intuition registers the information from both propositions; why would we then look for the connection regarding temporal order? By the same perspective of tending towards relevance?

In (3), *John was washing the car and singing*, at first glance, the sentence order does not correspond to the action order. They seem to take place at the same time. How do we know that? Probably due to our encyclopaedic knowledge expressed in the imperfective within the verbs. However, a different interpretation could not be blocked. Something like "*was washing and singing and washing and singing and...*" without the actions being simultaneous. But, again, the operational cost of such non-simultaneous actions would be bigger than "*washed and sang at the same time,*" what makes the latter more relevant. Note, also, that the verbal tense, on its own, does not justify such, since "*washed the car and sang quite happily*" would also suggest simultaneity.

In (4), *John fell and came running*, the example is interesting regarding that the sentential order of cause and consequence seems inverted in the order of the propositions. Yet, there is still correct understanding that falling was not the cause of running. The interpreter seems to execute a pragmatic restoration of order. This means more cost, which would indicate "*came running and fell*" as more relevant than "*fell and came running.*" In fact, the former suggests cause and the latter, explanation, in the old grammatical perspective of analysis of the conjunction "because" in Brazilian Portuguese. However, the pragmatic restoration seems to take place in a second instant only, for, a priori, we expect that the speaker is being relevant in their utterance. To Noveck and Chevaux (2002) children seek, at first, a logical interpretation for the utterance, even if it is potentially less informative. The authors affirm that the linguistic-pragmatic interpretations seem to evolve with language.

Case (5), *If you wash my car, then you get ten dollars; you do not, therefore you do not get ten dollars*, is a classic example of fallacy of the negation of the antecedent.  $P \rightarrow Q, \neg P$  then  $\neg Q$ . But such fallacy seems, at the same time, an invalid and yet acceptable argument. Why acceptable? An explanation could be that the invalidity of the argument is a cognitive-communicatively simpler and stronger way in a biconditional interpretation, "if you wash my car (and only in this case) you get ten dollars." That is, the fallacy does not appear. One reads the conditional and interprets it as biconditional. Obviously, the same is analogous to any other operator. In (6), *The mother or the father killed the son*, for example, one can illustrate the use of another connective, such as "or." It is the so-called " $P \vee Q$ " disjunction matter, inclusive or

exclusive, that brings into discussion a similar situation. One can read an inclusive disjunction in which both might have killed the son, but the standard interpretation is exclusive, only one of them did it. The definition by means of the exclusive disjunction would be more informative, more precise, simpler, and, consequently, more relevant.

### 3 THE CONTRIBUTION OF RELEVANCE TO THE CONCEPT OF INFERENCE

The examples above are essential to demonstrate that the notion of inference, in the course of natural language, needs to be understood through the construction of external interfaces—in this case, among Logic, Linguistics, Communication and Cognition. Only with this movement we will be able to have a more complex analysis, adopting an amplified rationality on the inferential process.

Within this framework, the complex object between ‘and/∧’ can be built within the notion of internal interfaces, working as an operator of truth conditions and acceptability, and communicability conditions. Thus, two basic conditions seem to occur when we speak of the operator ‘and/∧’ (that is not the logical ‘∧’, nor is it the natural language ‘and’, but a third element of the interface, intersection in which rationality is understood as a complex phenomenon, involving, at the same time, logical forms (validity) and content forms (acceptability)) at the level of argumentative abstract schemes and practical uses of arguments.

- *Truth conditions*: as in classical logic, deductive validity is taken as a property by which from true premises false conclusions cannot be followed. Validity is determined by the logical form and not by the proposition; in other words, the fact of the content of the propositions being true or false does not concern logic. On this side of the interface, we have a logical form, corresponding to a well-formed structure (of the type  $P \rightarrow Q$ ), and a semantic interpretation, that are the truth conditions, a formal concept as well. The notion of true or false is a formal idea, a priori established—one does not say what is true and what is false, it is a prior condition. That is, it is to be noted the fact that what is at stake here is the *logical form* of the argument, and not the *propositional content* present in it. When entering an interface with natural language, it would not be possible, simply, to abandon the idea that logical form is important and that the human mind/brain does not recognize deduction rules or deductively valid arguments. That would be a radical measure, and it would make it so that centuries of studies concerning logic would be left aside. When working with interfaces, we do not abandon classical ideas on argumentation.
- *Acceptability and communicability conditions*: If we assume that the logical form of the inferences is recognized by the cognitive system, we cannot dismiss considering that invalid logical forms also seem to be accepted during communication. Fallacies, for example, are arguments that stem from true premises and arrive at a false conclusion, resulting from formal rules of reasoning—but, many times, are accepted in communication. What is at play, in this moment, is the *propositional content* of the argument. And the content



