



Universidad de Valladolid



UNIVERSIDAD
DE SALAMANCA



DOCTORAL THESIS PROJECT

Abductive inferences and their relationship with the generation, maintenance and conviction of inappropriate beliefs in patients with mental disorders

A thesis submitted as partial fulfillment of the requirements for the degree of
Doctor in logic and philosophy of science

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April 2017

Acknowledgments

I appreciate the financial support granted by the University of Salamanca (USAL) in conjunction with Banco Santander, as well as the Institute of Genomic Medicine of Mexico, the Caracci Research Center and the National Center for Disaster Prevention for their invaluable support in conducting this research. The thesis was carried out under the supervision of Dr. Enrique Alonso González (Spain) and the advice of Dr. José Humberto Nicolini Sánchez (Mexico).

I also thank Mtra. Nuria Lanzagorta Piñol and her team, thanks to which it was possible to work with patients of the necessary characteristics.

I thank my loving wife, for her long hours of revision and style correction, who always provides me with a sharp and constructive criticism, which has made this thesis what it is, in addition to giving me the greatest gift I could ask for, my wonderful daughter.

To my mother who, through arduous effort, gave me a solid training as an individual and also allowed me a quality education.

To my friends for their constant support and comprehension.

Content

3 Acknowledgments

11 Introduction

13 Chapter I.

- 18 2. The notion of abduction, central distinctions (process / product)
- 19 3. Relationship with the notion of explanation
- 21 4. The inference to the best explanation
- 28 5. Relationship of the notion of abduction with the development of different research programs
 - 29 5.1 Brief history of the development of the family of dual processing models Dual processing
 - 34 5.2 Dual processing models with “family looks”
 - 37 Characteristics of the processes type 1 and type 2
 - 38 Characteristics of systems 1 and 2
 - 40 Consciousness
 - 41 Arguments from evolutionary psychology
 - 42 Functional characteristics
 - 43 Arguments related to the individual differences of the subjects
 - 44 6. Relationship between systems
 - 45 7. Abduction from dual processing models
 - 47 8. The theory of epistemic change (AGM))
 - 50 8.1 Abductive everyday inferences understood in terms of epistemic change
 - 53 8.2 Limitations of the Mode
 - 55 9. Case-based reasoning
 - 61 CBR explanation oriented
 - 65 10. Pragmatics

70	11. Relevance Theory Relevance
78	Chapter II.
78	Mental illnesses
79	1. Schizophrenia (Definition)
82	1.1 Clinical picture
84	1.2 Diagnostic characteristics
86	1.3 Course and prognosis
87	Environmental
87	Genetics
87	Development
89	Dopamine system
89	Glutamate system
89	Serotonergic system
90	2. Bipolarity and related disorders (Definition)
91	2.1 Clinical picture
91	2.1.1 Manic episode:
92	2.1.2 Hypomanic episode:
94	2.1.3 Major depressive episode:
95	2.2 Type I bipolar disorder
95	2.2.1 Diagnostic criteria
98	2.2.2 Diagnostic characteristics
100	2.2.3 Course and prognosis
100	2.2.4 Etiology
100	Environmental
100	Genetics
100	Gender
101	3. Obsessive-compulsive disorder and related disorders (Definition)
103	OCD meta-analysis

- 106 3.1 Clinical frame
108 3.2 Course and comorbidity
109 3.3 Etiology
109 Temperamentals
109 Environmental
109 Genetic and psychological
111 Neurochemical hypotheses
111 Neuro Epigenetic model
112 3.4 Suicide risk
112 3.5 Treatments
113 4. Meeting points between the different disorders

118 Chapter III.

118 Cognition

- 119 1. Cognitive distortions
120 1.1 The hypothesis of jump to conclusions:
122 1.2 The hypothesis of the attribution of styles
123 1.3 The abnormal perception hypothesis
124 1.4 The hypothesis of the discrepancy between the objective and subjective reliability of the information stored in the memory
125 2. Cognitive dysfunctions and their relationship with abduction
126 3. Metacognitive training
128 3.1 Meta-cognitive training aimed at reducing inappropriate beliefs
129 3.2 Design
129 Study subjects
129 Inclusion criteria
129 Age
130 Exclusion criteria
130 Evaluation
131 4. Description of the Tests

CRGR

- 131 Barratt Impulsivity Scale Version 11 (BIS-11)
- 131 Quality of Life Enjoyment and Satisfaction Questionnaire — Short Form (Q-LES-Q-SF)
- 132 Personality Inventory (NEO)
- 133 Fagerström Test
- 133 Positive and Negative Syndromes for Psychosis Scale (PANSS)
- 134 Yale-Brown OCD scale
- 134 Checklist
- 134 Revised Obsessive Compulsive Behavior Inventory (OCI-R)
- 134 Self-applied temperament scale (TEMPS-A)
- 135 Psychotic Symptoms Rating Scale (Psyrats)
- 135 Mania Evaluation Scale (SEM)
- 135 Peters Delusional Ideas Inventory (PDI)
- 135 Beck's Cognitive Insight Scale (BCIS)
- 136 Internal, Personal, and Situational Attributions Questionnaire (IPSAQ)
- 136 Irrational Beliefs Test (TCI-R)
- 137 Neuropsychological evaluation using CANTAB Eclipse® Cambridge Neuro-psychological Test Automated Battery:
- 138 5. Metacognitive Training Program
- 144 6. Presentation of Results
- 144 Sociodemographic Questionnaire
- 145 Barratt Impulsivity Scale Version 11 (BIS-11)
- 145 Quality of Life Enjoyment and Short Satisfaction Questionnaire - Form (Q-LES-Q-SF)
- 146 Personality Inventory (NEO)
- 146 Test Fagerstrom
- 146 Positive and Negative Syndromes Scale (PANSS)
- 147 Yale-Brown scale for TOC
- 148 Yale Brown
- 150 Revised Obsessive Compulsive Behavior Inventory (OCI-R)

150	Self-applied temperament scale (TEMPS -A)
151	Psychotic Symptoms Rating Scale (PsyRATS)
151	Mania Assessment Scale (SEM)
152	Inventory Peters delusions (PDI)
152	Beck Insight Scale (BCIS Cognitive)
153	Internal, Personal, and Situational Attributions Questionnaire (IPSAQ)
154	Irrational Beliefs Test (TCI-R)
155	Neuropsychological Assessment
158	Results Matrix
160	Chapter IV.
160	Results and Conclusions
160	Discussion of results
166	Conclusions
174	Bibliography

Introduction

This research is based on a great interest in understanding the way in which the abductive inferential process allows the individual to interact quickly and efficiently with the world.

We believe this great inferential process (capable of being subdivided into smaller processes) is present at the very base of many of the mechanisms that allow us to interpret the world consistently, which ranges from:

- Retrieval of information from our memory systems
- Generation of explanatory hypotheses to events in the world
- Helps in the selection of inputs for speech acts and interpretations of linguistic interactions
- Selection between hypotheses
- Construction of mental perspectives

What we assume affects, therefore, both in the generation and maintenance of beliefs, as well as in the conviction that the individual has in them, so this work seeks to clarify the inferential mechanism, this through reflection and empirical evidence obtained through the assessment of a therapeutic intervention strategy in individuals who systematically present, serious flaws in their inferential processes¹ for interpreting the world.

This psychological assessment uses Metacognitive Training as an intervention tool, which seeks to provide the individual with skills to directly influence a set of cognitive biases associated with their pathologies, which can be understood as specific failures in certain elements of cognition, their impact on inferential processes such as the abductive one is of specific interest for the present

¹ A non-exhaustive subset of mental pathologies that share the generation of inappropriate beliefs (delusions) was identified.

investigation.

Although this work is only a prospective study regarding Metacognitive Training as a strategy to influence the impact of certain systematic inferential failures, the favorable results obtained in the application of the instrument are a valuable result in themselves, in addition to obtaining, through of the results, clarity in the understanding of various facets of the abductive process in the healthy and the pathological individual.

It is hoped that the understanding of the abductive process partitioned into sub-processes, and identifying specific cognitive failures associated with inappropriate beliefs, may be useful for further developments, both in cognitive sciences and in therapeutic models oriented to systematic belief failure.

Chapter I.

Abductive Reasoning

1. Abductive reasoning: The Big Picture

Imagine waking up at home and going outside to get some fresh air. Outside, you realize that the grass is wet, which makes you question why this is so. However, quickly answers to yourself it possibly rained last night.

One day you enter the kitchen and find a plate and a cup on the table, with leftover bread with a little butter, surrounded by jam, a sugar packet and an empty carton of milk. You conclude that one of your roommates got up during the night to make a midnight snack, but was too tired to clear the table². While it is true that there could be alternative explanations for this event, such as someone wanting to play a prank on you, somehow the initial hypothesis seems more convincing than our alternative version.

In both examples, the information contained in the conclusions is not contained in the premises, they are expansive and explanatory hypotheses, arising through a clearly inferential process *sui generis*. This process is different from deduction and induction, inferential processes that are traditionally used to account for the context of justification³.

11

The distinction between these three types of reasoning can be clearly seen through the following scheme⁴:

2 (Douven, 2011, p. 2)

3 We refer here to the classic distinction proposed by Reichenbach in terms of context of discovery and context of justification. We anticipate here that although Peirce places would be the context of justification (Douven, 2011, p. 34), although authors such as Schurz support proposals much closer to the spirit of Peirce distinguishing between selective abductions and creative abductions (Schurz, 2007)

4 (Peirce, 1931, CP 2.623) quoted in (Aliseda, 2006, p. 171).

Scheme 1. Types of reasoning⁵

DEDUCTION	INDUCTION	HYPOTHESIS (ABDUCTION)
Rule	Case	Rule
All the beans in this bag are white	These beans are from this bag	All the beans in this bag are white
Case	Result	Result
These beans are from this bag	These beans are white	These beans are white
Result	Rule	Case
These beans are white	All the beans in this bag are white	These beans are from this bag

Source: Own elaboration.

The deduction maintains a character of necessity in its inference, it carries complete certainty in its results⁶, that is, the truth of the premises guarantees the truth of the conclusions by virtue of its formal scheme. Situation that is not possible to extend to extensive inferences such as induction and abduction.

Induction and abduction share a series of characteristics, although they are irreducible to each other⁷:

1. They are comprehensive, that is to say that their conclusions go beyond what is (logically) contained in their premises⁸ (in a certain sense it allows jumping directly to the conclusions from our beliefs). However, induction is directed to the probable and does not necessarily entail explanatory claims, since it only appeals to observed or statistical frequencies, throwing predictions about the future course of events⁹; produces a rule validated only in the long term¹⁰, while abduction addresses the possible and is ascribed an explanatory character¹¹, it is only suggested that something could be the case¹², seeking to infer something about the

5 (Peirce, 1931, CP 2.623) quoted in (Aliseda, 2006, p. 171).

6 (Aliseda, 2006, p. 171).

7 There are authors like (Harman, 1965) who consider that it is possible to see induction as an instance of abduction, however, in general they are considered irreducible.

8 (Douven, 2011, p. 5).

9 (Schurz, 2007, p. 202).

10 (Peirce, 1931, CP 5.170) quoted in (Aliseda, 2006, p. 171).

11 Establishing a clear difference between the probable and the possible turns out to be a complex philosophical question, so we will assume that a proposition p is probable, if perhaps p has a high frequency of occurrence given a given sample, while we will assume that a proposition p is possible only when we affirm that it is not necessary that it does not occur p (Herrera, 2010, p. 26).

12 (Peirce, 1931, CP 5.171) quoted in (Aliseda, 2006, p. 171).

unobserved causes or explanatory reasons for the events observed¹³.

1. In both types of inferences, the conclusions are fallible.

1. They do not have the property of monotonicity.

The monotony property of classical deductive logic can be summarized in the following sentence: the conclusions are here to stay. If from a set of premises ($\alpha_1 \dots \alpha_n$) we obtain a conclusion (ε), then it does not matter if we add another premise (β) to the argument, it is still valid¹⁴:

$$\frac{\alpha_1 \dots \alpha_n \Rightarrow \varepsilon}{\alpha_1 \dots \alpha_n, \beta \Rightarrow \varepsilon}$$

In hypothesis inference, this is not the case, since by adding new premises¹⁵, it is no longer possible to guarantee the validity of the conclusion. Similarly, to give up the monotonic, it is possible to infer a certain conclusion abductively a subset of S, premises we could not infer from the S entire¹⁶ set.

The reasoning by hypothesis is therefore one that implies that something may be the case, but that we invoke because it allows us to explain some fact given certain available information.

The first to use the term abduction was Charles Sanders Peirce, considered the father of North American pragmatism, whose philosophical project (Pragmatism) aims to be a philosophical method of reflection that allows clarifying ideas, clarifying the meaning of concepts.

13

The clarification of the concepts is carried out, according to Peirce: 1) Recognizing when the concept manifests itself, 2) Logically analyzing the concept to discover its constituent parts and 3) Discovering and recognizing those habits of behavior that the belief in the truth of the concept in question generates¹⁷.

Pragmatism, as Peirce understands it, is based on the following maxim: "Consider what practical effects the object you are considering might have. Therefore, his conception of these effects is the

13 (Schurz, 2007, p. 202).

14 (Garibay, 2010, p. 49)

15 Where the premise that add not inherently involve revising the set $\alpha_1 \dots \alpha_n$.

16 (Douven, 2011, p. 5).

17 (Aliseda, 2006, p. 169).

totality of his conception of the object”¹⁸. So a concept is clarified through the delimitation of its practical consequences, which in turn is reflected in the habits of action.

Peirce considers reasoning as a dynamic process where individuals constantly struggle to reach a state of belief in the face of doubt: “the irritation of doubt is the immediate reason for the struggle to achieve belief”¹⁹, of these states of doubt are interspersed / belief and this process is subject to logical investigation.

Abductive reasoning is part of its general program, as the only inferential process capable of generating new ideas²⁰ and therefore being a method of synthetic reasoning, immersed in a general mode of thought. “From these (abductive) suggestions, deduction can generate predictions that can be tested by induction”²¹.

Peirce characterizes deduction, induction and abduction through their shape²², so that from the formulation of the hypothetical reasoning presented above, the possibility that is concluded these beans are from this bag, on the basis that this would explain the fact that they were white, since we know that all the beans in this bag are white. This example shows that we accept the conclusion of a hypothetical reasoning as plausible because it has an explanatory relationship between the event and the cognitive information maintained at the time.

So for Peirce, abduction consists of the process of generating explanatory hypotheses²³ (as a process), but abductive reasoning is also the process of choosing a hypothesis²⁴ and presenting it (as a product). In this way, Peirce condenses this double function in abductive reasoning, not only the generation of hypotheses but also the selection of the most promising one (s), based on the following three criteria²⁵: 1) Explicativeness, 2) Contrastability and 3) Economy²⁶.

18 (Peirce, 1931, CP, 5.18) quoted in (Aliseda, 2006, p. 169).

19 (Peirce, 1877, A. III).

20 (Peirce, 1931, CP, 5.171) quoted in (Aliseda, 2006, p. 171).

21 (Peirce, 1931, CP, 5.171) quoted in (Aliseda, 2006, p. 171).

22 See scheme 1.

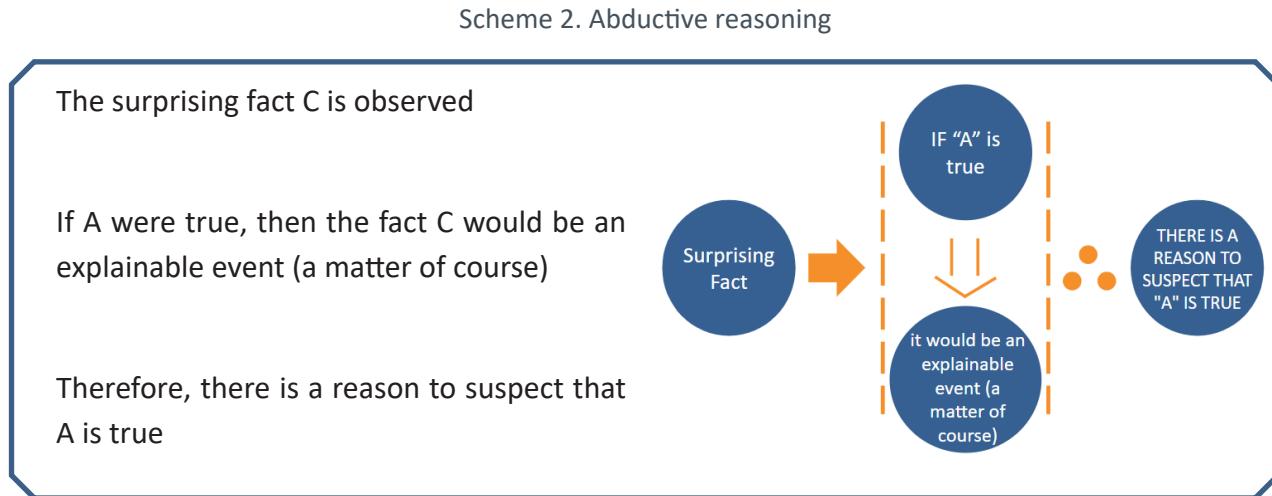
23 (Peirce, 1931, CP, 5.171) quoted in (Aliseda, 2006, p. 171).

24 (Peirce, 1931, CP, 7.219) quoted in (Aliseda, 2006, p. 171).

25 The analysis of the criteria for the evaluation of abductive hypotheses is a central theme of this work and will be addressed in depth later. However, let us advance that within the general debate on abduction, this particular aspect (the proposition of sensible or rational explanatory principles or virtues) is known as the problem of justification, as opposed to the descriptive problem (which consists of to give an account of the principles that guide inferences, as happens, for example, in scientific reasoning).

26 “A hypothesis is explanatory if it accounts for the facts, but it has a suggestive character until it is verified

Peirce approaches abduction through its syllogistic form, but the following logical formulation is also proposed to represent it²⁷:



Source: Own elaboration.

That is, we have a surprising fact²⁸ that explains (C) and for this, a hypothesis is generated that there is an event that naturally precedes the surprising event. If this is the case, then we have at least one reason to suspect that our hypothesis (A) is true and therefore explains the surprising fact.

— — — — —

Today, abduction has been represented by the following plot scheme:

$A \rightarrow C$

C

Possibly A

15

For Peirce, abductive reasoning is a process that is activated in the face of factual situations that question our beliefs (surprising experiences). There are situations that trigger abduction, that is, situations that generate doubt and the objective turns out to be to return us to the state of belief through the generation of hypotheses with explanatory claims and the selection of one of them as an explanation of the situation that generated the initial doubt.

(Contrastability). The economy requirement is required given the innumerable possible explanatory hypotheses, as well as the need to choose the best among the options" (Aliseda, 2006, p. 36)

27 (Peirce, 1931, CP, 5.189) quoted in (Aliseda, 2006, p. 172).

28 A surprising fact is one for which we do not have an explanation or that is against what we would expect.

CRGR

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So that, in general, we can say the following about abduction:

1. It is a form of everyday reasoning, whose inferential mechanism is capable of being formally expressed.
2. It can also be understood as part of an epistemic process for the acquisition of beliefs²⁹.
3. It has an explanatory character in the face of surprising events.

It is possible to understand abduction, both as the process to generate explanatory hypotheses, as well as the process to select between them by means of certain criteria (for Peirce they are testability, explanatory power and economy), which can be understood as a mechanism for reviewing beliefs.

2. The notion of abduction, central distinctions (process / product)

Abductive reasoning can be studied from different perspectives³⁰ and its development will be characterized depending on the research program that serves as a reference framework. However, it is possible, and useful, to establish some central aspects of it as common threads throughout the work, as well as to establish some distinctions.

16

The first distinction we would like to make is the distinction *process / product* within the term abduction, as it is commonly used in these two senses³¹. “These two uses are closely related. An abductive process produces an abductive explanation as its product, but the two are not the same”³².

When abduction is explored as a process, the emphasis is on generative and creative elements that

29 (Herrera, 2010, p. 24)

30 (Hintikka, 1998)

31 “The logical keywords of judgment and proof are nouns that denote either an activity, indicated by their corresponding verb, or the result of that activity. In just the same way, the word abduction may be used both to refer to a finished product, the abductive explanation, or to an activity, the abductive process that led to that abductive explanation”(Aliseda, 2006, p. 30).

32 (Aliseda, 2006, p. 32).

introduce new information³³ by which an abductive conjecture is constructed³⁴, while when it is examined as a product, the focus is on how to choose a candidate optimal among the multitude of possible explanations³⁵, This is usually carried out through the analysis of the conditions that link the information with a notion of explanatory force³⁶ (notion of explanation).

This distinction is clarifying since “Some authors consider these processes as two separate steps, wondering then what counts as a possible abductive explanation, while on the other hand they deal with justifying / selecting some preference criterion that operates on abductive explanations, in order to select the best one. Other authors consider abduction as a single process through which only the best explanation is obtained”³⁷. Both will be equally useful when reviewing the development of the notion of abduction within different disciplines.

3. Relationship with the notion of explanation

There is an intimate link between the characterization of abduction and the notion of explanation that determines the conceptualization of what will be understood by abduction:

“Speaking in a broad sense, abduction is the process of reasoning invoked to explain a disconcerting observation... Abduction is the thinking of the evidence towards the explanation, it is a type of reasoning characteristic of many situations with incomplete information”³⁸.

Expressed in this way, we can realize that abduction, by virtue of its relationship with the explanation (Even seen in a general way), it has a series of characteristics:

33 Schurz suggests that all types of inferences have a double strategic-justification function, which will vary depending on the kind of inference to which we want to refer. It suggests that there are different types of abductive patterns and depending on which one is used, different requirements must be established, although in general the main function of abduction in contrast to deduction or induction is strategic, since in the face of a multitude of possible explanations the essential function of abduction is to serve as a search strategy that allows us to establish which explanatory conjectures should be placed first for further investigation(Schurz, 2007).

34 (Schurz, 2007).

35 (Schurz, 2007).

36 (Herrera, 2010, p.25).

37 (Aliseda, 2006, p. 33) The inference to the best explanation or IBE, has been widely debated, resulting in a series of substantial sophistication to the classical formulation due to the various objections and problems raised, so it will be addressed later in a particular way.

38 (Aliseda, 2006, p. 28)

1. Abduction assigns a role of theoretical confirmation to the explanations³⁹, that is, considerations contribute to making some hypotheses more credible than others⁴⁰. They guide inference⁴¹.
2. “Abductive explanation” it is always an explanation with respect to a body of beliefs”⁴². This expansive inferential process allows generating hypotheses to explain a surprising fact only from the existence of a previously available information framework (background knowledge) and therefore, it is dependent on it.
3. Abduction seen as rules of inference, requires premises that entail explanatory considerations, by means of which a conclusion is generated that supports something about the truth of the hypotheses⁴³.
4. Abductive explanations, when referring to possibilities, are ascribed a typically fallible or retractable character⁴⁴, since it may be the case that the explanation turns out to be false.
5. By virtue of the process / product distinction, it is possible to maintain the same distinction in terms of the notion of explanation⁴⁵, referring to the finished product as the explanatory argument and to the process of constructing said explanation as the explanatory process⁴⁶.

However, the relationship between abduction and explanation becomes more complex, since it is not only possible to understand different ways in which something turns out to be an explanation, but by appealing to different *circumstances, forms, claims and explanatory aspirations*, it is possible to establish different abduction patterns⁴⁷, even without establishing the process / product

39 (Douven, 2011, p. 22)

40 There are different ways in which it can be considered that explanatory power is provided to abduction, so following Schurz (2007), we will make distinctions between different abductive patterns.

41 (Lipton, 2008, p. 193)

42 (Aliseda, 2006, p. 30). The background knowledge on which abduction operates can be viewed in many ways: spatial representations of categories, representations of characteristics, semantic networks, subsets of propositions, etc. (Markman, 2002) This topic will be addressed later.

43 (Douven, 2011, p.10)

44 (Aliseda, 2006, p. 31).

45 Various positions are held in the general literature in this regard. There are those who clearly distinguish between these steps, there are those who see it as a single step, and there are even those who hold intermediate positions.

46 (Aliseda, 2006, p. 33).

47 Hintikka already advanced this, establishing by holding different theses on abduction: the inferential thesis (process / product), the purpose thesis (as the purpose of science to generate new hypotheses), the understanding

distinction.

An example of this are the different sophistication that we can see in the conception of abduction as an inference to the best explanation⁴⁸ and the later internal developments of this notion⁴⁹.

4. The inference to the best explanation

The abduction understood as an *inference to the best explanation* (IBE)⁵⁰, in a first formulation of the book, is the following:

“Given certain evidence E and some candidate hypotheses for explanation H_1, \dots, H_n of E, inferring the truth of H_i that best explains E”⁵¹.

In a simple way we can think that the “IBE is an extension of the idea of self-evident explanations where the phenomenon that is explained provides an essential part of the reasons to believe that the explanation is correct”⁵².

Let’s remember the example: *You arrive at your house late at night, and you realize that the light in your bedroom that always stays on, is off. It’s been pouring rain, so you infer that the electricity to the house is gone.* The fact that the light has gone out explains why your bedroom light is not on; however, the fact that the breech light is not one may be an essential part of the reason to believe that the light has gone out.

19

This formulation reveals some problems: It

1. presupposes the notion of *candidate for explanation and better explanation*⁵³, none of which

thesis (as the set of operations by which scientific theories are generated) and the autonomy thesis (Irreducibility to deduction or induction) (Hintikka, 1998).

48 (Douven, 2011).

49 (Schurz, 2007).

50 For keeping the standard name in literature (Inference to the best explanation IBE) (Harman, 1965).

51 (Douven, 2011, p. 10)

52 (Lipton, 2008, p. 194)

53 Does it mean that it is the most probable explanation, or is it the one that, if correct, would provide the

has a unique interpretation, nor obvious⁵⁴. In response to this, a number of sophistications have been suggested:

- a. Weaken the formulation by assuming that abduction:
 - i. Only guarantees the *probable* truth of the best explanation.
 - ii. It only infers an *approximation* to the truth from the best explanation.
 - iii. It only guarantees a *probable approach* to the truth of the best explanation.

However, this may not be enough, since, in order for us to be justified in the use of this class of inferences, they must be *reliable*, so that when the premises are true (*or probably true or approximately true or probably approximate to the truth*), usually, the conclusion is also.

One of the weaknesses of the formulation that has been exposed, is that it requests only as a necessary condition that the be chosen *best explanation*⁵⁵ for the situation to be explained, from among a set of other hypotheses, which means that nothing prevents us from assuming that it was the case. where the total set of these hypotheses are not adequate as explanations and we only get *the best explanation of a bad lot*⁵⁶ and therefore a bad explanation.

In response to this weakness, formulations such as the following have been generated:

20

- b. “Given the evidence E and the candidate explanations H₁,..., H_n from E, infer the truth of that H_i that best explains E, the H_i proposed must be satisfactory / good enough

greatest degree of understanding? This distinction is emphasized by appealing to the terms “likeliest” (most probable) for the first sense and “Loveliest” (more beautiful) for the second. Lipton suggests that at least in the scientific context, inferences should tend towards the most comprehensive explanations (loveliest), taking the comprehensive aspect as a guide to the most probable (likeliest); However, a request like this, he says, faces several challenges: a) Identify those traits that contribute to the degree of understanding they provide, b) Show that those aspects of understanding (loveliest) match probability judgments (likeliest), that is say, those more comprehensive explanations are also the most likely, c) Show that, in fact, this is a guide within scientific practices (Lipton, 2008, p. 196-197).

54 There are those who argue that it is possible to formalize by appealing to logic or to another formal discipline, which is a “candidate for explanation”; however, regarding the “best explanation”, the general opinion is that it is necessary to resort to “theoretical virtues”, such as simplicity, economy and coherence, among others.

55 This being an argumentative hypothesis.

56 Teh called “bad lot arguments” (Van Fraassen, 1989, p. 143).

CRGR

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*qua explanation*⁵⁷. It is then possible to understand it as “inference to the best of the competing explanations available, when the best is good enough”⁵⁸.

- c. “Given some evidence E and candidates for explanation H₁, ..., H_n of E, if H_i explains E better than any of the other hypotheses, infer that H_i is closer to the truth than any of the other hypotheses”.
2. If abduction is seen as a logical inference, then it is necessary to specify the logical space for the generation of possible hypotheses, restricting the potentially infinite set of explanations, in addition to being necessary to establish comparative criteria for the quality of the abducted explanations⁵⁹.
3. The IBE can also be seen as an extension of the idea of self-evidential explanations, where the phenomenon that is explained in a reciprocal way provides an essential part of the reasons to believe that the explanation is correct. Although it is true that there is a curious circularity in self-evidential explanations⁶⁰, most could consider this circularity as benign.
4. We must specify between what is a potential explanation and what will, in fact, count as an explanation⁶¹, what is the minimum criterion for the acceptability of an abduction.

Schurz⁶² proposes to see abduction as special patterns of inference to the best explanation⁶³, whose *structure* determines a promising abductive conjecture⁶⁴, and in this sense, it serves as an abductive search strategy, in this way, he distinguishes between IBE patterns by virtue of three dimensions not independent of each other:

57 (Douven, 2011, p. 14)

58 This in order to solve the problem that the “best” explanation may not be good enough. Although, now the question of what are the criteria to consider some hypothesis “good enough” remains open.

59 (Schurz, 2007, p. 203).

60 Ex. The recession speed of the galaxy explains why its spectrum is reddish to a specific degree, but the reddish spectrum may be an essential part of the astronomer’s reasons for believing that the galaxy has a recession at that speed. (Lipton, 2008, p. 194).

61 A potential explanation is one that satisfies all the conditions of what, in fact, is the explanation with the possible exception of truth.

62 (Schurz, 2007).

63 A certain class of heuristic rules to discover promising explanatory hypotheses in different types of scenarios in reasonable times.

64 Taken from Hintikka (Hintikka, 1998, p. 528).

1. The type of hypotheses that are abducted.
2. The kind of evidence abduction tries to explain.
3. According to the beliefs or cognitive mechanisms that caused the abduction.

This, in principle, allows establishing different general objectives⁶⁵ and evaluative criteria depending on the characterization of the different abductive patterns⁶⁶, which in turn, can be understood more widely both in the way they are processed⁶⁷, and in the elements and contexts that can trigger them⁶⁸.

Scheme 3. Abductive patterns

TYPE OF ABDUCTION	EVIDENCE TO BE EXPLAINED	PRODUCT OF THE ABDUCTION	ABDUCTION DETERMINED BY
Fathic abduction	Unique empirical facts	New facts (reasons/causes)	Known laws or theories
Observable fact abduction	"	Fathic reasons	Known laws
Existential abduction of the 1st order	"	Factus reasons postulating new unknown individuals	"
No observable abduction fact (historic abduction)	"	Unobservable facts (facts of the past)	"
Laws abduction	Empirical laws	New laws	Known laws

65 These objectives may be to choose an optimal candidate from a multitude of possible explanations (selective abduction), or to introduce new theoretical models or concepts (creative abductions) (Schurz, 2007). For this, it is worth establishing a double functional character within all abductions: the justification function (consists of the justification of the conclusion given the premises) and the strategic function (consists of finding the most promising conjecture to face greater empirical tests) (Hintikka, 1998).

66 (Schurz, 2007, p. 203).

67 If there are different abductive patterns, then it is possible to think that the cognitive systems that support them are different, an idea that will be interesting when we look at the developments of abduction within disciplines such as psychology.

68 When abduction is placed in certain contexts, temporal information processing and memory considerations come into play, so that extra requirements are established, such as: "It is essential for a good search strategy that it leads to a conjecture optimal, not only in a finite time, but also reasonable" (Schurz, 2007, p. 204). It has even been formulated that there are "abductive instincts" (Peirce, 1931, Cp. 5.47, fn. 12). In general, one can speak of two categories of constrictions in abductive inference: a) The ecological ones, referring to the material context in which these inferences are developed, and b) The cognitive ones, which are those related to the state of the epistemic communities in which the abductive solutions are produced (Bustos, 2011, p. 47).

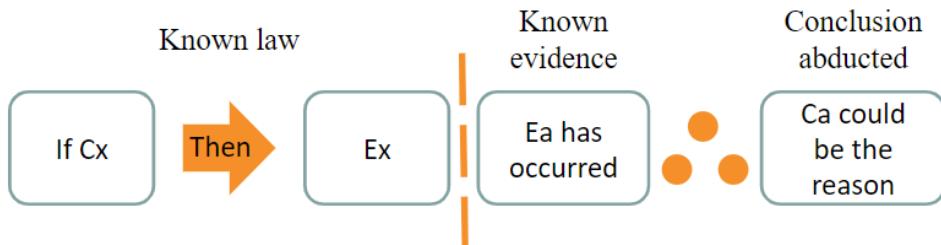
TYPE OF ABDUCTION	EVIDENCE TO BE EXPLAINED	PRODUCT OF THE ABDUCTION	ABDUCTION DETERMINED BY
Theoretical model abduction	General empirical phenomena (laws)	New theoretical models of the phenomenon	Known Theories
Existential abduction of the 2nd order	"	New laws/theories with new concepts	Theory of background knowledge
Micro part abduction	"	Microscopic composition	Background knowledge exploration
Abduction by analogy	"	New laws/theories with analogy concepts	Analogy with background knowledge
Abduction of hypothetical causes	"	Hide causes (unobserved)	(see down)
Speculative abduction	"		Speculation
Abduction for common causes	"	Hide common causes	Causal unification
Strict common cause abduction	"	New theoretical concepts	"
Statistical factor analysis	"	"	"
Abduction to reality	Introspective phenomena	Concepts of external reality	"

Source: Schurz⁶⁹.

1. Factual abductions (FA)⁷⁰: those generated by known implicational laws that go from causes to effects and abducted hypotheses are generated by re-introduction.

23

Scheme 4. Factual abductions



Source: Own elaboration.

69 (Schurz, p. 206, 2007).

70 It is important to point out that both the fact to be explained and the hypotheses abducted are singular facts.

- a. Abductions of observable events: reasoning following the FA scheme of observed effects (E_a) to causes not observed, but in principle observable in the background of known laws. So an attempt will be made to gain direct evidence in favor of the abducted conjecture.
- b. Existential abductions of the first order: in this case the antecedent of the law contains anonymous variables, that is to say that some variables remain without instantiating or exemplifying. The safest abductive conjecture will be the one in which the existential quantifies on that variable.

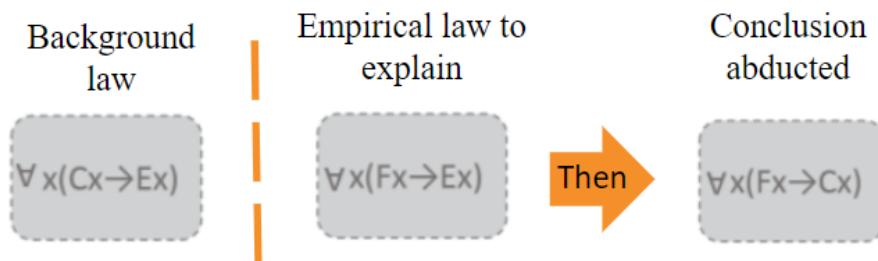
71

$$\begin{array}{l}
 L: \forall x \forall y (Ryx \rightarrow Hx) \quad \text{logically equivalent: } \forall x (\exists y Ryx \rightarrow Hx) \\
 Ha \\
 \hline
 \text{Conjecture: } \exists y Rya
 \end{array}$$

- c. Abduction of unobservable facts: the structural form is the same as that of the observable facts, but the abducted fact is unobservable, as in the abduction of historical facts. It is abductively conjectured given some background theories, to later seek support in empirical consequences that follow from these conjectures.
- 2. Abductions of laws: both the evidence to be explained and the hypotheses abducted are implicational laws, so that the abduction is generated by one or more known implicational laws.

24

Scheme 5. Abductions of laws



Source: Own elaboration.

71 That is, if for all "x" and for all "y" where yes "Ryx" then "Hx" and we find an instantiated case of "Hx", say "Ha", then the abductive mechanism will allow us to conjecture that there exists or existed an "And" "Rya", which explains the case "Ha".

3. Theoretical: The *explanandum* model abductions of a theoretical model abduction is a well-confirmed and reproducible empirical phenomenon, expressed in an empirical law. So abduction arises from an established scientific theory, usually formulated quantitatively. The abductive task is then to find the theoretical conditions (initials and frontiers) that describe the causes of the phenomenon, so that a derivation of the phenomenon from the theory is possible. The theory therefore, constricts the space of possible explanations so that here, the main objective of abduction does not consist in the elimination of alternative explanations, but in finding a plausible theoretical model that allows the derivation of the phenomenon to be explained.
4. Abduction of second-order existential: the *explanandum* consists of one or more general empirical phenomena or laws, and what is abducted, at least in part, is a new property or type of concept governed in part by new theoretical laws. Depending on the degree of novelty of the concept, we will talk about extrapolations, analogies, or unifications.
- a. Micropart abduction: a hypothesis about the microscopic composition of an observable object is abducted, in terms of microparts that obey the same laws as macroscopic observable objects. It is thus an abduction by extrapolation.
 - b. Abduction by analogy: a partially new concept is abducted along with new laws that connect it with a given empirical concept, to explain a “law-like phenomenon”⁷². The key element is the conceptual abstraction based on the mapping of isomorphism or homomorphism, preserving only the relationships between two structures.
 - c. Abduction of hypothetical causes: the *explanandum* consists of a) one phenomenon and b) several mutually interrelated phenomena. One abductively conjectures, in case (a), that the phenomenon is the effect of a hypothetical (unobservable) cause, and in case (b), that the phenomena are effects of a hypothetical common cause. So what guides this type of abduction is the search for unification in terms of common causes.
 - i. Common cause abduction: follows the same scheme as hypothetical cause abduction, but its guiding criterion is causal unification. It can be oriented towards dispositions,

72 Law-like phenomenon.

be based on statistical and probabilistic analysis, or serve to epistemologically account for reality⁷³.

The reason for establishing these distinctions, in addition to showing a classification between types of abductions following Schurz, is due to their usefulness to delimit the central problem of the present work (which is the relationship of abduction with the generation, persistence and conviction of inappropriate beliefs in a specific population).

The previous exposition of the concept of abduction allows us to form a panorama of what we can understand by abduction and to understand some of its different formulations. The next step, therefore, is to analyze the development of abduction in different research programs, particularly in relation to everyday reasoning and the interpretation of linguistic expressions in conversation.

5. Relationship of the notion of abduction with the development of different research programs

The notion of abduction is developed within a large number of different research programs. To mention a few examples, we see that in pragmatism, abduction is related to epistemology (theories of epistemic change) and logic; in philosophy of science we can see it related to the idea of scientific progress, of the context of discovery, realism and explanation⁷⁴; in psychology we see it related to heuristics⁷⁵, everyday reasoning and reasoning by cases; in pragmatics, it is related to the implicatures and the decoding of what a speaker means with a statement (utterance); in law we see it present in the judicial process; In artificial intelligence we see it stand out in the construction of algorithms to produce abductions, as well as in case-based reasoning, in logical approaches an attempt is made to develop semantics for abductive logic.

In this way and for the purposes of this work, although other areas of research have been

73 The fact of reasoning from introspective data of the senses towards an external reality is considered to be achieved from *sui generis* inferences. However, for Schurz, these occur in the same way as the abductive pattern of common causes.

74 As is the case of its relationship with skeptical arguments such as Cartesians and explanatory considerations and its role in determining hypotheses (Douven, 2011).

75 Understanding these as the schemes that serve as quick decision rules.

mentioned, we will only delve into some fields of study associated with abduction, particularly in relation to some proposals of everyday reasoning and pragmatics, starting with two Proposals close to cognitive sciences: *dual processing models*⁷⁶ and *case-based reasoning*, in order to delve into the structure of the abductive process and generate an articulated vision of the process that can only be appreciated in light of various approaches to the phenomenon. That is to say that each of the perspectives addressed throws clarity at different moments or sub-processes of the abduction.

5.1 Brief history of the development of the family of dual processing models Dual processing

Models arise from the contribution of various researchers around the 70s and concentrating on the works of the main exponents of the same, an adequately articulated vision is presented⁷⁷.

The general proposal starts from postulating a cognitive duality between logical and non-logical processes⁷⁸, an idea that dates back to the ancient Greeks. However, the cognitive duality to which the dual process processing models refer is very particular and has its origin in the works of Peter Wason (1972)⁷⁹, who, although he accepts the normative framework of logicism⁸⁰, according to which standards of correct thinking are those established by deductive logic, it also maintains that people's cognitive processes contain both logical and non-logical elements.

The first investigations in this direction were oriented towards the evaluation and mapping of the logical capacities of individuals, focusing on results that transgressed expectations.

