FOR A GOAL CONCILIATION THEORY: ANTE-FACTUAL ABDUCTIVE HYPOTHESES AND PROACTIVE MODELLING

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Abstract: Based on Sperber and Wilson's (1986/1995) relevance theory, I outline a goal conciliation theory in this paper in order to describe and explain the formulation and the evaluation of ante-factual abductive hypotheses in proactive contexts, claiming that the individual produces an inference to the best solution in these cases. I present this conceptual architecture in four stages—goal designing, and hypothesis formulation, execution and checking—with an example in which an individual intends to open his own locked front door. Finally, I evaluate goal self and hetero-conciliation processes in contexts of categorical, biconditional, conditional, enabling, and tautological ante-factual abductive hypotheses.

Keywords: Cognitive Pragmatics. Relevance Theory. Goal Conciliation Theory. Proactive Modelling of Goals. Ante-factual Abductive Hypotheses.

1 INTRODUCTION[1]

Sperber and Wilson's (1986/1995) relevance theory is based on the *cognitive principle* that the human mind tends to maximize the relevance, and the *communicative principle* that utterances generate precise expectations of relevance. Relevance is a property of the inputs directed to cognition. Processing an input in a context of assumptions can yield positive cognitive effects of modification or reorganization of these assumptions. An input is relevant, when these effects compensate processing efforts, i.e., *ceteris paribus*, the greater the cognitive effects and the smaller the processing effort, the higher the eventual relevance.

Lindsay and Gorayska (2004, p. 69) argue that relevance is a goal dependent predicate. So, individuals attribute relevance to inputs connected with a purpose. They formulate a goal dependent formal definition of relevance. According to this definition, "*P* is relevant to *G* if and only if *G* is a goal and *P* is an essential element of any plan that is sufficient to achieve *G*". For the authors, goals are abstract and symbolic representations of states of the world which can be considered objects of planning. They can be cognitive or final. Most of the goals are part of a complex chain of goals. A

cognitive goal stems from, is justified by, or contributes to the planning or execution of *final goals*. The specification of a cognitive goal is associated with conditions of satisfaction the agent believes are achieved when he/she is in the state of a final goal.

This argument converges with Silveira and Feltes (1999, p. 37), when they claim that people pay attention to stimuli which, to some extent, satisfy their interests or fit the circumstances of the moment. Thus, individuals can either be reacting to stimuli, many of which they have not contributed, or acting with previous interests, and the inputs are processed in a context that fits these purposes. Moreover, they can intervene in these contexts to achieve these interests. On these occasions, individuals are proactive rather than reactive.

It is worth noting that the relevance-theoretic comprehension procedure has proved to be efficient for modelling cognitive processes in the interpretation of verbal inputs. Individuals wish to find an interpretation that satisfies their expectations of *optimal relevance*; in fact, a goal. Thus, they follow a path of least effort. Based on the linguistic encoding, they enrich these inputs to find an explicit meaning (the explicature) and, eventually, an implicit meaning (the implicature). The process is ended when the interpretation satisfies their expectations of relevance. According to this expectation, they tacitly assume that the utterance should be relevant enough to be worth the hearer's processing effort and the most relevant one compatible with the speaker's abilities and preferences. By the way, Sperber and Wilson propose a deductive module in this procedure. This module captures assumptions from perception or memory, and deduces non-trivial and non-demonstrative conclusions only by elimination rules such as *elimination-and*, *elimination-or* and *modus ponens*.

Note that this model is essentially reactive, because both procedure and module are mobilized by the emergence of an utterance. The speaker's goal is presumed and generally inferred in the interpretation, and the hearer's goal is just limited to improve his/her cognitive knowledge. Furthermore, the creative emergence of hypotheses in the required increasing of the context is undeveloped.

I argue that this increasing is abductive, and the cognition is moved by a presumed conclusion rather than by the emergence of premises. Thus, the deductive procedure is only one part of the checking process of abductive hypotheses.

Once the aim of this text is modelling proactive goals, I claim that the individual produces an *inference to the best solution*, in a blatant analogy to Harman's (1965) concept of *inference to the best explanation*. Hence he/she insets the premise that best contributes to the goal achievement. Incidentally, both the presumption of optimal relevance and the very principle of communicative relevance are nothing more than inferences to the best explanation for the ostensive emergence of an utterance.

Abduction is defined by a process of reasoning that departs from an observation like *x is Q*. Then, one infers a hypothesis of a nomological connection between *P* and *Q*.[2] Therefore, one concludes the particular hypothesis *x is P*.

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[2] By *nomological connection*, from Greek νόμος [*nomos*], meaning "law" or "prescription", and λόγος [logos], meaning "discourse", it is defined a causal nexus or a prescriptive law between an antecedent cause and a consequent effect.

Take the case of a goal Q, and an individual i who realizes being in this state of goal Q in the future. In this case, x is Q corresponds to any state x which will satisfy the expectation of achieving the goal Q. So, the individual i formulates an abductive hypothesis that there is a causal/nomological connection between P and Q, and considers an antecedent action P as at least probably sufficient to achieve Q. It follows that x is P, and the individual i performs the antecedent action P in the expectation of achieving Q.

This procedure is obviously amplifier, because there is no guarantee that the conclusion will be true, even with true premises. Thus, abducting causes of an observed phenomenon may be a false explanation, as designing an ante-factual abductive hypothesis can result in manifest failure.[3] Nevertheless, it is always reasonable to assume that the action is probably sufficient to achieve a goal rather than the opposite. This expectation is crucial for both the individual and the human species survival.

As Psillos (2002, p. 7) argues, accepting post-factual abductive hypotheses means overcoming three problems: the multiple explanations, the connection between the abduction and the probability of the hypothesis that it generates, and the nature of explanation. Analogically, this can be extended to ante-factual instances.

First, if an event can be explained by many rival hypotheses, then a goal can be achieved by many rival solutions. In both, the abductive reasoning does not include tools to restrict them. However, Psillos (2002, p. 7-8) claims that the success how individuals abduct explanations suggests that there are mechanisms to classify hypotheses by their explanatory virtues. For him, explanatory hypotheses are the best ones when they explain the facts, are licensed by background beliefs, are simple, have binding power, are more testable, and entail new predictions. Although these requirements—which could be understood as experience, judgment, expertise, etc.—are not algorithmic, they allow classifying hypotheses and/or selecting a single hypothesis to be taken as the most plausible. This takes place, for example, in the diagnosis of mechanical problems or diseases by qualified professionals.