is connected to semantic (entailment, hyponyms, synonyms) and pragmatic (presuppositions, implicatures) processes. That is, even if the form is not correct, the relations established by the content, at the level of premises and conclusion, are acceptable. Acceptability seems to be connected to premises a priori known as true, them being based on the form of the argument (*Or it is snowing now or it is not*), avoiding contradictions and tautologies; based on the meaning of the words—true by definition (*All single men are non-married men*); or the premises based on common sense (*The Earth is round*), even if they depend on the audience and the context; the premises connected to witnessing (*I saw the accident with my own eyes*), considering plausibility, source trustworthiness, for example; the premises connected to opinion of authority (*Einstein said that x*); etc. According to GOVIER (2010), the premises of an argument are understood as being true or rationally acceptable.

Going back to the object ‘and/∧’, we can say that it works as a truth conditions and acceptability and communicability operator. Consider the example below:

$((P \wedge Q) \rightarrow R), P, Q \rightarrow R$

If John likes Mary and she likes him, then they get married; they love each other, therefore they get married.

In natural language, we can say ‘they love each other’ to imply that ‘John likes Mary and Mary likes John’—but this premise is based on acceptability, on prior knowledge that the speakers must love (each other), implying reciprocity and that there is a semantic relation of the words, that it does not depend on context. In terms of form, there would be a fallacy, for it is not warranted in the initial premises that *love* and *like* are related elements. However, within the built interface, such problem is solved with the acceptability expressed through language—the argument is accepted due to the coherence of the content.

Another point is necessary to be made in order to explain the reason why the mind/brain operates with invalid arguments from the logical point of view, but communicatively acceptable: there seems to be a natural tendency towards relevance. This way, besides being in a logical-linguistic-communicative relation, we also undertake another dimension for the interface: the cognitive inference. For such, the remarks done by Sperber and Wilson (1986/1995) come into play. Relevance Theory has already traversed many generations of theorization within the interfaces among language, cognition and communication. It is, by nature, one of the most successful cases of interdisciplinarity in the natural and social areas. One of their most successful strategies is the connection of their whole conceptual architecture with two interconnected principles through the powerful notion of relevance: the principle of Cognition and the one of Communication. Cognitive relevance is, in mind, a cost-benefit notion (human cognition would process more simply and would try to obtain knowledge to the maximum); the communicative is one which sustains that every message comes loaded with the assumption of optimal relevance, i.e., when a person communicates with another they are, hypothetically, trying to be as relevant as possible and that guarantees that B understands what A is talking about because B knows what would be more relevant.

Within this system, the authors adopt two general hypotheses: (i) the inferential process is non-demonstrative, for the speaker only builds a supposition based on evidence provided by the speaker's ostensive utterance; (ii) any available information, represented conceptually, can be used as a premise in the inferential process. When they affirm that the communicative-inferential process is non-demonstrative, one starts to understand that we are not facing the standard character of logic, which is trivial, but with a modified idea of logical processing.

In relation to the operator 'and/ $\wedge$ ', Wilson and Sperber (1998) affirm that *p and q* are not equivalent to *q and p*, because if they were, they could implicate tautologies of the type *It is always the same thing: or I eat and gain weight or I gain weight and eat*, or contradictions *It was not the case that Peter went out and Mary got enraged, but Mary got enraged and Peter went out*. Adopting the relation of relevance, the authors affirm that the mind works only with basis on elimination rules, for they would have an essential role in the spontaneous deductive processing. The authors reject a stronger role of logic in the process, as they believe that the inferential capacity is limited more due to cognitive reasons of hypotheses formulation than by logical confirmations. To SW (1995, p. 69), "Human spontaneous non-demonstrative inference is not, overall, a logical process." Ibaños (2009) questions the idea that there would be incompatibility between the systems of demonstrative logic and practical reasoning, arguing that classical logic principles and rules are included in the ideas of linguistic inferences (syntax, semantics, pragmatics...). It would be possible, by means of an idea of interfaces, to make compatible the foundations of logic within non-trivial calculus proposed by relevance theory.