Wason's Experiments

76 It should be noted that this thesis is supported by previous works (Garibay, 2010a).

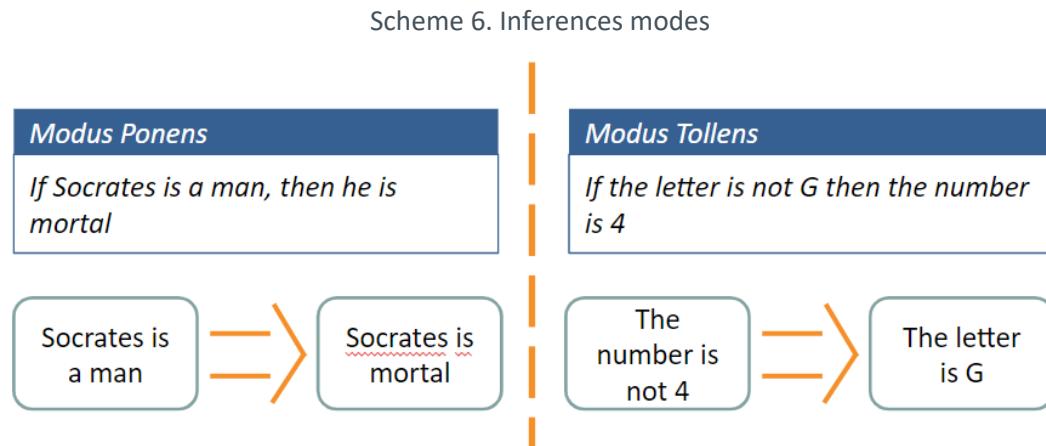
77 In particular in the works of Jonathan Evans ((J. Evans & Over, 1996), (J. Evans, 2003), (J. Evans, 2004)) and in two articles that make a general review of the proposal, the first by Stanovich (Stanovich & West, 2000) and the second by Shafir (Shafir & LeBoeuf, 2002).

78 The term "non-logical" is used instead of "illogical" in order to clarify the term and avoid confusion, since by saying "non-logical" we are referring to that they do not follow the forms of classical deductive logic, but not it means they don't have some other kind of guiding principle.

79 (J. Evans, 2004).

80 "Wason accepted the normative framework of logicism, but vigorously rejected the theories of Piaget, claiming in his early papers that people were both illogical and irrational" (J. Evans, 2004, p. 242).

One of the first experiments to be carried out for this purpose is the so-called “negation paradigm”⁸¹. This paradigm arises from the presentation, in an experiment, of a series of syllogisms that exemplify valid modes of inferences, such as modus ponens or modus tollens. This experiment consisted of asking the subjects what inferences they believed to be valid. Let's see the following example:



Source: Own elaboration.

If it is true that people reason according to classical logic and only the rules of classical logic, then individuals should likewise accept the conclusions of valid arguments with true premises. However, the results of the experiment indicate that the subjects have a greater tendency to accept conclusions positively (*modus ponens*) than negatively (*modus tollens*), even when in fact, the two arguments are logically valid.

28

The reason seems to be in the polarity⁸² of the conclusion, which affects the willingness to accept a conclusion, causing a bias in the results⁸³ constant throughout various experimental manipulations.

“The paradigm is based on the idea that the polarity (affirmative/negative) of logical premises or assertions can be varied orthogonally with the logical case...Hence, any biases associated with the processing of negations can be demonstrated with logic held constant. Conversely,

⁸¹ For a thorough review of this experiment see Evans (J. Evans, 2004, p. 243).

⁸² When we speak of polarity, we refer to the general presentation of the argument, the modus ponens is positive in the sense that, from a conditional and its antecedent, we obtain its consequent, while in the modus tollens it is negative in the sense of that the negation of the consequent is necessary to obtain the negation of the antecedent.

⁸³ We will call biases to the systematic deviations that individuals show regarding the predictions of logic and mathematics.

any effect of logic can be demonstrated with biases held constant. The paradigm was thus used to demonstrate the influence of logical and non-logical factors on reasoning: the two-factor theory⁸⁴.

These results appear, therefore, to support the idea that there are competing logical and non-logical factors, as Wason argued.

From this duality, JT Evans⁸⁵ formulates the first theory that serves as a direct antecedent of the dual processing models, the so-called *Theory of the two factors*.

The theory of the two factors has as its main thesis the existence of logical and non-logical factors competing for the production of inferences. However, the nature of these factors is not yet clear and some explanation is required, which is why Evans looks in a parallel way, a correlation with the level of consciousness of the reasoning processes, influenced by the idea of the psychoanalytic unconscious.

By assuming that there are conscious and unconscious processes, as well as logical and non-logical factors interacting in human cognition, Evans realizes that it is necessary to model human rationality differently. In his book “Rationality and Reasoning”, he stipulates a parallel *theory to the theory of the two factors*, which attempts to account for conscious and unconscious processes⁸⁶ through the postulation of two different notions of rationality: personal rationality, which is to ask about the individual goals of the subjects and their way of thinking or acting reliably to achieve the goals; versus impersonal rationality, which asks whether inferences are following the principles of logic and other normative principles of reasoning theories.

The idea of a double rationality (personal rationality and impersonal rationality) leads Evans later to postulate a theory of hybrid rationality, which incorporates the *state of consciousness* associated with different information manipulation processes, calling this theory: *the theory of dual processing*.

Dual processing theory, this first formulation, assumes that there are two different types of processes in cognition: unconscious processes rational, labeled with the number 1, and rational

84 (J. Evans, 2004, p. 243)

85 (J. Evans & Over, 1996)

86 (J. Evans & Over, 1996)

processes aware, labeled with the number 2.

The distinction between processes type 1 and type 2 of the *dual processing theory* occurs by virtue of the level of consciousness in which the reasoning occurs and not by virtue of its logical or non-logical form, as was sustained in *the theory of the two factors*, leading to Evans to support at the same time two different theories about human rationality, on the one hand, *the theory of the two factors* that proposes the existence of logical and non-logical factors interacting in the human mind, and on the other hand, *the theory of dual processing* that accounts for conscious and unconscious processes.

Returning to the main ideas of these two theories and incorporating some new ideas, Evans⁸⁷ later proposes a third theory that serves as a bridge between the previous two: *the analytic heuristic theory of reasoning*.

The *analytic heuristic theory of reasoning* states that type 1 processes associated with system 1 are heuristic⁸⁸, and by definition, pre-conscious⁸⁹. Its function is to selectively represent information⁹⁰ from the world. These processes are essentially pragmatic, while type 2 processes associated with system 2 are analytical and, by definition, conscious, with a logical scaffolding capable of being formalized.

Within *the analytic heuristic theory of reasoning*, the relationship between the two types of systems is a *sequential and non-competitive relationship*, as theory originally the *two-factor* postulated. However, the way in which the relationship between the two processes can currently be conceived is a matter of debate.

It remains here only to say that *dual processing models* as currently conceived (without specifically referring to any), are developed directly from these three theories; although they are also influenced by approaches such as Johnson and Laird's mental models⁹¹ and by proposals such as Rebers'⁹².

87 (J. Evans, 2004).

88 Heuristics are understood as decision rules that are mainly based on associative and recognition principles.

89 The term preconscious is used to characterize processes that cannot be completely reconstructed in consciousness, but whose results are accessible by consciousness.

90 So select one. It is a problem that will be addressed in depth when the concept of "relevance" is reviewed.

91 (Johnson-Laird, 1995).

92 In the present work it is not possible to review all the proposals that influenced the emergence of dual processing models; however, for an in-depth review of Rebers' influence on dual process theory, see Evans (J. Evans,

5.2 Dual processing models with “family looks”

The way in which systems 1 and 2 are conceived (as already mentioned) differs depending on the author, so there is a great variety of names for them. The following table shows some of the names⁹³ that various authors have used:

Table 1. Names linked to dual processes

REFERENCES	SYSTEM 1	SYSTEM 2
Fodor (1983, 2001)	Entrance modules	Superior cognition
Schneider & Schiffrin (1917)	Automatic	Controlled
Epstein (1994)	Experiential	Rational
Chaiken (1980)	Heuristic	Systemic
Reber (1993), Evans (1996)	Implicit/tacit	Explicit
Evans (1989, 2006)	Heuristic	Analytic
Sloman (1996)	Associative	Based on rules
Hammond (1996)	Intuitive	Analytic
Stanovich (1996, 2004)	System 1 (TASS)	System 2 (analytic)
Nisbett (2001)	Holistic	Analytic
Wilson (2002)	Unconsciously adaptive	Aware
Lieberman (2003)	Reflexive	Reflexive
Toates (2006)	Linked to stimuli	Higher order
Strack & Deustch (2004)	Impulsive	Reflective

Fuente: Evans⁹⁴.

31

As a result of previous analyzes⁹⁵, it was detected that the main differences ranging from author to author in the conception of dual processing lie in three transcendental aspects:

- 1. The characteristics of the processes:** Different characteristics are assigned to the processes that make up system 1 and system 2, such as the speed of information processing in each

2004).

⁹³ Names linked to dual processes in the literature, that is, they can be identified with the assumptions of a generic dual theory of processes.

⁹⁴ The original painting is found in Evans (JSBT Evans, p. 257, 2008).

⁹⁵ (Garibay, 2010b).

system or the type of information that each system processes, among others.

2. **The characteristics of the systems:** The way of globally conceiving system 1 and system 2 differs. These vary mainly in two aspects: in the characteristics assigned to each system and in the way of conceiving which processes belong to each system (for example, it is possible to assume that system 1 is made up of type 1 processes, which are entirely automatic, while system 2 is made up of both type 1, automatic processes, and type 2, analytical processes; however, it is also possible to maintain that all the processes of system 1 are type 1, automatic, and all System 2 processes are type 2, analytical, as there is no conclusive evidence).
3. **The relation between systems:** The way in which the relationship between system 1 and system 2 is conceived varies, either as systems working separately and in competition, or as systems interacting in a cooperative way.

Due to these differences, it is impossible to speak of a *single unified dual processing theory*, and it has been chosen to assume the existence of a set of dual processing models with certain *family airs*. However, it is still possible to present a global perspective of the proposal of dual processing models through the most recent works of authors such as Stanovich⁹⁶ or Evans himself⁹⁷. Starting by presenting those elements shared by most of the models of this *family*.

Most models of the family assume that human beings reason through the use of a wide variety of different inferential cognitive processes. These processes have similar characteristics that allow us to characterize and group them as type 1 or type 2 processes, which are diametrically different from each other, mainly in the following characteristics:

- Their procedural structure
- The speed of information processing
- The level of consciousness in the that occur
- Its possibility of logical formalization

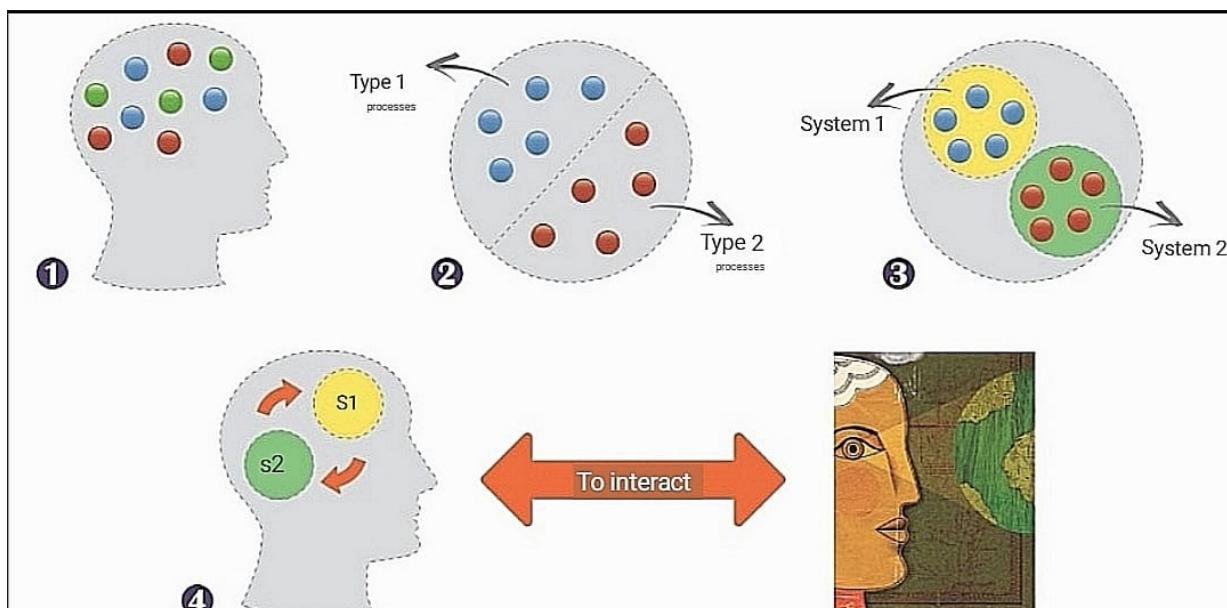
⁹⁶ (Stanovich & West, 2000).

⁹⁷ (JSBT Evans, 2008).

Type 1 and type 2 processes make up two different systems, system 1 and system 2. There are different conceptions about what type of processes make up each system. There are authors who assume that system 1 is made up of type 1 processes and system 2 is made up of type 2 processes, while others believe that systems have mixed processes whose activation depends on the context and type of information to be processed.

However, system 1 is commonly credited with the formation and use of heuristic principles, while system 2 is mostly credited with implementing inferential processes similar to those proposed by classical deductive logic.

Scheme 7. Unified dual processing



1. There are different cognitive processes in each individual.
2. These processes are grouped into type 1 and type 2.
3. Type 1 and type 2 processes in turn make up system 1 and system 2.
4. System 1 and System 2 have a relationship that allows the individual to reason and interact with the world.

Source: Own elaboration.

In this way, from the characteristics that are attributed to the processes that make up systems 1 and 2, to the characteristics of the systems themselves and the relationship that exists between them, we can conceive of the management of the information received by the individual from the outside world, as well as how to interact in a rational way. In this way, dual processing models aim to give

theoretical support to a series of inferential processes that are used daily, and at the same time, it is possible to account for some of the systematic biases that can be observed in laboratory tasks, such as decision-making problems.

The general form of the dual processing models is simple, but it is necessary to show in detail their different elements, which is why we will begin by presenting the characteristics of type 1 and 2 processes and the characteristics of systems 1 and 2.

Characteristics of the processes type 1 and type 2

The characteristics of each type of process that we want to present are related to the procedural structure, with the speed of information processing, their level of consciousness and the rules that follow, qualities which in turn inherit the systems they make up.

In particular, type 1 processes are conceived as automated, mainly associative in nature, with a parallel operating structure that makes them very fast and easy to use, although only their final products will enter consciousness. As they are processes of a mainly associative nature, the rules that follow are not those dictated by classical deductive logic, but rather are led by factors such as the recognition of family elements, emotional tone, etc., which lead to the system that makes up develop heuristic rules and make systematic errors in some tasks.

It is presumed that these type 1 processes do not have as many restrictions with access to working memory as type 2 processes, which would explain their speed, as well as part of the reasons why they cannot be reconstructed step by step in consciousness.

Type 2 processes are conceived as controlled analytical processes that process information in a serial way, which makes them slower than their counterpart. However, even when it is presumed that these processes have greater limitations with access to working memory, they have the advantage of a possible reconstruction, at the level of consciousness, of the mechanism by which the final results are reached. So it is possible to assume that they have an inferential structure that follows rules closer to deduction, which can be considered as the rules of correct thinking.

“My suggestion is that type 2 processes are those that require access to a single, capacity-limited central working memory resource, while type 1 processes do not require such access. This implies that the core features of type 2 processes are that they are slow, sequential, and capacity-limited. The last feature implies also that their functioning will correlate with individual differences in cognitive capacity and be disrupted by concurrent working memory load”⁹⁸.

It is possible to consider the existence of many different kinds of type 1 processes and type 2 processes in cognition, which expands the universe of processes and the activities they allow performing. The richness of the proposal of the family of dual processing models only appears, with all its force, when the set of processes is observed as systems or sets of subsystems.

Characteristics of systems 1 and 2

Systems 1 and 2, as can be expected, inherit the qualities of the processes that make up them (this will depend on what types of processes are conceived to make up each system) but also, the theoretical models of Dual processing assign additional characteristics and capabilities that the processes analyzed alone do not have, of which only those that are most important for the present work are highlighted.

According to Stanovich⁹⁹, system 1 is conceived as a system made up of a set of autonomous subsystems (TASS) that makes the system very fast, automatic, preconscious, with low energy cost and capable of generating and operating through heuristic rules of a mainly associative nature.

System 2, in contrast, is assumed to be slow, deliberate, conscious, capable of abstract or hypothetical reasoning (a characteristic that does not necessarily occur)¹⁰⁰, a higher energy expenditure and that follows some type of formal rules, making it preferable from the point of view from view of the normative dimension.

98 (Evans, 2008, page. 270)

99 This reference to Stanovich's work is found in (JSBT Evans, 2008, p. 261), although we can already see it in works such as (Stanovich & West, 2000)

100 “The consideration that System 2 thinking is not necessarily abstract and decontextualized is also one reason why it should not be equated with a mental logic. It would probably be more accurate to say that although abstract reasoning requires the use of System 2, concrete contexts do not preclude its application” (JSBT Evans, 2008).

"System 1 is generally described as a form of universal cognition shared between humans and animals. It is actually not really a single system, but a set of sub-systems that operate with some autonomy. System 1 includes instinctive behaviors that are innately programmed, and would include any innate input modules of the kind proposed by Fodor... The System 1 processes that are most often described, however, are those that are formed by associative learning processes of the kind produced by neural networks... Dual-process theorists generally agree that System 1 processes are rapid, parallel and automatic in nature: only their final product is posted in consciousness.

System 2 is believed to have evolved much more recently and is thought by most theorists to be uniquely human. System 2 thinking is slow and sequential in nature and makes use of the central working memory system... Despite its limited capacity and slower speed of operation, System 2 permits abstract hypothetical thinking that cannot be achieved by System 1"¹⁰¹.

Hypothetical thinking that cannot be achieved by System 1"¹⁰².

Determining which rules underlie system 2 is a central point of *dual processing theory* and has been the subject of deep reflection. For this reason, dual processing models have explored the possibility of using both the *theory of mental models* and the theory of mental logic, and complementary theories that allow accounting for the processes of system 2. However, proponents of dual processing models are not satisfied with any of these theories, since in System 2 they usually refer to something broader than deductive logical reasoning, including for example pragmatic elements, and since both the *theory of mental models* such as the *theory of mental logic* focus on logical-deductive processes, they are therefore inadequate from the point of view of the defenders of dual processing models to reflect the system 2.

"The idea that higher forms of thinking require a logic in the mind was popularized by Piaget (1958) and is particularly associated with the idea that people have natural logics composed of inference rules in their minds. However, the popular mental models theory of deductive reasoning can also be regarded as a form of mental logic, accounting for deductive competence by semantic rather than syntactic principles.

101 (Evans, 2003, pág 454).

102 (Evans, 2003, p. 454).

Whichever account of deduction is preferred, it is clear that the System 2 concept is much broader than that of logical reasoning, including such ideas as an inhibitory role (suppressing pragmatic influences of System 1) and the ability to engage in hypothetical thought via supposition and mental simulations. This is probably why most dual-process theorists prefer broader terms such as “analytic” or “systematic” to describe the second system”¹⁰³.

Due to the above, the theorists of dual processing models are usually vague when specifying the rules that underlie system 2. However, they are closer to what we understand by formal characterizations, to characterize system 2 versus system 1.

The arguments that are used to apply the characteristics of the different systems are condensed by Evans¹⁰⁴ in four different arguments:

- The characteristics that are related to the function of consciousness.
- The arguments that come from evolutionary psychology.
- Differentiation in terms of functional characteristics of each system.
- Arguments related to the individual differences of the subjects.

Consciousness

37

Among the attributes that are proposed related to consciousness, there are those that refer to awareness and human volition, key concepts in this discussion, so the characteristics assigned to the processes of system 1 and 2 in this area, they are those that reflect the differences between cognitively conscious and cognitively non-conscious¹⁰⁵.

“Authors talk of processes that are explicit and controlled (rather than implicit and

103 (Evans, 2008, pág. 262)

104 (JSBT Evans, 2008)

105 The concept “non-conscious” is used instead of “unconscious” since it better captures the different cognitive processes that are involved (such as pre-conscious ones) and avoids the relationship with some proposals and debates, as is the case with the psychoanalytic debate.

automatic)"¹⁰⁶.

Consciousness is considered to be inherently slow, sequential and with capacity limited by the central working memory compared to non-conscious processes, which are fast, parallel and without capacity limited by the central working memory.

It is associated to the TASS processes (system 1) with processes of a cognitively non-conscious order, and to the processes of system 2 with processes of a cognitively conscious order. Alternatively, it is possible to postulate that the processes of system 2 are a mixture of cognitively unaware and conscious processes.

Popular psychology (Folk psychology) proposes the following:

"System 2 is a form of thinking under intentional level control, supported by unconscious processes in System 1 that deliver percepts, memories, and so on"¹⁰⁷.

This statement, Evans says, would allow us to control our behavior at will, that is, it would be totally intentional, although opposed to this statement there is a good amount of research that indicates that our behavior is governed, to a large extent, by cognitively non-conscious processes, of which, by definition, we are not aware.

In addition to the level of consciousness that distinguishes TASS processes and system 2 processes, another important characteristic that is associated with these different processes is related to their automation¹⁰⁸, which, although we will not address, it is pertinent to mention.

Arguments from evolutionary psychology

It is postulated, from the perspective of evolutionary psychology, that the processes of type 1 of system 1 or TASS, evolved earlier than those processes of type 2 of system 2. The processes of

106 (Evans, 2008, p. 258).

107 (Evans, 2008, p. 258).

108 The analysis and discussion on how the TASS processes are automated is outside the limits of this work, since its apertaintment to the central theme of the same is minimal.

system 1 are not exclusive to the human, but are shared with other animals, whereas system 2 type 2 processes are distinctly human in development and use¹⁰⁹.

The processes of system 1, when they are assumed to be mainly associative principles, are linked to daily practical practice, while the processes of type 2 of system 2 are associated with the development of language, reflective consciousness and higher order control. Similarly, they are associated with the ability to reason hypothetically about the future, in addition to having the ability to use counterfactuals in the cognitive process.

Functional characteristics

At the moment, some attributes have been associated with the processes of system 1 and to the processes of system 2. In particular, the processes of system 1 are considered as fast and automatic compared to the processes of system 2, which are slower and more controlled. However, access to the central working memory has only been postulated as an explanation for the speed difference between systems 1 and 2, although other factors may be involved.

Why is one system faster than the other? The answer is found in how information processing is assumed in each system. It is postulated that the group of processes of system 1 are mostly carried out in parallel, that is, simultaneously; while the processes of system 2 are carried out in a serial manner, one after the other, thus explaining the difference in processing speed that can be seen between individuals when issuing responses.

On the other hand, the intrinsic nature of the processes that underlie each system is a matter of debate and reason for an important break between different conceptions of dual processing models.

It is possible to conceive of system 2 as a mixture between some type 1 processes and type 2 processes itself, since not necessarily all type 1 processes are equal to each other. Some may be necessary in a strong sense and be intrinsically related to the operation of certain type 2 processes,

109 Unlike some authors who propose that system 2 is uniquely human, others have proposed a somewhat different conception, according to which it is possible that some animals share type 2 processes with humans; however, only the human being has exploited these processes so much.

making it convenient to directly ascribe to system 2.

This point, although important for the theorists of dual processing models, does not have a significant impact in our objective, so we can say that in general terms, it is assumed that the processes of system 2, in some way, are based on rules, which can (although not necessarily) work with abstract and decontextualized concepts, while the system 1 works with defined contexts.

Arguments related to the individual differences of the subjects

Within this category are the arguments that arise from appealing to the relationship that is assumed to exist between the different type 1 and 2 processes with the central working memory, as well as with intelligence in general. It is postulated that the efficiency of the processes of system 2 is determined by the individual characteristics of the subjects, while the processes of system 1 do not have this limitation.

“In general, one of the stronger bases for dual-systems theory is the evidence that “controlled” cognitive processing correlates with individual differences in general intelligence and working memory capacity, whereas “automatic” processing does not”¹¹⁰.

The chart below provides an overview of most of the features mentioned above¹¹¹.

Table 2. Groups of attributes associated with dual systems of thought

System 1	System 2
Group 1 (Consciousness)	
Unconscious (preconscious)	Aware
Implicit	Explicit
Automatic	Checked
Little effort	Much effort
Fast	Slow
High capacity	Low capacity
Default processes	Inhibitorio

110 (Evans, 2008, p. 262).

111 Even though there are other tables and proposals that synthesize the position, such as the case of Stanovich's article (Stanovich & West, 2000), only the following table extracted from (JSBT Evans, 2008) is presented, since it is considered the most appropriate and sufficiently complete for the purposes of this work.

Default processes	Inhibitorio
Holistico, perceptual	Analytical, reflective
Group 2 (Evolutionary)	
Evolutionarily primitive	Evolutionarily recent
Evolutionary rationality	Individual rationality
Shared with animals	Only human
Non verbal	Linked to language
Modular cognition	Fluid intelligence
Group 3 (Functional characteristics)	
Associative	Rule-based
Domain specific	General domain
Determined by context	Abstract
Pragmatic	Logical
Parallel	Sequential
Stereotypical	Determined by the individual
Group 4 (Individual differences)	
Universal	Heritable
Independent of general intelligence	Linked to general intelligence
Independent of working memory	Limited by the capacity of the working memory

Source: Own elaboration.

Once the characteristics of the systems have been presented, the next step is to present the types of relationships that are conceived between the two systems.

6. Relationship between systems

41

Currently, there are two divergent perspectives regarding the relationship between both types of processes: competitive approaches (*Parallel-competitive forms of dual process theory*) and the so-called default interventionists (*default-interventionist*).

Competitive approaches have their focus on learning processes, maintaining the assumption that there are two types of learning, implicit and explicit, which gives rise to two different types of knowledge that are conceived competing with each other for control of our own behavior.

In the approaches *interventionist* by default, on the other hand, it is believed that systems 1 and 2

complement each other and the division of labor of the systems will depend on the activity faced by the agent, through which different processes will be triggered. This approach assumes that fast preconscious processes provide the content necessary for conscious processing. Thus, according to Evans, default behaviors generally associated with system 1 are activated that analytical reasoning can approve or intervene with a more demanding reasoning (*effortful*) associated with system 2:

“Parallel-competitive forms of dual process theory seem to be rooted in the idea of two forms of learning, leading to two forms of knowledge (implicit and explicit) that can then lead to competing attempts to control behavior”¹¹².

“However, the category of theories that I call “default-interventionist” assumes, in contrast, that rapid preconscious processes supply content for conscious processing, cueing default behaviors that the analytic reasoning may approve or intervene upon with more effortful reasoning”.

In a certain sense, competitive conceptions conceive of the two systems separately, each one self-sufficient and, therefore, capable of issuing its own responses. The two systems compete, and it is only when system 2 inhibits 1 that its responses are imposed and systematic errors in certain tasks, caused by the use of associative principles of a heuristic nature, can be corrected¹¹³.

7. Abduction from dual processing models

42

Apart from the possible characterizations and sophistications of dual processing models, they allow us to think of the abductive process as an interaction between system 1 and system 2, through which are generated. *Candidate hypotheses explanations* (search strategy) that are then faced with criteria for the selection of the most plausible.

A proposal like this is the one that is sustained in the **interactionist model of processes (MIP)**¹¹⁴, where it is postulated that there are two large different sets of processes in human cognition: A

112 (Evans, 2008, pág. 271).

113 The idea of two classes of systems interacting in cognition that generates a series of heuristics and biases, can be found at the base of different theoretical developments, as is the case of the efforts of Kahneman and Tversky, winners of the Nobel Prize in economics for their prospect theory.

114 (Garibay, 2010b).

set of autonomous subsystems (TASS) of system 1 and a set of analytical processes of system 2. TASS processes are conceived as mostly non-conscious¹¹⁵, heuristic in nature and mostly automatic processing, faster than system 2 processes, since they have the quality of working in parallel, avoiding some restrictions in terms of memory capacity. These processes are essentially pragmatic, evolutionarily older than System 2 processes, and shared with other species. Likewise, they work with defined contexts and with specific information, in addition, most of their processes are associative in nature.

On the other hand, the processes of system 2 are conceived as mostly conscious, analytical in nature, mostly deliberate (although they can also be influenced by the TASS processes), they work serially with restrictions by the central working memory. They are evolutionarily more recent and, although they may be shared with other species, only humans have developed them in this way.

These processes are capable of working both with concrete contexts and with abstract contexts and situations through the use of counterfactuals. However, they are strongly influenced by the environment. Likewise, they are more expensive in time and energy than the TASS processes and are conceived with the particular characteristic of following rules, which in principle allows them to be formalized using logical systems

The relationship between systems 1 and 2 is conceived as *interventionist by default*, with the particularity of its activation by task specialization, which means that, depending on the type of situation and the limitations of the environment, different processes will be activated.

43

The interactionist model of processes incorporates as a novelty compared to other models of dual processing, a theory of epistemic change (AGM), this is proposed by Alchourrón, Gardenfors and Makinson¹¹⁶ to formally address the moment of the generation of candidate hypotheses for explanation, thus allowing formally model the changes in the individual's states of knowledge, product of the confrontation between the world and the set of beliefs that the subject holds at that time.

115 The definition "non-conscious" is used in order to understand both unconscious and preconscious processes.

116 (Alchourrón, Gardenfors, & Makinson, p. 510-530, 1985).

The use of the AGM theory regarding the abduction, has been proposed by¹¹⁷ Aliseda, to formalize the change of the subject between different states of knowledge through abductive reasoning operations.

8. The theory of epistemic change (AGM))

The theory of epistemic change AGM ¹¹⁸ models changes in the individual's states of knowledge through epistemic change operations, thus trying to explain how an agent can *discard, correct or add information* to its set beliefs through *expansion, revision or contraction operations*.

A subject can be in different states, the first of which is when the information or event presented to him is explained by appealing to the set of previous beliefs (*background knowledge*) that the agent holds at that moment, which is not problematic for him. This state is even desirable for him and we will call it a *state of normality*. Its formalization is presented below:

Θ : Represents the set of all relevant beliefs held up to that moment by the agent¹¹⁹.

\Rightarrow : Establishes an explanatory relationship between the set of beliefs held so far and the information or event the agent is facing.

ϕ : Represents the information or event the agent is facing.

Normal state: $\Theta \Rightarrow \phi$ (ϕ can be accepted, that is, it can belong to the set of beliefs or propositions of Θ , that is, we incorporate ϕ to Θ : $(\phi \models \Theta)$).

The second state in which the agent can find himself is when the information he faces is new, which means that, from the set of beliefs held up to that moment by the agent, it is not possible to explain

¹¹⁷ (Aliseda, 2006)

¹¹⁸ Due to the initials of its three authors.

¹¹⁹ The problem of the "frame" in Artificial Intelligence consists of determining the way to know what the "relevant" beliefs are; However, in the proposed IPM model, the answer to this question is found by appealing to the relationship between the processes of system 1 and system 2. System 1 is in charge and specialized in identifying the relevant elements in each situation, and it is the latter who provides them to system 2 to act in the world.

the information or event, nor does it explain its denial. Formally we express it as follows:

Novel state: $\Theta \not\Rightarrow \phi, \Theta \not\Rightarrow \neg \phi$ (ϕ is indeterminate, that is, neither ϕ nor its negation belong to Θ ($\phi \not\in \Theta, \neg \phi \not\in \Theta$)).

The third state in which the agent can be found is when the information or event is anomalous, which means that the set of previous beliefs and the available information do not explain the observed fact ϕ , but they do explain the denial of the fact ϕ .

This should not be strange since, as Peirce said, “Not all the facts surprise us as unusual because they are novel, but only some because they are contrary to our expectations” (quoted in Aliseda, 2006, page 47). The formalization of this case is as follows:

Anomalous State: $\Theta \not\Rightarrow \phi, \Theta \models \neg \phi$ (ϕ can be rejected, which means that $\neg \phi$ is accepted in Θ ($\neg \phi \in \Theta$)).

The agent tries to change from the novel or anomalous state to the state normal and this is done through the operations of *expansion, revision or contraction*¹²⁰ of his set of beliefs “ Θ ”.

The **expansion** consists of adding an “ α ” statement to Θ that explains ϕ , which results in the expansion of Θ with ϕ and is denoted: $\Theta + \phi$.

The **revision** consists of adding a new statement to Θ , only now it is the proposition of a fact that was previously rejected by the Θ theory. The revision of Θ by ϕ is denoted $\Theta * \phi$.

The **contraction** consists of rejecting a statement ϕ previously accepted in Θ without adding any new statement. The contraction of Θ by rejecting ϕ is symbolized $\Theta - \phi$ ¹²¹.

In the case of the novel state, the subject will typically resort to expansion, that is, he adds an “ α ”¹²²

120 It is possible to define the three epistemic exchange operations using only two of them, since contraction and revision can be defined one in terms of the other; however, reviewing this is not relevant for the purposes of this paper.

121 These operations are defined in a way that ensures that the theory or belief system remains consistent and properly “closed” [under logical consequence] when incorporating new information.

122 Where α can be an isolated event, since sometimes this is enough to explain a surprise phenomenon,

to the set Θ to account for the fact ϕ . On the condition that for Θ , $\alpha \Rightarrow \phi$ constitutes a genuine solution to explain a novel event, it is necessary that $\alpha \not\Rightarrow \phi$ by itself, but only with the help of Θ . In this sense, α must be supported by Θ . Otherwise, ϕ would remain a fact that Θ does not explain.

In the case of the anomalous state, it would change to a normal state if our set of beliefs Θ first manages to change its state from: $\Theta \Rightarrow \neg \phi$ to $\Theta \not\Rightarrow \neg \phi$, that is, the prediction is no longer followed negation of the event, typically rejecting some previously accepted beliefs “ β ” in Θ (process contraction) to later produce an explanation “ α ” (expansion) that achieves that together with the revised theory (Θ'), the anomalous event in a principle ϕ is a normal thing (a matter of course): $\Theta' ; \alpha \Rightarrow \phi$ ¹²³.

In order to maintain consistency, before adding the statement α that explains the fact ϕ that was previously rejected in Θ , statements β of Θ that are inconsistent with ϕ should be deleted and only after this process has been carried out, you can incorporate incorporate to Θ .

It is important to point out that when performing the contraction operation, there is no single way to erase statements because “several formulas can be removed to achieve the desired effect, so it is impossible to state in purely logical or set-theoretic terms which of these is going to be chosen”¹²⁴. However, Gärdenfors¹²⁵ highlights two criteria to guide the contraction:

The first is that of the *minimum change*, according to which the minimum change must be made in the theory, in order not to unnecessarily lose explanatory capacity in ya, since by eliminating some propositions, it is possible that other areas of the theory are affected.

The second is through the notion of *epistemic entrenchment*, we say that a statement is more entrenched than another if this statement is more useful in theory, and if it has been more resistant to empirical refutation (in the manner of Popper)¹²⁶. At the time of the contraction process, the sentences that will be deleted are those that are less entrenched.

although other times it will be necessary to appeal to a rule that establishes a causal connection that constitutes the explanation of the surprising event or even, in some cases, it can be It is necessary to formulate a whole theory to account for the fact.

123 Similarly, “ α ” must be supported by the theory “ Θ ” ($\alpha \not\Rightarrow \phi$).

124 (Aliseda, 2006)

125 (Gärdenfors, p. 86-91, 1988)

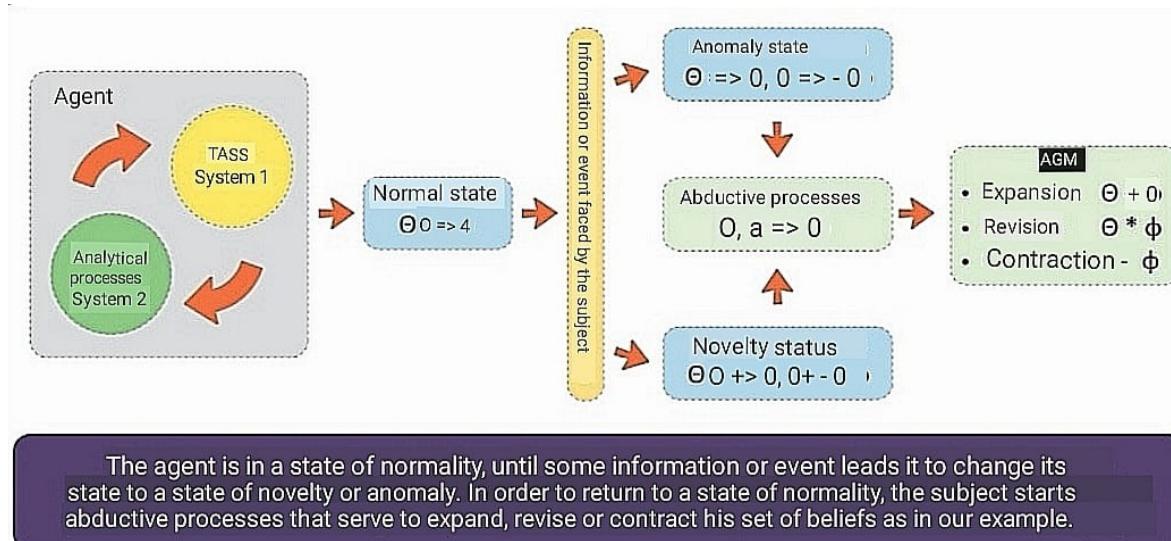
126 It should be noted that the notion of entrenchment has been widely discussed in the positivist tradition of the philosophy of science, and it is possible to review it in greater depth in various texts. See Popper (Popper, 1962).

8.1 Abductive everyday inferences understood in terms of epistemic change

AGM theory allows us to present a rigorous image of a complex cognitive activity, such as epistemic change in people, and in fact it seems to be very similar to how, apparently, this process occurs in individuals. We can generate a more local image of the process that individuals use to change from one state to another, providing greater depth in understanding the different parts of this activity.

The following diagram presents an integrated image of what is postulated in the MIP.

Scheme 8. Theory of epistemic change



Source: Own elaboration.

In short, the MIP model establishes a way of understanding the collaboration between type one and type two processes. However, incorporating the AGM theory, a modification mechanism is established more clearly in the epistemic processes that we assume occur in the individual at the moment of rectifying their beliefs, as well as in turn demarcating conditions to trigger the abductive process following Peirce. In other words, it exemplifies the starting point of the abductive inferential process. An example would be the following:

“You come home late at night, and you realize that the light in your bedroom, which is always on, is off. It has been raining heavily, so you think the electricity in the house is gone; however, the rest of the lights in the house work fine. So you wonder if you left both heaters on, which usually causes the switch in the room to trip, so you check, but it hasn’t come on. Finally, a simple explanation crosses your mind. Perhaps it is that the lamp bulb has burned out, even though the last time you saw it, it worked fine, and therefore you need to replace it”.

In order to take full advantage of AGM theory in the analysis of the example, think of the abductive processes in the example as those by which the agent is trying to change its state of novelty or anomaly to a state in the *normal* face of information or events that come your way.

The states of novelty or anomaly function as abductive triggers that initiate or provoke in the agent the generation of some proposition α to expand his set of propositions Θ or, on the other hand, revise and contract some propositions β of the universe Θ .

The abductive process is then formally defined as follows:

Abductive process: $\Theta, \alpha \supset> \phi$

Θ : It is a set of prior beliefs (*background knowledge*) of the agent.

ϕ : It is information or a fact that needs to be explained (*explanandum*).

α : It is what explains the puzzling fact (*explanans*).

The explanation that we will call *abductive*, then, involves three parameters:

1. An inferential parameter ($\supset>$) that establishes an adequate relationship between the *explanans*, the set of beliefs held at the time and the *explanandum*.
2. Abductive triggers that determine when the need to activate these processes arises.
3. The generation of α as a result of the abductive process.

The inferential parameter can be formalized in different ways¹²⁷; However, the logical form will be understood as follows:

Faced with the puzzling fact “ ϕ ”, we propose an explanation “ α ”, since from the set of background knowledge “ Θ ” and the proposition “ α ”, the fact “ ϕ ” is would turn into *something ordinary* (as defined) *or natural* (a matter of course).

Now let's do an analysis of the example using these terms:

The agent has a set of beliefs Θ upon arriving home, which includes, among others, the propositions: {The light in the room is always on, and all the necessary elements for the light turns on are working well (electrical current, switch, lamp, etc.)}. However, when he gets home he finds that the light in his room is off, placing the agent in an anomalous state, since of his whole Θ it follows that the light must be on, but the case is just the opposite.