This argument converges with Harman's (1965) *inference to the best explanation*, here extended as *inference to the best solution*. I argue that the best solution is linked to a *principle of plausibility*. Thus, if an abductive explanatory hypothesis H_e is accepted when it explains the evidence and no other rival hypothesis does this as well as H_e does, then an ante-factual abductive hypothesis H_a is assumed when it suggests achieving a goal more efficiently and no other rival hypothesis does this as well as H_a does.

Furthermore, in *ad hoc* situations, I argue that the first hypothesis H_a or H_e, consistent with the principle of relevance in the sense that this hypothesis H_a or H_e is the one which emerges at the lowest cost faced with the fixed effect to explain the fact or achieve the goal, will be assumed as true.

Secondly, why adopt abductive hypotheses when the abduction is cancellable, and the hypotheses H_e or H_a could be false? According to Psillos (2002, p. 9), "although the

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[3] I use the prefix 'ante-' by analogy to the Latin expression '*ex-ante factum*,' meaning "before the event," because the results of actions are anticipated. Normally, the abductive reasoning is retroactively used to explain '*ex-post factum*' situations. See also the term 'retroduction.'

hypothesis can be reasonably accepted as the most plausible hypothesis based on explanatory considerations (abduction), the degree of confidence in this hypothesis is linked to its degree of later confirmation." Psillos claims that, faced with new events, abduction is the first stage for the individual tries to add plausible assumptions to his/her *belief corpus*—the *encyclopaedic knowledge* in relevance-theoretic terms. When these predictions are fulfilled, the abducted hypothesis is confirmed.

Finally, Peirce (1975) has noted that an abducted hypothesis turns natural a surprising fact. According to Psillos (2002, p. 10), an explanation aims to improve the understanding of events. This occurs when the individual can show how an event can fit in the causal/nomological nexus of things he accepts. Therefore, individuals remove the surprise when the acceptance of certain explanatory hypotheses and their incorporation into the belief *corpus* help them to include the *explanandum event e* in this *corpus*.

Thus, if *M* is the *memory* of this *belief corpus*, *e* is the *explanandum event*, and *H* is a *potential hypothesis*, then *H* must be accepted as a potential explanation, if *M* does not explain it alone, but $M \cup H$ does (PSILLOS, 2002, p. 10). This converges with the inclusion of the new or the newly presented information in the context of the encyclopaedic information in relevance-theoretic terms.

This scenario also aligns with Tomasello and colleagues' (2005, p. 676-678) model of intentional action, in which *goal*, *action*, and *perceptual monitoring* compose an adaptive circular system of self-regulation of an organism with the environment.

The authors distinguish *internal goals*, the mental representation of desired states, and *external goals*, certain states of the environment representing the achievement of an internal goal. About actions, they distinguish goals and intentions. Following Bratman (1989), they propose *intention* as "a plan of action that the agent chooses and undertakes in pursuit of a goal." Hence, the concept of intention includes both the goal and the plan to achieve it, which allows assigning different intentions to the same action. Therefore, it follows from a goal *Q* an intention to perform in a certain way to achieve this goal. Finally, there is the *perceptual monitoring* of the current reality, implementation, and outcome.[4] In such cases, the organism does not perceive everything, but only attends to relevant aspects of the situation (intentional perception, or selective attention). The authors add: "This process of monitoring completes, therefore, the characteristic of circular arrangement of intentional action: organism acts to become reality (as it is perceived) in line with his/her goals."

Once considered these issues, I outline in this paper a *goal conciliation theory* to describe and explain the formulation and evaluation of ante-factual abductive hypotheses in proactive contexts. To illustrate this architecture, let us consider the case of Peter who wants to open his own locked front door.

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[4] Tomasello and colleagues (2005, p. 676-678) claim that there are three typical consecutions of the action: (1) *failure* and *deception*, when the state of reality does not alter, (2) *success* and *happiness*, when the state of reality coincides with the internal goal, and (3) *accident* and *surprise*, when there is an undesirable result. Failures and accidents are typically followed by persistent and sometimes variable efforts to the goal achievement.

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2 THE ARCHITECTURE
2.1 GOAL DESIGNING

The first stage consists in designing the (internal) goal as follows:

[1] The individual i designs a goal Q at the time t_1.

Such that:

a) The time t_1 represents the instance of the goal designing; and
b) The goal Q is a future state that does not exist at the time t_1.

Goal designing consists of some degree of cognitive emergency of the intention to open the locked door, namely:

[1] Peter i designs the goal Q of opening the locked door at the time t_1.

This formulation captures that: a) the process starts at t_1, which is the instance of the goal Q designing; and b) the goal Q of opening the locked door is a future possibility still absent at the time t_1, the instance of the goal Q designing. In simple words, the door is still locked.

The output of this stage can be schematically represented as follows:

[1]   Q   open the door, Peter

2.2 FORMULATION OF AN ANTE-FACTUAL ABDUCTIVE HYPOTHESIS

The second stage consists in formulating at least one ante-factual abductive hypothesis to achieve the goal Q. It follows the formulation:

[2] The individual i abducts an ante-factual hypothesis H_a to achieve the goal Q at the time t_2.

Such that:

a) The time t_2 is the instance of the formulation of the ante-factual abductive hypothesis H_a;
b) The time t_2 succeeds time t_1;
c) The ante-factual abductive hypothesis H_a corresponds to a formulation like "If P, then Q," so that P is an *antecedent action* and Q is a *consequent state*;
d) The goal Q is admitted by the individual i as a consequent state in the scope of the ante-factual abductive hypothesis H_a;
e) The antecedent action P is admitted by the individual i at least probably sufficient to achieve the consequent state Q in the scope of the ante-factual abductive hypothesis H_a;

f) The ante-factual abductive hypothesis H_a is the first formulation which is consistent with the principle of relevance, because the lowest processing cost faced with the fixed effect projected by the consequent state Q;

g) Simultaneously, the ante-factual abductive hypothesis H_a is taken by the individual i as an inference to the best plausible solution to achieve the consequent state Q.

Based on this formulation, though incomplete, it is anticipated that:

[2a] Peter i abducts the best ante-factual hypothesis H_a to achieve the goal Q of opening the locked door at the time t_2.