Namely, within this motivation, we assume that the mighty notion of relevance does not lose power in an interface built with deductive logic and linguistics. If I have P and I have Q, for example, why would I have to have  $P \wedge Q$ ? That would be redundant. Unless there would be some inference of  $P \wedge Q$ , or  $Q \wedge P$ , that would justify the introduction of and/ $\wedge$ . Through the interface, the rules of introduction (excluded in relevance theory) can be justified due to the existence of extra benefits—it is the case that the inference of effort and persistence is a rhetorical property as benefit in order to compensate for the cost of the redundancy, for example. Within this construction, we are going to illustrate, below, the construction of the notion of inference within the linguistic-logical-communicative-cognitive interface.

#### 4 LOGICAL-SEMANTIC-PRAGMATIC INFERENCES

Inferences, in a perspective of diverse interfaces, are impacted by heterogeneous, deductive, inductive, abductive properties, relations of meaning, implicatures, presuppositions, entailments, intentions, what has been said, etc. This means that analogies, conflicts, fallacies, persuasion, emotion, among other ingredients, emerge in a complexity of meanings, when language is instrument to practical rationality. Consider, also, that, as in its classical origins, dialog is a communicative piece rich in inferences of various types, potentially relevant to describe and explain the

conversational game<sup>5</sup>. It is also important to take into consideration the varied sources of inferences in the different linguistic levels: phonetic-phonological, morphic, lexical, syntactic, semantic and pragmatic. It is important to observe that, in natural language, we use, in a mixed way, logically organized propositions, propositions for the future, fallacies, because communication is not at the service of demonstrations, but of interactions—what implies a need of evaluation of cases in which we accept logically true arguments as well as fallacious ones.

Regarding the overall ideas of relevance theory, we can affirm that it is a defence of rationality, as a property of people having genetic baggage that drives them towards an intelligent mind/brain in some way, and property of having social baggage that drives them to what is more important in some way. Here, considerations about a historical debate between properly logical arguments and properly dialogical ones are fit. To the former, one attributes the beauty of the formal and of the precise and the limitations of the precise and of the formal; to the latter, the beauty of the social and of the rhetorical and the non-limitations of the rhetorical and of the social.

Relevance theory might perhaps be mentioned as a gigantic project in defence of compatibility between the social and the cognitive, between ample and narrow rationality, dodging the traps posed by improper reductionists from both directions. It is still worthy to be mentioned that principles of renowned value such as the law of least effort, Ockham's razor, the modularity of the mind, the universal grammar and minimalism, Grice's principle of cooperation, among others, maintain productive relationships with relevance theory and consistency in their effects, the most general ones at least in a conceptual level. Indeed, the notion of relevance is appropriate *per se* to the complexity of the tripod of language, cognition and communication.

The cases we are going to present are an attempt at systematizing crucial exemplification to the interdisciplinary approach. In it, the classical debate inaugurated by the types of argument in the tradition of Aristotle, Plato and the Stoics was redesigned as if predicate, propositional and informal logic must constitute de bases of the linguistic-cognitive-communicative inference, under the government of a new notion of relevance.

In this sense, cases in which there are complex relations between the matter of validity by the logical form (basically *modus ponens* and *modus tollens*) and the cognitive-communicative acceptability via the form of the content follow, and besides formal reasoning, the use of arguments constituted of multiform properties is also taken into consideration.

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<sup>5</sup> Overall, neo-gricean theories presuppose human communication through dialogs, even though they do not assume it as their object. Theorists speak of participants, interlocutors, listeners and speakers, exemplifying their approaches through dialogs. Grice (1989 [1975], p. 26), for example, affirms that "Our talk exchanges do not normally consist of a succession of disconnected remarks, and would not be rational if they did." Besides semantic-pragmatic theorists, other authors approach dialog in an interdisciplinary way. Walton (2007), for example, builds a dialogical theory based on informal logic, in which there is the possibility of evaluation of the used arguments. For this author, dialog is something conventional, defined as an activity between two speakers that might have different objectives. The types of dialogs can be characterized by the type of commitment of the participants, by the way of starting it, by the dialogic objective (WALTON; KRABBE, 1995).