The agent therefore performs a contraction to his set of beliefs, excluding the proposition β : {All the elements necessary for the light to turn on are working well}, thus forming a set of beliefs Θ^1 .

From this new set Θ^1 , the agent uses abductive processes $(\Theta^1, \alpha \Rightarrow \phi)^{128}$ to generate different α that explain the situation and make possible, through expansion, the incorporation of the information or the event ϕ that is faced to the agent a Θ^1 .

In our example, the subject is generating three different explanations that will be subjected to later empirical efforts to contrast with the world:

49

α^1 : There is no electricity in the house. This is because it has been raining heavily, when it rains the power lines go down and cause a power outage throughout the house, if there is no light in the house, then no lamp in the house would work, which is why which (if this is the case) it would be

127 This means that the inference made when abducting can be different. Thus, to formalize the inferential process of abduction, one can use a Hilbertian syntactic consequence ($=$), a Tarskian semantic consequence ($=$), a probabilistic inductive inference ($\Theta, \alpha \Rightarrow \text{probable } \phi$), a logic programming inference ($\Theta, \alpha \Rightarrow \text{prolog } \phi$), some kind of dynamic inference ($\Theta, \alpha \Rightarrow \text{dynamic } \phi$), or any other kind of inference; however, they all correspond to the same mechanisms.

128 It is important to emphasize that the “epistemic states” (normality, anomaly and novelty) and the “abductive processes”, although they are closely related, are not the same, and that is why the logical form with which it is used is conceived slightly differently. Present

natural for the light in my room to be off.

α^2 : There is no electricity in the room. This is because I have left both heaters on, when I leave both heaters on, usually, the switch that prevents overloads is activated, if the switch is activated there would be no electricity in the room, which is why, if this is the case, it would be natural for the light in my room to be off.

α^3 : There is a malfunction with the focus. Due to wear and time, the bulb may have burned out, if this is the case, it is natural that it is unable to function and therefore would be off.

The agent then, through abduction, generates hypotheses and looks for evidence in the world that allows him to contrast it. However, for your hypothesis α^1 where $(\Theta_1, \alpha_1 \Rightarrow \phi)$, the lights in the rest of the house turn on, so his hypothesis is disproved. Therefore, it resorts to α^2 , and proposes $\Theta^1, \alpha^2 \Rightarrow \phi$, but in the same way, it is necessary to look for evidence in the world to contrast it, which in this case implies the revision of the switch; however, his hypothesis is again disproved when the switch has not been actuated. Finally, it requires resorting to an alternative hypothesis, α^3 , and proposes $\Theta^1, \alpha^3 \Rightarrow \phi$, it should be noted that we do not know if this hypothesis indeed receives empirical support, that although the example seems to indicate that it does, it does not say so explicitly, so we will assume that it does receive empirical support¹²⁹.

This in principle, would allow the subject to incorporate ϕ thanks to α^3 and its relationship with Θ^1 , to his set of beliefs and, therefore, change to the state of normality $(\Theta_1 \Rightarrow \phi)$, where the subject can explain the information or event faced given the incorporation of α^3 to the new total set of beliefs.

In this way, understanding the abductive inferential process as a process of epistemic change, it is intended to formally capture it using AGM theory as a tool, gaining clarity in the analysis of explanatory power for dual processing models. However, as we will see, the proposal faces some limitations.

8.2 Limitations of the Mode

129 The analysis regarding how individuals manage to make abductive inferences without it being possible to carry out an empirical verification of the hypothesis goes beyond the purposes of this work.

Although in principle it is possible to apply this scheme to different instances of abductive inferences, it is not capable of capturing any inferential process with that form¹³⁰. The model that incorporates the AGM theory has some limitations that it is important to highlight.

1. In the examples that are presented, the agent is always capable of looking for evidence in favor or against the hypothesis generated, until accepting or rejecting it. However, in the world there are times when individuals have to act without having verified or refuted their hypothesis, an element that is not captured in the AGM theory, since it is not what it was designed for.
2. An important problem is defining the background information¹³¹, that is, the set “ Θ ”. What exactly are the propositions that should be considered as background knowledge in the abductive process: $\Theta, \alpha \Rightarrow \phi$? Since an event will only be novel or anomalous against a certain set of beliefs. This seems to indicate not only that abductive triggers depend on the pair (Θ, ϕ) , but that the propositions that are relevant, and that make up the set Θ that the subject holds at a given moment, depend largely on the event ϕ to which face.
3. AGM theory is not designed to work with inconsistencies within your system. This capacity is something that we would like to formally capture¹³², since we know that human beings at times consider incompatible assumptions within the total set of beliefs, and even so they are capable of issuing coherent answers, suspending at times the judgment of each assumption. The way to capture this ability cannot be by appealing to a tool that was not designed for this purpose, as in the case of AGM theory, so it is necessary to look for alternatives.

An approach like this is interesting in its aspirations to gain conceptual clarity by appealing to formal tools. However, it is not yet entirely clear how the universe of background knowledge is cut to present relevant elements in specific cases that the agent is facing; however, case-based reasoning

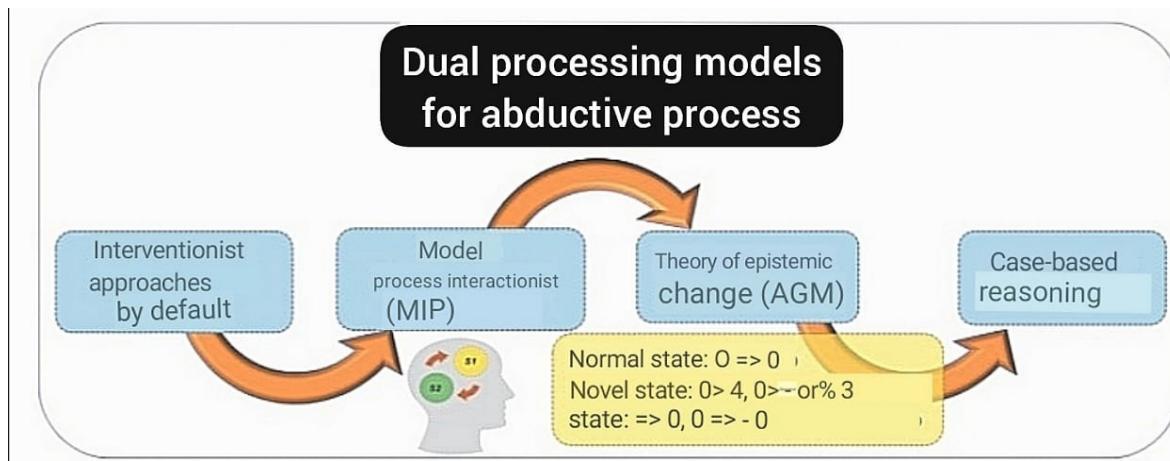
130 Recalling Schurz, this may be due to the fact that there are different abductive patterns and a proposal like this can only account for some of them, such as the factual abductions of observable facts.

131 This problem is known as the “frame” problem.

132 Logical systems have been developed that are capable of formalizing and working with inconsistencies within the system, as is the case of the adaptive logics proposed by Batens (Batens, 2009), although in the present work we will point out that, as a whole, the that guides the selection of hypotheses are a series of Principles that are not easily trapped by some strict logical system, so the main contribution of case-based reasoning (CBR) is the clarification of the mechanism of manipulation of the relevant background knowledge in the abductive inferences.

can be helpful in clarifying this particular part of the process.

Scheme 9.



Source: Own elaboration.

9. Case-based reasoning

The idea of abduction or inference to the best decision in the words of Patricia Churchland ¹³³ is found (known) in experimental psychology as: *case-based reasoning, CBR for its acronym in English (Case Based Reasoning)*, although that may not seem totally accurate given that most of the articles published on CBR focus on the development of expert systems, and therefore, the main advances are framed within automatic reasoning and the science of computing¹³⁴.

However, CBR has been approached by different research groups¹³⁵, including cognitive scientists or philosophers¹³⁶, due to the fertility of the field and its implications for the development of cognitive models.

133 (Churchland, 2009, p. 420).

134 It is worth mentioning that some of the researchers in the area recognize their similarity but differentiate abduction from reasoning by cases (Aamodt, 1994, p. 275).

135 (Aha, 1998, p. 261).

136 For a cognitivist, CBR is a high-level cognitive processing model (Aha, 1998 p. 261), unlike a good number of researchers within computer science who see CBR as a technological paradigm (Watson, 1999).

A standard conception of CBR is the following: “*case-based reasoning*¹³⁷ may mean adapting old solutions to account for new demands, using past cases to explain new situations, using past cases to criticize new solutions, or reasoning from precedents to interpret a new situation, or create a comparable solution to the new problem”¹³⁸. This procedure involves generating proposals for a problem¹³⁹ using a library of previous knowledge to find similar cases¹⁴⁰, so that the knowledge obtained in the past is adapted or applied to the present situation, reviewing its result and incorporating it into memory for future Applications.

The reasoning based on cases is then, a methodology that can serve both to model human reasoning and to build expert systems, betting on the assumption that the world is uniform (constant) and therefore, there are recurring problems and their solutions Similar.

In general, the CBR is conceptualized (with greater or lesser sophistication) around the claims to use the reasoning being evaluated¹⁴¹. However, in general the CBR has been classified into two general types:

- a) Reasoning based on cases **interpretative**¹⁴² (its key aspect is in the argumentation about whether a new situation should be treated as previous cases, based on the similarities and differences between them).
- b) Case-based reasoning for **problem-solving** (your goal is to build a solution to a new case based on adapting solutions to past cases).

53

Both forms of CBR require different reasoning to be done once the cases are recovered.

In the interpretive CBR, once a result is proposed¹⁴³, a moment of justification is followed, where

137 “A case is a piece of contextualized knowledge that represents an experience that teaches a fundamental lesson to achieve the goals of the reasoner”(Kolodner & Leake, 1996, p. 36).

138 (Kolodner, 1992, p. 64). A Definition that is very close to what we can understand by abduction.

139 This effort to delimit the information that each case must contain is called “case engineering” (case engineering)).

140 Based on similarity measures, prototypes and analogies.

141 These can be for example: adapting and combining past solutions to solve a new problem, explaining new situations according to previously experienced situations, criticizing new situations based on past cases, recovering past reasons to understand new situations or building a consensual solution based on cases previous (De Mantaras & Plaza, 1997, p. 21).

142 Or also called CBR of precedents (Rissland & Skalak, 1989).

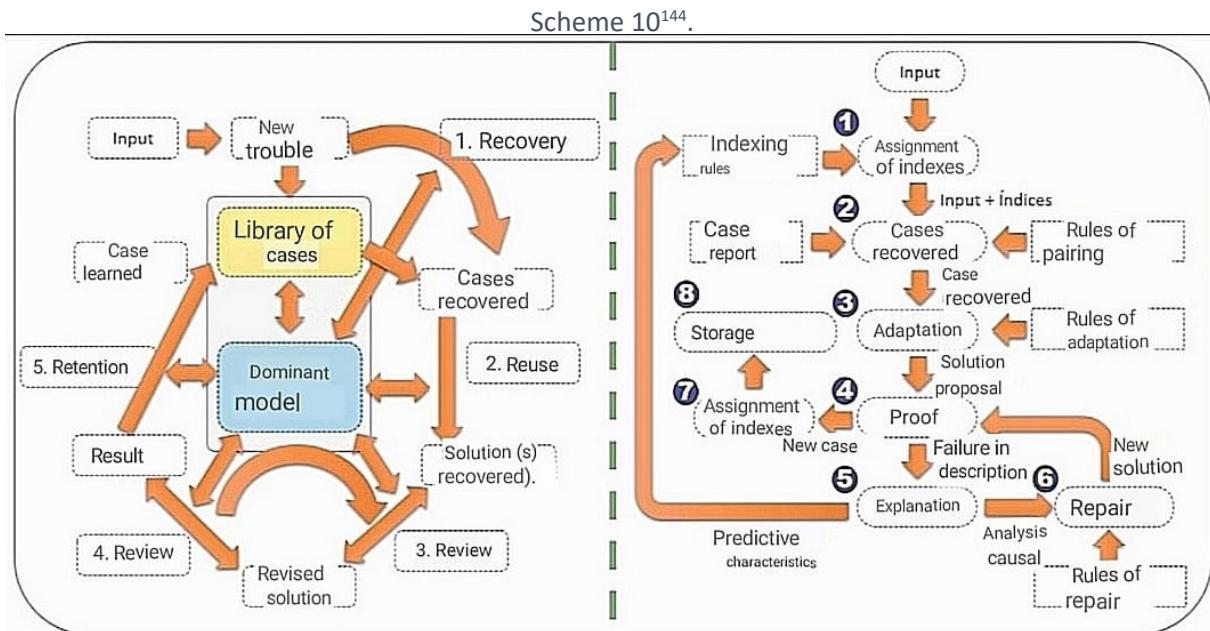
143 Sometimes based on previous cases and sometimes imposed from outside.

arguments are generated that support the proposed solution, comparing and contrasting the new situation with previous cases or looking for similarities between the new situation and other past ones that justify the result. After justification, a critique is sometimes followed in which hypothetical situations are generated to prove the result. This prior to the current contrast with the world.

In CBR troubleshooting, once the relevant cases have been retrieved, a solution is proposed to the new problem (by extracting a solution to a similar problem, etc.), which is subjected to a moment of adaptation and later to a critique (which tends to be followed by a better adaptation) for later contrasting with the world.

The distinction between the two types of CBR is very useful, although in the face of the reality that the world imposes on us (such as the construction of systems based on CBR or a cognitive model) the division tends to blur.

Case-based reasoning, in general, focuses on basic concepts such as the following: *retrieve, reuse, adapt, justify, repair, criticize, evaluate, retain, and learn*. The organization and depth of analysis given to them allow different processing schemes to be generated, as shown in the following scheme.



Source: Ketler (left figure) and Aha (right figure).

144 Examples can be found in Ketler ((Ketler, 1993, p. 5) fig. Left) and Aha ((Aha, 1998, p. 262) fig. Right).

All the models follow a series of stages generic that in some ways are put into operation when the agent faces a problem¹⁴⁵.

The first step consists of *the construction of the case*, which starts from a specific complete episode (a scenario) where the relevant elements of the situation are determined (*situation assessment*) given the contextualization of the problem, and an effort is made to delimit the information (internal and external) that the case must contain. In this way, the descriptive space of the problem is defined, which in turn recovers a subset of past problems that are similar to a greater or lesser extent to the problem¹⁴⁶ or a new situation.

The delimitation of the information in the construction of the case and the recovery of past cases¹⁴⁷ is guided by the *similarity*¹⁴⁸ established between the present case and the past cases, which in turn is determined, to a large extent, by the type of representation. Used for that information.

Depending on the type of representation¹⁴⁹ knowledge that is relevant at that time¹⁵⁰, different activation mechanisms can be generated¹⁵¹ the recovery process, which allows us to suppose that differences will be manifested in a variety of aspects, such as processing speed and results recovered, among others.

Once the description of the problem has been defined, it is possible to recover a space of solutions or ways of solving past problems, which can be adapted to the new problem. The solution of the

145 According to David Aha, the way to proceed for solving problems in case-based reasoning (and that is what unites the CBR with other disciplines) is “lazy” (lazy problem-solving), that is, solutions are generated by demand. The characteristics to define a lazy agent are three: 1) they do not process the inputs until there is a request given certain information, 2) they respond to the request by combining information from the stored data and 3) they discard any intermediate results during the solution of the problem (Aha, 1998).

146 The recovery and selection of previous cases is a central moment of the entire CBR since subsequent operations, such as adaptation and evaluation, will only be successful if the past cases recovered are relevant to a new problem (De Mantaras & Plaza, 1997, p. 25).

147 We assume that it is not only possible to remember cases, but also routes (traces) of how a solution was reached. “We reason by remembering, but we also remember reasoning” (D. Leake, 1996).

148 It is called “similarity” since restricting itself to similarity limits the possible recovery modes too much, since it is even possible to suggest that those that guide recovery are heuristic (De Mantaras & Plaza, 1997).

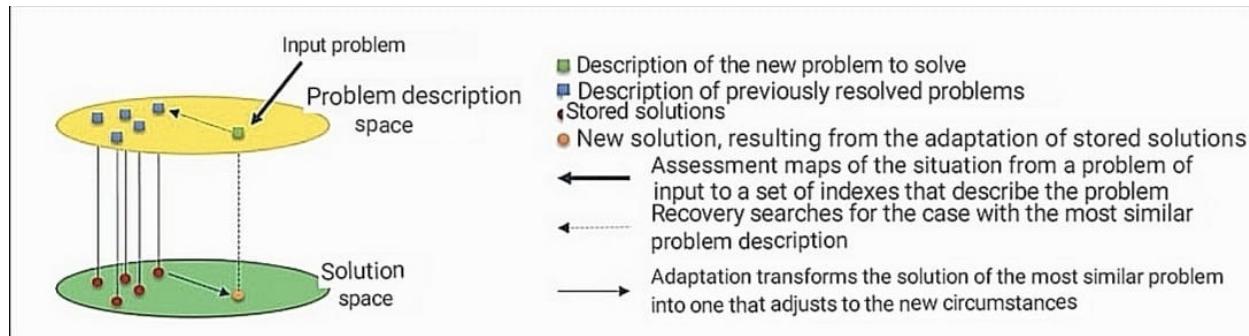
149 They can be spatial representations, representations by characteristics, semantic networks, etc. See Markman (Markman, 2002).

150 “It is possible that many types of knowledge can be used to encrypt equivalent information” (Leake, 1996, p. 12).

151 As it can be diffused activation (spread activation), by transmission of markers (marker passing), by parallel systems, etc.

most relevant past problem is used as a principle for the generation of possible new solutions.

Scheme 11¹⁵².



Source: self-made.

Once these possible solutions have been presented, the next step is to criticize¹⁵³, rank and apply them, and then adapt / repair them in the event that problems arise. The ability to adapt solutions is a central element when thinking about the flexibility of the system to face novel situations. This flexibility is therefore related to the ability to identify the central aspects of the situation on which the adaptations operate, which is key to showing that there is an understanding of the problem.

Kolodner¹⁵⁴ suggests that adaptation can occur through different methods, which are grouped as follows:

- **Substitution methods:** are those where the values are substituted¹⁵⁵ appropriate for the new situation using the guide of past solutions.
- **Transformation methods:** they are those that transform an old solution into something that works for the new situation, appealing to common heuristics (common sense).
- **Adaptation and repair with special purposes:** are those where specific structural modifications

152 (Leake, 1996, p. 10)

153 This is a first review of the so-called "candidate hypotheses" since not all will be equally good.

154 (Kolodner & Wills, 1993)

155 It may be that past solutions are instantiated with new objects (re instantiation), that solution parameters are adjusted depending on the specific situation (parameter adjustment), that an auxiliary knowledge structure is sought to replace part of the structure of an old solution that is inappropriate for the new situation (local search), that the memory is requested to provide something, given a certain description (Query memory), or that new possibilities of solution are generated by substitution based on cases (case based substitution).

are made responding to the domain. They are heuristics that respond to classes of specific situations.

- **Repetition of derivations:** it is when the way in which a solution was reached in the past is recovered, in order to derive a solution to the new problem.

Once a possible solution has been selected, it is applied or contrasted with the world to evaluate its performance¹⁵⁶, with which then the case (experienced situation)¹⁵⁷ is indexed¹⁵⁸ to be integrated into the memory and be used when a similar situation arises, also having the function to serve as contextualizing elements and starting point to interpret a new situation or to solve a new problem.

How the information is indexed, to a certain extent, predicts the usefulness of a case. Given that, if it is not stored properly, it is possible that the information cannot be recovered in the relevant circumstances, which is why the possible circumstances in which that knowledge may want to be recovered should be anticipated in its indexing mode.

This indexing is not only based on the content of the case, but on the context or circumstances in which it was generated and in which it is possible that the case *can teach a lesson*.

A case can be recovered for a great variety of different problems, the generality or specificity of it depends on the agent's capacity for reflection on the case itself.

The retrieval and indexing of cases is oriented to the achievement of purposes (such as understanding or solving problems), so we assume that the criteria that guide them are pragmatic and functional¹⁵⁹.

The CBR has certain advantages over other reasoning mechanisms:

156 In this second review of possible beliefs is when conviction is acquired in the now belief.

157 Key elements of both successes and failures can be integrated, but not all cases will be stored, only those that have provided some meaningful teaching to the agent regarding their goals will be stored (it is difficult to clearly define what we mean by "significant" since it will depend on the ability to reflect of the individual). However, we can say that a case provides an important lesson when something is obtained that is not easily inferred from the previous cases.

158 By indexing we will understand the fact of managing knowledge (cases, solution paths, etc.) for its future recovery.

159 (Kolodner & Leake, 1996, p. 41)

- Learning arises as a by-product of the reasoning activity, where experience helps the agent to improve their efficiency and develop their skills.
- It allows the agent to propose quick solutions to problems without having to elucidate the answers from the beginning.
- It is possible, for the agent, to propose solutions in domains that are not fully understood.
- It helps the agent focus his reasoning on the important parts of the problem, by highlighting which characteristics of the problem are crucial.
- It allows generating reasonably reliable projections before some plan of action or argumentative speech.

However, the most interesting systems for us are those where CBR is directed towards explanation¹⁶⁰, due to its resemblance to abduction, and also those approaches where reasoning based on cases is combined with other types of knowledge and reasoning methods such as heuristics¹⁶¹ and general domain knowledge, among others, since we suppose that the CBR¹⁶² is only one of the several mechanisms that intervene in abductive processes within daily reasoning and, therefore, its richness becomes evident when interacting with other mechanisms.

58 CBR explanation oriented

CBR oriented explanation (*Explanation-drive case-based reasoning*) is particularly interesting since it is designed to be able to function in domains theoretical weak, system understanding that a domain weak or open is one where the domain cannot be realistically modeled as it would be necessary for the agent to be able to anticipate changing world conditions. For example, medical diagnosis, law, etc. Knowledge of the domain is incomplete and in certain parts theoretically uncertain¹⁶³. Where general knowledge is less specific and mainly associative in nature (in the form

160 (Aamodt, 1994)

161 (Rissland & Skalak, 1989)

162 As a reasoning mechanism and not as an expert system.

163 (Aamodt, 1994).

of heuristic principles, or functional or causal knowledge), it is essential for the proper response of the agent in a world that can be divided into defined but dynamic scenarios and contexts. In this system, a general knowledge approach is integrated to the very method of reasoning by cases, in order to gain flexibility and explanatory capacity.

In weak theoretical domains, Aamodt says that the individual compensates for the lack of strong knowledge with large amounts of knowledge, represented, in a coherent (rather than strictly consistent) model¹⁶⁴. Utterances(statements)are more or less plausible, backed strongly or weakly, rather than true or false. So the type of inference generally involved is abduction, which generates explanations at different levels¹⁶⁵. The understanding of the problem therefore, involves the understanding of the same circumscribed within a resolution context which gives *traceability* to the problem. From Aamodt's perspective, the system's greatest resolution capacity occurs when it is capable of resorting to both case-based reasoning and generalization-based methods, which is why his proposal goes in this direction.

In Aamodt's proposal¹⁶⁶, it is necessary to differentiate between the explanations that the system presents to the user and intermediate explanations that the system itself generates for itself during the reasoning process, for which a difference is made between the tasks towards the user (tasks of application) and the tasks of the system's own reasoning process (reasoning tasks). It should be noted that we will only focus on the reasoning tasks, the main reasoning tasks within the system being the following:

- The identification of relevant characteristics for the description of the problem.
- The recovery of a past case by virtue of a judgment of similarity to the new problem.
- Modifying a past solution to fit the new context.
- The evaluation of the suggested solution.

164 (Aamodt, 1994, p. 275).

165 The kind of explanation that is generated depends on the kind of knowledge on which the abduction operates. Eg In a medical diagnosis, at a higher level, the task may be to explain the patient's symptoms in terms of causative physiological states, while at another level, the task may be to explain why one possible hypothesis is assumed and not another.

166 For expert systems (Aamodt, pag. 3, 1994)

- Identification of what should be withheld from the case just resolved.
- Learning how to index the case for future cases.

It is possible to group these tasks in a more general order: *recovery, reuse and learning*, on which in turn, knowledge mechanisms will operate in general as an integrated part of case reasoning.

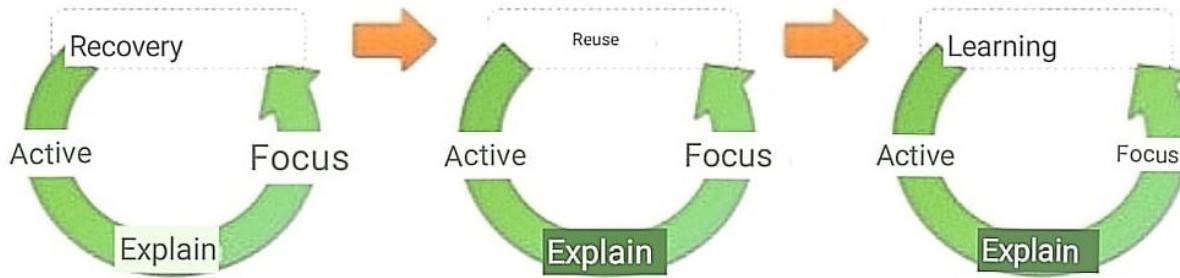
This generic mechanism, called the *explanation engine*, becomes the main reasoning strategy, separating each reasoning task into three subtasks or subroutines: Activate, Explain and Focus. It takes an initial *state description* and returns a goal *state description*. Once these three subroutines are applied to the reasoning task in question, the task is circumscribed and a solution is suggested:

1. **Activate:** in this process they are taken as initial data (*input*): the description of the problem in terms of tasks and objectives, a set of constraints, and a set of input data (*findings*). Thanks to this information, the system returns a set of activated concepts¹⁶⁷ that are assumed to be relevant for the achievement of the task and that serve as base knowledge for subsequent processes, thus establishing a broad but limited context on which to continue with the reasoning processes.
2. **Explain:** it takes the structure of activated knowledge and returns a set of hypotheses supported by explanations, those with greater explanatory power being preferred. For this, the explanation routine has a set of evaluation strategies for the explanations in the form of decision rules.
3. **Focus:** it takes the set of hypotheses supported by powerful explanations and returns only one of them, presumably, it is the best of the suggested solutions based on typically pragmatic criteria¹⁶⁸.

Scheme 12. Subtasks in the “explanation engine”

167 The activation of the concepts occurs through two different methods: 1) “(in each of the three large blocks [recovery, reuse and learning] all the concepts are activated within the sphere of discovery -which are also in the sphere of goals-, as well as all the concepts in paths [paths] of the set of initial goals and discoveries, these concepts are part of the base knowledge that will be used in the next block), and 2) through direct reminding through links with past cases (Aamodt, 1994, p. 277).

168 Determined by the interaction of the system with a human agent.



Source: Aamodt¹⁶⁹

This set of subroutines then allows generating a search mechanism, constrained by general knowledge related to the context of the problem, with the immediate benefit of providing a guide based on explanations that are oriented to particular goals. With this, in addition, the value of the subsystems within a greater inferential mechanism is evidenced¹⁷⁰.

Thus, we can observe the similarity¹⁷¹ between the CBR mechanism oriented towards explanation (*Explanation-driven case-based reasoning*) and abduction, where even the subroutines of the system (activates, explains and focuses) are oriented to perform the same functions as does the abduction, which starts from the determination of background knowledge to generate hypotheses with explanatory claims and selects from among them to account for an anomalous or novel event. For this reason, in relation to abduction and certain classes of beliefs (mainly the inappropriate ones), case-based reasoning will help us to propose a model that allows us to describe more clearly the process by which an is determined *specific complete episode*¹⁷² in a particular moment. From here the problem is delimited, and it is possible that abductive inferential mechanisms operate.

Thanks to the similarities in the abductive and CBR mechanisms, it is possible to understand more clearly, how to evaluate some belief, not only by virtue of the beliefs held by the individual at a given moment, but also in function of past experiences, linking the present scenario with past

169 (Aamodt, 1994, p. 278).

170 The “explanation engine” obtains an important part of its inferential capacity from the representation that underlies the system, this being a closely related semantic network where both nodes and relationships are represented as conceptual frames.

171 Hence, Patricia Churchland equates them.

172 The objective of introducing the CBR in the present work is to be able to determine the descriptive space of the problem and, therefore, the pertinent internal information in the form of the recovery of a subset of similar past problems where there are similar keys.

scenarios (the activated ones)¹⁷³.

However, before presenting the articulation of a complete model to work with inappropriate beliefs, we will enter fully into pragmatics and particularly relevance theory, an approach that will be useful and complementary when we delve into the way in which beliefs and concepts are recognized as relevant. So far, we have repeatedly mentioned that the criteria are pragmatic without going deeply into what criteria they are, or what we are clearly referring to.

10. Pragmatics

Pragmatics is concerned with expressions (*utterances*), understanding them as specific events, that is, with intentional acts of speakers in specific places and times, typically involving language¹⁷⁴. Because pragmatics deals with specific contexts, then we can say that it is characterized by dealing with the effects of context in conversational situations (typically). Given the above, it has been helpful to draw a distinction and talk about two sides of pragmatics: *the near side and the far side*.

A good example of this characterization is thinking of an enunciation of a declarative sentence. The close side of pragmatics would be concerned with the facts that are relevant to determining what is said, while the far side of pragmatics would focus on what happens beyond what is said: what speech acts¹⁷⁵ are performed by saying what said, or what implicates are generated when saying what is said¹⁷⁶.

Pragmatics, as opposed to Locke or Saussure perspective, where the communication of an expression focuses on the encoding of a thought into words and its subsequent decoding in reverse by the listener. Pragmatics assumes that for communication to occur it is necessary to involve broad inferences (such as induction or abduction), or the application of specific general principles to communication. In this way, the reasoning that pragmatics involves go beyond the mere application

173 This link can be sustained based on simple reinforcement mechanisms.

174 Following (Korta & Perry, 2011).

175 For Austin, a speech act that involves intentions (persuasive claims) on the part of the speaker acquires a certain force, turning a speech act (locutioner) into an illocutionary act, which in general causes the performance of a locutionary act is also an illocutionary act.

176 The implicatures will be dealt with a little later; However, we can anticipate that the concept of implicature in pragmatics refers to what is not said.

of rules and the information contained in the expression itself.

Pragmatics has undergone important advances since its inception, which is why it has tended to be considered (although somewhat arbitrarily) that there are two periods of its development. Classical pragmatics and contemporary pragmatics. For the purposes of this document, the focus will be on a part of contemporary pragmatics, relevance theory, so only the elements that are taken up in contemporary pragmatics of classical pragmatics will be mentioned (such as some contributions made by Grice), without going into them in depth.

In classical pragmatics, it was believed that it was possible to make a clear distinction between *what is said* (the domain of semantics) and what the expression entails or achieves in a particular linguistic and social context (the domain of pragmatics), establishing thus a kind of frontier of analysis.

Some of the greatest exponents of this period were Austin, Searle, and Grice. One of the key proposals is the one presented by Grice, who focuses on what a speaker is trying to communicate by using some particular expressions. That is, what is involved in the expression of a sentence?

For Grice, what one says is determined by the conventional meaning of the sentence and the contextual process of disambiguation and referential fixation. What a person implies is associated with the existence of some rational principles¹⁷⁷ and conversational maxims¹⁷⁸, that is to say that *what is said* has a literal content and a communicated non-literal (intentional) content, essential for the definition and interpretation of conversational implicatures.

On the listening side (far side from pragmatics), implicatures play a fundamental role¹⁷⁹ for the interpretation of an expression. Grice proposes that the following pattern is paradigmatically followed:

177 An example is the principle of cooperation. The idea is that, for communication to take place, you first need to openly draw the listener's attention. Once this has been achieved, it is reasonable to assume that the issuer is trying to comply with certain general rules and therefore, a common purpose or set of purposes is recognized, at least one mutually accepted direction. Given this, making contributions to the conversation as required by the mutually accepted purpose or direction is termed the "principle of cooperation" (Sperber & Wilson, p. 48, 1994).

178 Maxims of quantity, quality, relationship and modality (Sperber & Wilson, p. 48, 1994).

179 Although the idea of implicatures, as defined by Grice, are the most controversial part of his theory, and they certainly point to a central question: what information is necessary for the interpretation of an expression in the most accurate way?

"He has said that p; there is no reason to suppose that he is not following the maxims or at least the principle of cooperation; he couldn't do this unless he thought that q; he knows (and he knows that I know that he knows) that I can see that the assumption that he thinks that q is required; he has done nothing to stop me from thinking that q; he wants me to think or at least he wants me to think that q; so it has implied that q "¹⁸⁰.

Likewise, implicatures have the characteristic of being cancellable, they are not *unlinkable* (that is, it is not possible to find another way of saying the same thing without the implicature being present) and they are calculable.

For Grice, All communication is based on a communicative intention of a speaker, which gives it a specific meaning, which is called *M-intentions*. These intentions have the property of being oriented to produce a response in an agent, they are directed to be recognized by the agent to which they are oriented and their satisfaction consists precisely in being recognized by that agent.

Thus, we can summarize, that the three main contributions of Grice to pragmatics are the following:

1. Establish a fundamental distinction between what the speaker says and what it implies
2. Propose a set of rules or principles, derived from general principles of rationality and / or cognition, to guide, constrain or govern human linguistic communication.
3. Establish the notion of communicative intentions (M-intentions) whose satisfaction consists in being recognized by the subject to whom they are addressed.

These contributions give rise to what we understand as contemporary pragmatics, where the majority of current theorists are, in some way, Neo-Griceans, since they adopt some version of these three contributions.

According to Carston¹⁸¹, it is possible to encompass current pragmatics studies in terms of two dimensions.

¹⁸⁰ Quote from Grice (Grice, 1967a / 1989, 31) in Korta and Perry (Korta & Perry, p. 12, 2011).

¹⁸¹ (Carston, 2005)

The first dimension involves disciplines and methodologies, where three trends can be observed: 1) seeing it as a philosophical project (Grice), 2) concentrating on its interaction with grammar (Horn), and 3) seeing it as an empirical psychological theory on the interpretation of expressions (Sperber).

On the other hand, the second dimension has to do with the communication model that is assumed in the background. On the one hand, there are models such as those of John Locke and Saussure that assume encoding / decoding, and on the other hand, there are models in which, in the same way, it is assumed that what is communicated are beliefs, but the mechanism of their communication is not found in the decoding according to conventional rules, but in the recognition of intentions and their discovery, for which it is based on broad inferences.

Both dimensions are interrelated and depending on the project, their interaction will be greater or lesser.

Relevance theory (central to this work) focuses on the cognitive process of motivation, that is, what motivates us to attend to certain information and not other, and therefore, process certain (relevant inputs¹⁸²) while filtering others. Therefore, it uses an inferential communication model as a base compared to the traditional code model.

The traditional model of communication that emerged from Locke and Saussure, also known as the code model, focuses on a transmitter and a receiver¹⁸³, which transmit information through a stable channel, using a code shared by both. The sender encodes thoughts using this code, and its decoding allows the receiver to share the information. A kind of mechanism where content is packaged in the form of words and sent to a recipient¹⁸⁴.

Following this scheme, communication seems simple. Occurring between two information processing devices, where the first modifies through its expression, the physical environment of the other, initiating the communicative process, which will end with the decoding of the message and its representational pairing between individuals.

¹⁸² The relevant inputs are those that are potentially beneficial for the functioning that is being carried out in the cognitive system and whose processing costs for the system are relatively low. Carston ((Carston, p. 2, 2005) citing Sperber and Wilson (Sperber & Wilson, 1994)).

¹⁸³ It is necessary to have: a code (system that pairs messages with signals), a message (an internal representation of the devices of communication) and a signal (modification of the external environment produced by one device and recognized by the other).

¹⁸⁴ (Sperber & Wilson, p. 11, 1994)

However, if we assume this, it is reasonable to think that the second device builds representations similar to those that were already stored in the first¹⁸⁵ to understand the message¹⁸⁶.

But, how can the decoding of a physical stimulus produce a similarity of thoughts univocally? It seems that much more is required than the semantic dimension of human communication to account for these processes and therefore, these elements escape the explanatory capacity of the code model.

In 1957, an alternative to the code model was envisioned, thanks to the work of Grice, who laid the foundations for the development of an inferential model of communication, by giving a turn to the way of understanding “what it means for an individual H to give understand something by means of a statement x”¹⁸⁷, introducing the intentions of the speaker and the recognition of them by a listener as central pieces for communication, in addition to proposing a set of maxims and pragmatic principles that guide the expansive reasoning that helps to understand what is happening in other¹⁸⁸ minds.

Therefore, inferential models (which mark the beginning of contemporary pragmatics), on the one hand have at their core the recognition of the intentions¹⁸⁹ speaker’s, and on the other, the use of expansive reasoning is central to determine what the speaker is doing it implies. Defining as communicative success, not when the listeners recognize the linguistic meaning of the statement, but when they infer the meaning that the speaker attributes to it¹⁹⁰.

Although it is true that the inferential model opens up new alternatives, this model and the code model are not incompatible with each other, but are used in different types of communication¹⁹¹.

In the present work, we are interested in specific facets of communication, particularly those of a

185 Ibid

186 A kind of mind reading.

187 “[H] implied something by x” is (approximately) equivalent to “[H] I wanted the enunciation of x to provoke a certain effect in a certain listener through the recognition of their intention.” Grice (Grice, 1957) in Sperber and Wilson (Sperber & Wilson, p. 34, 1994).

188 is that it is not necessary taking all communication through inferences. It is also possible to communicate by encoding and decoding messages, because one way or another may be preferred depending on the situation.

189 The intentions can be of various kinds: informative intention (informing the listener of something) and communicative intention (informing the listener of our informative intention).

190 (Sperber & Wilson, p. 37, 1994).

191 (Sperber & Wilson, p. 37, 1994).

psychological nature addressed by later developments in the line of inferential-intentional theories, as is the case of relevance theory.

11. Relevance Theory Relevance

Theory is presented as a theory that aims to clarify the cognitive principles by which the relevance of an element is comparatively determined in the framework of human communication, in particular, and of cognition, in general¹⁹².

Relevance theory is proposed and developed by Sperber and Wilson following Grice's model, but focusing on the inferential aspect of communication, oriented towards the more psychological aspects of it. It is even accurate to say that it points towards the development of a theory of cognition in the framework of communication.

Relevance theory, as its name suggests, focuses on principles of relevance that go beyond both communication and humans¹⁹³. The phenomenon of relevance has gotten its shape evolutionarily. An animal's attention is drawn to the environmental cues that provide it with the most crucial information¹⁹⁴, so that its function in language seems a natural extension of human development. They even advance that "the purpose of reasoning is mainly to allow the production and evaluation of arguments during communication"¹⁹⁵.

In the words of its founders, "Relevance theory is a cognitive psychological theory; in particular it treats the interpretation of the statements as a cognitive process"¹⁹⁶.

To discuss the way in which the inferential process and the performance of these relevant principles

192 It is worth mentioning that this work focuses on abduction and therefore, on the explanatory nature of its products, even in the inferential framework, let us remember that "mere behaviors do not explain anything, it is their causes that are explanatory" (Millikan, p. 203, 2005).

193 Instead of continuing with the principle of cooperation and the conversational maxims proposed by Grice, principles of relevance are postulated that are derived from the applicability of the general phenomenon of relevance in linguistic situations in the context of a representational theory of mind. (Korta & Perry, p. 40, 2011).

194 (Korta & Perry, p. 39, 2011)

195 (Mercier & Sperber, p. 4, 2009)

196 (Wilson & Sperber, p. 271, 2004)

are conceived, it is first necessary to develop some concepts and an image of what is in the cognitive construct of the individual¹⁹⁷. So the idea of a *cognitive environment* is advanced¹⁹⁸.

When we think of the communication process, we think of the process by which some type of information is transmitted to another; However, to achieve this, it is essential to assume, on the one hand, that it is necessary to share a certain kind of prior information and, on the other, that the communication process itself originates shared information.

Let's start from the fact that individuals live in the same physical world with a similar cognitive and sensory apparatus. With this somatosensory apparatus and its cognitive instruments, it seeks to obtain the most useful information in the world by building a representation that allows it to operate in it, although each representation will vary from individual to individual.

In this process, it is necessary to filter and discriminate not only between stimuli, but also between information packages, in order to be functional, which leads to the construction of cognitive environments.

Sperber and Wilson use a parallel case to introduce this concept, the vision case. Vision generates a visual environment, which can be defined as the set of phenomena that are visible to the individual. This visual environment is given both by the physical environment and by their visual ability.