The output of the formulation [2a] does not explain the antecedent action P Peter accepts as at least probably sufficient to achieve the consequent state Q of opening the locked door. To fill this gap, consider the hypothesis that Peter's encyclopaedic memory (his *belief corpus*) just has the following restricted set of factual assumptions S_{1-7}:

S_1 – Using a key opens locked doors;
S_2 – Calling a locksmith opens locked doors;
S_3 – Using an axe opens locked doors;
S_4 – Lowering the door handle opens locked doors;
S_5 – The locked door is blue;
S_6 – The locked door is locked;
S_7 – The locked door is not locked.

I claim that the individual considers at least four criteria to choose the best hypothesis H_a in S_{1-7}. Firstly (see letter c) he/she considers that the hypothesis H_a can be mapped by a hypothetical formulation "If P, then Q." According to this formulation, if an antecedent action P is executed, then a consequent state Q can be achieved. S_{1-4} meet this criterion, because all of which may be converted into a formulation of this kind. However, S_{5-7} are not only so described, but are irrelevant. S_7 "the locked door is not locked" contradicts the perceptual input that the door is locked. As stated in relevance-theoretic terms, confronting a perceptual stimulus with an assumption from memory, the assumption obtained by perception will be maintained, excluding pathological cases. S_6 "the locked door is locked" is tautological with the perceptual stimulus, without any cognitive gain in processing it. Finally, the assumption S_5 "the locked door is blue" is disconnected with the goal, and it is difficult to check what contribution the colour does in opening the door.

Secondly (see letter e) he/she considers that the hypothesis H_a contains an antecedent action P which is probably sufficient to open the door. S_{1-4} are executable actions. However, S_4 "lowering the door handle opens locked doors," although correct in cases of opening non-locked doors, is not enough and useless to open a door known to be locked, excluding again pathological cases.

The third and the fourth criteria (see letters f and g) operate together. They suggest that the individual i will formulate the ante-factual abductive hypothesis H_a which is the best solution to achieve Q and is the first assumption which is consistent with the principle of relevance.

S_3 "using an axe opens locked doors" is feasible, but would not be the best solution. It is expected of a rational individual that he/she opens the door without destroying it. S_3 to be a better solution would be necessary to expand the context. The keys would not be available; the determination to open the door should be imperative, which would turn unfeasible to choose the locksmith; there could be anger or danger involved; etc. Note that all of these situations involve increased processing cost and loss of relevance when the fixed effect is merely opening a locked door.

S_2 "calling a locksmith opens locked doors" achieve the goal. However, it is difficult to see how, in front of a mere locked door, the first solution to come to Peter's mind is calling a locksmith when he has a key. S_2 to be the best solution would be essential to expand the context. The keys would not be available; the determination to open the door should not be imperative; etc. Again, these extensions require increased processing cost and loss of relevance when the fixed effect is merely opening a locked door.

S_1 "using a key opens locked doors" would be the best solution in this restricted set of assumptions S_{1-7}. It meets all the four criteria: a) S_1 can be mapped in a hypothetical formulation like "if Peter uses the key, then Peter will open the door;" b) S_1 is a plausible action, because it is at least probably sufficient to open the door—it may well be the case that the key does not work for many reasons; c) S_1 is the lowest cost processing hypothesis faced with the fixed effect of opening a locked door— obviously, without destroying it; and d) S_1 is a hypothesis that meets the criterion of best solution, since there is no reason to destroy the door or call a locksmith when someone has a key to open it.

Therefore, the ante-factual abductive hypothesis H_a, which emerges as the best solution (most relevant, pertinent, or plausible) in this *ad hoc* context, is:

[2b] Peter *i* abducts that if Peter *i* uses the key, then Peter *i* will open the locked door.

The output of [2b] can be represented in a schematic manner as follows:

[1]		Q		open the door, Peter
[2]	P	Q	use the key, Peter	open the door, Peter

2.3 EXECUTION[5]

The third stage is the probable implementation of the antecedent action *P*:

[3a] the individual *i* performs *P* to achieve *Q* at the time t_3; or
[3b] the individual *i* does not perform *P* to achieve *Q* at the time t_3,

Such that:

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[5] Although I design a performed situation in this paper, the stages of execution and checking can be simulated. This allows describing and explaining the construction of mental scenarios.

a) The time t_3 is the instance of the execution of the antecedent action P in the context of the hypothetical formulation "If P, then Q;"

b) The time t_3 succeeds time t_2;

c) The model [3b] is implied by the inaction in [3a];

d) The inaction can be voluntary or involuntary.

The description considers that: a) there is a proper time t_3 of the execution of the action; b) the time t_3 succeeds the instance of the ante-factual abductive hypothesis H_a formulation; c) by definition, the positive model, in which the action P is performed, can make to emerge the negative model $\neg P$, in which the action is not performed; and d) despite the plausibility of the hypothesis, there are contexts where the action is not possible or performed.

Execution is the instance when Peter uses or not the key to open the door. I argue that the foreground scheme, usually exclusive, will be agentive. In this *active model*, the individual performs the action P in the context of hypothesis H_a. Namely: Peter uses the key to open the locked door.[6]

On the other hand, the non-agentive or *passive model* can be triggered in at least two situations. First, the individual i can be unable to perform the action P, as is the case in which the hypothesis H_a is abducted, and Peter realizes that he does not have the key. Second, there is any kind of conflict or psychological problem (hesitation, fear, personal boycott, etc.) that puts in suspicion goals and/or plans. In these cases, although Peter formulates the goal of opening the door and the hypothesis of using the key, he does not use the key.

The active output of the third stage, with an *intentional action*, can be seen below:

[3a] Peter i uses the key to Peter i open the locked door at t_3.

Or, more schematically:

[1]		Q		open the door, Peter
[2]	P	Q	use the key, Peter	open the door, Peter
[3]	P		use the key, Peter	

2.4 CHECKING

The fourth stage consists in deductively checking the hypothetical formulation:

[4a] the individual i, considering [2] "If P then Q" and [3a] "P," achieves Q' at the time t_4; or

[4b] the individual i, considering [2] "If P then Q" and [3b] "$\neg P$," achieves $\neg Q'$ at the time t_4.

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[6] In the context of mental model theory, Johnson-Laird and Byrne (2002) claim that alternative models to a positive formulation stay in footnotes, and are generally forgotten.