## A: DEDUCTION AND HYPONYM (INTERFACE BETWEEN LOGIC AND LEXICOLOGY)

Logically valid argument (*modus ponens*) and cognitive-communicatively acceptable

If you saw an animal, then it was a cat.

You saw an animal.

---

Then it was a cat.

Logically invalid argument (fallacy) and cognitive-communicatively acceptable

If you saw an animal, then you saw a cat.

You saw a cat.

---

You saw an animal.

In logic, the concern regarding the evaluation of the arguments is related to the form and not the meaning, that is, every argument that has a valid form will be valid, regardless of its content. We have, thus, in the interface we have built, the fact that the argument can be valid and acceptable, invalid and acceptable, valid and unacceptable, invalid and unacceptable. In the case above, there is, firstly, an argument via *modus ponens* ( $P \rightarrow Q$ ,  $P$  then  $Q$ ), whose logical form is valid and whose semantic-pragmatic structure is acceptable. However, in the second example, *modus ponens* seems to have failed ( $P \rightarrow Q$ ,  $Q$  then  $P$ ), generating the fallacy of the affirmation of the consequent. In this example, the argument is fallacious even though its content is acceptable due to a hyponym. If we would make a fallacy negating the antecedent (*you did not see an animal, then you did not see a cat*), we would have the same situation—the entailment would guarantee the acceptance of the argument, but it would remain logically fallacious. As the notion of hyponym is not expressed in logical calculus, but in a semantic context, that is, it is already at the level of the interface with natural language, we can notice that there might be collisions between validity and acceptability. The former being in the formal interface, and the latter, in the cognitive-communicational interface. What we can notice is that the propositional structure of the argument is acceptable, independent from the logical form being invalid.

## B: DEDUCTION AND RELATIONS OF MEANING (SYNONYM)

Logically invalid argument and cognitive-communicatively acceptable

If John is single, then he can get married officially

He is not married

---

He can get married officially

We have, in the example above, another case in which the argument is logically invalid, for there is no established guarantee in the premises that who is single is not married, but it is communicatively accepted. In synonym, a semantic process, the meaning of the concept *single* implies the one of *not-married* and vice-versa; however, such relation is connected to natural language, and does not show up in the formal agenda. That is, synonym is not a formal rule, but yet an idea connected to the semantic proposition—free of context. Human perception seems to accept some linguistically correct conclusions, as in the case above, but with incomplete arguments. That would only be possible because there is a strong notion of relevance guiding the communicative process—semantic inferences, free of context, would be realized within the interpretation process, assuming that the dialog would be in an ostensive relation. In this sense, the deductive inference has been altered by changing the meaning in the second premise—instead of repeating *single*, *not-married* was said. In the logical information, it is not possible to change the meaning of the propositions, but in communication it is possible and even desirable, in some cases, to change the meaning of the propositions. In logic, validity in the deduction is guaranteed *a priori*, because of the rules; in communication, other linguistic elements are at play.

### C: DEDUCTION AND ENTAILMENT (INTERFACE BETWEEN LOGIC AND SEMANTICS)

Invalid argument (fallacy) and cognitive-communicatively acceptable

If John has sons, then he has, at least, a son.

He has, at least, a son.

---

Then he has sons.

The argument above is also an example of fallacy of the affirmation of the consequent, as shown in A. The case above, however, has a complication: the presence of the quantifier that inserts the entailment element. Consider a variation of the example above:

If John has sons, then he has, at least, a son.

John does not have at least a son.

---

John does not have sons.

The argument seems to be well constituted from the logical point of view, as well as from the communicative point of view. Even though it is not a fallacy, and yet an argument via *modus tollens* ( $P \rightarrow Q, \neg Q$  then  $\neg P$ ), it is shown that the semantic relations of content seem to be as, if not more, important as to logical validity—weighing on the inferential notion of relevance. In this case, since logic does not rule over the true or the false, but over the consistency of the propositions, it would be desirable for us to have a regulated system by informative content as well as by validity, built through the logic-linguistic-cognitive-communicative interface.