In the case of communication, the interest is in the conceptual cognitive capacity and therefore, in the construction of cognitive environments. Manifest facts for conceptual knowledge is the counterpart of visual phenomena for visual knowledge¹⁹⁹.

1. A fact is manifest²⁰⁰ to an individual at a given moment only if at that moment he is able to mentally represent it and accept its representation as true or probably true.

197 This is one of the reasons it relies on a representational perspective of the mind.

198 Own terms.

199 (Sperber & Wilson, p. 54, 1994).

200 Being manifest is equivalent to being perceptible or inferible, which extends not only to the facts, but to the totality of the assumptions, but this being a matter of degree. The assumptions and their inferential derivations can be more or less manifest, eg. An assumption is manifest in a certain cognitive environment when said environment provides sufficient evidence for the adoption of said assumption, regardless of its truth value. However, the notion that it is manifest to an individual is weaker than the notion of what his knowledge or assumptions are, in fact.

2. The cognitive environment of an individual is a set of facts that are manifest to him.

The *cognitive environment* of an agent in a given situation can be explained as “the bundle of ideas with which we face the task of understanding the world that surrounds us”²⁰¹ Thus, a *cognitive environment* is conceived as the set of external stimuli and representations of relevant internal factors that serve as inputs to a cognitive process.

When two individuals communicate, each has their own cognitive environment; however, there are elements that both share, thus intersecting the cognitive environments, and constituting a mutual cognitive environment (NDE) whose manifest assumptions are mutually manifest assumptions²⁰².

However, cognitive environments are not built randomly, but are directed towards the achievement of some goal. In this case we will say that human knowledge is oriented towards relevance, having to clarify what it means to then *be relevant*.

Intuitively, it can be thought that relevance is not an immovable and fixed property of objects, there is no such thing as being relevant regardless of the situation (even though it is true that given the cognitive organization of human beings there are classes of phenomena that have greater *salience*²⁰³), relevance is a value determined by the agent’s cognitive scaffolding²⁰⁴ towards any input in a particular situation.

Sperber and Wilson establish the following:

69

“An input is relevant for a subject when it comes into contact with prior information that he has available, thereby producing a series of results that concern him”²⁰⁵.

201 (Pons, p. 19, 2004).

202 As there is a mutual cognitive environment, there are mutually manifest assumptions. However, this does not imply that the same assumptions are made, only that, in principle, they can. It is the speaker who mostly guides the construction of the mutual cognitive environment, since by directing it, it is possible to infer what assumptions it is reasonable for the other to conceive.

203 We will understand by salience: the ability to relate the brain functions of integration, and allows us to make a selection, among the different stimuli that we receive, to focus our attention on the information that interests us, leaving the other stimuli buffered or canceled.

204 The processes that determine relevance, as well as those that allow the rapid arrival of a speaker’s meaning, can be seen as inferential processes that belong to type 1 automatic processing subsystems and, in this sense, belong to some heuristic class (with the characteristics that this entails).

205 (Wilson & Sperber, p. 239, 2004).

They later specify this notion of relevance in the following terms:

“An input is relevant for a person when it’s processing in the context of a series of previously available assumptions produces a cognitive effect²⁰⁶ positive... which represents a significant difference for the mental representation that the subject sustains the world”²⁰⁷.

So his idea of relevance is not only not a matter of all or nothing, but it is conceived in degrees and being dependent on the effects it produces on the agent. The greater the effects or changes the inputs involve, the greater their relevance, and conversely, the greater the processing effort, the less relevance the input will have.

“Relevance can be conceived in terms of cognitive effects and processing effort”.²⁰⁸

From this is extracted the first and most important principle of relevance from which the other principles related to communication are derived, the so-called *cognitive principle of relevance*. This principle indicates that human beings have an automatic tendency to select the most relevant inputs, that is, to seek the maximum relevance, establishing a (comparative) criterion to choose between different inputs.

206 The most important type of cognitive effect is called a contextual implicature, a conclusion that follows from input and context, taken broadly.

207 The most important type of cognitive effect is called a contextual implicature, a conclusion that follows from input and context, taken broadly.

208 (Wilson & Sperber, p. 241, 2004). When referring to processing effort, the idea of cognitive efficacy is naturally followed and in particular Wilson and Sperber focus on short-term cognitive efficacy. What is our mind going to spend the next few seconds or milliseconds on? There are many different possibilities for moment-to-moment information processing, which are decided based on the optimal allocation of processing resources since the human sensory capacity monitors much more information than the conceptual capacity can process. The core capacity always has a lot of unfinished work left, and therefore resources should be allocated to the processing of information that can make a greater contribution to the general cognitive objectives of the mind with the minimum processing cost. Some of the information is already old, that is, it is already in the representation of the world that the individual has. Unless it is necessary to carry out a specific task and is easier to access from the environment than from memory, it is not worth processing that information. Another part of the information is not only new, but it is also not connected with anything of the representation of the world that the individual has. It can only be added to said representation in the form of small isolated elements, and generally means too great a processing cost for the benefit to be obtained. The Other part of the information is new, but it is connected to the old information. When these new and old interconnected pieces of information are used together as premises within an inferential process, it is possible to deduce further new information: information that could not have been inferred without this combination of new and old premises. When the processing of new information elicits this kind of multiplication effect, we say that it is relevant. The greater the multiplication effect, the greater the relevance (Sperber & Wilson, p. 65, 1994). If we assume that human beings tend toward the most efficient information processing possible, then we are justified in assuming that the cognitive system is relevance-oriented, as it carries guarantees of efficacy.

Among two alternative inputs, the one that produces the greatest cognitive effects with the lowest processing cost will be more relevant. In the words of Sperber and Wilson, this principle “contributes to an adequate distribution of cognitive resources in the face of potentially relevant inputs”²⁰⁹, which means that the listener is justified in following the path that means the least effort to derive meaning and implications of an expression, stopping when an interpretation is reached that meets your expectations of relevance²¹⁰.

In this way, relevance theory allows the individual to exploit the environmental structure in relation to his background knowledge to reach efficient conclusions without having to review all the theoretical possibilities²¹¹, and in this sense, it can be thought of as a special kind of process²¹². heuristic, which seeks optimal solutions given a particular stimulus in a context, but stops adequacy finding(satisficing)²¹³ explanatory. Which makes the understanding procedure of theoretical relevance an excellent example of adaptive rationality.

Relevance theory provides the final elements that are needed to generate a way of understanding the process and abductive products in reality, which is presented from an example.

You arrive home late at night and realize that the light in your bedroom, which is always on, is off. It has been raining heavily, so you think the electricity in the house is gone; however, the rest of the lights in the housework fine. So you wonder if you left both heaters on, which usually causes the switch in the room to trip, so you check it, but it hasn't been activated. Finally, a simple explanation crosses your mind, maybe it is that the lamp bulb has burned out, even though the last time you saw it, it worked well, and therefore you need to replace it.

71

Let's start by thinking about the abductive process in the face of this anomalous event²¹⁴. What

209 (Wilson & Sperber, p. 272, 2004).

210 (ALLOTT, p. 72, 2002). This is called the “relevance theoretic comprehension procedure”.

211 We assume that this is a rational behavior following Allott (ALLOTT, 2002) and, as has also been defended in previous works (Garibay, 2010b), the consistency of the system is at most a secondary criterion for evaluating rationality, behind precision, speed and transparency (Gigerenzer et al., 2002, p. 149 cited in Allott (ALLOTT, p. 72, 2002).

212 This is important, since it is possible that the emergence and maintenance of some delusional beliefs is precisely related to heuristics that do not work well.

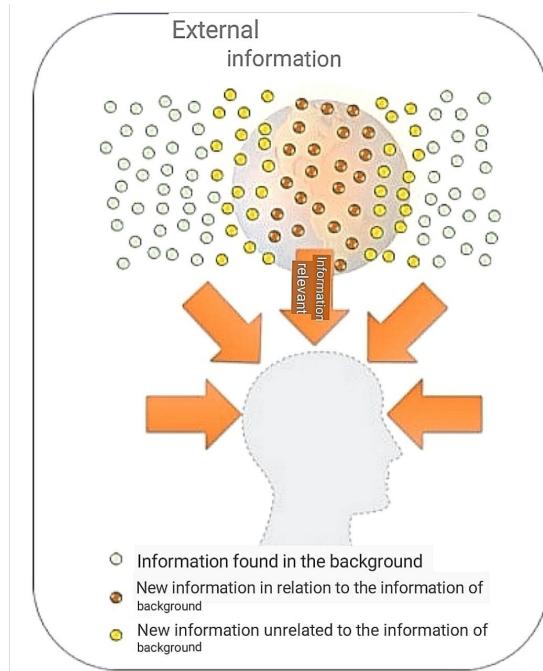
213 It is a unique heuristic in this sense. See Allott (ALLOTT, 2002) for defense of this assumption.

214 In a previous analysis we defined the anomalous case as follows: $\Theta \not\Rightarrow \phi$, $\Theta \models \neg \phi$. Assuming then that the agent has a set of beliefs Θ upon arrival at home, which includes, among others, the propositions: The light in the room is always on — All the elements necessary for the light to turn on are working well (the current switch, lamp, etc.). However, when he gets home he finds that the light in his room is off, placing the agent in an anomalous state, since from his set Θ it follows that the light must be on, but the case is just the opposite. However, with the concep-

information of all that is presented in the environment to the individual when arriving at home is relevant? The importance of understanding this process is obvious, already thanks to this, it is possible to assign the cognitive resources necessary for its processing²¹⁵.

The answer that we suggest is found in the novelty of the information and its relationship with previous information²¹⁶ as the first element to discriminate between stimuli.

Scheme 13. Selection of relevant information



Source: Own elaboration.

In our example, the most relevant in the first moments seems to be the fact that the light that always stays on, in this case it is not, changing the epistemic state to a state of abnormality (abductive trigger).

This causes information to be recovered from the background knowledge that is related (through previous associations and by similarity using type 1 processes) with this manifest and for actual

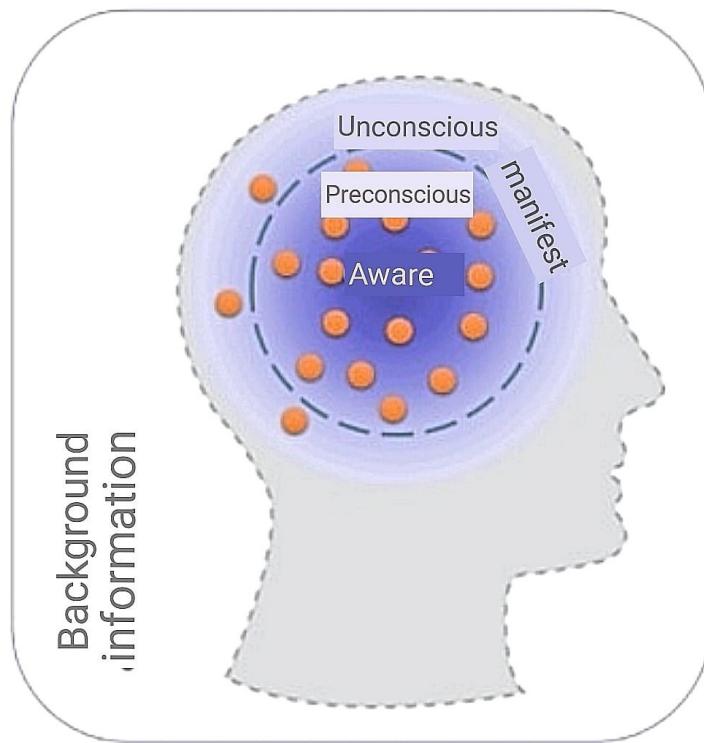
tual tools that were incorporated thanks to case-based reasoning and relevance theory, we can go much deeper into what we should understand by Θ .

215 We assume that these processes are type 1, automatic, rapid, and preconscious.

216 Following Sperber and Wilson at this point.

relevant information (situation assessment).

Scheme 14. Background information



Source: Own elaboration.

Given the fact that a state of epistemic anomaly is generated, it is first dictated that, in effect, there is an event that requires an explanation, triggering inferential processes, among them, the abductive process is triggered in order to return to the state of normality.

73

This thus creates a descriptive space for the problem²¹⁷.

It begins with the internal and external delimitation of the information that will serve for the construction of a case²¹⁸ given its momentary cognitive environment. Resulting in information retrieval²¹⁹.

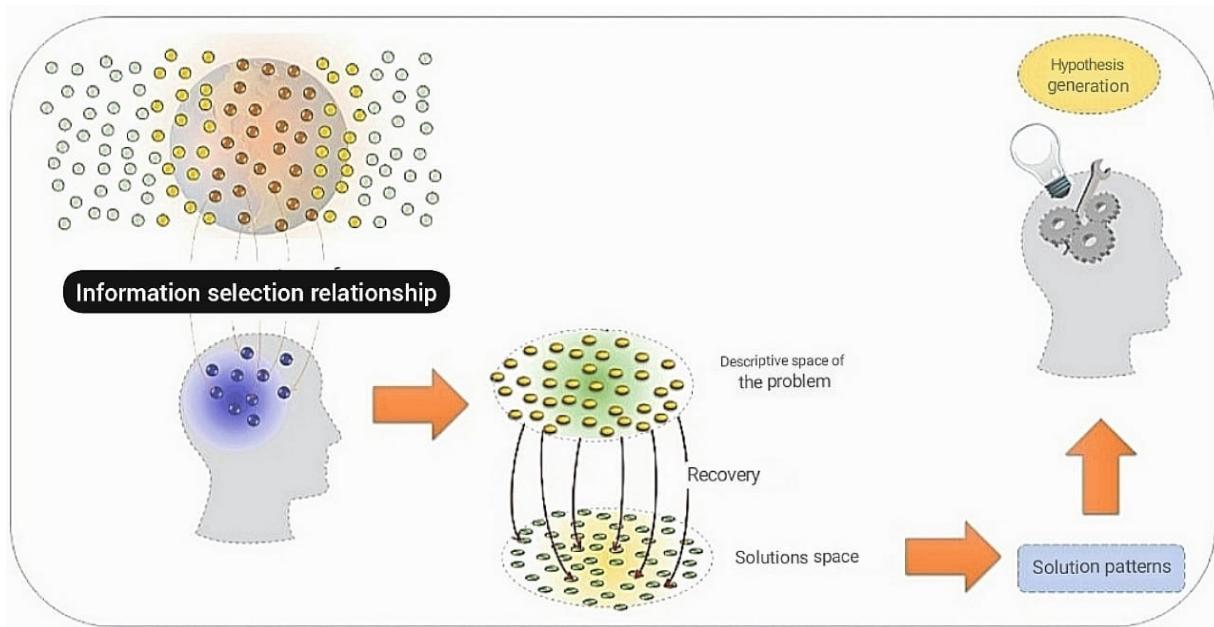
217 This space is not well-defined and is in a certain sense fuzzy since the scope of system 1 is much greater than that of system 2, but only the data that reaches a certain level of activation are brought to consciousness. In this way, defining the scope of the systems for the individual himself from his reflection is impossible.

218 Case engineering.

219 They can be beliefs, cases, traces, principles of solution, etc.

In the event that what is recovered are relevant past cases by virtue of their similarity and adaptability with the present problem, these in turn entail a space of applied past solutions²²⁰, from which solution patterns can be obtained that guide the generation of hypotheses candidates for explanation in a coherent model²²¹.

Scheme 15. Hypothesis generation



Source: Own elaboration.

These hypotheses more or less plausible, supported in a strong or weak way, have yet to pass a *verification*²²² that allows saying that “given the evidence E and the candidate explanations H₁,..., H_n of E, the truth of that H is inferred better explain E, H_i proposal should be satisfactory / good enough qua explanation “to²²³ the address with the facts of the²²⁴ world.

Scheme 16. Acquisition of beliefs

220 Which can be rules, processes or beliefs.

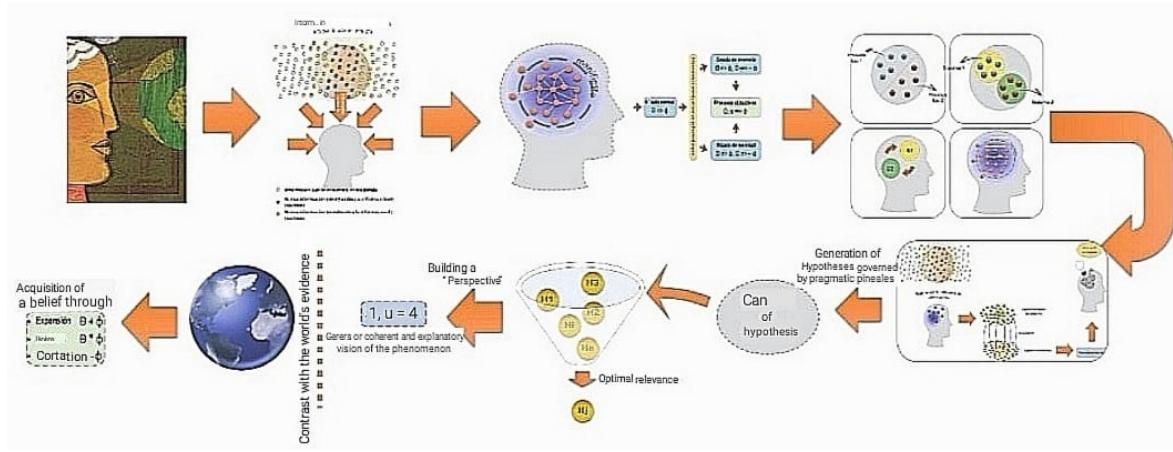
221 The model is articulated with the information cognitively manifested for the individual. What generates coherent spaces, more than consistent, with the entire system.

222 It can be through criticism, coherence, explanatory force, etc.

223 (Douven, 2011, p. 14).

224 The idea of the “explanation engine” (activates, explains and focuses) used in reasoning by cases, suggests a certain similarity with what we suppose occurs in the cognitive system of the individual.

CRGR



Source: Own elaboration.

This model allows us to understand the inferential process of abduction within a framework of normality, in order to ask ourselves now why are the cognitive deficiencies involved with the failure of the inferential process that gives rise to the generation and maintenance of inappropriate beliefs? As it is observed in an extreme way in several psychological conditions such as: schizophrenia, obsessive compulsive disorder and bipolar disorder.

Chapter II.

Mental illnesses

Mental illnesses, like any other condition typified as abnormal, are characterized by identifiable signs and / or symptoms, which once related to each other, frame or frame a certain classification or label. In the particular case of this research, where what is relevant are the systematic and consistent alterations in the cognitive process of generating conclusions, the product of an abductive inferential process, the common thread for the selection of the pathologies to be studied are systematic failures in these processes. In order to be able to elucidate the flaws in these processes, some pathologies have been selected as an extreme example of the presence of flaws in reasoning. However, we assume that these failures may be present to a lesser degree in most people.

Systematic failures in reasoning are known as cognitive biases and are evident under particular circumstances in daily life. However, when working with patients with mental disorders whose nature shares the alteration of inferential processes, then the presentation and analysis of these phenomena will be more marked, so the objective of this chapter is to initially characterize three different mental illnesses that we assume share alterations in inferential processes: schizophrenia, obsessive compulsive disorder and type I bipolar disorder, in order to delimit the area of the same that may be related to failures in the abductive process.

1. Schizophrenia (Definition)

Schizophrenia is a complex condition with a worldwide prevalence in adults of between 0.3% to 0.7%²²⁵, although this may vary by race, sex, or geographic location. In epidemiological studies carried out in Latin America, the prevalence remains at low levels²²⁶. In Mexico in particular, there

225 See Association (Association, p. 102, 2013)

226 See a Kohn, et al. (Kohn, et al., 2005).

are studies that report a prevalence of 0.7%²²⁷ and, for example, the National Institute of Neurology and Neurosurgery Manuel Velasco Suárez reported in 2007 that 22% of its patients present it, this being the disorder with the highest representation in the institution as of that date²²⁸.

The DSM-V²²⁹ defines *the spectrum of schizophrenia and other psychotic disorders* (which includes schizophrenia worth the redundancy) as a psychotic disorder defined by abnormalities in one or more of the following five domains: delusions, hallucinations, disorganized thinking (speech), abnormal or mostly disorganized motor behavior, and negative symptoms, which are described below.

Delusional beliefs: Delusional beliefs are beliefs (*fixed beliefs*) that are not easy to change (*threatened*) even in light of conflicting evidence. Your content can include a variety of topics²³⁰, with delusions of persecution being²³¹ the most common.

However, referential delusions are also common²³², delusions of grandeur²³³, and erotomania²³⁴ and there are also nihilistic delusions²³⁵ and somatic delusions²³⁶.

Within the beliefs themselves, we find a subtype called *bizarre*, which involve a clear impossibility and misunderstanding even by peers from the same culture and do not derive from ordinary life experiences²³⁷. Drawing the distinction between a delusional belief and a belief held with strong conviction is difficult to do. It depends in part on the degree of conviction with which the belief is held regardless of contradictory evidence about its veracity.

227 See Caraveo-Anduaga and Medina-Mora (Caraveo-Anduaga & Medina-Mora, 1996).

228 See Trejo Contreras and Velásquez Pérez (Trejo Contreras & Velásquez Pérez, 2006)

229 See Association (Association, p. 87-122, 2013). Although the central definition that will be used is that provided by the most recent version, most current studies still use the definition and taxonomy of its previous edition which defined schizophrenia as a chronic psychotic disorder whose characteristic symptoms encompass a set of cognitive and emotional alterations that include perception, language, behavior, affectivity, fluency and productivity of thought and speech, will, motivation and attention.

230 Persecutor, referential, somatic, religious, greatness.

231 The belief that one is going to be hurt by an individual, organization, or group.

232 The belief that certain gestures, comments, environmental cues, and so on, are directed towards you.

233 When an individual believes that he or she has exceptional abilities, wealth, or fame.

234 The belief that another person is in love with the subject.

235 They involve the conviction that a major catastrophe will occur.

236 His focus of concern is health and bodily function.

237 An example may be the belief that an external force removed all the internal organs of the individual replacing them with someone else's organs without leaving any kind of scar.

Hallucinations: Hallucinations are involuntary perceptual experiences that occur without an external stimulus, vivid and clear, containing the force and impact of a normal perception occurring in any of the sensory modalities²³⁸.

Disorganized thinking: Disorganization of thought is typically inferred from the individual's speech by jumping from one topic to another²³⁹, when answering questions, the answers are not related or are minimally related. It is possible that the speech is so disorganized that it is almost incomprehensible²⁴⁰. However, in most cases the disorganization goes from mild to moderate, so to be an important item, the disorganization must be severe enough to prevent communication effectively. This disorganization of thought or language correlates in magnitude directly with the phases of the disease from the prodrome period²⁴¹.

Mostly disorganized behavior or abnormal motor behavior: These disturbances can manifest in a variety of ways ranging from childhood behaviors²⁴² to unpredictable agitation. These kinds of problems can be seen in any form of goal-oriented behavior.

Catatonic behavior is a marked decrease in reactivity to the environment, which can range from a resistance to following instructions²⁴³, to maintaining rigid, inappropriate or bizarre postures, to a complete absence of verbal and motor responses²⁴⁴. Excessive motor activity may also appear without obvious cause or purpose in addition to other characteristics such as stereotyped movements, fixed gaze, grimaces, silence and speech echo.

Negative symptoms: Negative symptoms account for a substantial portion of the morbidity associated with schizophrenia but are less prominent in other psychotic disorders. Two different negative symptoms are particularly prominent in schizophrenia: decreased emotional expression²⁴⁵ and apathy.

238 Auditory hallucinations are the most common in schizophrenia.

239 Derailment or free associations.

240 Word disorder.

241 Symptom or set of early symptoms that may indicate the onset of a disease before specific symptoms of the same occur. The correlation is referred to in the Association (Association, p. 88, 2013) as well as in various studies such as that of Mondragón Maya (Mondragón Maya, 2013).

242 Childlike silliness.

243 Negativism.

244 Mutism and stupor.

245 Affective flattening.

The decrease in emotional expression includes reduction in the expression of emotions in the face, eye contact, intonation of language²⁴⁶, and movements of the hands, head and face that normally give an emotional tone to speech.

Abulia is the decrease in the ability to initiate and persist in activities motivated and initiated by the same subject directed to an end²⁴⁷.

Other negative symptoms include alogia, anhedonia, and social isolation²⁴⁸.

Thus, the symptoms of schizophrenia can be initially divided into positive and negative symptoms²⁴⁹ whose development has a pre-psychotic or prodromal phase, during which changes in the individual's functioning can be observed. Similarly, as part of the symptoms of schizophrenia, other cognitive alterations have been documented, mainly in attention, memory, processing speed, social cognition and executive functions²⁵⁰.

1.1 Clinical picture

The diagnostic criteria marked in the DSM-V for the identification of the disease are the following:

- A. Two or more of the symptoms listed below, each present for a considerable portion of time, for example during the period of one month (or less if the treatment was effective²⁵¹). At least one of the symptoms must be one of the first three.

246 Prosody.

247 Original text: "decrease in motivated self-initiated purposeful activities" (Association, p. 88, 2013). The individual may sit for long periods of time and show little interest in participating in social activities.

248 Praise: Decrease in speech production. Anhedonia: Decrease in the ability to experience pleasure from positive stimuli or a degradation in the collection of previously experienced pleasure. Social isolation: It refers to the apparent loss of interest in social interactions that can also be associated with apathy, but that can be the manifestation of limited opportunities for social interaction.

249 Positive: Behaviors and thoughts that are not present in the general population. Negative: Behaviors and thoughts that are absent in patients with schizophrenia but present in the general population.

250 See Heinrichs and Zakzanis, Rund and Borg, and Mondragón Maya [(Heinrichs & Zakzanis, 1998), (Mitchell, Elliott, & Woodruff, 2001), (Rund & Borg, 1999) y (Mondragón Maya, 2013)].

251 In the event that the active phase of symptoms subsides within a month in response to treatment, criterion A is met if the clinician estimates that the symptoms would have persisted in the absence of treatment.

1. Delusions
 2. Hallucinations
 3. Disorganized speech disorganized
 4. Catatonic or severely behavior
 5. Negative symptoms
- B. Social / work dysfunction: For a significant part of the time, from the onset of the disturbance, one or more important areas of activity, such as work, interpersonal relationships, or self-care, are clearly below the level prior to the onset of the disorder.
- C. Duration: Continuous signs of alteration persist for at least six months. During this period, at least one month of symptoms should be observed (or less if the treatment was effective) and may include periods of prodromal and residual symptoms. During these prodromal or residual periods, the signs of the alteration can manifest only by negative symptoms or by two or more symptoms from the list of criterion A, present in an attenuated form.
- D. Exclusion of Schizoaffective and Mood²⁵² Disorders: These disorders can be ruled out for the following reasons:
5. There has been no concurrent major depressive, manic, or mixed episode with the symptoms of the active phase.
 6. If the episodes of mood disturbance have appeared during the active phase and their total duration has been short in relation to the duration of the active and residual periods.
- E. Exclusion from substance use or other medical illnesses: The disorder is not attributable to the physiological effects of any substance or to any other medical condition.

252 Depression or bipolar disorder with psychotic characteristics.

F. Relationship to Pervasive Developmental Disorder: If there is a history of autistic or other pervasive developmental disorder²⁵³, further diagnosis of schizophrenia will only be made if delusions or hallucinations, in addition to the other required symptoms of schizophrenia, are also present for at least a month (or less, if the treatment was effective).

For the diagnosis of schizophrenia, it is necessary to specify²⁵⁴ the following:

- If you have had a single episode and are currently in an acute episode: It is the first manifestation of the disorder that meets the diagnostic criteria (symptomatic and temporary) and is in an acute episode²⁵⁵.
- If you have had only one episode and are currently in partial remission²⁵⁶.
- If you have had only one episode and, are currently in full remission²⁵⁷.
- Multiple episodes²⁵⁸ and is currently in an acute episode.
- Multiple episodes and is currently in partial remission.
- Multiple episodes and is currently in full remission.
- ²⁵⁹Continuous.
- Not specified.
- If there is catatonia²⁶⁰.

253 "disorder of childhood onset"(Association, p. 99, 2013).

254 These course specifications should only be used after the one-year duration of the disorder and if they are not inconsistent with the course of the diagnostic course criteria.

255 An acute episode is a period of time in which the symptomatic criteria are met.

256 Partial remission is a period of time in which improvement occurs after an episode and the diagnostic criteria for the disease are only partially met.

257 It is a period of time after an episode where specific symptoms of the disease no longer appear.

258 It is described as multiple episodes when you have experienced at least 2 episodes.

259 Symptoms that meet the diagnostic criteria remain for most of the course of the disease, there may be periods of remission of symptoms but they are very brief compared to the general course of the disease.

260 Use the catatonia criterion(Association, p. 119-120, 2013).

- Its severity²⁶¹.

1.2 Diagnostic characteristics

The characteristic signs of schizophrenia include a range of behavioral, cognitive and emotional dysfunctions where none of the symptoms is pathognomonic²⁶² of the disease, so that what is recognized is a constellation of signs and symptoms associated with an occupational impairment or of social functioning.

At least two Criterion A symptoms should be present for a significant portion of time within a month or more. At least one of these symptoms must be the clear presence of delusions, hallucinations, or disorganized speech. In the event that the active phase of symptoms subsides within the period of the month in response to treatment, criterion A is met if the clinician estimates that the symptoms would have persisted in the absence of treatment.

Schizophrenia is also reflected in the deterioration in one or more major areas of functioning such as social, cognitive and functional.

Some of these disturbances must persist for a continuous period of at least six months. Prodromal symptoms usually precede the active phase preceded by residual symptoms characterized by mild or sub-threshold forms of hallucinations or delusions in the form of rare or unusual beliefs that do not yet have delusional proportions²⁶³, the speech is understandable but vague, and their behavior may be unusual but not mostly disorganized. Negative symptoms are common in the prodromal and residual stage and can be severe. Social withdrawal is usually the first sign of the disorder.

Mood disorders are common in schizophrenia and may be concurrent with the active phase of the disorder, however, unlike a psychotic mood disorder²⁶⁴, the diagnosis of schizophrenia requires

261 For the severity of the primary symptoms, each symptom is evaluated according to the most severe event in the last seven days, on a scale of five points (0 to 4) where zero is equal to: not present and 4 refers: present and severe.

262 “Symptoms that appear only in the context of a specific disease”.

263 They can be presented as magical thinking where unusual perceptual experiences are also presented, such as feeling the presence of someone who is not seen.

264 “Psychotic mood disorder”.

the presence of delusions or hallucinations in the absence of an episode of mood disturbances. Furthermore, mood episodes taken globally should be a minority of the total duration of active and residual periods of the disease.

In addition to the five central domains of the diagnostic criterion (delusions, hallucinations, disorganized thinking, abnormal or mostly disorganized motor behavior and negative symptoms), the evaluation in the domains: cognitive and affective (symptoms of depression or manic phases) are vital for making distinctions between different spectra of schizophrenia and other psychotic treatments.

Cognitive domain: The deficit in cognitive areas is common in schizophrenia (which is related to professional and functional impairment). Among the areas that can be affected are declarative memory, working memory, attention, language functions and other executive functions, processing speed, and abnormalities in sensory processes and inhibitory capacity.

Similarly, there are deficits in social cognition such as deterioration in the ability to infer the intentions of other people²⁶⁵ and then attend and interpret irrelevant events as full of meaning, which can give rise to the generation of explanatory delusions. These failures often persist during the remission of other symptoms.

1.3 Course and prognosis

83

The psychotic characteristics of schizophrenia typically emerge between adolescence and the mid-30s. The age peak for the onset of the first psychotic episode varies in men and women, being in men from adolescence to mid-20s and in women, the late 20s. Although the onset can be abrupt or insidious, the vast majority of individuals have a slow and gradual development of a variety of clinically significant signs and symptoms. Half of the patients have symptoms of depression and cognitive decline is also common. Cognitive alterations appear throughout the development of the disease and precede the emergence of psychotic crisis. These alterations in cognition tend to become a stable form of cognitive processing in the adult.

265 In other words, assume a Theory of mind.

Mondragón Maya in a recent study with a Mexican population, obtained significant differences in tests of attention, processing speed and social cognition between control patients, patients at clinical risk of developing schizophrenia and patients with a first psychotic episode, where performance correlates the presence and development of the disease (absence, prodromal phase and diagnosed pathology) with worse executions²⁶⁶.

In schizophrenia, the predictors remain largely unexplained and the course of the disease is difficult to define, so predictions are usually not very reliable; However, the course of the disease is positive in 20% of the patients, where even a small group recovers completely²⁶⁷, however, the total improvement must occur within a period of a few years after the diagnosis, since if not, only a small percentage of patients show improvement later²⁶⁸.

Psychotic symptoms tend to decrease over the course of life, although negative symptoms are much more persistent.

Environmental

It has even been identified that the season where the birth occurs may be involved in the incidence of schizophrenia (in some places there is a higher incidence of cases in children born between late winter and early spring). On the other hand, children who grow up in urban environments also seem to have a higher prevalence.

The presence of obstetric and perinatal complications including, hypoxia, stress, infections, malnutrition, maternal diabetes, older parental age and marijuana use²⁶⁹ have also been linked to the occurrence of the disorder; however, the vast majority of children with these risk factors do not develop the disease²⁷⁰.

Genetics

In the genetic aspect, most studies suggest that the pathology is conferred by a spectrum of

266 See Maya (Mondragón Maya, 2013).

267 See Association (Association, p. 102, 2013).

268 See Randolph, Goldberg, & Weinberger (Randolph, Goldberg, & Weinberger, 1993).

269 See Ortuño, Soutullo, & Pla (Ortuño, Soutullo, & Pla, 2005).

270 See Association (Association, p. 103, 2013)

alleles, a constellation of genes (rare and common) whose interaction results in vulnerability to the presence of the disorder²⁷¹. However, there are epidemiological studies that indicate that, for example, there is a higher prevalence of the disease in relatives of patients with schizophrenia²⁷² and in homozygous and dizygotic twins²⁷³, although the vast majority of individuals diagnosed with the disease do not have a family history of psychosis.

Development

One of the most accepted hypotheses regarding the genesis of the disease appeals to the defective development of the central nervous system (CNS), which conditions a greater risk²⁷⁴ of the presence of the disease. The processes of proliferation, migration, neuronal differentiation and synaptogenesis that occur in embryonic development, which are decisive in the connection pattern of neuronal circuits, are altered in schizophrenic patients²⁷⁵. Subsequent processes such as apoptosis and synaptic pruning or environmental neuropathological events also interact with pre-existing alterations triggering the disease²⁷⁶.

Obvious differences have been found in multiple brain regions through neuropathological, neurophysiological and neuroimaging studies, such as in the prefrontal cortex, thalamus and in the spinal brain tract²⁷⁷.

Likewise, differences have been found in brain architecture, white matter connectivity, and gray matter volume in cortical regions such as the prefrontal, temporal, and limbic cortex²⁷⁸.

On the other hand, tomography studies report ventricular widening and reduction in the general

271 See Quintero Gutiérrez del Alamo, Baca García, Correas Lauffer, Pérez Rodríguez, & González de Rivera and Association (Quintero Gutiérrez del Alamo, Baca García, Correas Lauffer, Pérez Rodríguez, & González de Rivera, 2004), (Association, p. 103, 2013).

272 First degree relatives of a patient have a 10 times greater risk of developing the disease than the general population (Gottesman, 1991), (Lichtermann, Karbe, & Maier, 2000).

273 See Gottesman & Bertelsen (Gottesman & Bertelsen, 1989),

274 See Walker & Bollini (Walker & Bollini, 2002).

275 See Bloom (Bloom, 1993).

276 See Mueser & McGurk (Mueser & McGurk, 2004).

277 See (Andreasen, Paradiso, & O'Leary, 1998).

278 See a Grace, Moore, & O'Donnell, Gray, Feldon, Rawlins, Hemsley, & Smith, and (Kasai et al. (Grace, Moore, & O'Donnell, 1998), (Gray, Feldon, Rawlins, Hemsley, & Smith, 2011), (Kasai et al., 2002), (Andreasen et al., 1998).

size of the brain²⁷⁹, mainly in the temporal and frontal lobes, hippocampus, thalamus, and amygdala, as well as greater volume in sulci and ventricles, especially in the third ventricle²⁸⁰.

By means of positron emission tomography and functional magnetic resonance, hypo-frontality has been reported in the dorsal and infero lateral areas of the prefrontal cortex²⁸¹. In fact, it has been proposed that the abnormalities observed in the brain activity of patients with schizophrenia could be related to the connections between the prefrontal cortex and other cortical areas²⁸². On the other hand, deterioration of skills such as eye tracking is also observed.

Regarding the neurochemical aspect, imbalances have also been reported in the neurotransmission chemical systems²⁸³, with the added complication of being interacting systems, which is why a cascade effect is possible when anyone is altered.

Dopamine system

Pharmacological treatment of the disease has been based on blocking dopamine receptors²⁸⁴, so it is not surprising that the most studied neurotransmitter in the etiology of the disease is dopamine²⁸⁵. A hypodopaminergic state has been proposed in cortical areas and a hyperdopaminergic state in subcortical regions²⁸⁶, suggesting that there are variations in dopamine concentration according to the CNS region.

Glutamate system

279 See Lawrie, McIntosh, Hall, Owens, & Johnstone, Raz & Raz, Van Horn & McManus, and Association (Lawrie, McIntosh, Hall, Owens, & Johnstone, 2008), (Raz & Raz, 1998), (Van Horn & McManus, 1992), (Association, 2013), (Association, p. 102, 2013).

280 See a Cannon et al., a Kasai et al., a McDonald et al., a Montoya, Lepage, & Malla, a Pfefferbaum & Marsh, ya Staal, Hulshoff, Schnack, Hoogendoorn, Mechteld LC Jellema, & Kahn (Cannon et al., 2003), (Kasai et al., 2002), (McDonald et al., 2006), (Montoya, Lepage, & Malla, 2005), (Pfefferbaum & Marsh, 1995), (Staal, Hulshoff, Schnack, Hoogendoorn, Mechteld LC Jellema, & Kahn, 2000).

281 See Achim & Lepage, ya Glahn et al. (Achim & Lepage, 2005), (Glahn et al., 2005).

282 See Lawrie (Lawrie et al., 2008).

283 Chemical disruptions can be explained due to alterations in neuro-anatomical circuits, since most neuro-transmission systems occur in their mid-regions.(Andreasen et al., p. 211, 1998).

284 See Graff-Guerrero, Apiquian, Fresán, & Garcia-Anaya, and Tost, Alam, & Meyer-Lindenberg (Graff-Guerrero, Apiquian, Fresán, & Garcia-Anaya, 2001), (Tost, Alam, & Meyer-Lindenberg, 2010)

285 Dopamine is a neurotransmitter that participates in the release of hormones related to happiness, libido and appetite, affects muscle movement, the functioning of the immune system and stimulates the memorization process.

286 See Davis, Kahn, Ko, & Davidson (Davis, Kahn, Ko, & Davidson, 1991).

Lower levels of glutamate have been found²⁸⁷ in the cerebrospinal fluid of schizophrenic patients as well as an increase in the cingulate cortex²⁸⁸, suggesting the idea of a hypofunction of the glutamatergic receptor N-methyl-D-aspartate (NMDA). NMDA receptors tonically stimulate GABAergic cells, which establish synapses with excitatory neurons, so that NMDA antagonists cause a decrease in tonic excitation on GABAergic neurons, thus releasing the action of excitatory neurons, which may be responsible of psychotic crises and induced cytotoxicity.

Serotonergic system

The serotonergic system interacts with the dopaminergic system, since serotonin²⁸⁹ inhibits the release of dopamine in the substantia nigra, blocking dopamine release in the striatum and cortex. Extra pyramidal symptoms are probably produced by treatment with serotonergic agonists²⁹⁰.

The negative symptoms of the disease have been related to the reduction of dopamine transmission in the prefrontal cortex, so that using serotonergic antagonists will increase the release of dopamine in prefrontal areas, decreasing the symptoms²⁹¹.

2. Bipolarity and related disorders (Definition)

87

Bipolarity and other related disorders have their own place²⁹² as a bridge between two different kinds of diagnoses, on the one hand having the spectrum of schizophrenia and on the other, depressive disorders, this by virtue of its symptomatology, and family and genetic history. Worldwide, it is estimated that between 1 and 3% of the population suffers from this condition²⁹³, in the United

287 Glutamic acid is an excitatory neurotransmitter by stimulating specific receptors, called glutamate receptors.

288 See Benes, Sorensen, Vincent, Bird, & Sathi (Benes, Sorensen, Vincent, Bird, & Sathi, 1992), (Tsai et al., 1995).

289 Serotonin is a transmitter of the nervous system, relevant to modulate anxiety and aggressiveness, sexual desire, and appetite and satiety, among other inhibitions that are directly related to symptoms of depression.