Such that:

a) The time t_4 is the instance of achieving the goal Q;

b) The time t_4 succeeds t_3.

c) The model [4a] is the model of the attainment of the action P [3a], and the model [4b] is the model of the attainment of the inaction $\neg P$ [3b];

d) The consequent state Q' is the result of the action P [3a], and $\neg Q'$ is the result of the inaction $\neg P$ [3b];

e) The consequent state Q' or $\neg Q'$ is an actuality at the time t_4.[7]

This stage represents the evaluation or monitoring of the antecedent action P or inaction $\neg P$ within the deductive scope of the hypothetical formulation "If P, then Q," which merges with Sperber and Wilson's (1986/1995) deductive module. Thus, in the active scenario [4a] (Q; If P, then Q; P), Peter evaluates if the door opens with the key; and, in the passive scenario [4b] ($\neg$Q; If $\neg$P, then $\neg$Q; $\neg$P), Peter evaluates if the door does not open when he does not use the key.

The output of the fourth stage [4a] can be seen below:

(4a) Peter i checks the door opening consecution at t_4.

Or, more simply:

[1]		Q		open the door, Peter
[2]	P	Q	use the key, Peter	open the door, Peter
[3]	P		use the key, Peter	
[4]		Q'		open the door, Peter

Given the output of the fourth stage, it is possible to evaluate or check both the achieving of the goal Q and the confirmation of the ante-factual abductive hypothesis H_a. I argue that two concepts can be considered in these procedures: *goal conciliation* and *hypothesis confirmation*.

3 EVALUATION

3.1 GOAL CONCILIATION

By *goal conciliation* I define the actual state Q' at the time t_4 that satisfies, coincides or corresponds with the goal Q at the time t_1, i.e., the result of the action P (the external goal) is similar or congruent with the result the individual i previously designed (the internal goal).

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[7] The expression Q' highlights that the achieving of the external goal is always different from its projection – the internal goal. In more complete or complex descriptions, the very instances of Q could be indexed by numbers $Q_1, Q_2, Q_3, ..., Q_n$, so that Q_1 stands for the instance of the goal emergency.

Given this concept, four possibilities can be observed: (a) *active conciliation*, when the individual *i* performs the action *P* in the scope of the hypothesis H_a, and the state *Q'* at the time t_4 conciliates with the goal *Q* at the time t_1; (b) *active non-conciliation*, when the individual *i* performs action *P* in the scope of hypothesis H_a, and the state *Q'* at the time t_4 does not conciliate with the goal *Q* at the time t_1; (c) *passive conciliation*, when the individual *i* does not perform the action *P* in the scope of hypothesis H_a, and the state *Q'* at the time t_4 even so conciliates with the goal *Q* at the time t_1; (d) *passive non-conciliation*, when the individual *i* does not perform the action *P* in the scope of hypothesis H_a, and the state *Q'* at the time t_4 does not conciliate with the goal *Q* at the time t_1.

In simple terms: in the *active conciliation* (a) Peter uses the key, and the door opens; in the *active non-conciliation* (b) Peter uses the key, but the door does not open; in the *passive conciliation* (c) Peter does not use the key, and the door even so opens; and in the *passive non-conciliation* (d) Peter does not use the key, and the door does not open.

The four situations can be seen in Figure 1:

Figure 1 - Possibilities for achieving goals

Stages	*Active conciliation* (a)		*Active non-conciliation* (b)		*Passive conciliation* (c)		*Passive con-conciliation* (d)	
[1]		Q		Q		Q		Q
[2]	P	Q	P	Q	P	Q	P	Q
[3]	P		P		¬P		¬P	
[4]		Q'		¬Q'		Q'		¬Q'

3.2 HYPOTHESIS CONFIRMATION

By *confirmation of an ante-factual abductive hypothesis H_a*, I defined the case in which the state *Q'* at the time t_4 satisfies, coincides, or corresponds with the hypothesis H_a at the time t_2, i.e., the consequence of the action *P* reinforces the ante-factual abductive hypothesis H_a that the antecedent action *P* causes the consequent state *Q*.

I argue that the evaluation of an ante-factual abductive hypothesis H_a depends on the degree of confidence or strength which is attributed to the hypothesis, so it is possible to rank abductive hypotheses from categorical to tautological, including biconditional, conditional, and enabling cases.[8]

It is worth noting that I take by *hypothetical formulation*, any proposition which can be paraphrased by utterances such as "If *P*, then *Q*." A categorical proposition can be taken as hypothetical when converted into this formulation. For example, the proposition "keys open doors" can be converted into the proposition "If something is a key, then it opens doors." Thus, if a proposition of this kind is a factual assumption, and if this proposition was embedded into an ante-factual abductive scheme, then this proposition is a categorical hypothesis.

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[8] This ranking can also clarify the controversial relationship how individuals lead with utterances like "If *P*, then *Q*."

A *categorical ante-factual abductive hypothesis* is a formulation $P \Leftrightarrow Q$, whose truth table returns "true" only when P and Q are true.[9] In this case P and Q are sufficient, necessary, and certain; and the only achievement admitted by the individual is the *active conciliation* (a).

I claim the strong hypothesis that, by default, ante-factual abductive hypotheses H_a emerge as categorical in conscious or unconscious circumstances. This implies that the same abductive mechanism works both in automatic innate or learned situations, when the individual has no conscious access to the mechanism, and in deliberated situations, when the hypothesis itself emerges as relevant.

Previously (RAUEN, 2010), I have argued that the notion of relevance is moderated by a variable of saturation. According to this hypothesis, the successive recurrence of stimuli beyond an optimal threshold promotes their saturation, so that they are no longer relevant.[10] Therefore, such as innate neural networks, saturated hypotheses are not available to consciousness, since the successive confirmation processes become them irrelevant, and filter their emergence. However, when the assumptions are unsaturated, they tend to be categorically treated because the individual extrapolates innate and learned schemes. So, once a hypothesis is chosen, the individual is usually blind to alternative hypotheses and achievements. It is only in very limited cases that a genuine choice of hypotheses and a clear consideration of alternative achievements are taken into account. See the cases.

In a *biconditional ante-factual abductive hypothesis* $P \leftrightarrow Q$, are true the cases where both P and Q are true or false. Categorical abductive hypotheses become biconditional in inactions $\neg P$, whether in involuntary problems or in voluntary dilemmas. In such cases, the individual admits *passive non-conciliations* (d), and the mere consideration of the option $\neg P \rightarrow \neg Q$ weakens the first categorical hypothetical formulation. P and Q are now sufficient and necessary, but not certain.