## D: DEDUCTION AND PRESUPPOSITION (INTERFACE BETWEEN LOGIC AND PRAGMATICS)

Invalid argument (fallacy) and cognitive-communicatively acceptable.

If John does not smoke anymore, then he quit smoking.

He quit smoking.

---

Then, he does not smoke anymore (He used to smoke.)

Verbs are a very special class of words, as they can have different things to be analyzed, such as tense and aspect. The first refers to the location of an event or action in time, either the present or the past (in English, the future is marked by a modal auxiliary or a semi-auxiliary); whilst aspect refers to how an event or action is viewed with respect to time, rather than to its actual location in time. In the argument above, we have a fallacy (affirmation of the consequence), but the presupposition indicated in parentheses relies on the imperfective aspect, more specifically on the habitual past<sup>6</sup>. In this sense, we have an argument based on the structure of the meaning, on its internal relationship, not based on the logical form<sup>7</sup>.

## E: DEDUCTION AND IMPLICATURE

Invalid argument (fallacy) and cognitive-communicatively acceptable

If John has money, then he can travel abroad.

He is a Bill Gates (implicature of having money)

---

Then he can travel abroad

The interesting matter, in this case, is that the argument is ill-formed, being the second premise false and unacceptable. However, the argumentative form is interpretable and acceptable. This occurs due to the fact that, given the contextual conditions, the second premise is understood by what is said more than by what is implied. It is necessary to understand that the conclusion is only possible due to world knowledge—it is communicatively necessary that both speaker and listener know who Bill Gates is and also know that he has enough money to travel abroad. Relevance theory itself deals with this matter rather well, showing the relation between encyclopaedic memory in the building of context, which happens online.

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<sup>6</sup> According to Dahl (1985), the habitual past is the most common tense context for the habitual, occurred in only seven of 60 languages sampled, including English. In Brazilian Portuguese, there is no grammatical form that specifies to the habitual aspect. In the past tense, we have a form called the *imperfect*, which combines past tense with the imperfective aspect—*Ele fumava* (presupposes he doesn't smoke anymore).

<sup>7</sup> In a Gricean perspective, this is a case of conventional implicature—where the implicature is part of the linguistic meaning.

## F: DEDUCTION AND NEGATION OF THE INTENSIFIER

Valid argument and cognitive-communicatively unacceptable

If Mary loves John, then she does not love him very much.

She loves him very much.

---

Then, she does not love him.

Here, *modus tollens* seems perfect. Yet still, the argument is in contradiction between the second premise and the conclusion—contradiction at the level of the proposition and not logic. What happens is that the first premise does not seem unreasonable, because it is the intensity of the adverb that generates the affirmation (or not) to be assumed. That is, the presence of the adverb ‘very’ is the point to be considered—a linguistic element that directly demonstrates the cognitive relations that need to be established—to *love* and *to love very much* are different things in the real world. Technically, the argumentative propositional structure in this example cannot be considered well-formed.

## G: DEDUCTION AND PROBABILITY

Invalid argument and cognitive-communicatively acceptable

If you wash my car, you get ten dollars.

You did not wash the car.

---

You do not get ten dollars.

This proper case of fallacy of the negation of the antecedent seems to be one of a rather reasonable argument. Indeed, it would be weird if one would suppose the possibility of another different conclusion. Why would someone get money without having washed the car? One of the alternatives to explain it is that the conditional is interpreted as a biconditional. But the question resists, why? Maybe because, even if the conclusion is not necessary, it is highly probable. Another alternative would also be the perspective that the biconditional is more determined, more informative and, consequently, more relevant.

## H: DEDUCTION AND PROVERB

Invalid argument and cognitive-communicatively acceptable

If you are in a hurry, you will not perform this task well.

Haste is the enemy of perfection.

---

You will not perform this task well.

The second premise is constituted by a proverb. They are, normally, expressions that, due to their history, are assumed consensually as true. It is a premise with consecrated truth strength. It corresponds to the logical idea that, if P is true then Q, (whichever) implies it, a type of paradox of the conditional.