290 See Mondragón Maya (Mondragón Maya, p. 12, 2013).

291 See Graff-Guerrero et al. (Graff-Guerrero et al., 2001).

292 It is no longer located by the DSM-V within depressive disorders.

293 Data provided by Glaxo Smithkline México.

States a prevalence of 0.6% was found and in Mexico, the presence of manic episodes is found in 1.4% of women and in 2.5% of men²⁹⁴. Even though this condition has good prognoses resulting from treatment, it is estimated that only 30% of patients are treated, even when left untreated, there is a high suicide rate (one in four or five patients without treatment commit suicide)²⁹⁵.

Bipolarity and other disorders are defined according to three classifications²⁹⁶:

1. Type I bipolar disorder: It is characterized by chronic episodes of depression and extreme mania²⁹⁷, there may be affective psychotic episodes, although they are not necessary for diagnosis, nor is the presence of an episode of major depression throughout life.
2. Type II bipolar disorder: Requires the presence of a major depressive episode throughout life and at least one hypomanic episode. It is usually accompanied by serious work and social disabilities.
3. Cyclothymic disorder: Adults who have experienced at least two years of depressive and hypomanic periods without meeting the criteria for an episode of mania, hypomania, or major depression (in the case of children, the period is one year).

2.1 Clinical picture

88

The diagnostic criteria established in the DSM-V for the identification of type I bipolar disorder require the appearance of at least one manic episode preceded or followed by hypomania or episodes of major depression.

294 It is difficult to present the prevalence of bipolarity, due to the change in its classification from DSM-IV to DSM-V, since the studies included it within depressive disorders, with a prevalence in Mexico of 4.5%: 5.8% in women and 2.5% in men (Belló, Puentes-Rosas, Medina-Mora, & Lozano, 2005).

295 (Judd et al., 2002).

296 In the present study, we focus on patients with type I bipolar disorder, for which its other two variants are not defined, however, it is possible to review the DSM-V pages 132-154 if more information is sought (Association, 2013).

297 See Becoña & Lorenzo (Becoña & Lorenzo, 2001)

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2.1.1 Manic episode:

- A. A clear, persistently elevated and expansive period of abnormal mood with irritability, in addition to abnormal and persistent increase in energy or goal-directed activities, which lasts at least one week and is present most of the day, almost every day (and any length of time if hospitalization was required).
- B. During the period of mood and energy disturbances or increased activity, there were three or more of the following symptoms (four if the mood was only irritability), present to a significant degree and representing a marked change from usual behavior:
 - 1. Inflated self-esteem or grandiosity
 - 2. Decreased need for sleep (three hours is enough to feel rested)
 - 3. More talkative than usual or experience pressure to keep talking.
 - 4. Flight of ideas or the subjective experience that your thoughts are racing.
 - 5. Easily distracted by irrelevant stimuli.
 - 6. Increased goal-directed activity (can be social, work, school, or sexual) or psychomotor agitation (goalless activities).
- C. The mood disturbance is severe enough to cause marked social or occupational functioning dysfunction, to necessitate hospitalization to prevent harm to self or others, or to present psychotic features.
- D. The episode is not attributable to the psychological effects of a substance or to any other medical condition.

It is important to note that a manic episode that emerges during antidepressant treatment but that persists showing the full syndrome, beyond the psychological effects of that treatment, is sufficient

evidence to diagnose a manic episode and, therefore, for the diagnosis of a disorder bipolar type I.

Criteria A - D constitute a manic episode and at least one manic episode is necessary to diagnose a bipolar disorder type I.

2.1.2 Hypomanic episode:

- A. A clear, persistently elevated and expansive period of abnormal mood with irritability, in addition to the abnormal and persistent increase in activity or energy, which lasts for at least four consecutive days and is present most of the day, almost every day.
- B. During the period of disturbances there is an increase in energy and activities, three or more of the following symptoms appear (four if the mood was only irritability), present to a significant degree and represent a noticeable change with respect to the usual behavior:
 - 1. Inflated self-esteem or grandiosity
 - 2. Decreased need for sleep (three hours is enough to feel rested)
 - 3. More talkative than usual or experience pressure to keep talking.
 - 4. Flight of ideas or the subjective experience that your thoughts are racing.
 - 5. Easily distracted by irrelevant stimuli.
 - 6. Increased goal-directed activity (can be social, work, school, or sexual) or psychomotor agitation (goalless activities).
 - 7. Excessive involvement in activities that have a high potential for unfavorable consequences (shopping sprees, sexual indiscretions, or poorly planned investments).
- C. The episode is associated with an unequivocal change in functioning, which is not characteristic

of the individual when he is not manifesting symptoms.

- D. The character disturbance and the change in functioning are observable by others.
- E. The episode is not severe enough to cause marked social or occupational functioning dysfunction, or to necessitate hospitalization. If psychotic features are present, the episode is by definition manic.

The episode is not attributable to the psychological effects of a substance or to any other medical condition.

It is important to note that a hypomanic episode that emerges during antidepressant treatment but that persists showing the full syndrome, beyond the psychological effects of that treatment, is sufficient evidence for a diagnosis of a hypomanic episode. However, caution is advised as one or two symptoms are not sufficient for the diagnosis of a hypomanic episode and not necessarily bipolar syndrome.

Criteria A - F constitute a hypomanic episode. Hypomanic episodes are common in type I bipolar disorder, but are not required for diagnosis.

2.1.3 Major depressive episode:

- A. Five or more of the following symptoms must have been present for a period of two weeks and represent a change in functioning from their previous functioning; at least one of the symptoms is (1) depressed mood, or (2) loss of interest or pleasure.
- 2. Depressed mood most of the day, almost every day (can be reported by the individual or reported by others).
- 3. Marked decrease in interest or pleasure in all, or almost all, activities most of the day, almost every day (maybe reported by the individual or reported by others).
- 4. Significant weight loss when not dieting or weight gain (a change of more than 5% in body

- weight in a month), decrease or increase in appetite almost every day.
5. Insomnia or hypersomnia almost every day.
 6. Agitation or psychomotor slowness almost every day (observable by others).
 7. Fatigue or loss of energy almost every day.
 8. Feelings of worthlessness, excessive or inappropriate guilt (may be illusory) almost every day.
 9. Decreased ability to think or concentrate, lack of decision may occur almost every day (maybe reported by the individual or by others).
 10. Recurring thoughts of death (not just fear of death), suicidal ideation with a specific plan, a suicide attempt, or a specific plan to commit suicide.
- K. Symptoms cause significant anxiety or social inadequacy, occupational disorders, and other important areas of functioning.
- L. The episode is not attributable to the psychological effects of a substance or to any other medical condition.

92

It should be noted that criteria A - C constitute an episode of major depression. Episodes like these are common in type I bipolar disorder, but are not required for diagnosis.

As a result of significant losses (financial losses, major illnesses, disability, etc.), feelings of deep sadness, rumination regarding the loss, insomnia, loss of appetite, weight loss may occur, which may seem like an episode of major depression, however, these symptoms are understandable in the context of the loss, so the case should be carefully considered²⁹⁸.

298 To distinguish loss from a major depressive episode (MDE), it is helpful to remember that in loss, the predominant feelings are feelings of emptiness, whereas in MDE the mood is continuously depressed and there is an inability to anticipate joy or happiness. pleasure.

2.2 Type I bipolar disorder

2.2.1 Diagnostic criteria

- A. The criteria for at least one manic episode have been met.
- B. The occurrence of manic episode and major depressive episode (MDE) is not better explained by schizoaffective disorder, schizophrenia, schizopreniform disorder, delusional disorder, or any other form of the specific or non-specific spectrum of schizophrenia, or by other psychotic disorders.

It is necessary to specify the severity of the disorder based on the number of diagnostic symptoms and the severity of those symptoms, in addition to the degree of functional dysfunction:

- Mild: Few to no symptoms (beyond those necessary to meet the diagnostic criteria), the intensity of the symptoms are distressing but manageable, resulting in minor social and occupational functioning dysfunctions.
- Moderate: Both the number of symptoms, their intensity and functional dysfunctions are between mild and severe.
- Severe: The number of symptoms is substantial (beyond those necessary to meet the diagnostic criteria), the intensity of the symptoms is extremely distressing, and they are not manageable. The symptoms generate a marked interference with social and occupational functioning.

It is also necessary to specify if the disorder:

- I. Has psychotic characteristics: Delusions or hallucinations are present at any time during the episode. If this is the case, it must be clarified if:
 - i. The psychotic characteristics are congruent with the mood: During the manic episode, the content of all delusions or hallucinations is consistent with typical manic themes, such as

- themes of grandeur, invulnerability, etc. It may also include issues of distrust or paranoia, especially with respect to others, doubts about one's own ability and achievements, etc.
- ii. Psychotic characteristics are not congruent with mood: The content of the delusions and hallucinations is inconsistent with the polarity of the episode themes, as described above, or the content is a mixture of both.
 - II. With catatonia: This specification may apply to an episode of mania or depression if features of catatonia are present for most of the episode.
 - III. Occurring around childbirth: When the symptoms appear during pregnancy or four weeks around it.
 - IV. With seasonal patterns: This specification applies to the individual's life patterns and its essential characteristic is that the appearance of manic, hypomanic or major depression episodes usually occur recurrently in similar periods of the year.
 - i. Whether there has been a regular temporal relationship between the onset of the episodes and the time of year in any of the bipolar disorders (type I and II).
 - ii. If a total remission or change from major depression to mania or hypomania, or vice versa, occurs at a particular time of year.
 - iii. In the last two years, the individual's episodes have demonstrated the temporal relationships defined above and furthermore, no other non-seasonal episodes have occurred with the previous polarity.
 - iv. Seasonal episodes substantially exceed the number of non-seasonal episodes the individual has had in their lifetime.

Finally, it must be said if there is any kind of remission in the patient:

- In partial remission: The symptoms of the immediately previous episode (be it mania,

hypomania or major depression) are present but the complete criterion has not yet been met, or if it occurs a period of less than two months without any significant symptoms of mania, hypomania, or major depression.

- In total remission: If during the past two months there have been no significant signs of the disorder.

The mode of presentation of the diagnosis follows the following order: “type I bipolar disorder, type of current episode or the last episode, specifications of severity / psychotic / remission traits, followed by extra specifications” such as the following:

- With alterations of anxiety
- With mixed characteristics
- With rapid cycling
- With melancholic characteristics
- With atypical characteristics
- With psychotic characteristics
- With catatonia
- With onset around parturition (peripartum)
- With seasonal patterns

2.2.2 Diagnostic characteristics

The essential characteristic of a manic episode is the presence of a distinguishable period where there is an abnormal, persistently elevated, and expansive rise in mood. It can be characterized by irritability and a persistent increase in activity or energy that is present most of the day, and almost every day for a period of at least a week, accompanied by three or more criteria B symptoms (or four if it is that the mood is irritable rather than elevated or expansive).

The mood in a manic episode is usually described as euphoric, overly cheerful, or *feeling on top of the world*. In some cases humor is of a quality that is easily contagious and therefore easily recognizable as excessive, and it can be characterized by a lack of limits or by an even dangerous enthusiasm towards interpersonal, sexual or occupational relationships, although the typical state of mind is irritability, particularly when the individual's wishes are thwarted.

Also, rapid changes in mood can occur in short periods of time, which is called *emotional lability*.

It is likely that during the manic episode, the individual embarks on various projects that interfere with each other, usually misinformed about them. However, everything seems within reach to the individual. High levels of arousal can occur at unusual times of the day.

Inflated self-esteem is typically present, ranging from self-confidence to delusions of grandeur. The need for sleep decreases and there are alterations even in speech such as increased speed, volume, greater need for participation, etc.

As for the flight of ideas, the individual's thoughts go faster than he can express them through speech, leading him to a sudden jump from topic to topic, it can even generate a disorganized and incoherent speech. Sometimes, the accumulation of ideas is such that it is difficult for the individual to speak.

Loss of attention or the facility to be distracted is evidence of an inability to purify external stimuli, which prevents the individual from following instructions or maintaining a rational conversation.

Increased activity consists of excessive planning and participation in multiple activities, including politics, religious, occupational, and sexual activities. In fact, there is usually an increase in sexual drive, fantasies, etc. Psychomotor agitation is also usually present, which is reflected in walking or

having many simultaneous conversations.

The expansive mood and excessive optimism, coupled with poor judgment lead to behaviors such as shopping sprees, reckless driving, sexual promiscuity, poorly planned investments that are unusual for the individual and can have catastrophic consequences.

It is important to mention that many symptoms or syndromes can be attributable to the physiological effects of the consumption of a drug, even the collateral effects of some medication or treatment, or some other medical condition, so they would not count for the diagnosis of bipolar disorder type I. However, a manic episode that arises during drug treatment or use but persists beyond the agent-induced physiological effects is sufficient evidence for the diagnosis of a manic episode.

A major problem arises because individuals do not perceive themselves as ill, so they often vehemently resist treatment. Depressive symptoms can occur during a manic episode; however, these last moments, hours or, in a few cases, days.

Some individuals may become hostile, physically threaten others, and even when delusional they may physically assault others or commit suicide²⁹⁹.

2.2.3 Course and prognosis

The average age of onset of the first manic, hypomanic or major depression episode is around 18 years for type I bipolar disorder and the onset of the disorder usually occurs at different stages of life, a first episode may appear in the 60s and 70s. More than 90% of individuals who have had a single manic episode usually have subsequent recurrent mood disturbances, and about 60% of manic episodes occur immediately before an episode of major depression.

Those individuals with type I bipolar disorder tend to score lower on cognitive tests than healthy people, so cognitive deficits can contribute to vocational and interpersonal difficulties, which persist throughout life.

2.2.4 Etiology

²⁹⁹ The risk of suicide in individuals with bipolar disorder is estimated to be 15 times higher than that of the general population and is a quarter of all completed suicides (Association, p. 131, 2013).

The disorder has associated environmental characteristics, such as genetic and psychological.

Environmental

Bipolar disorder is more common in high-income countries, with a difference of 1.4 to 0.7%. Similarly, the separated, divorced or widowed have a higher incidence than people who are married or who have never been married.

Genetics

Having a family history of bipolarity is one of the strongest and most consistent risk factors out there, which increases depending on how close you are to past cases. Both schizophrenia and bipolarity share genetic origins, which is reflected in their co-aggregation.

Gender

Regarding the incidence of the disorder in gender issues, a similar proportion between men and women is maintained, however, women have a greater probability of experiencing rapid cycling and mixed states with greater comorbidity for eating disorders, in addition to being more likely to experience depressive symptoms. Those women with type I or II bipolar disorder are more likely to consume alcohol than men or women who do not have this type of disorder.

3. Obsessive-compulsive disorder and related disorders (Definition)

The complex of *obsessive-compulsive disorder* and other related disorders includes both the obsessive-compulsive disorder (OCD) itself and the body dysmorphic disorder, hoarding, trichotillomania, excoriation, and the disorder Obsessive-compulsive medication induced, as well as OCD associated with other medical conditions and nonspecific OCD. The prevalence of this

type of disorders worldwide is between 1.1% and 1.8%, and in the United States it is 2%³⁰⁰, with women being slightly more affected during adulthood, in contrast to men, who are affected more in childhood, 25% of men even start with the disorder before the age of 10.

In general, the mean age of onset is around 19.5 years, although a quarter of cases begin around 14 years.

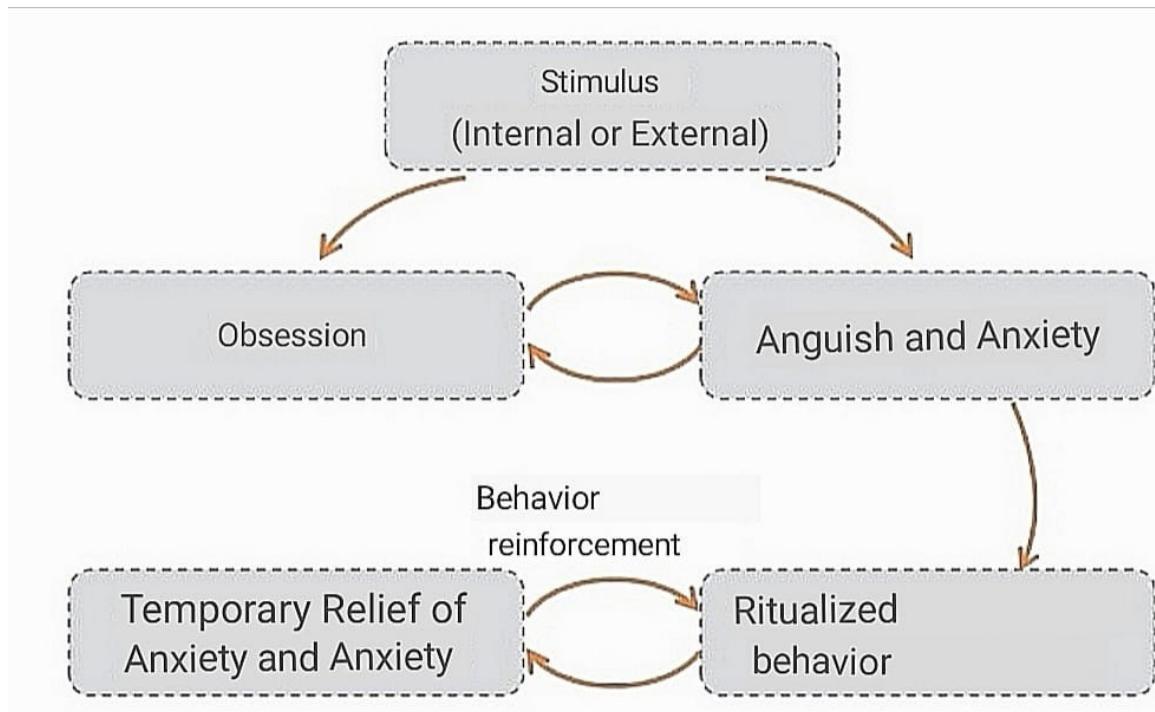
OCD is characterized by repetitive thoughts and behaviors that are experienced as undesirable (obsessions and / or compulsions). Obsessions are recurring and persistent thoughts, urges or images that are experienced as intrusive and unwanted, while compulsions are repetitive behaviors or mental acts that an individual feels compelled to perform in response to an obsession or according to rigidly applied rules . Some other disorders in this same set are also characterized by worries and behaviors, or repetitive mental acts, that an individual performs in response to worries. While still other disorders of the group are characterized mainly by recurrent body-oriented behaviors, in addition to repeated attempts to stop, or at least decrease, these behaviors.

Many of the subjects with OCD also have dysfunctional thoughts, which may include a magnified sense of responsibility and a tendency to underestimate threats, show perfectionism and intolerance to uncertainty; They give too much importance to thoughts³⁰¹ and therefore try to control them.

Scheme 17. Theoretical foundation of obsessive-compulsive behavior

300 See Pauls, Abramovitch, RAuch and Geller (Pauls, Abramovitch, Rauch, & Geller, 2014).

301 For example, many have the belief that having a forbidden thought is just as bad as putting it into practice.



An individual with obsessive-compulsive disorder experiences an exaggerated concern about danger, hygiene, or harm, resulting in conscious and persistent attention to the perceived threat or threats, in other words, results in obsessions. In response to this distress and / or anxiety associated with these obsessions, the person acts (that is, performs a behavior) to neutralize the distress and / or anxiety, which provides temporary relief from the anxiety associated with the obsession. However, this relief supposes the reinforcement of the behavior, which leads to a repetitive, compulsive behavior when the obsessions are repeated³⁰².

OCD differs from normal rituals and worries by being excessive and persistent beyond appropriate developmental periods. The distinction between the presence of subclinical symptoms and a clinical disorder requires the evaluation of a number of factors, including the individual's level of anxiety as well as the degree of functional disorder. Within this group of disorders, there are common features, for example, although the content of obsessions and compulsions varies between subjects, certain symptomatological dimensions are common in OCD, such as cleanliness (obsessions of contamination and compulsions towards cleanliness), symmetry (obsessions of

302 Ver a Pauls et al. (Pauls et al., 2014).

symmetry and repetition, ordering and numbering compulsions), prohibited or taboo thoughts (aggressive, sexual and religious obsessions with associated compulsions) and associated with harm (fear of being harmed or harming others and review compulsions).

A meta-analysis of 21 studies conducted between 1994 and 2008 with a sample of 5,124 patients, showed that it is possible to group symptoms in four dimensions, within their heterogeneity³⁰³:

Table 3. Dimensions of obsessive-compulsive behavior

Factor (% of variance)	Obsession	Compulsion
Symmetry (26.7)	Symmetry	<ul style="list-style-type: none"> ◦ Counting ◦ Sorting out • • Repeating
Taboo thoughts (21.0)	<ul style="list-style-type: none"> • • Aggressive • • Religious • • Sexual • Somatic 	Reviewing
Contamination (15.9)	Contamination	Cleaning
Compulsive hoarder (15.4)	Compulsive hoarding	Accumulating

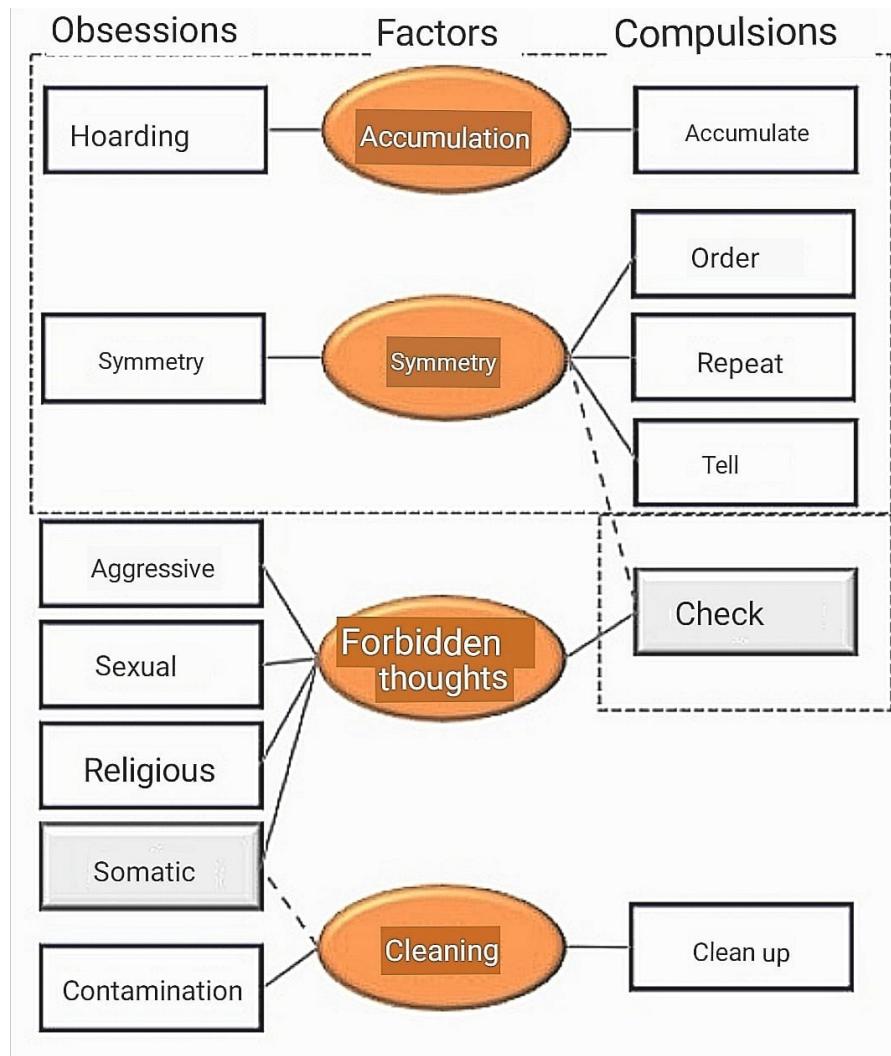
Source: Pauls, Abramovitch, Rauch, & Geller, 2014, own translation.

OCD meta-analysis

Yale-Brown factor structure Obsessive-compulsive symptom listing scale during life

Scheme 18. Dimensions of obsessive-compulsive behavior

303 See Pauls, Abramovitch, Rauch, & Geller (Pauls, Abramovitch, Rauch, & Geller, pag. 412, 2014).



The categories of symptoms shaded in white are associated with the same factor throughout life. The gray shaded symptom categories are associated with different factors in adulthood and childhood. Solid lines indicate that a symptom category is associated with a particular factor in adults. Dotted lines indicate that a symptom category is associated with a particular factor only during childhood. The accumulation and symmetry factors that are enclosed by the dotted rectangle were collapsed by the same factor in some subgroup analyzes, including studies with non-English-speaking subjects or when symptom severity ratings were used. The forbidden thoughts factor is split into two separate factors in subgroup analysis that include non-English-speaking subjects and when considering studies that only use data at the object level.

It has been suggested that there at the least four different familial forms³⁰⁴ of TOC:

³⁰⁴ The term Familial indicates that it is a condition that is “transmitted” between families, which may be due to environmental conditions, that is, it does not necessarily mean that the condition is genetic.

1. TOC with early onset and comorbid with tics
2. OCD early start without tics
3. TOC late onset without tics
4. A non familial sporadic TOC that is not associated with tics

Disorder dysmorphic Body is characterized by concern for one or more perceived defects in physical appearance that, in fact, may be observable to others (at least slightly), in addition to the presence of repetitive behaviors (looking in the mirror, skin pinching, or searching constant reassurance) or mental acts (comparing appearance with that of others) that concern appearance³⁰⁵.

Hoarding disorder is characterized by persistent difficulty discarding or leaving possessions, regardless of its actual value. This is the result of a need to save objects and an anxiety to discard them. Hoarding disorder differs from normal collecting by reaching degrees where the accumulation of objects seriously compromises the individual's living space.

Trichotillomania is characterized by constant pulling or pulled from the hair, resulting in the loss of the same. There are usually repeated attempts to get rid of hair pulling.

Galling is constant pinching of the skin, resulting in injury thereof. As in trichotillomania, there are usually previous attempts to put this behavior aside.

103

Both disorders, unlike OCD, are not triggered by obsessions, but rather by emotional states with high anxiety or boredom.

The *OCD induced by substances or medications* consists of the appearance of the symptoms of OCD but caused by intoxication due to the abstinence of some substance or, even, to some medication.

Finally, nonspecific OCD is typified when the symptoms do not meet the specific criteria for diagnosing OCD, mainly due to an atypical presentation of it or an uncertain etiology.

³⁰⁵ It should be noted that concerns about appearance are not necessarily better explained by the existence of disorders associated with eating.

Altogether, obsessive-compulsive disorders can manifest different levels of consciousness (*insight*) that refers to the understanding or awareness of the patient of their obsessions or compulsions, which ranges from good insight, to an absent one or with delusional beliefs in relation to the obsessions. However, in these latter patients, psychotic disorders will not be diagnosed, but OCD with the specification of “missing insight” or “delusional beliefs”.

3.1 Clinical frame

Diagnostic criteria marked in DSM-V for identification of the disease are:

- A. Presence of obsessions, compulsions or both:

Obsessions are defined by the following criteria:	Compulsions are defined by the following two criteria:
Recurring and persistent thoughts, urges, or images that are experienced (at some point during the disturbance) as intrusive and undesirable, causing marked anxiety and distress in most individuals.	Repetitive behaviors or mental acts that the individual feels compelled to perform in response to an obsession or according to a series of rigidly applied rules.
The individual tries to ignore or suppress these thoughts, urges or images through some other thought or action (performing compulsions).	The behaviors or mental acts are aimed at preventing or reducing the anguish and anxiety of the individual or to prevent some feared situation; however, these behaviors or mental acts are not realistically connected to what they are intended to prevent or neutralize.

- B. Obsessions or compulsions require more than one hour a day to perform or cause significant distress or disability in social, occupational, or other important areas.
- C. Obsessive compulsive symptoms are not attributable to the physiological effects of any substance or medical condition.
- D. The disturbances are not better explained by the symptoms of some other mental disorder.

Likewise, it is necessary to **specify the degree of insight**, which refers to the degree to which the patient recognizes that his beliefs are exaggerated or irrational, that is, he is aware that his behavior is obsessive and meaningless. In this way, there are three degrees of insight:

With **good insight**: the individual recognizes that obsessive-compulsive beliefs are definitely or probably not true, or at least that they could not be true.

With **poor insight**: The individual maintains that obsessive-compulsive beliefs are probably true.

With **absent insight / delusional beliefs**: The individual is fully convinced that the obsessive-compulsive beliefs are true.

The degree of insight of the individual can change throughout the course of the disease. However, the presence of a low level of insight is associated with worse long-term results.

Additionally, it is necessary to specify whether the individual has or had a tic, since 30% of patients with OCD have had or have a tic. This, in fact, is more common in men who started OCD in their teens.

The characteristic symptoms of OCD, as mentioned above, are the presence of obsessions and compulsions, which are not enjoyed by the individual, although this does not mean that they cannot obtain some relief by performing their respective rituals, and decrease the anxiety. Most patients suffer from both obsessions and compulsions, with different degrees of insight between them.

105

However, in the general population, intrusive thoughts or repetitive behaviors occasionally occur, so criterion B emphasizes elements focused on time consumption and clinical dysfunctions that allow generating more accurate diagnoses, also differentiating in moderate symptoms (1 to 3 hours a day) until severe symptoms.

It should be noted that it is common for patients with OCD to experience a wide range of responses³⁰⁶ when confronted with situations that trigger their obsessions and compulsions, for which it is common for them to try to avoid people, places or things that trigger them, which

306 They can range from marked anxiety to panic attacks, feelings of discomfort, or incompleteness.

generates dysfunctions and behavioral restrictions.

It is common for OCD to be associated with a decrease in the quality of life, as well as with serious dysfunctions in socialization (in general, with other members of the family, and in other dimensions of life). The time invested in these behaviors can affect everything from school work to professional job performance, which will affect the level of independence and autonomy of the individual.

3.2 Course and comorbidity

The course of OCD is often complicated by the co-occurrence of other disorders. 76% of these patients also have anxiety disorder, 63% depression or bipolar disorder, 23% to 32% have comorbid obsessive compulsive personality disorder, and 30% have tics (more common in men than women). Thus, for example, it is common to observe a triad of OCD, tics and attention deficit hyperactivity disorder in children. OCD can also be found as a comorbid disorder in disorders characterized by impulsivity, schizophrenia (12%), eating disorders and Tourette. In fact, comorbidity is more the rule than the exception, in a study with 955 patients, only 7.7% of the patients had pure OCD³⁰⁷, the majority of whom were women who were working at that time. Patients with pure OCD presented a lower presence of suicidal ideation and suicidal attempts, in addition to a lower severity on the Yale Brown scales (Y-BOCS and DY-BOCS³⁰⁸).

It is important to note that if this disorder is not treated, the prognoses are poor, since without treatment, it tends to become chronic and its remission rate in adults is low (20%). It should be mentioned that when the onset is in adulthood, there is a better prognosis for remission or control, this because compulsions are observable and, therefore, are more easily diagnosed than obsessions in children.

Also, when its onset is in childhood or adolescence and is not treated, it can lead to a lifetime with OCD. In children there are usually both compulsions and obsessions, of course the contents are usually appropriate to the age of mental development, which is why it is more common for

307 Ver a Torres (Torres et al., 2013).

308 Yale–Brown Obsessive-Compulsive Scale (Y-BOCS) y Dimensional Yale-Brown Obsessive-Compulsive Scale (DY-BOCS).

the contents mainly associated with sexuality to appear in adolescence while the contents of fear of catastrophic events or the death of oneself or loved ones occurs in childhood. Particularly when the onset of the disease occurs before the age of 12, it may be accompanied by Attention Deficit Disorder (ADD) with hyperkinesis, tic disorder, oppositional defiant disorder (ODD), learning disorders and enuresis³⁰⁹.

3.3 Etiology

The disorder has associated environmental, genetic and psychological characteristics.

Temperamentals

Greater internalization of symptoms, greater emotionality towards the negative pole and behavioral inhibition in childhood are some risk factors in children.

Environmental

Physical and sexual abuse in childhood, as well as other stressful or traumatic factors, such as head trauma and encephalitis³¹⁰, have been associated with an increased risk of developing OCD. Some children may have OCD symptoms suddenly. These cases have been associated with different environmental factors that may be due to infectious agents such as streptococcus, or for example, a post-infection autoimmune syndrome. In this sense, studies with twins suggest that environmental factors are crucial for the onset of OCD, mostly in adults³¹¹.

Genetic and psychological

The rate of OCD in a patient's first-degree relatives is twice that of someone without this relationship. Similarly, if the relationship is first degree with someone who developed OCD in childhood, the prevalence increases 10 times. Likewise, there is a higher incidence of OCD when there is a history of Tourette in first-

309 See Pauls, et al. (Pauls et al., 2014).

310 See Hollander (Hollander et al., 2005).

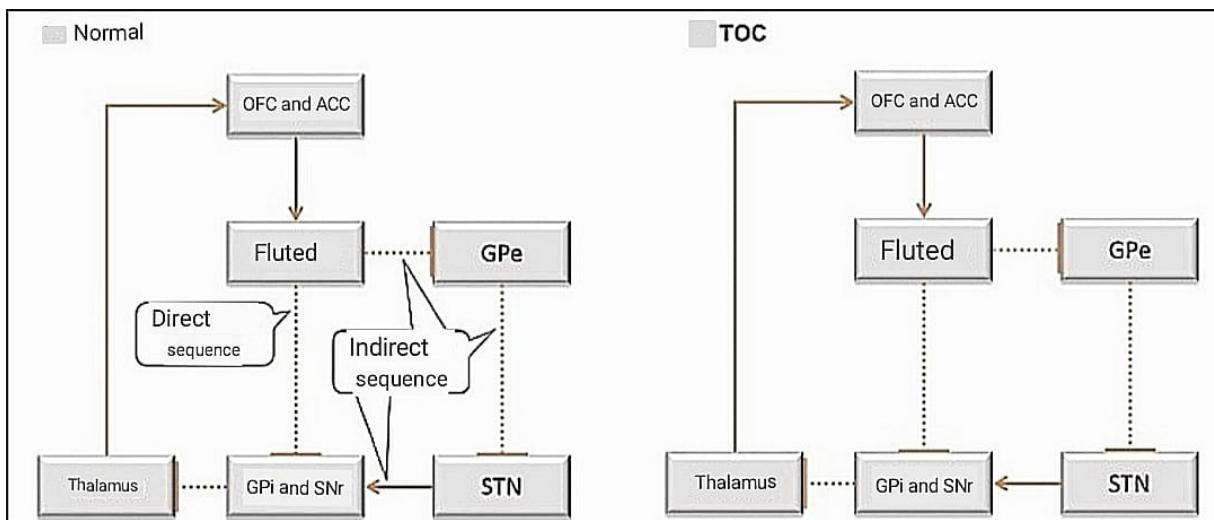
311 See Pauls, Abramovitch, Rauch, y Geller (Pauls, Abramovitch, Rauch, & Geller, p. 413, 2014).

degree relatives, which may even suggest that the two disorders have common neurobiological mechanisms.

In some studies³¹² carried out with twins, there were correlations between the presence of sleep rituals at an early age with a subsequent occurrence of OCD, which seems to suggest that genetic factors play a part in the manifestation of obsessions and compulsions, being It is even possible that genetic factors are related to an increase in the severity of the expression of symptoms.

Regarding the neural bases, dysfunctions have been found in the corticostriatal circuits³¹³, in the frontal orbital cortex (OFC)³¹⁴, in the dorso lateral prefrontal cortex and the parietal lobes³¹⁵, in the anterior cingulate cortex³¹⁶ and in the striatum. The prevailing model is a cortico-striatal-thalamic-cortical (CSTC) model.

Scheme 19. Cortico-striatum-thalamus-cortical circuit



Source: Nature 2014³¹⁷, own translation.

Solid arrows represent the glutamate (excitatory) sequence and the dotted lines represent the GABAergic (inhibitory) sequence. Case a) In the normal functioning of the cortico-striatum-

312 Ibid.

313 This region facilitates behavioral flexibility (SR Chamberlain, Blackwell, Fineberg, Robbins, & Sahakian, 2005) and is also the region where neuroimaging findings have been most frequently reported. (Samuel R Chamberlain et al., 2008).

314 The OFC is involved in reverse learning, that is, in the flexibility of behavior change after negative feedback. However, reversal learning is dependent on the serotonergic system.

315 Both areas are thought to be used for planning and working memory.

316 This area is thought to have a central role in the evaluation of conflict situations and also in error monitoring.

317 (Pauls et al., 2014)

thalamus-cortical circuit, glutamatergic signals from the frontal cortex (specifically the orbitofrontal cortex (OFC) and the anterior cingulate cortex (ACC)) lead the excitation to the striatum. Through the so-called “Direct Sequence”, striatal activation increases GABA inhibitory signals to the inner globus pallidus (GPi) and the substantia nigra (SNr). This decreases the GABA inhibitory result from the GPi and SNr to the Thalamus, so there is a resulting glutamatergic excitation from the thalamus to the frontal cortex. This direct sequence is a positive feedback loop. In an indirect, external circuit, the striatum inhibits the external globus pallidus (GPe), which decreases its inhibition in the subthalamic nucleus (STN). The STN, then, is free to excite the GPi and SNr and thus inhibit the Thalamus. Case b) In sequences with OCD, an imbalance between the direct and indirect sequences results in an excessive tone of the first, with respect to the second³¹⁸.

When there is a failure in the inhibitory function, a lower threshold is presented for the activation of the system, which results in an over activation of the subcortical orbitofrontal circuits, which results in an exaggerated concern about danger, hygiene or damage, (mediated by the orbitofrontal cortex). This results in continuous conscious attention to the perceived threat (obsession) and a subsequent compulsion aimed at neutralizing it. The temporary relief resulting from the realization of the compulsion is reinforced and therefore tends to recur, which ends in ritual behaviors when the obsession reappears.

Neurochemical hypotheses

There is a hypothesis that OCD is caused mainly by alterations of the serotonergic system³¹⁹ since benefit has been observed with antidepressants. However, there is also evidence of alterations in dopaminergic mechanisms³²⁰, in the glutamate system³²¹ and in GABA³²², through pharmacological manipulations as well as by functional imaging and positron emission tomography.

109

Neuro Epigenetic model³²³

The data obtained on the heritability of OCD point to a transmission of 40%, so that the rest of the variability

318 (Pauls et al., p. 416, 2014).

319 Relevant in the modulation of anxiety, aggressiveness, sexual desire, appetite and satiety, among other inhibitions (see note 65).

320 Relevant in the release of hormones related to happiness, libido and appetite(see note 59).

321 Glutamic acid is an excitatory neurotransmitter (see note 61).

322 Inhibitory neurotransmitter (see note 63).

323 See Pauls et al. (Pauls et al., 2014).

seems to be due to environmental events such as perinatal adverse events, psychosocial stressors, trauma and inflammatory processes, by means of which it is possible that the expression of genes related to the serotonergic system, the dopaminergic system, the modulation of catecholamines modified through³²⁴ and the glutamate pathways epigenetic mechanisms.

The result of changes in glutamatergic activity affects the CSTC circuit, resulting in the manifestation of OCD in some of its variants. Within these conglomerates (clusters) of symptoms, each of these groups (four or five) is associated with the manifestation of specific behavioral components, which may be influenced by certain genes, changes in specific neural pathways that are activated in response to defined environmental events. This means that each of the different dimensions of OCD can have a specific etiology and pathophysiology.

3.4 Suicide risk

The risk of suicide is very high in patients with OCD, half of the patients with OCD have presented or present suicidal ideation, while a quarter of the individuals have made suicide attempts.

3.5 Treatments

Some of the empirically validated treatments for OCD include antipsychotics / antidepressants³²⁵, serotonergic inhibitors (SRIs)³²⁶, and cognitive behavioral therapy (CBT)³²⁷ exposure-focused and response prevention (ERP). Both approaches (the pharmacological and the behavioral) have modest

324 Catecholamines are hormones secreted into the blood when a person is under physical or emotional stress. The major catecholamines are dopamine, norepinephrine, and epinephrine (which used to be called adrenaline).

325 Antipsychotic intervention, even increased in resistant patients, only shows a significant response in 1/3 of patients (MH Bloch et al., 2006). Risperidone works better than other antipsychotics.

326 OCD is characterized by its resistance to first interventions with SRI, where approximately 25-60% do not respond adequately (Van Ameringen et al., 2014) and the effects to pharmacotherapy range between 0.37 - 1.09 (Abramowitz, 1997).