In a *conditional ante-factual abductive hypothesis* $P \rightarrow Q$, the antecedent action becomes a sufficient but not necessary condition for the subsequent state Q, so that the material implication applies. In this case, there is a further weakening of the strength of the abductive hypothesis because the individual also admits passive conciliations (c).

In an *enabling ante-factual abductive hypothesis* $P \leftarrow Q$, the antecedent action P becomes necessary, but not sufficient to achieve the consequent state Q.[11] The action P enables, but does not guarantee Q. This allows admitting active non-conciliations (b).[12]

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[9] I propose '$\Leftrightarrow$' as a logical symbol that captures the sufficient, necessary and certain connection among the terms of the proposition. The true table for this symbol is similar to $P \wedge Q$, because $P \Leftrightarrow Q$ shares with conjunction the certainty of the truth of the terms. However, there is a crucial difference, because $P \Leftrightarrow Q$ is embedded in a synthetic formulation while $P \wedge Q$ is embedded in an analytic formulation.

[10] It is an extrapolation of the concept of Pareto's Optimal, according to which there is threshold beyond which the economic gain does not justify the investment. In our case, the positive cognitive effects are not worth the expended processing effort.

[11] I have loaned the term from Johnson-Laird & Byrne (2002, p. 661). Other formulation could be $Q \rightarrow P$.

[12] I recognize a less than formal deductive logic here. The claim that true premises always generate true conclusions is abandoned, when enabling ante-factual abductive hypotheses and, later, tautological hypotheses are accepted.

Finally, in a *tautological ante-factual abductive hypothesis P–Q*, *P* and *Q* are not sufficient, necessary, or certain, modelling situations like "If *P*, then possibly *Q*."[13] In this case all types of achievements are possible.

These options can be summarized in a truth table, as follows.

Figure 2 – True table for modelling hypothetical utterances

Conciliations	Terms		Categorical	Biconditional	Conditional	Enabling	Tautological
	P	*Q*	$P \Leftrightarrow Q$	$P \leftrightarrow Q$	$P \rightarrow Q$	$P \leftarrow Q$	$P–Q$
(a) Active Conciliation	**T**	**T**	**T**	**T**	**T**	**T**	**T**
(b) Active Non-Conciliation	T	F	F	F	F	T	T
(c) Passive Conciliation	F	T	F	F	T	F	T
(d) Passive Non-Conciliation	F	F	F	T	T	T	T

3.3 COGNITIVE EFFECTS IN CATEGORICAL CONTEXTS

With respect to cognitive effects, and arguing that in stage [2] the ante-factual abductive hypothesis emerges as categorical by default $P \Leftrightarrow Q$, the various situations illustrated in this study can be described and explained as follows.

In *active conciliation* (a), Peter uses the key *P* and opens the door *Q'*.

[1]	Q	Peter designs opening the door (Internal Goal)
[2]	$P \Leftrightarrow Q$	Certainly, if Peter uses the key, then Peter opens the door
[3]	P	Peter uses the key
[4]	Q'	Peter opens the door (External Goal Achievement)

In this case, Peter achieves the goal *Q* and confirms the categorical ante-factual abductive hypothesis H_a that the key opens the door. This hypothesis is still more strengthened and stored as a factual assumption in the encyclopaedic memory to be triggered in future situations. The more conciliation, the lower the processing cost of this factual assumption and the greater the probability that it will be the first abductive hypothesis to be taken as categorical in similar contexts (habit, experience, expertise, etc.). Furthermore, the individual turns to next proactive goals or reactive demands. In our example, it is likely that Peter loses his interest on doors and keys—they are no longer relevant—and pays attention to other feasible goals.

In *passive non-conciliation* (d), once the decision for using the key was made in the context of the categorical abductive hypothesis $P \Leftrightarrow Q$, may well be the case that Peter does not find it *¬*P*, which sets it as a problem (represented by the asterisk). In this case, I argue that there are two basic cognitive effects: the first effect [4] of

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[13] I have loaned the term from Johnson-Laird & Byrne (2002, p. 660-661). I propose '–' as a logical symbol that captures the lack of certain, necessary or sufficient connection among the terms of a conditional proposition.

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weakening the hypothesis, which now becomes biconditional $P \leftrightarrow Q$, and the implied conclusion [5] that the door cannot be opened $\neg Q$ in the scope of this new hypothesis.[14]

[1]	Q	Peter designs opening the door (Internal Goal)
[2]	$P \Leftrightarrow Q$	Certainly, if Peter uses the key, then Peter opens the door
[3]	$*\neg P$	Peter cannot use the key
[4]	$P \leftrightarrow Q$	If and only if Peter uses the key, then Peter opens the door
[5]	$\neg Q$	Peter will not open the door (External Goal Achievement)

Stopping at [5] in this scenario implies giving up the goal, so that the individual complies with the first setback. The achievement $\neg Q'$ is stronger than the goal Q. However, in cases of determination, perseverance, or even stubbornness, the goal Q is stronger than the achievement $\neg Q'$. Thus, the deductive mechanism cannot stop at [5] under penalty of implausibility. To pursue the goal in this case, I suggest confronting Q and $\neg Q'$ by an *introduction-and* rule, despite Sperber and Wilson's conviction that the deductive module is confined to elimination rules.[15] In this case, because both propositions are true, I suggest maintaining Q by *elimination-and* rule.

[6]	$Q \wedge \neg Q'$	1, 5 by *introduction-and*
[7]	Q	by *elimination-and* (Maintaining the Goal)

Keeping the goal, a new problem appears and enables a new abductive/deductive cycle, or plan B. Peter must abduct a new hypothesis to open the door, and calling a locksmith could be carefully considered in the restricted set of assumptions S_{1-7}.

In *active non-conciliation* (b), Peter cannot open the door $*\neg Q'$ even using the key. Now, although the key remains necessary, it is not enough to open the door. In this scenario, the ante-factual abductive hypothesis becomes enabling $P \leftarrow Q$.[16] Furthermore, the lack of conciliation becomes relevant, whether to put the individual in the dilemma between giving up or persevere in achieving the goal, or to formulate a post-factual abductive hypothesis to explain the setback.