## I: DEDUCTION AND EMOTION

### Invalid argument and cognitive-communicatively acceptable

If you vote with Lula, you vote for Dilma.

I like Lula.

(I should vote for her, but I am not confident)

---

Then, I do not vote for her.

Here, the matter at hand is the possibility of cancelling a valid conclusion by inserting a proposition that is affective in nature. Interestingly, it is the cognitive-communicative acceptability of the argument even if it hurts validity and accepts the additional explanation. At this point, one infers that emotion has priority over reason. To the contrary, in an argument such as:

If I do not trust Lula, I do not vote for him.

I do not trust Lula.

---

I should not vote for him, but I do because he knows how to govern.

It is inferred that reason predominates over emotion, from the cognitive point of view. It is shown, thus, that the practical argument includes the logical argument, that the mind registers the validity, but accepts apparently different conditions, for there are reasons, such as the ones proposed by relevance, to understand the process.

## 5 CONCLUSION

In the disputes between Philosophy of Mind and Philosophy of Logic, among Wittgenstein, Frege, Russell, Strawson, Austin, Grice and Searle, as most salient ones, there was tremendous effort to model natural language as the root of rationality; within Logic, the attempt of formalization; in the cognitive context, the search of the mind/brain bases that would be capable to describe how it is possible to understand what lies beyond what has been said, the implied, the inferred, with perfectly acceptable reasonability. Indeed, rationality in the broad sense comprehends *stricto sensu* logic and goes beyond the rules that govern calculi. Practical reasoning is creative and rich in its rhetorical nuances, and the Greeks could not help but recognize it. It is not about radicalizing over the necessary deductive inferences, nor falling in the obscurity of fallacious speculations. It is possible to think correct and relevantly, even if one cannot characterize a logicist project in which only one pattern can be assumed. In effect, the



argument in its daily use is a complex object for which there is also the need for complex or interdisciplinary approaches. It is, then, about creating perspectives of different interfaces that can elucidate various problems. The notion of relevance, such as in relevance theory, for example, can represent a linguistic-logic-cognitive-communicative interface to contribute with the resolution of matters in each interface building process.

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**Título:** Sobre inferências e interfaces: validade e relevância

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**Resumo:** Os gregos clássicos, desde que os textos sofistas representavam ameaças ao raciocínio legítimo ancorado na noção de verdade, trataram de examinar as relações entre os argumentos válidos, informais e falaciosos. Aristóteles, principalmente, distinguiu os modos formais de abstrações dos usos práticos cotidianos, abordando as relações entre as

*formas lógicas e as interferências do conteúdo sobre elas. O presente texto, motivado por esse roteiro de reflexões, investiga problemas nas relações entre os operadores lógicos e as relações de sentido, probabilidade, acarretamentos e suas propriedades na linguagem natural, constituídos como inferências na interface lógico-cognitivo-comunicativa. Para isso, aproximam-se fundamentos da lógica clássica – proposicional – com os de semântica, pragmática e uma noção inspiradora de relevância.*

**Palavras-chave:** *Inferências. Interfaces. Lógica. Validade. Relevância.*

**Título:** *Acerca de inferencias e de interfaces: validez y relevancia*

**Autores:** *Jorge Campos da Costa y Claudia Strey*

**Resumen:** *Los antiguos griegos, ya que los textos sofistas representaban amenazas para el razonamiento legítimo anclado en la noción de verdad, trataron de examinar la relación entre argumentos válidos, informales y falaces. Aristóteles distinguía principalmente los modos formales de abstracciones de usos prácticos cotidianos, frente a las relaciones entre las formas lógicas y la interferencia de los contenidos sobre ellas. Este trabajo, motivado por este guión de reflexiones, investiga problemas en las relaciones entre los operadores lógicos y las relaciones de significado, probabilidad, acarreamientos y sus propiedades en el lenguaje natural, constituidas como inferencias en la interface lógico-cognitivo-comunicativa. Para esto, se aproximan fundamentos de la lógica clásica – proposicional – con fundamentos de semántica, pragmática y una noción inspiradora de relevancia.*

**Palabras-clave:** *Inferencias. Interfaces. Lógica. Validez. Relevancia.*