327 The effectiveness ranges from 0.99 - 1.13 (Rosa-Alcázar, Sánchez-Meca, Gómez-Conesa, & Marín-Martínez, 2008).

effects although most use a combination of them³²⁸, the first line of treatment since numerous studies have shown a reduction in metabolic activity in the orbitofrontal cortex in the caudate and in the cortex Ventrolateral prefrontal post intervention.

Additionally, some studies on the use of glutamatergic agents in OCD that show resistance to first-line treatments appear to be effective; however, more research is needed in this line of treatment.

4. Meeting points between the different disorders

The disorders reviewed above have common characteristics, such as: a high comorbidity, a high rate of heritability, the presence of similar symptoms and affectations, in addition to sharing some endophenotypes³²⁹.

The following review focuses on the endophenotypes shared between these three pathologies, since it is reasonable to assume that the manifestation of common alterations between these processes are the result of shared failures in basic cognitive mechanisms, which affect higher processes of the individual, such as their inferential capacity³³⁰.

In order to identify these possible altered common basic processes, in addition to identifying what kind of tests could be useful for its early diagnosis, various meta-analyses were reviewed³³¹ on each of the pathologies treated here, to then group the areas and skills that present deficiencies or

328 The combination of treatments shows better results than monomodal therapy with SRI, but similar to CBT alone (Simpson, Huppert, Petkova, Foa, & Liebowitz, 2006).

329 Endophenotypes are measurable components not visible to the naked eye that lie on the path between a disease and a distal genotype. They can be neurophysiological, biochemical, endocrinological, neuroanatomical, cognitive or neuropsychological (Gottesman & Gould, 2003).

330 If this is the case, it is reasonable to assume that these alterations can have a global impact on the inferential capacity of the individual, thus causing the generation and maintenance of inappropriate beliefs, which in turn impact (in different ways) on the functional life of the individual patient.

331 The studies that were included met the following criteria: The research model included a control group of volunteers, the characterizations of patients in different clinical phases were not mixed, they were published between 1980 and 2008. ((Arts, Jabben, Krabbendam, & van Os, 2008; Michael H Bloch, Landeros-Weisenberger, Rosario, Pittenger, & Leckman, 2008; "Cognitive deficits in unaffected first degree relatives of schizophrenic patients: meta-analytic review of possible endophenotypes," nd; Dobbs, 2010; Glahn et al., 2007, 2010; Judd et al., 2002; Kurtz & Gerraty, 2009; Menzies et al., 2007), (SR Chamberlain et al., 2005), (Samuel R. Chamberlain, Fineberg, Menzies, & Blackwell, Andrew D. Bullmore, Edward T. Robbins, Trevor W. Sahakian, 2007).

alterations for their clear understanding, appearing in the following results.

Results:

The following table shows disorder by disorder and area by area, the alterations that have been reported in the literature, in order to be able to identify in more detail the affectations that are shared.

Table 4. Affected areas

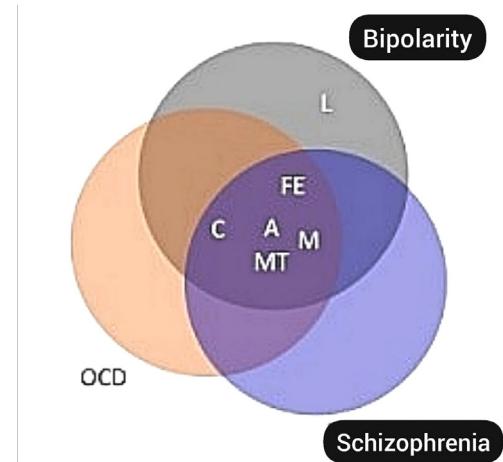
	Bipolarity	OCD	Schizophrenia
Attention (A)	Attention Sustained auditory attention (sustained auditory attention) Sustained visual attention conceptual flexibility (conceptual flexibility / concept shifting) <u>perseverations (perseverations)</u> ability to answer inhibit (response inhibition) Problem-solving	Attention control Inhibitory Control Detections selections risk Impairment on strategies for organizing information memorize Efficiency index Cognitive inflexibility Cognitive inhibition <u>Perseverations</u> Planning Risk-benefit processing Reward-based decision-making Risk picks Scheme change	Attention Slowing cognitive (cognitive slowing) Inflexibility cognitive Information processing (processing speed) Concept formation
Cognition (C)			
Executive functions (FE) ³²²	Phonemic fluency Sorting Processing speed fluency Semantic fluency / Category fluency	errors Decrease in processing speed	Digit symbol coding Letter Verbal fluency
Learning (L)	Speed to set patterns (speeded set-shifting) Verbal fluency Verbal learning		
Motor (M)	psychomotor speed (psychomotor speed) visuospatial functions (visuospatial function)	<u>motorImpulsivity</u> Inhibition motor Psychomotor Down Psychomotor	speed psychomotor (psychomotor speed) motor Dysfunctions <u>slowingDelayed</u>
Working memory (TM)	repetition of prose (delayed prose recall) Delayed verbal memory (Delayed verbal memory) Immediate verbal memory (immediate verbal memory) immediate prose repetition (immediate prose recall) (long delay verbal memory) Non-verbal memory Verbal free recall Visual memory	Memory associated with planning Verbal working visuospatial working nonverbal memory memory	Declarative memory (Declarative memory) memory Verbal memory (verbal memory) memory Episodic memory (episodic memory) spatial working memory

332

332 Executive functions are understood to be the system that coordinates the processing, prioritization, and expression of information. Some locate it mainly in the prefrontal cortex (Andreasen et al., p. 204, 1998).

So it is possible to appreciate that there are large areas of involvement shared by the three disorders:

Scheme 20. Overlapping affected areas



As can be seen in the image before making a meta analysis of the results of various studies, most large affected areas are shared among the disorders (Attention (A), Cognition (C), Executive Functions (FE), Motor (M) and Working Memory (MT)). However, by analyzing each area more thoroughly, it is possible to appreciate differences between the specific manifestations in each one, which allows us to refine the battery that we can use to sample the dysfunctions present transversally to the pathologies analyzed.

Using the same format for presenting results as in the case of the affected areas in each pathology, the tests used to detect these alterations are grouped together³³³.

Table 5. Tests used to monitor functions

³³³ This in order to provide useful information to the professional who wishes to delve (in a finer grain) in which specific part of the great superior processes (memory, executive functions, etc.) is that alterations are being found.

BIPOLARITY									
Attention	Working	memory Episodic	memory Verbal	memory Non-verbal memory	Visuospatial function	Language	Psychomotor	Executive functions	speed Processing speed
Continuous Performance Test Hits	Digits Backward	California Verbal Learning Test	Rey Auditory / California Verbal Learning Test- Total Recalled, Long Delay Free Recall	Rey Complex Figure Test (RCFT) – Immediate and Delayed Recall	Block Design	Controlled Oral Word Association Test (COWA-FAS)	Digit Symbol Substitution Test (DSST)	Wisconsin Card Sorting Test (WCST) -Categories Achieved and Perseverative Errors	Letter fluency
Continuous Performance Test Catch Trials	Letter number span	Digit symbol recall	Wechsler Memory Scale-Logical Memory (WMS-LM)	Wechsler Memory Scale-Visual Reproduction (WMS-VR)	Rey Complex Figure Test (RCFT) -Cop	Animal Naming (AN)		Stroop Color Word Test (SCWT)	Semantic fluency
Digits Span Forward	Spatial delayed response task	Facial Memory Immediate						Trails B	Digit symbol Coding task
Trails Making A	Object delayed response	Facial Memory Delay						Spatial delay response time	Trails Making A
	delayed prose recall							Matrix Reasoning	
								Problem solving tasks	
								Verbal interference	
								Set switching tasks	

TOC					
Neuroimaging	Planning	Tasks Decision-making	tasks Response inhibition tasks	Delayed verbal memory and memory tests non-verbal	
Gray matter density	Tower of london	iowa gambling task	stroop test	Wechsler scale logic memory	
PET scanning while using Stroop task	Tower of hanoi	set shifting task	stop signal task	Wechsler memory scale visual memory	
Motor inhibition / go / no-go and stop signal task		monetary incentive delayed task	go / no go	Rey auditory verbal learning test	
Attentional set shifting tasks					
object alternation task					

SCHIZOPHRENIA								
Decision-making tasks	Processing speed	Attention / vigilance	Working	memory Episodic verbal memory	Reasoning & problem solving	Verbal memory	Psychomotor speed	
set shifting task	Letter fluency	CPT a'	Digit span backward	CVLT learning recall	Test of non-verbal intelligence	California Verbal Learning Test- Total Recalled, Long Delay Free Recall	Digit Symbol Substitution Test (DSST)	
	Semantic fluency	CPT Beta	Spatial working memory	CVLT semantic cluster				
	Trail Making Test, Part A	Digit span forward	Spatial delay response task (the manifestation of psychosis may be linked to deficits in spatial working memory)	CVLT delayed recall				
	Digit-symbol coding	Trails Making A		CVLT recognition				
	Digit symbol coding task (is the most sensitive trait for schizophrenia)			Digit-symbol recall				

Based on the analysis of the results extracted from the documentary review that allowed us to identify the common areas of affectation and once carried out, an analysis of the elements that surround the abductive process and delimiting a model of the inferential process itself that allows us to systematically approach the fine recognition of cognitive problems related to the object of study of this work, It was determined that specific cognitive areas are of interest to us, not only to sample, but also to seek to influence the patients who will collaborate with the present prospective study, through the application of some specific sessions of meta-cognitive training (MCE).

Metacognitive training, as its name implies, is a training aimed at analyzing and confronting inappropriate hypotheses and beliefs generated by recurrent dysfunctional cognitive mechanisms (biases) in patients with specific pathologies.

Similar belief generation processes also normally occur in healthy people. However, they do not have the same characteristics as in patients with mental disorders and, in their case, they do not undergo a systematic review of system two for reasons of pragmatics and relevance.

Metacognitive training (CMT) is proposed as an intervention tool to explore the inferential failures that we believe are at the basis of the generation and maintenance of inappropriate beliefs both in ordinary people, and more markedly in patients with mental illnesses.

However, it is necessary first to review the state of the art associated with metacognition and some cognitive biases, in addition to reviewing the main assumptions behind metacognitive training (MCE).

Chapter III.

Cognition

The central element of the present investigation, let us remember, is the *abductive inferential* process, which we suppose that human beings use in a common way to explain reality³³⁴.

Given the frequency of occurrence and impact of this inferential process, present in all human beings on a daily basis, its importance in general cognition is understood and, therefore, it is expected that if the person presents cognitive alterations, which we suppose they are involved in the inferential process, the dysfunction for the correct development of the normal inferential process will be more marked³³⁵, so the results of this process will affect the assumptions that are held for the development and maintenance of anomalous beliefs (identifying them as inadequate beliefs) both in healthy people and in people with pathologies.

It is expected that with the intervention of the CME, mechanisms for identifying and correcting biases will be incorporated that generate positive results in individuals, affecting their psychosocial functioning and their quality of life in general, in addition to that the expected improvements will mean so much for the individual and for society, a decrease in its economic and social costs.

116 The conditions reviewed in previous sections of this work, obsessive compulsive disorder, bipolar disorder and schizophrenia, were selected because all three share the fact of generating inadequate beliefs in patients, ranging from plausible but unlikely beliefs (which still have repercussions strongly in the general state of the individual) to frank false beliefs (delusions), which we suppose can trigger psychotic episodes (complete loss with reality) if they generate too much anxiety in the individual with their maintenance.

The patients who have these disorders share, as we have seen thanks to the previous review,

334 It is important to distinguish between the formation of beliefs and the reasoning that maintains or alters these beliefs, which is why the present work will support various assumptions regarding these points within the general scheme.

335 Reasoning processes are associated with, for example, delusional conviction (PA Garety et al., 2005).

affectations in basic and higher psychological functions, such as the following failures in executive functions, memory, processing speed, cognitive flexibility and decision-making, among others. As a result, cognitive distortions are presented, also called *cognitive biases*, which contribute to the development, severity and maintenance of inappropriate beliefs³³⁶, so we assume here that these *cognitive biases* aim to act as indicators of the possible occurrence of disorders, and to understand how it fails. The inferential process.

1. Cognitive distortions

There are different explanatory approaches for the generation of inappropriate beliefs³³⁷, which in turn generates different proposals regarding which mechanisms are failing.

Some of the most studied approaches are the following:

- The *hypothesis jump to conclusions (JTC)*³³⁸
- The *hypothesis of the attribution of styles*³³⁹
- The *hypothesis of abnormal perception*³⁴⁰
- The *hypothesis of the discrepancy between the objective and subjective reliability of the information stored in the memory*³⁴¹

336 (PA Garety et al., 2005).

337 There are key characteristics to classify a delusion (which is a type of inappropriate belief): Certainty, incorrigibility (imperviousness), impossibility or falsity of the content and that the origin of the belief must defy reason.

338 (Moritz, Woodward, Whitman, & Cuttler, 2005), (PA Garety et al., 2005).

339 (Bentall, David, & Cutting, 1994).

340 (Maher, 2014)

341 Patients such as schizophrenics have trouble figuring out what information is valid or invalid from memory, in addition to having a greater tendency to trust incorrect information from memory. This may be due to a deficiency in your ability to doubt fallible information. (Moritz et al., 2005).

1.1 The hypothesis of jump to conclusions:

The hypothesis of jump to conclusions focuses on abnormalities in the inferential process, which are observed in various types of patients³⁴². These subjects show a tendency to make decisions extremely quickly based on very little evidence, in addition to overcompensating³⁴³ their evaluations in light of contradictory evidence, which is why it is considered as an information collection bias.

The greatest empirical support for this hypothesis has been obtained through the application of probabilistic reasoning paradigms³⁴⁴, through which the decision-making procedure of the subjects is observed when faced with tasks where they must decide on different options (usually two alternatives). Patients then show a tendency to commit to a conclusion with significantly fewer trials than control patients³⁴⁵.

The rapid jump towards an explanatory hypothesis of the phenomenon, which is shown in these tasks, we believe is related in the patient's day-to-day life with the rapid jump to conclusions (sometimes inappropriate) in the face of everyday events. It is suggested that patients readily accept some of the possible options³⁴⁶ as they do not tolerate uncertainty very well.

However, when there is a greater range of options, what is proposed to happen is that they accept as plausible (of all the options) a greater range of alternatives than the control groups. This phenomenon has been called *liberal acceptance* (acceptance liberal³⁴⁷ account).

342 (PA Garety & Freeman, 1999) Schizophrenic patients are those who show a greater alteration in this area, compared with other populations of psychiatric patients and of course with the control group.

343 Overcompensation is understood as the process of presenting arguments that support the initial assertion even in light of contradictory evidence.

344 In this class of tasks, the individual is asked through individual trials, to which jar (with different proportions of colored beads) the beads shown to him belong. In a different version of the task, participants are also asked to give probabilistic estimates with the different trials. These tasks expose a bias of individuals to collect information, rather than deficits in probabilistic reasoning. (PA Garety et al., 2005).

345 Between 40% and 70% of delusional patients make their final decision after just one trial (Moritz & Woodward, 2005).

346 When the problem is a dichotomy, they select one of the options very quickly without actually having much evidence (Moritz & Woodward, 2005).

347 The idea of liberal acceptance can be considered as a variant of the JTC hypothesis or as a bias in itself "liberal acceptance" (LA) (Moritz, Woodward, & Lambert, 2007). According to the LA, JTC bias occurs when situations do not have very ambiguous alternatives; however, it tends to decrease when ambiguity increases. LA bias assumes that patients use less information to make logical inferences than controls, which in fact does not imply making quick decisions, but rather that patients more readily accept options as valid hypotheses, leading to an over-decision acceptance of false hypotheses. "A lax criterion to judge hypotheses in conjunction with some cognitive biases can lead to the acceptance of false hypotheses" (Moritz et al., 2007).

The phenomenon of liberal acceptance we suppose that it causes a bad selection, since some hypotheses that we can label as absurd, are not quickly discarded and it is possible that even these hypotheses (absurd) are the ones that may prevail in the inferential process, thus resulting in the development of an inappropriate belief.

If JTC is added to the phenomenon of liberal acceptance, it is possible that another phenomenon of serious cognitive alteration may be generated in parallel, related to the flexibility of beliefs, which consists of failures in the ability of the subject to generate doubt about the conclusions obtained, which we assume generates such anxiety that delusions may even occur in the subjects.

In general, it appears that this style of thinking is a characteristic that contributes both to the formation and persistence of inappropriate beliefs.

On the other hand, it has also been seen that there is a directly proportional correlation between the presence of *jumping to conclusions with an inflexibility* on the possible falsehood of one's own beliefs (less flexibility of beliefs / greater JTC)³⁴⁸. In turn, cognitive flexibility turns out to be a good predictor in the generation of inappropriate beliefs (the more flexible, the less presence of delusional symptoms), since, apparently, cognitive flexibility mediates the relationship between jumping to conclusions and severity of delusional conviction. Thus, by aiming at strengthening the metacognitive process in which inappropriate beliefs are reflected upon, we assume, the individual's belief in them can be reduced.

JTC is related to some important cognitive functions such as working³⁴⁹ memory, verbal memory and cognitive processing speed³⁵⁰, which in fact allows us to suppose that it may be present in different classes of patients who share alterations in these areas. Similarly, JTC is related to the presence of hallucinations or propensity to hallucinations. Neuroimaging studies suggest that JTC is related to the prefrontal lobe, especially the dorso-lateral area³⁵¹.

Finally, the last of the most important biases related to rapid decision-making (JTC) is the "need for

348 Belief flexibility is the meta-cognitive ability to reflect on one's own beliefs, change them in the light of reflection and evidence, as well as generate and consider alternatives (P. Garety et al., p. 374, 2005).

349 (Philippa Garety et al., 2013)

350 La memoria de trabajo y la memoria verbal son las áreas más afectadas (Ochoa et al., 2014).

351 (Blackwood et al., 2004), (Malloy & Aloia, 1998).

closure”³⁵², which is understood as an increased need to have things settled, which manifests itself in the individual as problems to tolerate open-ended events and to handle ambiguity.

Daring to advance some assumptions of the link that may exist between the phenomenon of jumping to conclusions and the interactionist model of processes, it is possible that the line of demarcation that would establish the change of the processing system between systems one and two, for generation of a series of alternative explanatory hypotheses, it is altered in patients with the need for closure bias, with the one-over-two system acting predominating, which added to the low cognitive flexibility and the need for closure, could account for the rapid jump to conclusions.

1.2 The hypothesis of the attribution of styles

In the hypothesis of attribution of styles, the key is in the attribution of *responsibilities assigned by the individual*. The failures, it is assumed, are given due to *the way in which individuals explain the causes of some behavior or event*.

As Fritz Heider mentioned³⁵³: “Our perception of causality is generally distorted by our needs and by some cognitive biases”, such as cultural, dispositions, etc. Therefore, the same event can be attributed both to the person himself, to others or to the environment.

In particular, studies in patients with mental disorders, how in schizophrenic patients, have shown constant flaws in their attributive style, for example, showing a tendency to externalize and personalize guilt by resorting to *scapegoats*, that is, to blaming others as the main cause of negative / positive events (self-service bias). According to Bentall³⁵⁴, these biases reflect selective processing of information in relation to information related to the alleged threats, affecting attention and memory. This mechanism, although generating anomalous beliefs so to speak, prevents the occurrence of thoughts with a negative tone that can affect the self-esteem of the individual, hence its occurrence is reinforced.

352 Close pressure.

353 (Heider & F., 1944)

354 (Bentall et al., 1994).

Supporting this assumption, delusional patients show higher self-esteem at this time than when their symptoms subside. This may be due to the fact that at times the symptoms provide the individual with a feeling of importance and company (a secondary gain resulting from the disease), which can be an important factor in maintaining these alterations³⁵⁵.

1.3 The abnormal perception hypothesis

The abnormal perception hypothesis, as its name indicates, is a psychological approach that explains the production of abnormal beliefs, assuming that delusions are almost always rational interpretations of abnormal experiences.

The model on delusions proposed by Maher³⁵⁶ focuses on the following hypotheses:

1. Delusional beliefs, as well as normal beliefs, arise as an attempt to explain the experience.
2. The process by which delusional patients reason from experience to belief is not significantly different from the processes of non-delusional people. In no case do typical beliefs arise from the conscious application of the formal rules of logic or statistical inference.
3. Faulty reasoning about normal personal experience is not the main reason for delusional belief formation. The most critical difference between delusional and non-delusional beliefs is the nature and intensity of the phenomenological experience being explained.
4. The origins of the abnormal experience lie in a wide range of neuropsychological disorders.

Thus, the inflection point that triggers the generation of anomalous beliefs as a result of pathology is found in the neuropsychology of experience, that is, in the phenomenological experience of the individual and not in the neuropsychology of deduction or inferential reasoning.

Consistent with this hypothesis is the fact that on many of the occasions prior to delusional episodes,

355 (Moritz & Woodward, p. 620, 2007).

356 see (Maher, p. 551, 2014).

ais present *delusional mood* (the vague feeling that the world has been altered in some subtle but sinister way even though the reason is unknown) that is stressful for the individual, who tries to explain it from this perception, which sometimes leads to the generation of inappropriate beliefs.

One of the arguments that Maher presents to support his hypothesis is found in the notion of *parsimony*, according to which there is no a priori reason to suppose that the psychological processes of patients differ in some fundamental way from those of the general population.

1.4 The hypothesis of the discrepancy between the objective and subjective reliability of the information stored in the memory

In the hypothesis of the discrepancy between the objective and subjective reliability of the information stored in the individual's memory, the base information from which the person starts, it is assumed that on many occasions, it is incorrect and even so, the individual has a high degree of confidence³⁵⁷ in it. This phenomenon has been called *corruption of knowledge* (knowledge corruption) which predisposes individuals to have distortions: perception, problem-solving and inferential developments because as expected, all these processes use background information of the individual. Then, this corrupt framework of knowledge will not allow the individual to develop a good evaluation of external reality, since fallacious interpretations are offered regarding the point of view held at that time.

122

However, to assume that memory problems are the only reason for the generation of inappropriate beliefs would be a mistake. Key concepts such as knowledge corruption are more sophisticated and multifactorial, for example, this concept is explained as errors in memory added to a decrease in the ability to doubt those same errors (*belief flexibility*)³⁵⁸ and a decrease in the ability to integrate

357 Confidence in responses is linked to error-related cortical activity, which is typically associated with the anterior cingulate cortex (Alain, 2002). Schizophrenic patients have repeatedly demonstrated high confidence in their mistakes while, at the same time, being distrustful of their correct answers (Moritz & Woodward, 2007).

358 In (Moritz et al., 2005) it can be observed that patients with schizophrenia, although they can also present in another class of patients, for example with OCD, (Macdonald, Antony, Macleod, & Richter, 1997) significantly tend to show a greater confidence in their wrong answers (21%) than the control group (9%), which supports the idea of the difficulty of these patients to categorize wrong answers as possibly fallacious. It is interesting to mention that apparently the neural system involved in error processing shows different activation patterns after a correct or incorrect response in the control group; however, schizophrenic patients show similar patterns in both correct and incorrect responses, which may presuppose that they are less sensitive to errors, as in fact they are.

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evidence that disconfirms a belief,³⁵⁹ that is, they cling to previous opinions despite subsequent evidence.

2. Cognitive dysfunctions and their relationship with abduction

As can be seen, the way of understanding the genesis of inappropriate beliefs has a direct impact on how we conceptualize the abductive inferential process.

Following the *abnormal perception hypothesis*, the problem would begin in the way of gathering information from the outside and its activation relationship with the background information of the individual, in addition to its reliability.

According to the *hypothesis of the discrepancy between the objective and subjective reliability of the information stored in memory*, what would fail is the organization and recovery of the background information, developing a fallacious inferential process from this point on. The *hypothesis of the attribution of styles* would assume that the information selection relations would fail, since the criteria for its recovery would be guided by certain style attributions, which in turn would generate hypotheses whose relevance would be a function of the altered assumptions of the individual, rather than with common pragmatic criteria. Finally, the *hypothesis of the jump to conclusions* focuses on the failure of hypothesis filtration and on the contrasting strategies of the same with the world, added to the development of expansion strategies and revision of anomalous beliefs developed in order to present a justification to a process that may be wrong.

123

However, even when it is difficult to define in which specific part of the process the failures can be found, there are intervention strategies (such as meta-cognitive training) that can help us, not only to clarify the process, but also to improve the quality of life of people. Next, what we will do is show one of these strategies and present, in the next chapter, the approach to an intervention and research protocol to study the involvement of the abductive inferential process in different patients.

359 Bias against disconfirmatory evidence (BADE).

3. Metacognitive training

Due to the identification of various cognitive biases³⁶⁰ (such as those mentioned above) in patients with conditions that are susceptible to the formation of inappropriate beliefs, it is sensible to think about the implementation of strategies that aim to correct or at least minimize the impact of these failures, for which authors such as Moritz³⁶¹ bet on strategies such as metacognitive training³⁶², which tries to make patients realize some of their reasoning biases and internalize strategies to deal with them. It is worth mentioning that this training has been used in psychotic patients with good results³⁶³.

In short, metacognition can be understood as “thinking about how you think”, in order to select appropriate responses.

Metacognitive training focuses on two fundamental components:

1. Psychoeducational phase (knowledge translation³⁶⁴) in which patients are presented with what has been found about some knowledge biases and their relationship with inappropriate beliefs (delusions) in a friendly way and understandable using multiple examples.
2. The second part consists of a demonstration of the negative effects of these cognitive biases one by one. Exercises developed that target each bias individually demonstrate the fallibility of human cognition in general.

In addition, one of the advantages of this training is that within the therapeutic space, patients can express personal examples and ways in which they counteract it, which provides corrective forms within a supportive atmosphere. In this way, patients are trained to recognize and counteract the cognitive biases that can sustain or worsen their condition, while they are offered alternative

360 Cognitive biases such as JTC or BADE can be benign when the neuropsychological faculties of the individual and their social reasoning are normal; However, when these faculties are damaged (as in the case of schizophrenia), knowledge biases can have serious consequences, such as psychotic misinterpretations.

361 (Moritz & Woodward, 2007).

362 Metacognitive training was initially developed in Germany, although today it has been translated into 23 languages, including Spanish since February 2009. It has proven to be effective in reducing biases such as JTC with a single application session(Moritz & Woodward, 2007)(Favrod et al., 2014)

363 (Moritz & Woodward, 2007).

364 Knowledge translation

strategies that allow them to reach more appropriate inferences.

This training consists of the modular application of strategies, so only some of them were selected (more convenient for our purposes). However, a summary of all the EMC sessions is presented below:

Table 6. EMC sessions

#	Module	Domain	Description of exercises
1	Attribution: Guilt and Credit	Self-service bias / Depressive attributional style	The different causes must be considered from both positive and negative events. Preference is given to multi-causal explanations over mono-causal ones.
2	Jumping to Conclusions I	Jumping to Conclusions / Liberal acceptance / Bias against disconfirming evidence	The reasons that contribute to hasty decision-making and their negative effects are discussed. Evidence of failures with simple exercises.
3	Change of beliefs	Bias against <u>disconfirmatory</u> evidence	It is sought through exercises that demonstrate how interpretations change as more information is gained, in such a way that it seeks to generate open attitudes against arguments or alternative views of events.
4	Empathy I	Theory of Mind	Facial expressions are shown and their importance in social reasoning is discussed, seeking to confront the belief that the quick interpretation of an
			expression is enough to make a judgment.
5	Memory	On confidence in errors	Exercises are presented that show the constructive nature of memory, in order to identify false memories based on their vividness.
6	Empathy II	Theory of Mind / Need for Closure	The disadvantages of this bias are highlighted, particularly with regard to Psychosis.
7	Jumping to conclusions II	Jumping to conclusions / Liberal acceptance	The disadvantages of jumping to conclusions are shown through the high possibility of false responses
8	Mood and self-esteem	Mood and self-esteem	The first-onset symptoms in depression are discussed as follows like the therapeutic options, closing with coping strategies that transform negative schemes to more positive ones. ³⁶⁵

365

125

365 (Moritz & Woodward, pa. 622, 2007)

3.1 Meta-cognitive training aimed at reducing inappropriate beliefs

The inferential model articulated in previous sections allows a simplified conceptualization of a set of complex processes *per se*, in a simplified model to understand part of the interaction between the individual and the world.

In order to gain clarity in the abductive process, particularly in the *relationship* that exists between alterations in the inferential process and the emergence, maintenance and conviction in inappropriate beliefs, a type of psychological intervention, the CME, will be used in a group of patients with mental disorders that within their symptoms exhibit epistemic failures (Obsessive Compulsive Disorders and Bipolarity).

The patients have been typified by expert therapists from the Caracci research center, and their diagnosis has been confirmed by applying the Positive and Negative Syndromes Scale "(PANSS)", among other tests within the battery of psychological tests designed expressly for the study in question.

It is therefore a prospective study where patients with specific psychiatric disorders, who share the generation of within their symptoms, *inappropriate beliefs* are subjected to sessions of the EMC in a group manner. It seeks to mitigate the effects of these anomalous processes of belief generation, the results of which will allow us to make more accurate conjectures about where cognitive failures are found within the abductive inferential process, as well as to evaluate the impact of the CME.

126

As part of the experimental design, all patients were subjected to a psychological battery before, as well as after the application of the EMC sessions. This battery evaluates a good number of different dimensions, for which a description of the tests that comprise it is offered³⁶⁶.

It is important to mention that the EMC sessions did not last more than 45-60 min. The audiovisual material presented to the group was translated and validated in Spanish by members of the research team, led by Dr. Susana Ochoa at the Sant Joan de Déu Sanitary Park (PSSJD), sponsored by the Spanish government.

366 A brief description of each of the tests is presented given that an analysis of them is not contemplated in the scope of this investigation.

The recruitment, the application of the neuropsychological battery and the applications of the EMC sessions were carried out with the help of the Caracci Medical Center, in a physical area exclusively dedicated to clinical research in outpatients.

Likewise, evaluations were performed with the Cantab Eclipse neuropsychological battery: motor control tasks (MOT), reaction time (RTI), spatial working memory (SWM), associated pair learning (PAL), rapid visual information processing (RVP)) and the Stroop test.

The sample consisted of six patients, who were asked for their consent to participate. The procedure was supervised by members of the Ethics Committee of the Caracci group.

3.2 Design

In the study, the entire group received the EMC sessions corresponding to the modules on: attribution of styles, jumping to conclusions, changing beliefs and on memory lapses (sessions 1, 2, 3, 5 and 7 EMC).

The evaluators were oblivious to the application of the CME in these patients.

Study subjects

The sample consisted of patients with a psychological disorder diagnosed by specialists and cared for within the Caracci Medical Group (in Mexico City and registered with the National Council of Science and Technology).

Inclusion criteria

Presence of any of the primary disorders specified above, according to the DSM-V criteria: Bipolar disorder and obsessive compulsive disorder.

Age

Between 18 and 50

Exclusion criteria

Presence of head injury, dementia or intellectual disability.

Evaluation

The tests that will be applied to the patients in each of the moments (Pre and Post) are listed below, each one is described below:

Table 7. Tests

General	Baseline	Post-training
Inclusion / exclusion criteria	X	
Informed Consent	X	
Socio-demographic Questionnaire	X	
Bis -11 (Impulsivity Scale)	X	X
Questionnaire to evaluate quality of life and satisfaction in its short form (Q-LES-Q-SF)	X	X
Personality Inventory (NEO)	X	X
Fagerström (Addiction)	X	X
Psychopathological evaluation		
PANSS	X	X
Yale-Brown Scale for OCD Extended version	X	X
OCI-R	X	X
TEMPS-A	X	X
PSYRATS (AA and Delusions)	X	X
SEM	X	
EY-BOC	x	
PDI	X	X
BCISMetacognition	X	X
Assessment		
IPSAQ	X	X
TCI-R	X	X
Neuropsychological Assessment		
MOT (Cantab)	X	X
SWM (Cantab)	X	X
RVP (Cantab)	X	X
RTI (Cantab)	X	X
PAL (Cantab)	X	X
STROOP	X	X

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4. Description of the Tests

Barratt Impulsivity Scale Version 11 (BIS-11)

The Barratt impulsivity scale is designed to evaluate the behavior of the impulsivity construct as a personality characteristic. The authors consider that impulsivity is a multidimensional construct which is made up of three factors: attentional impulsivity, motor impulsivity, and unplanned impulsivity. The first of these factors, attentional impulsivity, is defined as the inability to maintain attention and concentration, while motor impulsivity refers to acting without thinking and unplanned impulsivity implies a lack of vision for the future³⁶⁷.

The purpose of the construction of this scale was to develop an instrument that discriminates impulsivity from other behaviors, such as search for sensation, extraversion as well as risk-taking.

It has been indicated that subjects with Obsessive-Compulsive Disorder score significantly high in the attentional impulsivity factor since aggressive obsessions and constant verification are associated with this factor.³⁶⁸

The score of 74 is one standard deviation above the mean to designate that an individual has high impulsivity³⁶⁹.

Quality of Life Enjoyment and Satisfaction Questionnaire — Short Form (Q-LES-Q-SF)

129

This test is a self-administered questionnaire with 16 items extracted from the original version of 93 items. It generally assesses happiness and satisfaction on: physical health, mood, work, pleasure activities, social and family relationships, daily functioning, sexual life, economic status, medication and general well-being. The higher you score, the better life satisfaction is indicated³⁷⁰. Means are presented item by item.

367 (Loyola Álvarez, 2011)

368 (Ettelt et al., 2007).

369 (Patton, Stanford, & Barratt, 1995) It is possible to find the scales, as well as the results of all the patients in the annexes of this work.

370 (STEVANOVIC, 2011).

Personality Inventory (NEO)

The Five-Factor Personality Inventory is a personality test that has been used for decades, its results score on: Neuroticism, Extraversion, Openness, Kindness / Cordiality and Responsibility. Adult scales were developed with 1136 Spanish ³⁷¹ ³⁷² volunteers.

Neuroticism: It is oriented towards emotional stability. People who score high in this area, are prone to have irrational ideas, to be less able to control their impulses and to cope with stress worse than others (Facets: Anxiety, Self-awareness, Depression, Vulnerability, Impulsivity and Hostility).

Extraversion: People who score high in extraversion are sociable, prefer groups, are assertive, active and talkative. They like excitement and stimulation, they tend to be cheerful in character. An introvert should be understood more as the absence of extraversion rather than the opposite of it (Facets: Gregariousness, High activity level, Assertiveness, Search for emotions, Positive emotions and Warmth).

Openness: Its components are, for example, active integration, aesthetic sensitivity, attention to inner feelings, preference for variety, intellectual curiosity and independence of judgment. They experience positive and negative emotions in a profound way (Facets: Fantasy, Aesthetics, Feelings, Ideas, Actions and Values).

Friendliness: It is a dimension that refers to interpersonal behavioral tendencies. Kindness is associated with altruistic people who happen to be nice to others. Its counterpoint is antipathy, that is to say, egocentric people, suspicious of the intentions of others and rather opposing than cooperating. Low scores on Kindness are associated with narcissistic, antisocial, and paranoid disorders, while high scores are associated with dependent personalities (Facets: Ease of Handling, Trust, Altruism, Modesty, Complacency, and Idealism).

Responsibility: It refers to high levels of self-control. Planning, organization and good performance are also associated with the execution of tasks. The responsible subject is willful and determined. High scores are associated with academic or professional performance as well as traits such as

371 (Manga, Ramos, & Morán, 2004).

372 (Costa Jr & McCrae, 1992)

punctuality and reliability. It can lead to excessive neatness (Facets: Discipline, meets objectives, Competence, Order, Deliberation and Orientation to achievements).

Fagerström Test

A Test that seeks to identify the level of tobacco dependence through six questions directed towards the habits of the subject in relation to tobacco.

Positive and Negative Syndromes for Psychosis Scale (PANSS)

The PANSS is a structured interview widely used in clinical practice. It is intended to discriminate between positive and negative symptoms identified by the therapist during an interview and provides a general psychopathology score. It is based on the idea that in pathologies such as schizophrenia, there are positive symptoms, as well as deficit symptoms, so this test is useful to identify them and establish a therapeutic strategy directed to the case in question.

Its score is given by:

- The sum of each subscale:
 - ◊ Positive and negative (7-49)
 - ◊ General (16-112)
- Composite scale (PANSS P - PANSS N)
- Restrictive system
 - ◊ Positive subtype: three or more items above four PANSS P but not in PANSS N
 - ◊ Negative Subtype: three or more items above four PANSS N but not in PANSS P

Yale-Brown OCD scale

The scale is designed to quantify the severity of the cardinal symptoms of patients with a diagnosis of Obsessive Compulsive Disorder , without the need to know their characteristics, which allows not being influenced by the content of the patient's symptoms and, thus, planning the intervention and monitoring the response to treatment³⁷³.

Checklist

Allows you to recognize the features of OCD.

Revised Obsessive Compulsive Behavior Inventory (OCI-R)

The inventory is self-applied, it is a reduced version of the original test that assesses obsessions and a variety of compulsions³⁷⁴, where a score above 20 points indicates the probable presence of OCD.

Self-applied temperament scale (TEMPS-A)

The self-applied scale is designed to measure temperamental variations, the evaluation of which yields results in five different dimensions: Cyclothymia, Depression, Irritability, Hyperthymia and Anxiety.

132

There are interesting correlations between different dimensions, for example, there is a positive correlation between all dimensions (except hyperthymia) and harm avoidance behaviors, likewise there are positive correlations between the hyperthymia dimension and the cyclothymia dimension with a search for novelties. Another interesting relationship was a positive correlation between hyperthymia and a dependence on rewards, persistence, and self-direction. Likewise, there are positive correlations between self-transcendence with cyclothymia, hyperthymia and anxiety, and a negative correlation between depression, cyclothymia, irritability and anxiety with cooperative behaviors³⁷⁵.

373 (Paez et al., 1996)

374 (Foa et al., 2002).

375 (Akiskal et al., 2005).

Psychotic Symptoms Rating Scale (Psychotic Symptom Rating Scale)

The psychotic symptomatology scale is an appropriate scale to assess delusions and hallucinations³⁷⁶.

Mania Evaluation Scale (SEM)

This 11-item scale aimed at the assessment of manic symptoms, is scored through an interview of between 15 and 30 minutes in which the verbal and behavioral manifestations of the interviewee are taken into account, as well as the symptomatology presented by the subject in the last week. Scores less than six are compatible with euthymia, scores between seven and 20 indicate hypomania, and more than 20 are related to mania.³⁷⁷

Peters Delusional Ideas Inventory (PDI)

The test is designed to measure delusional ideation in any class of people, since it is based on the idea that a continuum is established between normality and delusion³⁷⁸. The presence of delusions in the nucleus of psychotic disorders is common; however, delusional beliefs below clinical levels are common in the general population. This test reveals the presence of different components such as paranoia, magical thinking, referentialism, depression, religiosity, apocalyptic ideas, thought disruptions, grandiosity, etc³⁷⁹.

Beck's Cognitive Insight Scale (BCIS)

133

This scale has been translated, adapted and validated by a group of Spanish researchers. It is a self-applied scale in which 15 phrases focused on self-reflexivity of unusual experiences are collected, the ability to correct errors of judgment and erroneous judgments. The gradation of the scale ranges from none at all to fully agree (four-point scale).

The Beck scale is aimed at evaluating the capacity of awareness (insight) cognitive that an individual has, that is, "the practice of self-reflection as a metacognitive mechanism for examining and

376 (Drake, Haddock, Tarrier, Bentall, & Lewis, 2007).

377 (Ariquian et al., 1997).

378 (ER Peters, Joseph, & Qarety, 1999)

379 (Fonseca-Pedrero, Paino, Santarén-Rosell, Lemos-Giráldez, & Muñiz, 2012).

analyzing the symptoms of the disease, which allows re-evaluation continual misinterpretations"³⁸⁰.

It consists of two dimensions: Self Reflection and Self Certainty, in addition to giving a composite index.

Internal, Personal, and Situational Attributions Questionnaire (IPSAQ)

This test allows identifying some thinking biases where everyday events tend to be attributed, inward (oneself) or outward (others) depending on whether they are perceived as positive or negatives. Thus, the test allows seeing trends of attribution judgments, that is, scores on personal, other people or situational attributions, both of positive and negative events³⁸¹.