[1]	Q	Peter designs opening the door (Goal)
[2]	$P \Leftrightarrow Q$	Certainly, if Peter uses the key, then Peter opens the door
[3]	P	Peter uses the key
[4]	$*\neg Q'$	Peter does not open the door (Failure/Frustration)
[5]	$P \leftarrow Q$	The key is necessary, but not sufficient to open the door
[6]	$Q \wedge \neg Q'$	1, 5 by *introduction-and*
[7]	Q	by *elimination-and* (Maintaining the Goal)

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[14] This weakening comes from the rejection of the categorical strength of the hypothesis $P \Leftrightarrow Q$. As biconditional $P \leftrightarrow Q$, the hypothesis continues to be confirmed. It is just this *ad hoc* flexibility in face of (non-)conciliations, which characterizes the architecture proposed here.

[15] Strictly, this *introduction-and* rule does not incorporate arbitrary material, because it is the resumption of the goal Q.

[16] Strictly speaking, in terms of a formal deductive logic, the hypothesis should be rejected.

In *passive conciliation* (c), the door opens despite Peter's passivity. Someone opens the door from the other side for example. In this scenario, Peter could conclude that using the key is sufficient, but not necessary to open the door $P{\rightarrow}Q$. Since the goal achieving, it is likely that the door will be no longer relevant, and Peter starts to pay attention to other goals or demands. However, this sudden conciliation may require a post-factual abductive explanation when unintentional, or even may yield new problems when the inaction was due to hesitations, fears, etc.

[1]	Q	Peter designs opening the door (Goal)
[2]	$P{\Leftrightarrow}Q$	Certainly, if Peter uses the key, then Peter opens the door
[3]	$*{\neg}P$	Peter does not use the key
[4]	$P{\leftrightarrow}Q$	If and only if Peter uses the key, then Peter opens the door
[6]	$*Q'$	The door was opened without the key (Accident/Surprise)
[7]	$P{\rightarrow}Q$	The key is sufficient, but not necessary to open the door

The four modulations are summarized in Figure 3 below:

Figure 3 – Conciliations of a categorical ante-factual abductive hypothesis

Stages	*Active conciliation* (a)	*Active non-conciliation* (b)	*Passive conciliation* (c)	*Passive non-conciliation* (d)
[1]	Q	Q	Q	Q
[2]	$P{\Leftrightarrow}Q$	$P{\Leftrightarrow}Q$	$P{\Leftrightarrow}Q$	$P{\Leftrightarrow}Q$
[3]	P	P	$*{\neg}P$	$*{\neg}P$
[4]	Q'	$*{\neg}Q'$	$P{\leftrightarrow}Q$	$P{\leftrightarrow}Q$
[5]		$P{\leftarrow}Q$	$*Q$	${\neg}Q'$
[6]		${\neg}Q'{\wedge}Q$	$P{\rightarrow}Q$	${\neg}Q'{\wedge}Q$
[7]		Q		Q

3.4 COGNITIVE EFFECTS IN NON-CATEGORICAL CONTEXTS

When the individual considers dual situations like "all or nothing," he/she can set a biconditional architecture $P{\leftrightarrow}Q$. Now, performing P necessarily implies achieving Q, the *active conciliation*, and not performing P necessarily implies not achieving Q, the *passive non-conciliation*. It is worth noting that the mere consideration of alternatives weakens the strength of the ante-factual abductive hypothesis. In questions or dilemmas, for example, the individual hesitates to act, drawing the respective scenarios with increased processing cost.

Figure 4 shows the situation when the hypothesis emerges as biconditional. In this architecture, active non-conciliations and passive conciliations are problematic. In the first case, the lack of conciliation converts the biconditional hypothesis into enabling hypothesis, because the action, although necessary, is now not sufficient.[17] In the second, the conciliation converts the biconditional hypothesis into conditional hypothesis, because the action, although sufficient, is now not necessary.

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[17] Strictly speaking, in terms of a formal deductive logic, the hypothesis should be rejected.

Figure 4 – Conciliations of a biconditional ante-factual abductive hypothesis

Stages	*Active conciliation* (a)	*Active non-conciliation* (b)	*Passive conciliation* (c)	*Passive non-conciliation* (d)
[1]	Q	Q	Q	Q
[2]	P↔Q	P↔Q	P↔Q	P↔Q
[3]	P	P	¬P	¬P
[4]	Q'	*¬Q'	*Q'	¬Q'
[5]		P←Q	P→Q	Q∧¬Q'
[6]		Q∧¬Q'		Q
[7]		Q		

When the individual considers three plausible possibilities, he can draw a conditional $P{\rightarrow}Q$ or an enabling $P{\leftarrow}Q$ architecture.

In a *conditional architecture* $P{\rightarrow}Q$, the individual considers that the action P is sufficient, but not necessary to achieve Q. Only in this case, the evaluation of the ante-factual abductive hypothesis is the same as provided by the material implication of classical logic. Therefore, he/she admits active conciliations, passive conciliations and passive non-conciliations, but not active non-conciliations. The emergence of an active non-conciliation, i.e., when the individual performs the action P and does not obtain Q, the assumption will be weakened as tautological.[18]

Such situations can be seen in the Figure 5.

Figure 5 – Conciliations of a conditional ante-factual abductive hypothesis

Stages	*Active conciliation* (a)	*Active non-conciliation* (b)	*Passive conciliation* (c)	*Passive non-conciliation* (d)
[1]	Q	Q	Q	Q
[2]	P→Q	P→Q	P→Q	P→Q
[3]	P	P	¬P	¬P
[4]	Q'	*¬Q'	Q∨¬Q	Q∨¬Q
[5]		P—Q	Q'	¬Q'
[6]		Q∧¬Q'		Q∧¬Q'
[7]		Q		Q

In an *enabling architecture* $P{\leftarrow}Q$, the individual admits active conciliations, active non-conciliations and passive non-conciliations, but not passive conciliations. Hence, he/she considers that the action P is necessary, but not sufficient to achieve Q. So, the assumption will be weakened as tautological only in passive conciliations, that is, when the individual does not perform the action P, and he/she achieves the consequent state Q even so.

Figure 6 shows the respective possibilities:

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[18] Again, in terms of a formal deductive logic, the hypothesis would be rejected.

Figure 6 – Conciliations of an enabling ante-factual abductive hypothesis.

Stages	*Active conciliation* (a)	*Active non-conciliation* (b)	*Passive conciliation* (c)	*Passive non-conciliation* (d)
[1]	Q	Q	Q	Q
[2]	P←Q	P←Q	P←Q	P←Q
[3]	P	P	¬P	¬P
[4]	Q∨¬Q	Q∨¬Q	*Q'	¬Q'
[5]	Q'	¬Q'	P–Q	Q∧¬Q'
[6]		Q∧¬Q'	Q'∧¬Q	Q
[7]		Q	Q'	

Finally, when all the four possibilities are plausible, the architecture is tautological *P–Q*. Actions and achievements are possibilities, and any achievement is previewed by the ante-factual abductive hypothesis.

The tautological architecture can be seen in Figure 7.

Figure 7 – Conciliations of a tautological ante-factual abductive hypothesis

Stages	*Active conciliation* (a)	*Active non-conciliation* (b)	*Passive conciliation* (c)	*Passive non-conciliation* (d)
[1]	Q	Q	Q	Q
[2]	P–Q	P–Q	P–Q	P–Q
[3]	P	P	¬P	¬P
[4]	Q'	¬Q'	Q'	¬Q'
[5]		Q∧¬Q'		Q∧¬Q'
[6]		Q		Q

5 COMMUNICATION AND GOAL HETERO-CONCILIATIONS

So far, I have modelled cases of goal self-conciliations. Peter has designed the goal of opening the door himself, and he has checked himself if the key would open it. However, conciliation processes can be triggered by more than one individual. In these cases it is necessary to coordinate common goals and sub goals.

Take the case where Peter is faced with the same locked door, but is Hannah who has the key to open it. He designs the goal of opening the door himself, and the first abductive hypothesis is that Hannah's key will open it. However, there is the obvious obstacle that this goal must be communicated. It is at this particular moment that the relevance-theoretic ostensive-inferential architecture comes into play. To Peter open the door, the first pertinent ante-factual abductive hypothesis is to communicate his intention to use her key. As predicted by relevance theory, he will design a communicational ostensive stimulus, communicative intention, which allows him to get the key, informative intention, with the lowest cost processing. In this case, because his preferences, he wants to open the door himself, and abilities, his expertise in interacting with Hannah, Peter could say the following:

Peter – Give me the key, please?

It is worth noting that there is a goal hierarchy in this process. First, the plan selected by Peter to open the door involves opening it himself with Hannah's key. This requires getting the key as a goal, and asking her the key as a sub goal. Second, Peter asks the key for some reason: supposedly to open the door. So, observing more general goals explains why someone has a particular goal; and observing more particular plans specifies how a goal is achieved in terms of intentional actions.

In Peter's case, the modelling could be the following:

[1]	Q	Peter himself designs opening the door (Internal Goal);
[2]	P⇔Q	Certainly, if Peter uses Hannah's key, then Peter will open the door;
[3]	P	Peter designs using Hannah's key (Internal Sub goal);
[4]	O⇔P	Certainly, if Hannah gives Hannah's key to Peter, Then Peter will use Hannah's key;
[5]	O	Peter designs asking that Hannah gives Hannah's key to Peter (Internal Sub goal);
[6]	M⇔O	Certainly, if Peter asks that Hannah gives Hannah's key to Peter, Then, Hannah will give Hannah's key to Peter;
[7]	M	Peter asks that Hannah gives Hannah's key to Peter (Action);
[8]	O'	Hannah gives Hannah's key to Peter (External Sub goal O Achievement);
[9]	P'	Peter uses Hannah's key (external sub goal P achievement);
[10]	Q'	Peter opens the door (External Goal Q Achievement).

Or, more schematically:

	(M)	(O)	(P)	(Q)
[1]				open the door, Peter
[2]			use the key, Peter	open the door, Peter
[3]			use the key, Peter	
[4]		give the key, Hannah	use the key, Peter	
[5]		give the key, Hannah		
[6]	ask the key, Peter	give the key, Hannah		
[7]	ask the key, Peter			
[8]		give the key, Hannah		
[9]			use the key, Peter	
[10]				open the door, Peter

In Hannah's point of view, the first step is using the relevance-theoretic comprehension procedure. So, following a path of least effort, Hannah fits the linguistic form of Peter's utterance in a logical form, and elaborates the respective explicature.[19]

Linguistic Form: Give me the key, please?

Logical Form: (give x, y, z, α_{manner}).

Explicature: Give $\varnothing_x$ [HANNAH$_x$] me$_y$ [TO PETER$_y$] the [DOOR] key$_z$, please$_{manner}$.

Expanded Explicature: *PETER ASKS* THAT HANNAH GIVE THE DOOR KEY TO PETER PLEASE.

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[19] On the descriptive methodology, see Rauen (2011).

This explicature is not Peter's communicative intention. To achieve this intention, Hannah must abduct it post-factually. Since there are many interpretations for this utterance, again, the assumption to be chosen will be both the best explanation of Peter's behaviour and the lowest processing cost option.

The modelling could be the following:

[1]   Q   Peter asks that Hannah give Hannah's key to Peter
                    (Utterance Explicature);

[2] $Q \Leftrightarrow P$ Certainly, if Peter asks that Hannah give Hannah's key to Peter,
                    Then [is because] Peter intends opening himself the door with
                    Hannah's key (Post-Factual Abduction);

[3]   P   Peter intends opening himself the door with Hannah's key
                    (Implicature/Peter's Supposed Goal).

In this context, it follows the ante-factual modelling:

[1]   Q   Peter intends opening himself the door with Hannah's key (Goal).

[2] $P \Leftrightarrow Q$ Certainly, if Hannah gives Hannah's key to Peter,
                    Then Peter will open himself the door with Hannah's key
                    (Ante-Factual Abduction);

[3]   P   Hannah gives Hannah's key to Peter (Execution);

[4]   Q'   Peter opens himself the door with Hannah's key
   (Goal External Consecution);

Or, schematically:

	(P)	(Q)
[1]		open the door, Peter
[2]	give the key, Hannah	open the door, Peter
[3]	give the key, Hannah	
[4]		open the door, Peter

What is at stake here is a complex chain of self and hetero-conciliations. Peter and Hannah must hetero-conciliate goals Q and achievements Q', coordinating at least one sub goal to achieve a high level goal; and therefore must be able to check, each in his/her own way, if achievements Q' are conciliated with goals Q (self-conciliations).[20]

Goal self and hetero-conciliations are summarized in Figure 8 below.