Irrational Beliefs Test (TCI-R)

This test, as its name indicates, evaluates irrational ideas, characterizing them with the following features³⁸²:

- They are false (they do not agree with reality).
 - They are orders or mandates (they are expressed as demands, duties and needs).
 - They lead to inappropriate emotions (like anxiety, depression, etc.).
- 134
- They do not help to achieve the objectives (when the person is dominated by absolute beliefs and overwhelmed by emotions, they are not in the best position to carry out tasks and enhance the positive aspects of their life).

The test groups its items (46) under the following headings³⁸³:

- Need for approval by others (high scores indicate that the person believes that they need to

380 (Gutiérrez Zotes et al., 2012).

381 (Peterson et al., 1982).

382 (Zumalde & Ramírez, 1999).

383 (Castaño & Pérez, 2011).

have the support and approval of others).

- High personal expectations (high scores indicate that the person believes that they should be successful and fully competent in everything they do and that they judge their worth as a person based on their achievements).
- Blaming (irrational thinking is believing that people, including themselves, deserve to be blamed and punished for their mistakes and bad actions).
- Emotional Control (high scores indicate that the person believes they have little control over their unhappiness or other negative emotions. They think that everything is caused by other people or events).
- Avoidance of problems (denotes the belief that it is much easier to avoid certain difficulties and responsibilities and, instead, to do activities that are pleasant).
- Dependence (you have the belief that you should always have someone stronger to lean on, and you feel incapable of making your own decisions).
- Helpless to change (high scores indicate that the person believes that, since he is the result of his story, he can do little to change his status quo).
- Perfectionism (consists of believing that all problems have a perfect solution and that one cannot feel happy or satisfied until one finds it).

135

Neuropsychological evaluation using CANTAB Eclipse® Cambridge Neuropsychological Test Automated Battery:

- *Motor Control Task* (MOT). This test is used to become familiar with the equipment that will take the measurements. It can measure vision, comprehension or movement problems that can affect the performance of the rest of the tests.
- *Spatial Working Memory* (SWM), Memoria de Trabajo. Working memory is a type of short-

term memory that involves the prefrontal cortex, the seat of executive functions. It allows integrating instantaneous perceptions produced in short periods and combining them with the memory of past experiences, which is essential in everyday tasks such as having a conversation, adding numbers or reading a sentence. It is essential for reflection and problem-solving because it allows us to combine the information that comes to us from the environment with that stored in long-term memory. It measures the ability to retain spatial information and manipulate it in working memory. It is related to the dorsolateral and medial ventrolateral prefrontal cortex.

- *Rapid Visual Information Processing* (RVP), Sustained Attention. Sustained attention can be defined as maintaining the response to the same activity for a prolonged period of time. Activation of brain structures such as the parietal and frontal lobes.
- *Reaction Time* (RTI), processing speed. Processing Speed is a capacity that establishes the relationship between cognitive execution and the time invested in performing a task. It measures speed of mental and motor processing, as well as precision and tendency to respond prematurely (impulsivity). It is related to frontal and parietal areas.
- *Paired Associates Learning* (PAL), Visual Recognition Memory. Visual memory describes the relationship between the perceptual process, the encoding, storage and retrieval of representations of neural processing. It is associated with the functional integrity of the temporal lobes, especially the entorhinal cortex.

136

- The Stroop test. The Stroop color test has been applied to measure very diverse cognitive processes related to executive function, flexibility and the ability to inhibit automatic responses. This test consists of three parts in which the subject must be able to inhibit the stimuli that interfere with the fulfillment of the task.

5. Metacognitive Training Program

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The Metacognitive Training Program (EMC) consists of five sessions lasting between 45 and 60 minutes.

The material available for the Metacognitive Training (EMC) program consists of *PowerPoint presentations* (additional material is available in case more examples are required in each session), a manual and brochures with homework assignments.

The sessions are explained by means of the slide projection, which are available for free download at the link <http://www.uke.de/mkt>. All this material has been translated into Spanish and adapted by María Luisa Barrigón with the supervision of the original author Dr. Steffen Moritz. The beginning of each session is raised with a discussion of the previous module and the tasks of the last session are reviewed.

Module 1: **Accusing and taking credit**

Central theme: External attributional style for negative events; moncausal inferences.

Basic task: In the first part of the program, patients are familiarized with extreme attributional styles and their possible social consequences (eg blaming others for mistakes can lead to interpersonal tensions). Patients are encouraged to come up with more objective and balanced explanations for each situation (eg sharing success with others rather than attributing it exclusively to oneself). In the second part, patients have to find reasons for the briefly described events; for example, why hasn't a friend called (negative), or why someone invited him to dinner (positive). Situational and personal factors must be taken into account. Please note that the solutions to these exercises do not have a single answer. There are always a number of different possible explanations to consider, even when a single explanation seems valid at first (eg *A friend is talking behind your back*; possible explanation: *Not a true friend*; alternative explanations: *This person asked the others if I was sick*. He did not want to ask me directly since I could get angry or worry; It is normal, we all gossip from time to time. This does not mean that we are bad people). The second group of tasks incorporates a section on auditory hallucinations. The participants are confronted with various arguments about how the internal voices (hearing voices) are actually a self-generated fact and not inserted from the outside.

Module 2: Jumping to conclusions, part one

Central theme: Jumping to conclusions bias; *bias against disconfirmatory evidence.*

Basic task: The possible consequences of jumping to conclusions are illustrated using several examples at the beginning of the module. In the section *Jumping to Conclusions: In Action - Modern Myths*, the group discusses modern false beliefs (eg *Paul* is a dead myth in cycle A³⁸⁴). The arguments for and against this belief must be collected, exchanged, and evaluated for plausibility. It should be clear that these types of legends have arisen due to *jumping to conclusions* and these are based on dubious evidence. In this way, modern myths are a good model for delusions in general.

The exercises in the first group of tasks show common objects (e.g. a frog) that are taught in decreasing degrees of fragmentation: new lines are added in eight successive stages, until finally the whole object is shown. Alternatively, participants are asked to assess the plausibility of self-generated or pre-specified interpretations. Patients must wait until they have enough evidence to make their decision. For example, in the first stage of the *frog*, the figure resembles a lemon, since only the outline of the frog appears. A hasty decision would consequently lead to an error.

In the second group of tasks, are shown *gestalt images*, which, according to the observer's perspective, contain two objects or scenes (e.g., in the first image of cycle B the profile of an old man and a night street scene are shown simultaneously). Participants are asked to give their first impression of the image, and then change their perspective in order to find the alternative figure.

138

Module 3: Change beliefs

Central theme: Bias from jumping to conclusions (*jumping to conclusions bias*), bias against disconfirmatory evidence (*bias against disconfirmatory evidence*);

Basic task: After a brief introduction, is demonstrated in practice *confirmation bias* through short tasks. Three objects are presented (version A: three flowers; version B: three fruits). The participants are asked to think of a category to which the presented objects belong by suggesting new objects in

384 There are 2 different cycles of each session, cycle A and B, so it is possible not to repeat the presentation if part of the patients are already familiar with one.

this category (higher categories: living beings, food). The coach will say (by yes / no) if the proposed new elements fit into the higher category. Since the presented objects may mislead many people to believe that the top category is *flowers or fruits*, many people will propose objects that fit into those categories despite confirming alternative hypotheses or comparing their assumptions with other items. This is intended to illustrate a strong response bias, confirmation bias, which occurs when people ignore sources of information (e.g. newspapers, certain TV shows, books) that do not match their opinions and attitudes. Even if some members of the group are already familiar with the exercise or give the correct solution, do not confirm the answer immediately, but allow suggestions from other members.

Additionally, an exercise consisting of a series of three images that are shown in reverse order is performed. The sequences of images gradually reveal a complex story (example of cycle B: a man leans over a fence and observes a dog barking; in the next two images it is clear that the man has just escaped the dog by jumping the fence). For each image, participants are asked to assess the plausibility of the four different interpretations. At the end of each test the correct interpretation is discovered. One of the four options seems unlikely when displaying the first image, but it is the true one (in the example above: *The man has just run away from the dog that is barking*). Two of the other interpretations seem possible in the first image, but are ultimately false (decoy, e.g. "*The man is playing with his neighbor's dog*"; *The man has just built a fence for his dog*). All exercises include at least one performance that seems unlikely all the time. Examples include three different conditions presented in random order: *revealed to the first (revealed-on-first)* (the most plausible option after presentation of the first image is valid), *revealed to the second (revealed-on-second)* (the plot of the story is revealed with the presentation of the second image), and *revealed to the third (revealed-on-third)* (the plot of the story is revealed with the presentation of the final image)

Module 5: Memory

Central theme: Excess confidence in errors

Basic task: Visual stimuli are presented following the *Deese-Roediger-McDermott paradigm*, or the *false memory paradigm*³⁸⁵. This material is known to induce a large number of false memories, even in 50-80% of healthy subjects. In cycle A, a typical beach scene is initially shown (e.g. children

385 (Gallo, Roediger, & McDermott, 2001), (Roediger & McDermott, 1995).

playing, people sunbathing, water), intentionally omitting objects that we would normally expect to find on the beach (e.g. a ball, towels). In fact, participants later often recall seeing these plausible but actually absent objects.

Through the first two images and a brief description, the participants become familiar with the effect of false memories. After that, the participants are instructed to look carefully at the following images and recall each item as vividly as possible in order to avoid the effect of false memories. Each image (sample time: 15 to 30 seconds, depending on the performance level of the group) is followed by a recognition task in which the participants have to decide whether an object has been shown or not. Reflection on typical scenes and what to expect in them is encouraged on various occasions, which usually increases the likelihood of false memories appearing.

Module 7: Jumping to conclusions II

Central theme: Bias of jumping to conclusions (*jumping to conclusions bias*); Liberal acceptance (*liberal acceptance*)

Basic task: Participants are shown various pictures. Your task is to deduce the title of the painting from four possible options. For some frames the solution is quite obvious, but for others it becomes clear only after careful consideration. In several paintings it is even possible to question whether the actual title is misleading.

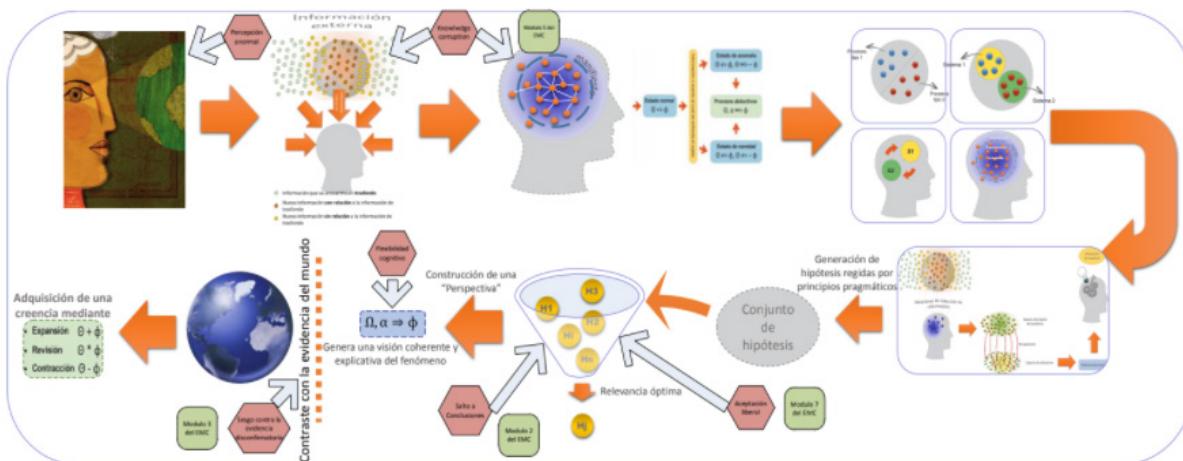
Analogous to Module 2, the introduction deals with the jump to conclusions and presents a modern myth / conspiracy theory (example of cycle A: *The owners of Marlboro are the Ku-Klux-Klan?*). The arguments for and against this belief must be collected, exchanged, and evaluated for plausibility. It should be clear that these types of legends have arisen due to *jumping to conclusions* and these are based on dubious evidence. In this way, modern myths are a good model for delusions in general.

These modules, we assume that they affect the hypothesis generation process and the maintenance of inappropriate beliefs. In this way, failure in a certain stage of the inferential process would be associated with the presence of specific biases.

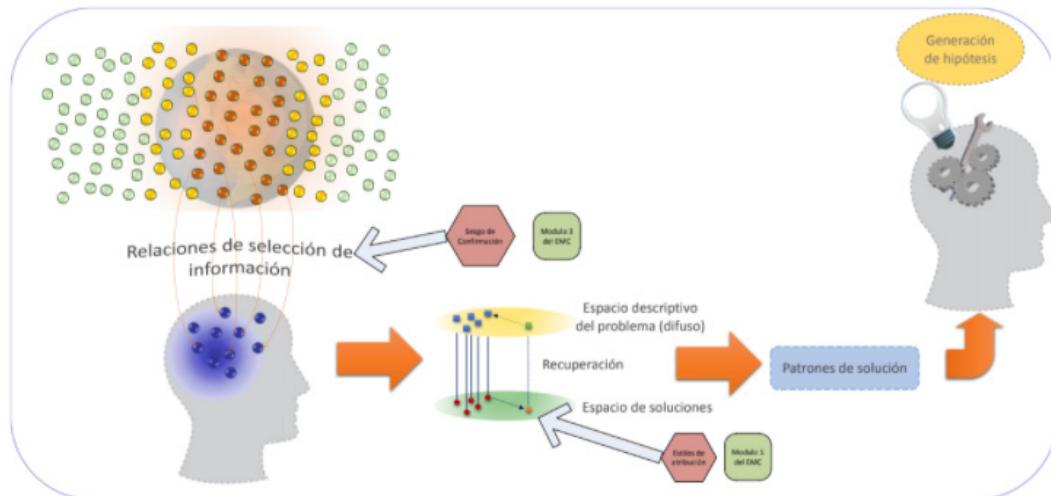
The main reasoning biases that we believe are embedded in the abductive process, as well as the

EMC modules that seek to mitigate their effects, are illustrated below.

Scheme 21. Biases and modules of the EMC



Scheme 22. Biases and modules of the EMC



It is expected to acquire, through the analysis of the battery results, greater clarity in the anomalies of the process related to the inappropriate beliefs, as well as an assessment of the efficiency of the application of Metacognitive Training in specific areas.

6. Presentation of Results

The results obtained from the work with the group of patients are presented below.

Sociodemographic Questionnaire

Table 8. Results

AGE		
AVERAGE	46.67	
STANDARD DEVIATION	11.04	

SEX		
MAN	0	0%
WOMAN	6	100%
TOTAL	6	100%

MARITAL STATUS		
SINGLE	3	50%
MARRIED, OR LIVING WITH A COUPLE	2	33%
SEPARATE / A	0	0%
DIVORCE / A	1	17%
WIDOW / A	0	0%
TOTAL	6	100%

STUDY LEVEL		
WITHOUT STUDIES	0	0%
INCOMPLETE PRIMARY	0	0%
FULL PRIMARY	0	0%
INCOMPLETE SECONDARY	0	0%
COMPLETE SECONDARY	3	50%
INCOMPLETE HIGH SCHOOL	0	0%
FULL HIGH SCHOOL	0	0%
UNIVERSITY INCOMPLETE	2	33%
COMPLETE UNIVERSITY	1	17%
TOTAL	6	100%

EMPLOYMENT SITUATION		
ACTIVE EMPLOYED	3	50%
ACTIVE UNEMPLOYED	2	33%
STUDENT	0	0%
HOUSEWIFE	1	17%
PENSIONISTA	0	0%
WORK PROTECTED	0	0%
DISABILITY (LOW) TEMPORARY	0	0%
OTHERS	0	0%
TOTAL	6	100%

HOSPITAL INCOME		
YES	1	17%
NO	5	83%

PSYCHIATRIC BACKGROUND		
YES	6	100%
NO	0	0%

CURRENT PSYCHOLOGICAL TREATMENT		
YES	1	17%
NO	5	83%

PHARMACOTHERAPY		
YES	5	83%
NO	1	17%

ASSOCIATED MEDICAL ILLNESSES		
YES	5	83%
NO	1	17%

Barratt Impulsivity Scale Version 11 (BIS-11)

DIMENSIONS		TOTAL											
		EVALUAT EDPRETE ST PATIENT 1	POST-TES T PATIENT 1	PRETEST PATIENT 3	POST-TEST PATIENT 3	PRETEST PATIENT 4	POST-TES T PATIENT 4	PRETEST PATIENT 6	POST- TEST PATIENT 6	PRETEST PATIENT 10	POST-TES T PATIENT 10	PRETEST PATIENT 11	POST-TES T PATIENT 11
ATTENTION		11	12	9	7	9	6	13	11	13	9	18	15
COGNITIVE INSTABILITY		11	11	6	8	6	9	8	7	5	5	10	7
MOTOR		17	20	14	15	9	9	20	18	12	15	23	16
PERSEVERANCE		7	10	6	5	10	8	10	12	4	7	10	8
SELF-CONTROL		15	17	10	9	13	17	13	13	13	12	19	19
COGNITIVE COMPLEXITY		14	13	11	12	11	12	17	15	14	13	14	15
TOTALS		75	83	56	56	58	61	81	76	61	61	94	80

MEDIA	PRETEST	POST-TEST
ATTENTION	12.17	10.00
COGNITIVE INSTABILITY	7.67	7.83
MOTOR	15.83	15.50
PERSEVERANCE	7.83	8.33
SELF-CONTROL	13.83	14.50
COGNITIVE COMPLEXITY	13.50	13.33

Quality of Life Enjoyment and Short Satisfaction Questionnaire - Form (Q-LES-Q-SF)

	PRETES T PATIEN T 1	POST-T EST PATIEN T 1	PRETE ST PATIEN T 3	POST-T EST PATIEN T 3	PRETES T PATIEN T 4	POST-T EST PATIEN T 4	PRETES T PATIEN T 6	POST-T EST PATIEN T 6	PRETES T PATIEN T 10	POST-T EST PATIEN T 10	PRETES T PATIEN T 11	POST-T EST PATIEN T 11
TOTAL RAW	36	29	43	41	40	53	36	40	41	42	24	22
MAXIMUM PERCENT	0.39	0.27	0.52	0.48	0.46	0.70	0.39	0.46	0.48	0.50	0.18	0.14
Question	Averag e	Pre-tes t	Post-te st									
1	3.07	3.17	2.33									
2	2.86	2.67	3.17									
3	2.13	2.67	2.67									
4	3.16	2.33	2.17									
5	2.73	2.67	3.17									
6	3.25	3.17	3.67									
7	2.96	2.83	2.50									
8	2.91	2.67	2.83									
9	2.75	2.67	2.50									
10	2.34	1.83	2.00									
11	3.17	2.33	3.00									
12	3.18	3.00	2.50									
13	2.88	2.17	2.17									
14	2.8	2.50	3.17									
15	na	na	na									
16	3.04	3.33	3.67									

Personality Inventory (NEO)

DIMENSIONS	PRETEST PATIENT 1	POST-TEST PATIENT 1	PRETEST PATIENT 3	POST-TEST PATIENT 3	PRETEST PATIENT 4	POST-TEST PATIENT 4	PRETEST PATIENT 6	POST-TEST PATIENT 6	PRETEST PATIENT 10	POST-TEST PATIENT 10	PRETEST PATIENT 11	POST-TEST PATIENT 11
NEUROTICISM	30	29	22	24	29	19	25	23	24	21	19	27
EXTROVERSION	23	26	20	18	22	23	25	23	22	22	21	22
APERTURA	24	24	24	23	23	16	22	25	21	20	19	21
KINDNESS / CORDIALITY	25	25	23	26	32	28	27	28	29	28	27	27
RESPONSIBILITY	28	25	28	24	19	21	19	23	28	27	20	20

NEUROTICISM	VERY HIGH	VERY HIGH	HIGH	HIGH	VERY HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
EXTROVERSION	VERY LOW	LOW	VERY LOW	VERY LOW	VERY LOW	VERY LOW	LOW	VERY LOW	VERY LOW	VERY LOW	VERY LOW	VERY LOW
OPENING	LOW	LOW	LOW	LOW	LOW	LOW	VERY LOW	LOW	LOW	LOW	VERY LOW	LOW
KINDNESS / CORDIALITY	VERY LOW	VERY LOW	VERY LOW	LOW	MEDIUM	LOW	MEDIUM	LOW	LOW	LOW	LOW	LOW
RESPONSIBILITY	LOW	VERY LOW	LOW	VERY LOW	VERY LOW	VERY LOW	VERY LOW	VERY LOW	LOW	VERY LOW	VERY LOW	VERY LOW

AVERAGE	PRICE	TESTPOST
neuroticism	24.83	23.83
EXTROVERSION	22.17	22.33
OPENING	22.17	21.50
AMABILIDAD / CORDIALITY	27.17	27.00
LIABILITY	23.67	23.33

Test Fagerstrom

PATIENT	SCORING PRETEST	RATING AFTER TEST	SCORE
1	0	1	VERY LOW
3	0	2	VERY LOW
4	0	0	VERY LOW
6	3	2	VERY LOW
10	0	0	VERY LOW
11	0	0	VERY LOW

Positive and Negative Syndromes Scale (PANSS)

CRGR

Postgraduate in Logic and Philosophy of Science University of Salamanca

SYMPTOMS	PRETEST PATIENT 1	POST-TEST PATIENT 1	PRETEST PATIENT 3	POST-TEST PATIENT 3	PRETEST PATIENT 4	POST-TEST PATIENT 4	PRETEST PATIENT 6	POST-TEST PATIENT 6	PRETEST PATIENT 10	POST-TEST PATIENT 10	PRETEST PATIENT 11	POST-TEST PATIENT 11
TOTAL POSITIVE SYMPTOMS	8	7	7	7	7	7	7	7	26	7	18	7
TOTAL NEGATIVE SYMPTOMS	7	7	7	7	8	7	7	7	22	8	41	7
TOTAL GENERAL SYMPTOMS	23	18	21	16	25	16	17	16	56	20	99	21
TOTAL PANSS	38	32	35	30	40	30	31	30	104	35	158	35
COMPOSITE SCALE	1	0	0	0	-1	0	0	0	4	-1	-23	0

% POSITIVE SYMPTOMS	21%	22%	20%	23%	18%	23%	23%	23%	25%	20%	11%	20
% NEGATIVE SYMPTOMS	18%	22%	20%	23%	20%	23%	23%	23%	21%	23%	26%	20
% GENERAL SYMPTOMS	61%	56%	60%	53%	63%	53%	55%	53%	54%	57%	63%	60%

AVERAGE	PRETEST	POST-TEST
	T	
POSITIVE SYMPTOMS	12.17	7.00
NEGATIVE SYMPTOMS	15.33	7.17
GENERAL SYMPTOMS	40.17	17.83
TOTAL PANSS	67.67	32.00

Yale-Brown scale for TOC

	PRETEST PATIENT 1	POST-TEST PATIENT 1	PRETEST PATIENT 3	POST-TEST PATIENT 3	PRETEST PATIENT 4	POST-TEST PATIENT 4	PRETEST PATIENT 6	POST-TEST PATIENT 6	PRETEST PATIENT 10	POST-TEST PATIENT 10	PRETEST PATIENT 11	POST-TEST PATIENT 11
TOTAL NORMAL	27	22	0	0	30	16	22	15	26	21	40	27
TOTAL INVESTIGATION	18	15	4	8	19	20	17	14	18	23	24	23

HALF	PRETEST	POST-TEST
TIME OCCUPIED BY OBSESSIVE THOUGHTS	2.50	1.50
OBSESSION-FREE INTERVALS (Not included in the total score)	2.50	2.00
INTERFERENCE DUE TO OBSESSIVE THOUGHTS	2.33	1.50
DISEASE ASSOCIATED WITH OBSESSIVE THOUGHTS	2.33	1.50
RESISTANCE IN CONTRA Obsessions	2.33	1.67
DEGREE OF CONTROL OVER OBSESSIVE THOUGHTS	2.50	1.67
TIME EMPLOYED IN THE REALIZATION OF BEHAVIORS COMPULSIVE	2.50	1.33
free interval COMPULSIONS (not included in the total score)	2.50	2.00
INTERFERENCE DUE TO CONDUCT Compulsive	2.33	1.83
Discomfort associated A compulsive behavior	2.67	1.83
RESISTANCE AGAINST compulsions	2.17	1.83
DEGREE OF CONTROL ON BEHAVIORS compulsive	2.50	2.17
INSIGHT IN obsessions and compulsions	1.83	1.83
AVOIDANCE	2.33	1.67
GRADE indecision	1.33	1.50
SENSE OF RESPONSIBILITY OVERRATED	2.17	1.67
EXAGGERATED slowing / ALTERATIONS INERTIA	1.83	1.50
PATHOLOGICAL DOUBT	1.83	1.33
GLOBAL SEVERITY	3.17	2.83
GLOBAL IMPROVEMENT	1.00	3.83
RELIABILITY	1.17	1.00

Yale Brown

Checklist OBSESSIONS

Aggression	0	0	2	3	2	13
Contamination	8	0	2	11	12	18
Sexual	0	0	0	0	0	0
Hoarding / Collecting	0	0	0	1	2	1
Religious	0	0	0	0	0	4
Symmetry and accuracy	0	0	0	3	2	2
Various	2	0	4	5	14	14
Somatic	2	0	2	1	2	4
TOTAL	12	0	10	24	34	56

COMPULSIONS

Cleaning / Washing	8	0	0	8	8	8
Review	3	0	4	5	2	7
Repeat	0	0	2	4	6	4
Count	0	0	2	1	0	2
Sort / Arrange	2	0	0	2	0	2
Save / Collect	0	0	0	1	2	1
Multiple	0	0	6	3	10	14
TOTAL	13	0	14	24	28	38

OBSESSIONS

Aggression	0%	0%	20%	13%	6%	23%
Pollution	67%	0%	20%	46%	35%	32%
Sexual	0%	0%	0%	0%	0%	0%
Hoarding / Collecting	0%	0%	0%	4%	6%	2%
Religious	0%	0%	0%	0%	0%	7%
Symmetry and accuracy	0%	0%	0%	13%	6%	4%
Various	17%	0%	40%	21%	41%	25%
Somatic	17%	0%	20%	4%	6%	7%

COMPULSIONS

Cleaning / Washing	62%	0%	0%	33%	29%	21%
Review	23%	0%	29%	21%	7%	18%
Repetition	0%	0%	14%	17%	21%	11%
Count	0%	0%	14%	4%	0%	5%
Sort / Fix	15%	0%	0%	8%	0%	5%
Save / Collect	0%	0%	0%	4%	7%	3%
Various	0%	0%	43%	13%	36%	37%

AVERAGE OBSESSIONS

Aggression	3.33
Pollution	8.50
Sex	0.00
Hoard / Collect	0.67
Religious	0.67
Symmetry and Accuracy	1.17
Various	6.50
Somatic	1.83
Total	22.67

AVERAGE COMPULSIONS

Cleaning / Washing	5.33
Review	3.50
Repetition	2.67
Count	0.83
Sort / Fix	1.00
Save / Collect	0.67
Various	5.50
Total	19.50

Revised Obsessive Compulsive Behavior Inventory (OCI-R)

PATIENT	PRE	-TEST SCORE	ASSESSMENT
		POST-TEST SCORE	
1	60	53	TOC
3	24	26	TOC
4	20	23	TOC
6	16	12	NP
10	44	43	TOC
11	48	25	TOC

Self-applied temperament scale (TEMPS -A)

DIMENSION	PRETEST PATIENT 1	POST-TES T PATIENT 1	PRETEST PATIENT 3	POST-TES T PATIENT 3	PRETEST PATIENT 4	POST-TES T PATIENT 4	PRETEST PATIENT 6	POST-TES T PATIENT 6	PRETEST PATIENT 10	POST-TES T PATIENT 1010	PRETEST PATIENT 1111	POST-TES T PATIENT 11
CYCLOTYMIC	11	10	8	11	8	3	2	2	3	2	6	4
DEPRESSIVE	4	6	5	3	1	0	3	3	3	1	4	3
IRRITABLE	7	7	3	4	1	0	1	1	2	3	3	2
HYPERTIMIA	7	6	3	4	0	3	5	5	1	4	6	5
Anxiety	3	3	2	2	2	2	0	0	0	0	3	0

DIMENSION	SCALE OF MEDIA IN WOMEN	SCALE OF MEDIA GENERAL	MEDIA PRETEST	MEDIA AFTER TEST
cyclothymic	4.60	4.30	6.33	5.33
DEPRESSIVE	3.10	2.90	3.33	2.67
IRRITABLE	2.90	3.10	2.83	2.83
hyperthymia	4.50	4.50	3.67	4.50
ANXIETY	5.60	5.20	1.67	1.17

Psychotic Symptoms Rating Scale (PsyRATS)

MEDIUM HALLUCINATIONS	PRETEST	POST-TEST
APPEARANCE FREQUENCY	0.00	0.00
DURATION	0.00	0.00
LOCATION	0.00	0.00
INTENSITY (VOLUME)	0.00	0.00
DEGREE OF CONVICTION OF THE ORIGIN OF VOICES	0.00	0.00
AMOUNT OF NEGATIVE CONTENT OF VOICES	0.00	0.00
FREQUENCY OF NEGATIVE VOICE CONTENT	0.00	0.00
FREQUENCY WITH WHICH THEY PRODUCE ANXIETY	0.00	0.00
ANXIETY INTENSITY	0.00	0.00
REPERCUSSION ON DAILY LIFE CAUSED BY VOICES	0.00	0.00
CONTROL OVER VOICES	0.00	0.00

MEDIUM DELUSIONS	PRETEST	POST-TEST
DELUSION FREQUENCY	0.00	0.00
DURATION OF CONCERN	0.67	0.00
CONVICTION	0.33	0.00
DEGREE OF EMOTIONAL IMPACT	0.00	0.00
INTENSITY OF EMOTIONAL REPERCUSSION	0.33	0.00
INTERFERENCE IN EVERYDAY LIFE	0.17	0.00

Mania Assessment Scale (SEM)

	PRETEST PATIENT 1	PRETEST PATIENT 3	PRETEST PATIENT 4	PRETEST PATIENT 6	PRETEST PATIENT 10	PRETEST PATIENT 11
TOTAL	11	5	0	0	48	20

%	PRETEST PATIENT 1	PRETEST PATIENT 3	PRETEST PATIENT 44	PRETEST PATIENT 6 PRETEST PATIENT 6	PRETEST PATIENTP RETEST 10	PATIENT PRETEST 11	MIDDLE
EUPHORIA	0%	0%	0%	0%	4%	0%	0.33
HYPERACTIVITY	9%	0%	0%	0%	0%	5%	0.33
SEXUAL DRIVE	0%	0%	0%	0%	0%	0%	0.00
SLEEP	0 %	0%	0%	0%	0%	15%	0.50
IRRITABILITY	36%	0%	0%	0%	33%	20%	4.00
VERBAL EXPRESSION	36%	80%	0%	0%	25%	20%	4.00
COURSE DISORDERS THOUGHT	9%	0%	0 %	0%	0%	15%	0.67
FORMAL THOUGHT DISORDERS	0%	0%	0%	0%	8%	20%	1.33
AGGRESSIONESS	0%	0%	0%	0%	25%	0%	2.00
APPEARANCE	0%	0%	0%	0%	4%	5%	
disease awareness	0.50%9	20%	0%	0%	0%	0%	0.33

Inventory Peters delusions (PDI)

FEATURE	PRETEST PATIENT 1	Patientp ost-test 1	PretestP ATIENT 3	Post-tes tPatient 3	Patient 4 PRETEST	POST- TEST PATIENT 4	PRETEST PATIENT 6	POST-TE ST PATIENT 6	PRETEST PATIENT 10	POST -TEST PATIENT 10	PRETEST PATIENT 11	POST-TE ST PATIENT 11
ANXIETY	20	15	0	11	30	13	2	1	51	8	21	9
CONCERN	20	19	21	0	28	10	1	3	64	30	19	9
CONVICTION	20	24	10	6	32	13	8	0	66	0	27	8
TOTALS	60	58	31	17	90	36	11	4	181	38	67	26

AVERAGE	PRETEST	POST-TES T
ANXIETY	20.67	9.50
CONCERN	25.50	11.83
CONVICTION	27.17	8.50
TOTAL	73.33	29.83

AVERAGE SPANISH	AVERAGE SPANISH WOMEN	AVERAGE PATHOLOGIC AL
58.9	61.0	130.5

Beck Insight Scale (BCIS Cognitive)

TRAIT	PRETEST PATIENT 1	AFTER TEST PATIENT 1	PRETEST PATIENT 3	POST-TE ST PATIENT 3	PRETEST PATIENT 4	AFTER TEST PATIENT 4	PRETEST PATIENT 6	POST-TE ST PATIENT 6	PRETEST PATIENT 10	POST-TE ST PATIENT 10	PRETEST PATIENT 11	POST-TE ST PATIENT 11
autoreflexion							17 18 17 16 19 7 16					15 12 14 11 12
self							11 8 8 6 15 8 8	8	5	4		6 July
COMPOSITE INDEX								6 10 9 10 4 -1 8 7				

MEDIA		Bare mo	SD	PRETEST	AFTER TEST
autoreflexion		15.13	4.6 9	15.33	13.67
SELF-CERTAINTY		8.79	3.7 1	9.00	6.67
COMPOSITE INDEX		6.33	6.2 5	6.33	7.00

Internal, Personal, and Situational Attributions Questionnaire (IPSAQ)

	PRE-TEST PATIENT 1	POST-TEST PATIENT 1	PRE-TEST PATIENT 3	POST-TEST PATIENT 3	PRE-TEST PATIENT 4	POST-TEST PATIENT 4	PRETEST PATIENT 6	POST-TEST PATIENT 6	PRE-TEST PATIENT 10	POST-TEST PATIENT 10	PRE-TEST PATIENT 11	POST-TEST PATIENT 11
Total score Internal attribution positive event	NE	12	10	7	15	12	13	12	9	12	14	8
Total score Internal attribution negative event	NE	4	5	2	15	15	5	2	7	3	13	0
Total score Attribution to other people positive event	NE	2	4	6	0	4	1	2	6	3	0	0
Total score Attribution to other people negative event	NE	10	11	10	0	1	0	3	5	7	0	0
Total score Situational attribution positive event	NE	2	2	3	1	0	2	2	1	1	2	8
Total score Situational attribution negative event	NE	2	0	4	1	0	11	11	4	6	3	16

Externalizing Bias score	NE	8	5	5	0	-3	8	10	2	9	1	8
Personalizing Bias score	NE	1	1.36	1.14	0	5	0.09	0.36	1.22	0.77	0	0

Irrational Beliefs Test (TCI-R)

ME DAY	PRETEST	POST-TEST
NEED FOR ACCEPTANCE	24.00	23.50
HIGH self	18.33	15.50
scapegoating	21.33	19.83
INTOLERANCE FRUSTRATION	22.00	21.50
ANXIETY	17.50	18.00
EMOTIONAL IRRESPONSIBILITY	17.00	20.33
AVOIDANCE OF PROBLEMS	7.83	9.00
DEPENDENCE	22.67	23.50
HELPLESSNESS	26.67	21.17
PERFECTIONISM	17.17	16.83

Scale Rating	Min-Max	Medium
Need for acceptance	Range 7-42	20
High self-expectations	5-30	11
Guilt	6-36	18
Intolerance to Frustration	6-36	21
Worry and Anxiety	5-30	18
Emotional Irresponsibility	7-42	23
Avoidance of Problems	3-18	5
Dependence	6-36	20
Helplessness / influence of the past	7-42	15
Perfectionism	5-30	14

Neuropsychological Assessment

Subject ID	Age	Gender	Session	Start Time	SWM Between errors Z-score	Percentile	SWM Strategy Z-score	Percentile
RG001	31	Female	1	08/17/2015 18:51	0.19	55-60%; 55-60%	-0.36	35-40%; 40-45%
RG0014: 49 PM	31	Female	2	06/27/2016	0.98	75-80%; 75-80%	-0.52	25-30%; 35-40%
RG003	57	Female	1	08/17/2015 21:15	-1.22	10-15%; 10-15%	-1.69	0-5%; 0-5%
RG003	57	Female	2	06/27/2016 17:52	-0.14	40-45%; 45-50%	-1.19	5-10%; 10-15%
RG004	55	Female	1	02/19/2015 12:25	-0.56	25-30%; 30-35%	-1.02	10-15%; 15-20%
RG004	55	Female	2	06/27/2016 11:50	-0.89	20-25%; 20-25%	-0.52	25-30%; 35-40%
RG00602 /18/2015	56	Female	1	13:31	-0.60	25-30%; 25-30%	-0.69	20-25%; 25-30%
RG006	56	Female	2	06/29/2016 13:27	-1.34	5-10%; 5-10%	-1.02	10-15%; 15-20%
RG01002 /24/2016	44	Female	1	18:18	0.56	65-70%; 65-70%	-0.02	50-55%; 55-60%
RG010	44	Female	2	06/29/2016 12:00	-0.31	35-40%; 35-40%	-1.02	10-15%; 15-20%
RG011	37	Female	1	20:44	02/24/2016-1.22	10-15%; 10-15%	-1.02	10-15%; 15-20%
RG011PM	37	Female	2	06/28/2016 4:45	0.15	50-55%; 55-60%	-0.52	25-30%; 35-40%

Subject ID	Age	Gender	Session	Start Time	RVP A 'Z-score	Percentile	RVP Probability of hit Z-score	Percentile	RVP Total false alarms Z-score	Percentile	RVP Mean latency Z-score	Percentile
RG0011 7/08	31	Female	1	/ 2015 18:51	-0.62	20-25%; 20-25%	-0.69	20-25%; 20-25%	0.62	60-65%; 100%	-0.52	20-25%; 20-25%
RG0014 :49 PM	31	Female	2	06/27/2016	0.40	75-80%; 75-80%	0.54	65-70%; 65-70%	-0.66	5-10%; 15-20%	1.30	90-95%; 90-95%
RG003	57	Female	1	08/17/2015 21:15	-0.67	20-25%; 20-25%	-0.69	20-25%; 20-25%	0.20	30-35%; 60-65%	0.18	45-50%; 45-50%
RG003	57	Female	2	06/27/2016 17:52	-0.07	45-50%; 45-50%	-0.07	40-45%; 40-45%	0.62	60-65%; 100%	0.61	70-75%; 70-75%
RG004	55	Female	1	02/19/2015 12:25	-2.63	0-5%; 0-5%	-2.54	0-5%; 0-5%	-0.66	5-10%; 15-20%	-1.71	5-10%; 5-10%
RG004	56	Female	2	06/27/2016 11:50	-1.10	15-20%; 15-20%	-1.10	15-20%; 15-20%	-0.23	15-20%; 30-35%	-0.06	35-40%; 35-40%
RG006	56	Female	1	13:31	02/18/ 2015-2 .30	0-5%; 0-5%	-2.34	0-5%; 0-5%	-0.23	15-20%; 30-35%	0.18	45-50%; 45-50%
RG006	57	Female	2	06/29/2016 13:27	-1.43	5-10%; 5-10%	-1.51	5-10%; 5-10%	0.20	30-35%; 60-65%	-0.71	15-20%; 15-20%
RG010	44	Female	1	18:18	02/24/ 2016-3 .51	0%; 0%	-3.16	0-5%; 0-5%	-0.66	5-10%; 15-20%	-0.65	15-20%; 15-20%
RG010	44	Female	2	06/29/2016 12:00	-3.21	0%; 0%	-2.54	0-5%; 0-5%	-2.78	0-5%; 0-5%	0.29	50-55%; 50-55%
RG011	37	Female	1	20:44	02/24/ 2016-0 .80	15-20%; 15-20%	-0.69	20-25%; 20-25%	-1.08	5-10%; 5-10%	0.07	40-45%; 40-45%
RG011PM	37	Female	2	06/28/2016 4:45	-0.85	15-20%; 15-20%	-0.69	20-25%; 20-25%	-1.51	0-5%; 5-10%	-0.98	15-20%; 15-20%