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[20] Obviously, any problem in this complex process can lead to non-conciliations in goals (e.g. Hannah can open herself the door) and subgoals (e.g. Hannah might question why Peter has no keys).

Figure 8 – Basic scheme for goal self and hetero-conciliations

Peter   Hannah

| Q | ← Hetero-conciliation → | Q |

↑   ↑

Self-conciliation   Self-conciliation

↓   ↓

| Q' | ← Hetero-conciliation → | Q' |
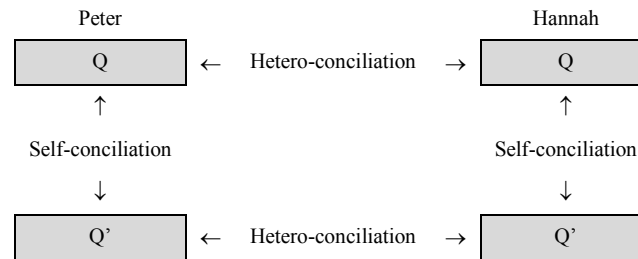
This model aligns with Tomasello and colleagues' (2005, p. 680-681) argument that the crucial difference between human and other species cognition is the human ability to take part with others in collaborative activities with shared goals and intentions. For *shared intentionality* or *intentionality-we*, the authors define collaborative social interactions of individuals able to understand each other as intentional agents where they share common goals and commitments, and coordinated roles of action to achieve them.

These collaborative activities require an alignment of the individual with others individuals to form a common goal, and a differentiation between oneself and others to understand and coordinate different but complementary roles in common will. So, goals and intentions of each one must include in their content part of the others' goals and intentions, and the individual cognitive representation of the goal must contain the representation of the other's goals and intentions. Furthermore, the cognitive representation of the intention must contain both the personal goal and the others' goal, a joint intention.

In the example, Peter and Hannah must not only share the personal goal of opening the door, but also a personal goal that this will be done with a partner. So, they choose his/her own plan of action, considering and coordinating with the partner's plan of action. Hannah's role is giving the key, and Peter's role is opening the door.

6. FINAL THOUGHTS

I have outlined in this paper a *goal conciliation theory*, connecting the notion of relevance to the notion of goal in a symbolic point of view. I argued that in proactive contexts the cognition is abductively moved by an assumed conclusion rather than by an emergence of premises. Thus, the agent abducts a hypothesis or inference to the best solution, *principle of plausibility*, which simultaneously is the solution with the lowest cost faced with the fixed effect of the goal, *principle of relevance*.

Goal conciliation is a four stage model (goal designing, and ante-factual abductive hypothesis formulation, execution, and checking). The model designs four types of achievements, according to the notion of goal conciliation (active conciliation, active non-conciliation, passive conciliation, and passive non-conciliation), and five architectures for ante-factual abductive hypotheses evaluation (categorical, biconditional, conditional, enabling, and tautological).

Although abductive hypotheses can emerge in any of these five architectures, I argue that they emerge as categorical $P \Leftrightarrow Q$ by default, and model active conciliations. Faced with problems or dilemmas, this formulation becomes biconditional $P \leftrightarrow Q$, and the individual assumes passive non-conciliations. When P is only sufficient, the formulation becomes conditional $P \rightarrow Q$, and the individual assumes passive conciliations. When P is necessary, but does not guarantee Q, the formulation becomes enabling $P \leftarrow Q$, and the individual assumes active non-conciliations. Finally, when all possibilities are plausible, the formulation becomes tautological $P - Q$. Thus, I claim that, while processing any hypothetical formulation "If P, then Q," individuals are able to build the proper *ad hoc* connection between P and Q. That would explain how humans modulate different meanings and inferences from them, despite the same linguistic formulation.

It follows from that approach the possibility to describe and explain not only goal self-conciliations, but goal hetero-conciliations when the case is to establish common goals and sub goals collaboratively. In these cases it is possible to work both the production and the perception of informative and communicative intentions in the scope of an architecture that seriously considers relevance as a goal dependent predicate.

Finally, it is worth saying that this architecture is nothing more than a set of abductive hypotheses that aims to compete with other qualified sets of hypotheses. It is now imperative to put these hypotheses to the abductive stage of checking in expectation of external conciliations.

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Título: *Por uma teoria de conciliação de metas: hipóteses abdutivas antefactuais e modelação proativa*

Resumo: *Fundamentado na Teoria da Relevância de Sperber e Wilson (1986/1995), apresenta-se neste artigo uma arquitetura descritiva e explanatória para a formulação e a avaliação de hipóteses abdutivas em contextos proativos, a ser denominada de Teoria de Conciliação de Metas, alegando que o indivíduo produz uma inferência para a melhor solução nestes casos. O texto expõe o modelo conceitual em quatro estágios – projeção de meta e formulação, execução e checagem de hipótese antefactual – ilustrando-o com um exemplo no qual um indivíduo pretende abrir uma porta chaveada. Em seguida, avaliam-se processos de auto e heteroconciliação de metas conforme contextos formados por cinco categorias de hipóteses abdutivas antefactuais: categóricas, bicondicionais, condicionais, habilitadoras e tautológicas.*

Palavras-chave: *Pragmática Cognitiva. Teoria da Relevância. Teoria de Conciliação de Metas. Modelação Proativa de Metas. Hipóteses Abdutivas Antefactuais.*

Título: *Hacia una teoría de conciliación de metas: hipótesis abductivas antefactuales y modelación proactiva*

Resumen: *Con base en la teoría de la relevancia de Sperber y Wilson (1986/1995), este artículo presenta una arquitectura descriptiva y explicativa para la formulación y evaluación de hipótesis abductivas en contextos proactivos, que se llamará teoría de conciliación de metas, alegando que el individuo produce una inferencia a la mejor solución en estos casos. El texto expone el modelo conceptual en cuatro etapas – proyección de metas, y formulación, ejecución y comprobación de hipótesis antefactuales – ilustrándolo con un ejemplo en que una persona tiene la intención de abrir una puerta con llave. A continuación, evaluamos procesos de auto y heteroconciliación de metas en contextos formados por cinco categorías de hipótesis abductivas antefactuales: categóricas, bicondicionales, condicionales, habilitadoras y tautológicas.*

Palabra- clave: *Pragmática Cognitiva. Teoría de la Relevancia. Teoría de la Conciliación de Metas. Modelización Proactivas de Metas. Hipótesis Abductivas Antefactuales.*