Subject ID	Age	Gender	Session	Start Time	RTI Mean simple reaction time Z-score	Percentile	RTI Mean simple movement time Z-score	Percentile
RG001	31	Female	1	08/17/2015 18:51	-0.27	20-25%; 20-25%	0.24	55-60%; 55-60%
RG001	31	Female	2	06/27/2016 16:49	-0.28	20-25%; 20-25%	0.58	65-70%; 65-70%
RG003	57	Female	1	08/17/2015 21:15	-0.16	25-30%; 25-30%	0.51	65-70%; 65-70%
RG003	57	Female	2	06/27/2016 17:52	-0.37	15-20%; 15-20%	0.64	70-75%; 70-75%
RG004	55	Female	1	02/19/2015 12:25	-0.86	5-10%; 5-10%	0.28	55-60%; 55-60%
RG004	56	Female	2	06/27/2016 11:50	0.90	95-100%; 95-100%	0.61	70-75%; 70-75%
RG006	56	Female	1	13:31	02/18/2015-0.26	20-25%; 20-25%	1.26	90-95%; 90-95%
RG006	57	Female	2	06/29/2016 13:27	-0.67	10-15%; 10-15%	0.56	65-70%; 65-70%
RG01002 /24/2016	44	Female	1	18:18	-0.25	20-25%; 20-25%	0.24	55-60%; 55-60%
RG010	44	Female	2	06/29/2016 12:00	-0.59	10-15%; 10-15%	0.31	55-60%; 55-60%
RG01102 /24/2016	37	Female	1	20:44	-0.74	5-10%; 5-10%	0.94	80-85%; 80-85%
RGO11	37	Female	2	06/28/2016 16:45	-0.26	20-25%; 20-25%	1.04	85-90%; 85-90%

Subject ID	Age	Gender	Session	Start Time	PAL Total errors (adjusted) Z-score	Percentile	PAL Total errors (6 shapes, adjusted) Z-score	Percentile
RG001	31	Female	1	17/08/2015 18:51	0.31	50- 55%; 50-55%	0.71	75-80%; 100%
RG0014: 49 PM	31	Female	2	06/27/2016	0.59	70-75%; 70-75%	0.71	75-80%; 100%
RG003	57	Female	1	08/17/2015 21:15	-0.59	15-20%; 15-20%	-0.39	15-20%; 15-20%
RG003	57	Female	2	06/27/2016 17:52	-0.27	20-25%; 20-25%	-0.47	15-20%; 15-20%
RG004	55	Female	1	02/19/2015 12:25	-0.04	30-35%; 30-35%	-0.05	20-25%; 25-30%
RG004	56	Female	2	06/27/2016 11:50	0.23	45-50%; 45-50%	0.54	60-65%; 70-75%
RG00602 /18/2015	56	Female	1	13:31	0.27	45-50%; 50-55%	-0.05	20-25%; 25-30%
RG006	57	Female	2	06/29/2016 13:27	0.20	40-45%; 45-50%	0.46	50-55%; 60-65%
RG010	44	Female	1	18:18	02/24/2016-0.47	15-20%; 15-20%	-0.30	15-20%; 20-25%
RG010	44	Female	2	06/29/2016 12:00	0.47	60-65%; 60-65%	0.54	60-65%; 70-75%
RG01102 /24/2016	37	Female	1	20:44	0.66	75-80%; 80-85%	0.71	75-80%; 100%
RGO11PM	37	Female	2	06/28/2016 4:45	0.66	75-80%; 80-85%	0.54	60-65%; 70-75%

Subject ID	Age	Gender	Session	Start Time	RTI Five-choice movement time Z-score	Percentile	RTI Mean five-choice movement time Z-score	Percentile
RG001	31	Female	1	08/17/2015 18:51	-0.04	40-45 %; 40-45%	-0.69	15-20%; 15-20%
RG0014: 49 PM	31	Female	2	06/27/2016	0.66	70-75%; 70-75%	0.54	65-70%; 65-70%
RG003	57	Female	1	08/17/2015 21:15	-0.57	20-25%; 20-25%	0.67	70-75%; 70-75%
RG003	57	Female	2	06/27/2016 17:52	-0.34	25-30%; 25-30%	1.02	85-90%; 85-90%
RG004	55	Female	1	02/19/2015 12:25	-0.43	25-30%; 25-30%	0.20	55-60%; 55-60%
RG004	56	Female	2	06/27/2016 11:50	1.00	85-90%; 85-90%	-0.16	35-40%; 35-40%
RG006	56	Female	1	13:31	02/18/2015-0.19	35-40%; 35-40%	0.69	75-80%; 75-80%
RG006	57	Female	2	06/29/2016 13:27	-0.29	30-35%; 30-35%	0.75	75-80%; 75-80%
RG010	44	Female	1	18:18	02/24/2016-0.21	30-35%; 30-35%	0.20	55-60%; 55-60%
RG010	44	Female	2	06/29/2016 12:00	0.06	45-50%; 45-50%	0.04	50-55%; 50-55%
RG011	37	Female	1	20:44	02/24/2016-0.24	30-35%; 30-35%	0.76	75-80%; 75-80%
RG011	37	Female	2	06/28/2016 16:45	-1.27	5-10%; 5-10%	-0.22	35-40%; 35-40%

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Stroop Test

AVERAGE				
STROOP TEST		RECORDS	PRETEST	POST-TEST
P	TIME (sec.)	16.50	16.00	
	HITS (36 max.)	36.00	36.00	
C	TIME (sec.)	25.50	25.33	
	HITS (36 max.)	34.67	35.17	
PC	TIME (sec.)	48.17	48.00	
	HITS (36 max.)	34.17	35.33	

AVERAGE	PRETEST	POST-TEST
TIME	30.06	29.78
HITS	34.94	35.50

PRETEST	TRAIT PATIENT 1	POST-TE ST PATIENT 1	PRETEST PATIENT 3	POST-TE ST PATIENT 3	PRETEST PATIENT 4	POST-TE ST PATIENT 4	PRETEST PATIENT 6	POST-TE ST PATIENT 6	PRETEST PATIENT 10	POST-TE ST PATIENT 10	PRETEST PATIENT 11	POST-TE ST PATIENT 11
PC'	17.75	18.00	18.00	18.00	16.06	16.66	18.00	18.00	18.00	18.00	18.00	18.00
Interference	18.25	18.00	18.00	18.00	8.948.94	15.3415. 34	18.00	18.00	18.0018. 00	18.0018. 00	18.00	18.00

Results Matrix

Table 8. Biases and Modules of the EMC

	Patient pre1 Patient	-testpost-test 1	Comparative	evaluation Patient pre3 Patient	-testpost-test 3	Comparative evaluation
Bis -11 (Impulsivity)	Impulsive	Impulsive	There is no significant change in this trait	Non-impulsive	Non-impulsive	Above the mean, but without reaching a typification of impulsivity
Quality of Life Enjoyment and Satisfaction Questionnaire - Short Form (Q-LES-Q-SF)	Below the average	Below the average	The patient had a significant decrease in his happiness report, which can be explained by he was in the depressive phase of his condition	Slightly above the average	Slightly above the average	There are no significant changes
Personality Inventory (NEO)	Reports high levels of Neuroticism which reflects a propensity to generate irrational ideas and high impulsivity, in addition scoring very low in extroversion, which presupposes shyness and withdrawn attitude, added to a lack of self-control.	It remains consistent with the previous evaluation.	There are no significant changes.	Reports high levels of neuroticism, which reflects a propensity to generate irrational ideas and high impulsivity, in addition to scoring very low in extroversion, which presupposes shyness and a withdrawn attitude coupled with a lack of self-control.	Remains consistent with previous assessment	No significant changes
Fagerström (Addiction)	Very low	Very low	No representative consumption	Very low	Very low	No representative consumption
PANSS	Shows moderate anxiety, as well as minimal levels of failure of attention, judgment and impulse control	It shows a minimum for anxiety levels	Lowlevel, as well as the other altered factors it shows	a minimum for anxiety levels, as well as depression, judgment and attention	Does not show the presence of alterations	Improved in all its areas
Yale-Brown scale for OCD Extended version	Presents a severe prevalence in most of the original items, being in the pathological mean	There is a significant decrease in all items	Both the normal test and the complementary reagents show a decrease in the presence of the	The test does not show presence of symptoms in the normal version, the more it shows a mild manifestation in some of	The test does not show the presence of symptoms in the normal version, but it shows a mild manifestation in	There is no significant presence of symptoms
			manifestation of the Disorder	the supplementary questions	some of the supplementary questions	
OCI-R	Positive for OCD	Positive for OCD	Positive for OCD	Da positive for TOC	Test positive for TOC	Test positive for TOC
TEMPS-A	Scores very high particularly in the area of cyclothymia	Scores very high particularly in the area of cyclothymia	There are slight variations, but broadly speaking it remains constant	Scores very high particularly in the area of cyclothymia	Puntúa muy alto particularmente en el rubro de ciclotimia	Hay ligeras variaciones, mostrando especial incremento en ciclotimia y el resto se mantiene constante
PSYRATS (AA y Delirios)	No hay sintomatología psicótica	No hay sintomatología psicótica	No hay sintomatología psicótica	No hay sintomatología psicótica	No hay sintomatología psicótica	No hay sintomatología psicótica
EEM	Presence of maniac elements	x	x	Presencia leve de elementos maniacos	x	x
PDI	En la media	En la media	No hay cambios significativos	Por debajo de la media	Por debajo de la media	Hay un decremento importante en la valoración
BCIS	Auto reflexión y auto certeza por arriba de la media normal	Auto reflexión por arriba de la media y auto certeza por debajo de la media	La auto reflexión aumentó, mientras que la auto certeza disminuyó lo que apunta a efectividad en el tratamiento	Auto reflexión por arriba de la media y auto certeza por debajo de la media	Auto reflexión ligeramente por arriba de la media y auto certeza por debajo de la media	Ambos valores disminuyeron, lo que apunta a eficiencia del entrenamiento
IPSAQ	No Evaluado	Presenta self serving bias	El paciente no contestó adecuadamente el primer test, por lo que no fue posible hacer una comparativa	Presenta self serving bias	Presenta self serving bias	Aunque se mantiene una tendencia a presentar este sesgo de pensamiento, es posible apreciar una diversificación en los tipos de atribución

	Pretest paciente 1	Post-test paciente 1	Evaluación Comparativa	Pretest paciente 3	Post-test paciente 3	Evaluación Comparativa
TCI-R	La mayoría de las puntuaciones se encuentran por arriba de la media	Se tendió a acercar a las medias en muchos de los rubros	Hay una tendencia a la normalización en muchos factores	Puntuaciones cercanas a la media en la mitad de los rubros, mostrando, así mismo, parámetros altos en 4 factores	Puntuaciones cercanas a la media en la mitad de los rubros, mostrando, así mismo, parámetros altos en 4 factores	Se mantienen relativamente constantes las valoraciones salvo en indefensión y necesidad de adaptación
SWM (Cantab)	En la media	En la media	x	Una desviación estandar (SD) por debajo de la media	Una SD por debajo de la media	x
RVP (Cantab)	En la media	En la media	x	En la media	En la media	x
RTI (Cantab)	En la media	En la media	x	En la media	En la media	x
PAL (Cantab)	En la media	En la media	x	En la media	En la media	x
STROOP	Poco susceptible a interferencia	Poco susceptible a interferencia	Se mantiene estable	Poco susceptible a interferencia	Poco susceptible a interferencia	Se mantiene estable

	Pretest paciente 4	Post-test paciente 4	Evaluación Comparativa	Pretest paciente 6	Post-test paciente 6	Evaluación Comparativa
Bis -11 (Impulsividad)	No impulsiva	No impulsiva	Por arriba de la media, normal pero sin alcanzar una tipificación de impulsividad	Impulsiva	Impulsiva	Se presenta un decremento en el rasgo; sin embargo, no abandona la tipificación de impulsividad
Quality of Life Enjoyment and Satisfaction Questionnaire – Short Form (Q-LES-Q-SF)	En la media	Significativamente por arriba de la media	El paciente tuvo un incremento significativo en su reporte de felicidad, lo que puede explicarse por que se encontraba en la fase maníaca de su padecimiento	Ligeramente por debajo de la media	En la media	Hay un ligero incremento
Inventario de personalidad (NEO)	Reporta altos niveles de Neuroticismo lo que refleja propensión a la generación de ideas irrationales y alta impulsividad, además de puntuar muy bajo en extroversión, lo que presupone timidez y actitud retraída, sumado a falta de autocontrol.	Se mantiene consistente con la evaluación anterior	No hay cambios significativos	Reporta altos niveles de Neuroticismo lo que refleja propensión a la generación de ideas irrationales y alta impulsividad, además de puntuar muy bajo en extroversión lo que presupone timidez y actitud retraída sumado a falta de autocontrol.	Se mantiene consistente con la evaluación anterior	No hay cambios significativos
Fagerström (Adicción)	Muy bajo	Muy bajo	No hay consumo representativo	Muy bajo	Muy bajo	No hay consumo representativo
PANSS	Arroja un mínimo para niveles de retraimiento social, preocupaciones somáticas y ansiedad, así como en alteración leve de sentimientos de culpa y depresión	No muestra presencia de alteraciones	Mejoró en todos sus rubros	Arroja un mínimo para niveles de ansiedad	No muestra presencia de alteraciones	Mejoró en todos sus rubros
Escala Yale-Brown para TOC Versión extendida	Presenta una prevalencia severa en la mayoría de los rubros originales, encontrándose ligeramente por arriba de la media patológica	Hay una disminución significativa en todos los rubros	El test normal muestra una disminución significativa (50%) en la presencia de la manifestación del Trastorno, aunque en las preguntas complementarias se mantiene estable	Muestra una presencia de moderada a severa de la sintomatología	Hay una disminución significativa en la mayoría de los rubros	El test normal muestra una disminución significativa (50%) en la presencia de la manifestación del trastorno, aunque en las preguntas complementarias el decremento es mínimo
OCI-R	Da positivo para TOC	Da positivo para TOC	Da positivo para TOC	No da positivo para TOC	No da positivo para TOC	No da positivo para TOC
TEMPS-A	Puntúa bajo en la mayoría de los rubros, excepto en ciclotimia donde puntúa alto	Todos los rubros se encuentran bajos	Hay un descenso significativo en el rubro ciclotímico pero aumentó la hipertimia	Hay presencia de la mayoría de los factores, mostrando valores medios en hipertimia	Hay presencia de la mayoría de los factores, mostrando valores medios en hipertimia	No hay cambio alguno en los valores
PSYRATS (AA y Delirios)	No hay sintomatología psicótica	No hay sintomatología psicótica	No hay sintomatología psicótica	No hay sintomatología psicótica	No hay sintomatología psicótica	No hay sintomatología psicótica
EEM	Sin presencia de elementos maníacos	x	x	Sin presencia de elementos maníacos	x	x

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PDI	Por arriba de la media normal	Por debajo de la media normal	Hay un descenso significativo en todas las dimensiones	Hay poca incidencia en estas dimensiones	Hay poca incidencia en estas dimensiones	Hay un decremento, aunque no había de primer momento gran incidencia
BCIS	Reflexión y certeza significativamente por arriba de la media normal	Reflexión significativamente por debajo de la media normal, auto certeza, ligeramente por debajo de la media normal	La reflexión bajó significativamente mientras que la certeza se encuentra ligeramente por debajo de la media normal	Auto reflexión ligeramente por arriba de la media y auto certeza ligeramente por debajo de la media	Auto reflexión en la media y auto certeza ligeramente por debajo de la media	No hay cambios significativos y el paciente puntuó en los rangos normales
IPSAQ	Egocentrismo marcado	Egocentrismo marcado	Aunque se empiezan a ver que el paciente puede asumir algunas otras razones diferentes a las internas, los rasgos	Presenta self serving bias	Presenta self serving bias	Se mantiene estable el puntaje

900RTS	Reflexión y certeza significativamente por arriba de la media normal	Reflexión y certeza significativamente por debajo de la media normal	Reflexión y certeza significativamente por debajo de la media normal	Reflexión y certeza significativamente por debajo de la media normal	Reflexión y certeza significativamente por debajo de la media normal	Reflexión y certeza significativamente por debajo de la media normal
(dentes) (JAF)	EN	EN	X	EN	EN	X
(dentes) (TIA)	EN	EN	X	EN	EN	X
(dentes) (TIA)	EN	EN	X	EN	EN	X
(dentes) (TIA)	EN	EN	X	EN	EN	X
(dentes) (MWS)	EN	EN	X	EN	EN	X
RCI	Reflexión y certeza significativamente por arriba de la media normal	Reflexión y certeza significativamente por debajo de la media normal	Reflexión y certeza significativamente por debajo de la media normal	Reflexión y certeza significativamente por debajo de la media normal	Reflexión y certeza significativamente por debajo de la media normal	Reflexión y certeza significativamente por debajo de la media normal

Chapter IV.

Results and Conclusions

Discussion of results

The application of the selected battery in this study allows a test-by-test analysis, as well as a general evaluation that facilitates the identification of the areas where the EMC has an impact, thus allowing to identify in which part of the abductive process there are alterations that affect the generation, maintenance and conviction of inappropriate beliefs.

We will begin by interpreting the general results test by test.

Bis-11

As expected, the scores on this instrument were high relative to the mean, with several of the patients reaching the designated standard deviation to be classified as impulsive. It can be seen, with the second post-strategy assessment, that although there was a decrease in the average scores, these were not significant other than in the area of attention, which is possible to explain thanks to the jump to conclusions modules reviewed in the training.

Quality of Life Enjoyment and Satisfaction Questionnaire - Short Form (Q-LES-Q-SF)

159

This scale yielded data consistent with OCD, since it is possible to appreciate consistent emotional lability with all patients.

Personality Inventory (NEO)

This instrument consistently showed that the group's personality has a homogeneous profile. High levels of Neuroticism were reported, which reflects a propensity to generate irrational ideas and high impulsivity, in addition, very low scores were observed in extroversion, which presupposes shyness and withdrawn attitudes, added to a lack of self-control.

Given that the patients share a common pathology, it is possible to assume that this assessment instrument can yield a personality profile.

Fagerström

Participants do not show addiction to tobacco and in the case of scores above zero, the level of addiction is very low.

PANSS

This test yielded consistently significant improvement in all affected factors, decreasing symptoms by almost 50% positive and negative, and even a little more than 50% in symptoms in general.

Yale Brown Scale for OCD

The test consistently shows an improvement in the severity of the symptoms, which indicates that the treatment was effective.

Self-applied Temperament Scale (TEMPS-A)

The mean obtained from the results of the patients was found above the normal mean in the cyclothymic dimension and below the normal mean in the hyperthymic and anxiety dimensions. This can be explained due to cultural changes. However, with respect to the Pre-test / Post-test evaluation, we can see significant decreases with respect to their own evaluations in various areas, such as cyclothymia. There was also an increase in the hyperthymia category.

The high score in the cyclothymic trait was expected given that this factor is identified as a predictor of affective disorders, such as bipolarity.

Psychotic Symptoms Rating Scale (Psyrats)

Only one of the patients seems to have a problem with delusions, so it is not accessible with the sample we have, although there seems to be some improvement in this area.

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Mania Evaluation Scale (SEM)

This test confirmed that patients present manic elements, the most relevant being those related to irritability, verbal expression and, to a lesser extent, aggressiveness.

Peters Delusional Ideas Inventory (PDI)

The pre-test showed that the dimensions associated with delusions are found in the study population, although it is possible to observe some of these dimensions in the normal population. However, it is possible to appreciate a frank decrease in the severity of these deviations after the application of Metacognitive Training, particularly in the area of conviction.

Beck's Cognitive Insight Scale (BCIS)

The results obtained by this instrument are interesting since the behavior of the group is not consistent. You can find both patients who correspond to Beck's thesis, (in which subjects prone to delusions score higher than the mean on both scales), and patients who do not behave like this. However, it is possible to appreciate that, although the certainty scale was more or less stable in each of the pre and post CME measurements, a decrease in the certainty of their beliefs remains consistent, which suggests that the CME was effective in inducing a behavior of doubt towards their own beliefs.

Internal, Personal, and Situational Attributions Questionnaire (IPSAQ)

161

The test allowed us to observe how marked is the attributional style in patients, it was observed that many of them, as expected, present the “self-serving bias”, where positive events are attributed to themselves and the negatives, to elements external to the patient. However, it is not possible to see significant changes even when one of the sessions of the EMC is specifically aimed at dealing with this bias.

Irrational Beliefs Test (TCI-R)

The test showed a constant in scoring below the average in the area of emotional irresponsibility, as

well as repeatedly high scores in problem avoidance, helplessness, high expectations, dependence and perfectionism, which is understandable given the pathology of the patients and that the CME does not affect these areas.

Spatial Working Memory (SWM)

Deviations (one standard deviation below the mean) consistent with the normal mean were observed in more than half of the sample, pointing to weaknesses in spatial memory.

Rapid Visual Information Processing (TestRVP)

Half of the sample presented significant alterations in the test, which denotes a lower attention span, which supports the theory that these patients have abnormal perception.

Test Reaction Time (RTI)

The group remained within the mean, although it would have been expected to find different results given the impulsivity score of the patients.

Test Paired Associates Learning (PAL)

No deviations from the mean, indicating comprehensive processing capabilities in the group.

Stroop test

Most of the patients are not susceptible to interference and the only one who presented susceptibility decreased his post-test score.

General Interpretation

The battery allowed to identify the specific characteristics that the group presents as a result of their ailments, especially interesting are the NEO (Neuroticism) and IPSAQ (Self Serving Bias) tests, in which the presence of certain thinking biases remains. that remain constant, even with specific

training (CME) aimed at mitigating the adverse effects of these thinking styles.

The above suggests that it is not easy to modify the attributional structure that patients have. However, supervision over these processes can be given and reflects changes in the general condition of the patient, as well as in the severity of the symptoms, which supports the idea that it is possible to volitionally develop supervision strategies that mitigate tendencies of thought pathological, such as the generation or maintenance (by diminishing conviction) of inappropriate beliefs.

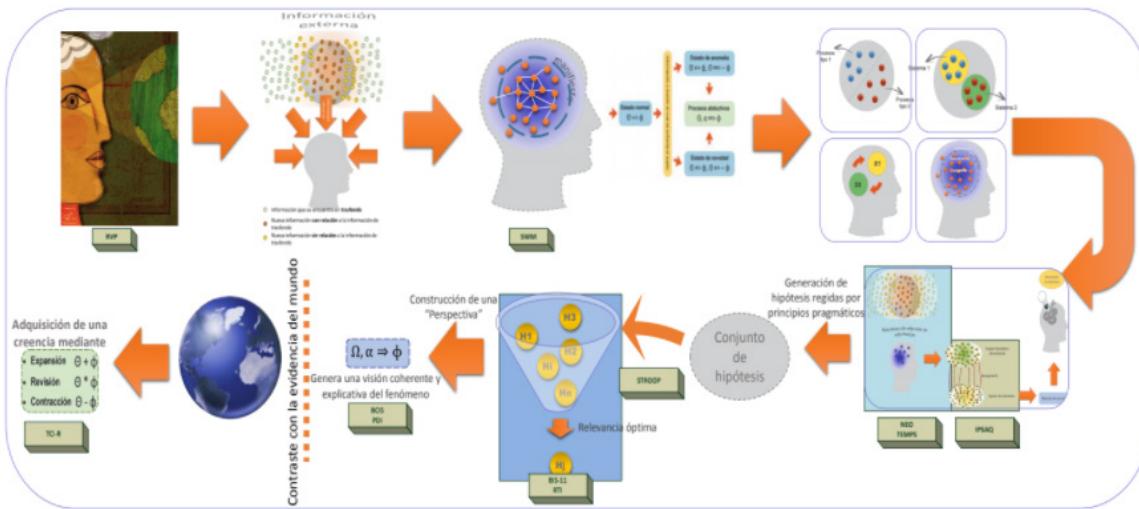
On the other hand, it is possible to state that the application of training had a positive impact on patients, which is noticeable in various battery tests (PANSS, Yale-Brown, OCI-R and PDI), where there is a considerable decrease in the presentation of the symptoms, as well as in the discomfort that this produces in the patients. It is pertinent to mention that most of the patients were under pharmacological treatment, which established a stable baseline evaluation, and it was on this line of evaluation that improvements were observed, which makes CME a valuable intervention without collateral effects, as may be supposed not observing dropouts or complaints about it from patients.

The evaluation of the battery, then, invites us to suppose that patients share both personality traits and mental structures that carry a certain susceptibility to patients presenting reasoning biases and attributional styles that cause the generation and selection of inappropriate hypotheses.

This has repercussions on emotional alterations, which in turn, worsen the inferential generation process, thus maintaining a pathological reasoning circle that is susceptible to correction through metacognitive training.

Below is a diagram showing which part of the abductive inferential process can be evaluated with each test.

Diagram 23. Relationship between sub-processes and tests



Conclusions

The main objective of this research was to deepen the understanding of the *abductive inferential process*, identifying: sub-processes, activation mechanisms, generation of hypotheses, selection of information and construction of cognitive perspectives to interact with the world, as well as recurrent failures in this process that explain the generation of inappropriate beliefs, for which a multidisciplinary review was necessary.

This review allows us to sustain a model articulated by threads involved in abduction, whose partition, albeit artificial, allows the inferential process to be explored in a more systematic way, while it is possible to locate systematic failure styles.

The conception of abduction and its approach from Peirce's pragmatism project seems to have already marked the route to follow given by the way in which he proposes the method to clarify the concepts: 1) *Recognizing when the concept manifests itself*, 2) *Logically analyzing the concept to discover its constituent parts* and 3) *Discovering and recognizing those habits of behavior that the belief in the truth of the concept in question generates*.

The model proposed in this study, although it broadens the panorama proposed by Peirce, starts from the way in which the individual initially manifests the information (*cognitive environment*), both from the world and from their memory, through type 1. processes. These processes, although they follow *associative* and *pragmatic*³⁸⁶ as the *principles such cognitive principle of Relevance or proximity*, show patterns similar to those of case-based reasoning and its engine explanation, specifically with regard to *the descriptive space for the problem* and *recovery of solution spaces guided by principles such as similarity and adaptability*.

The biological bases that embody the different cognitive processes and sub-processes (type 1 and type 2) have different processing characteristics, speed and structure, as well as different formalization elements with different edges in the inferential process itself (pragmatics, philosophy of science, logic, psychology, epistemology, etc.), making it difficult to identify systematic failures in

³⁸⁶ From the review on the area of pragmatics, the principles that are assumed to guide a large part of the inferential process are recovered and that are also at the basis of our ability to generate and interpret illocutionary acts, such as intentionality, the principle of relevance and the principle of cooperation. These elements permeate system 1 and guide the determination of the manifest information.

this process. However, by virtue of the model, it is possible to identify in this part of the inferential process, that systematic failures may occur as a result of *abnormal perception or corruption of beliefs*. and therefore it is also possible to mitigate the impact of failures by applying EMC module 5.

Abduction has a fallible character, not monotonic, expansive and with explanatory pretensions, which is activated by situational abductive triggers (that is, the event from the epistemic perspective puts the individual in a state *anomalous or novel*) at the moment the world presents the individual with a situation that requires explanation. Once a set is generated by *active information* (beliefs), at that moment *manifest*, the processes are started to obtain a set of *hypotheses* with explanatory claims (constrained by the active information itself) and it is necessary to select between them.

The selection process was widely discussed from *inference to the best explanation* that addresses this problem, although Peirce also touched on his criteria of *explanatory, contrastability and economy*, and the principles for this selection were established, mentioning in the model, the importance that criteria such as *optimal relevance* have in this process.

At this stage of the process, it was identified that the biases of *jumping to conclusions* and that of *liberal acceptance* are involved, so it is sought to mitigate their disruptive impact through modules 2 and 7 of the EMC.

Once the winning hypothesis is determined (after submitting them to a series of pragmatic principles for their evaluation and later emergence as a candidate hypothesis for their integration), it gains strength due to its *role of theoretical confirmation*, that is, to a certain circularity, *as in the case of self-evident explanations*³⁸⁷, and ends up generating a coherent view of the event, a *perspective*³⁸⁸ from which evidence is sought, or to acquire some epistemic certainty to act given the evidence that is available³⁸⁹.

387 If the mutually reinforcing circularity between the explanatory character of the abductive hypothesis and the phenomenon being explained is accepted, then this serves as an essential part of the reasons for believing it to be correct. In the case of mental pathologies, this plays against the patient, since it alters the individual and in turn strengthens the belief itself (self-service bias).

388 The idea of perspective construction arises from Grice's inferential model of communication. Thus, to interpret a speech act, the listener recognizes the speaker's intentions and builds a perspective, where the speech act takes on a specific meaning.

389 It may not have complete information and therefore aspects that support the belief are assumed.

The ability of the individual to make adaptations and modifications to their *perspective* is linked to the concept of *cognitive flexibility*, whose rigidification is assumed as an element that predisposes a cognitive bias that is reflected in *problems to accept non-confirmatory evidence*, for which The EMC uses module 3.

The built model articulates, therefore, a way of conceptualizing the inferential process, which is proposed, allows explaining more clearly why it is that there are certain reiterative failures in the generation and maintenance of some beliefs. Thus, in order to find empirical evidence in this regard, an analysis was carried out to identify and correct these failures in people who are susceptible to presenting them, with the presence of delusions being the guiding thread for selecting patients.

In this way, the following disorders were selected and punctually characterized: obsessive compulsive disorder, bipolar disorder and schizophrenia (which is expected to contribute to future research). Cross-sectional failures were identified in the following areas: attention, cognition, executive functions, motor skills and working memory, being the most important for the present study, cognition (cognitive inflexibility, ability to inhibit responses and decision-making problems), executive functions (processing speed) and memory (non-verbal memory), due to their direct relationship with the presence of cognitive biases that are associated with problems in the abductive inferential process.

It is pertinent to mention that all these disorders are mostly chronic and therefore the strategy assumes that cognitive failures will continue to occur. Efforts are focused on identifying and building skills to correct these failures. In all these disorders, the level of *awareness* of the individual about the abnormality of the belief is poor, so that the continuous identification of failures, together with the systematic challenge of these beliefs are essential elements of training.

In this sense, the intervention was valuable since improvements were found in patients who were already pharmacologically stabilized.

In the case of schizophrenia, for example, differences in brain architecture (particularly in the *frontal lobes*) could point to the presence of *the jumping to conclusions bias*, since the frontal lobes are those that function as inhibitors. On the other hand, alterations in the *amygdala* could indicate problems in the recovery of cases (*corruption of beliefs*), since the emotional tone is in that region.

In the same sense, alterations in the *glutamate system and the serotonergic system* suggest the presence of states in which there is an abnormal perception on the part of individuals, directly impacting the inference. Likewise, the *cognitive inflexibility* shown by schizophrenic patients affects the processes of epistemic change since, apparently, it is easier for them to ignore information than to start the correction process.

In bipolar disorder, as in schizophrenia, disturbances occur in mood. These disturbances come to trigger psychotic characteristics in the individual, which points to *failures in perception*, as well as problems in *information retrieval*, since the *cognitive environment* is altered depending on the emotional tone of the patient. Psychotic characteristics are usually congruent with mood.

The loss of attention or the ease to be distracted that patients show is evidence of an inability on the part of the individual to purify external stimuli, which supports the idea of an *abnormal perception* in the individual.

In the case of obsessive compulsive disorder, the *cognitive* and *epistemic* disorders are marked and easy to identify, characterizing them through the individual's *need and intentionality*. Although, in this disorder it does not seem that the emotional alteration (and therefore, an abnormal perception) is the basis of the inferential problem, it is possible to appreciate a *corruption of beliefs* consistently in patients.

As in schizophrenia, in obsessive compulsive disorder there are alterations at the frontal level that affect the *inhibitory systems*, which results in an *overestimation of danger*, reinforcing the corruption of beliefs that are enhanced by this circularity that, in fact, it involves the abductive process in a normal way.

This allows us to appreciate that, depending on the disorder, the cognitive impairments (*jumping to conclusions, attribution of styles, abnormal perception and discrepancy*) that affect the abductive inferential process vary. However, the general model is robust enough to account for these distinctions.

One more contribution of the present work is the identification of specific psychological tests (Bis 11, PANSS, Yale Brown, NEO, IPSAQ, OCI-R and PDI) that allow observing the impact in different

areas associated with inferential problems. Likewise, systematic doubt was introduced into some typical beliefs of the patients, in order to correct some cognitive patterns that the patient's ordinary thinking style presents, seeking to avoid maladaptive behaviors and beliefs.

In order to support the above, the research was carried out in stages:

First stage: Characterization of abduction as complete as possible enriched from different fields of analysis, such as pragmatics, psychology and expert systems.

Second stage: Identification of pathologies that share the trait of generating and maintaining inadequate beliefs, presenting their genesis, etiology, course, prognosis and tests used for their assessment, in order to identify the affected areas and functions that they share, as well as to select the useful evidence to map the impact of the intervention.

Third stage: Presentation of Metacognitive Training, and review of the main reasoning biases that, it is argued, negatively affect the abductive process.

Fourth stage: Application of the battery developed to a group of psychiatric patients with some of the target disorders studied.

Fifth stage: Application for a month and a half of the selected sessions of Metacognitive Training, also providing them with tasks and complementary materials.

Sixth stage: Second application of the designated tests to evaluate if there is an impact on the abductive inferential process in the parts that, we suppose, the Metacognitive Training is capable of influencing.

Seventh stage: Qualification of tests, analysis of results and discussion of the same.

These stages allowed the generation of a prospective map towards abductive inference, as well as towards its relationship with the generation, maintenance and conviction of inappropriate beliefs in patients with mental disorders (who share the generation of inappropriate beliefs), which allows the following conclusions to be sustained:

- The characterization of a cognitive process such as abductive inference requires a multidisciplinary approach given its complexity. Without appealing to research from pragmatics, case-based reasoning, cognitive approaches, epistemology, logic, among others, it would be impossible to sustain the proposed model.
- The cognitive processes of selection and retrieval of information from the background knowledge towards the manifest cognitive environment of the individual are mainly associative and belong to system 1, although all parts of the model contemplate the interaction between systems and, that constrains the types of activations that can be generated.
- Abductive triggers are susceptible to logical formalization. It has also been identified which situations trigger this process and, in turn, the importance of identifying the elements that affect the process (such as emotional activation or affective tone) is denoted, by allowing the development of skills that mitigate systematic failures.
- The information retrieval mechanisms are similar to case-based reasoning, which generates characteristic trends such as attribution styles. Likewise, processes such as those reviewed in the CBR allow the elements that emerge as candidates for explanation to be circumscribed in a more specific way, in addition to which it is glimpsed what impairments in memory processes would impact at these moments of the abductive process.
- The selection criteria between hypotheses are mostly pragmatic, particularly the relevance principle allows discerning between the best explanation with the available information.
- Different psychiatric pathologies share cognitive alterations that affect the epistemic scope of the patients. These alterations are capable of being addressed through metacognitive training, through which consistent improvements are observed in various areas of the inferential process in patients, these without adverse effects.
- Elements such as abnormal perception, the phenomenon of knowledge corruption and attribution styles do not seem to be susceptible to modification with metacognitive training. However, the products (hypotheses) generated by the individual, even under these assumptions, are capable of verification and control through system 2 processes, once the

individual is taught to identify them and act accordingly. Hence the visible improvement in the results of the battery applied.

- It is in the filter of possible hypotheses and their optimal relevance, given the manifest cognitive environment, where there are a large number of systematic errors that can be corrected by metacognitive training, so it is suggested to strengthen the EMC in this area with some sessions Additional features.
- The conviction in the belief is susceptible to change through metacognitive training, as is observable through the PDI test. By introducing a systematic doubt process in addition to the establishment of external belief verification mechanisms, patients report that they can control or avoid over-ideation and negative bodily activation by virtue of these beliefs. These elements make the EMC particularly important for pathologies that generate over activation, such as bipolarity or schizophrenia.
- Cognitive flexibility allows the patient to be able to face the fallibility of their own hypotheses, which determines the efficiency of metacognitive training and their ability to review beliefs modeled by the proposed epistemic change model. If cognitive flexibility is not addressed directly, it is unlikely that EMC will have a significant impact over time. Gaining cognitive flexibility is a watershed in estimating improvement for patients.
- The inability to deal with inappropriate beliefs is the reason for the increase in pathological symptoms, by increasing anxiety and establishing non-adaptive avoidance mechanisms, so providing metacognitive tools helps to reduce general pathological symptoms, as well as showing benefits in a good number of areas of the individual, as can be observed in various tests in the results' matrix (as well as in annex 1).
- The abductive inferential model presented in this research allows us to understand most of the cognitive biases present in the target pathological population, as well as to show a complete model for functional mapping and its correlation with psychological batteries, such as the one used in the present study. This model is robust, and it is expected that in future research the model will be able to account for more cognitive biases and allow solutions to be proposed.

- Metacognitive Training is a valuable intervention in itself, which can be complementary to pharmacological treatments in a stable phase, without observable collateral effects. Likewise, it is expected that an attenuated general diffusion training or training that improves decision-making processes in other areas, such as psychological care, can be developed.

Given the above, this research presents a novel approach to the inferential process, gaining clarity in it, while strengthening the framework of reference of interventions (such as metacognitive training) supporting the idea that by attacking systematic failures in the process, many of the Side effects resulting from these biases can be mitigated, so as to reduce the severity of the symptoms generated by the pathologies in the inferential process, which therefore generates and maintains inappropriate beliefs.

It is worth mentioning that the present work gives rise to reflect, in the future, about the normative dimension that underlies a logicist conception of the correct inferential process. In particular, this research seeks to show that it is possible to bring logic closer to what is appreciated in the world, even when characteristics such as monotony are abandoned.

Although usually in the deontic dimension, it is logic that sets the guidelines for the evaluation of the correctness of the inference, it would be convenient to assess that there are elements, such as harmony and cognitive tranquility in the framework of mental health, that are important to also consider in the evaluation of the correct inferential process, since, in general, they are not taken into account.

Elements such as the relationship between the practical uses of logic, and mental health or happiness, are little explored. Therefore, its analysis could be particularly interesting from areas such as psychology or psychiatry, whose field of work is oriented to seek as an ultimate goal, happy human beings, capable of living and developing fully from their own living conditions.

Bibliography

Aamodt, A. (1994). Explanation-driven case-based reasoning. *Topics in Case Based Reasoning*, 54(1), 274–288. <http://doi.org/10.1007/s10462-005-4607-7>

Abramowitz, J. (1997). Effectiveness of psychological and pharmacological treatments for obsessive-compulsive disorder: a quantitative review. *Journal of Consulting and Clinical Psychology*, 65(1), 44–52. <http://doi.org/10.1037/0022-006X.65.1.44>

Achim, AM, & Lepage, M. (2005). Episodic memory-related activation in schizophrenia: meta-analysis. *The British Journal of Psychiatry: The Journal of Mental Science*, 187(6), 500–9. <http://doi.org/10.1192/bjp.187.6.500>

Aha, DW (1998). The omnipresence of case-based reasoning in science and application. *Knowledge-Based Systems*, 11(5–6), 261–273. [http://doi.org/10.1016/S0950-7051\(98\)00066-5](http://doi.org/10.1016/S0950-7051(98)00066-5)

Akiskal, HS, Mendlowicz, M. V, Jean-Louis, G., Rapaport, MH, Kelsoe, JR, Gillin, JC, & Smith, TL (2005). TEMPS-A: validation of a short version of a self-rated instrument designed to measure variations in temperament. *Journal of Affective Disorders*, 85(1–2), 45–52. <http://doi.org/10.1016/j.jad.2003.10.012>

Alain, C. (2002). Neurophysiological Evidence of Error-monitoring Deficits in Patients with Schizophrenia. *Cerebral Cortex*, 12(8), 840–846. <http://doi.org/10.1093/cercor/12.8.840>

Alchourrón, CE, Gardenfors, P., & Makinson, D. (1985). On the Logic of Theory Change: Partial Meet contraction and Revision Functions. *The Journal of Symbolic Logic*, 50(2), 510–530.

Aliseda, A. (2006). *Abductive Reasoning. Abductive Reasoning Logical Investigations into Discovery and Explanation*. Springer.

ALLOTT,N.(2002).Relevanceandrationality.Phon.ucl.ac.uk,1–33.Retrievedfromhttp://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Relevance+and+rationality+*#3

Andreasen, NC, Paradiso, S., & O ' Leary, DS (1998). "Cognitive dysmetria" as an integrative theory of schizophrenia: a dysfunction in cortical-subcortical-cerebellar circuitry? *Schizophrenia Bulletin*, 24(2), 203–218.

Apiquián, R., Páez, F., Tapia, RO, Fresán, A., Vallejo, G., & Nicolini, H. (1997). Validity and reliability of the Mania Assessment Scale. *Mental Health*, 20(3), 23–29.

Arts, B., Jabben, N., Krabbendam, L., & van Os, J. (2008). Meta-analyses of cognitive functioning in euthymic bipolar patients and their first-degree relatives. *Psychological Medicine*, 38(6), 771–785. Retrieved from http://journals.cambridge.org/abstract_S0033291707001675

Association, AP (2013). DSM 5. *American Journal of Psychiatry*. American Psychiatric Publishing. <http://doi.org/10.1176/appi.books.9780890425596.744053>

Batens, D. (2009). *Adaptive Logics and Dynamic Proofs. Mastering the Dynamics of Reasoning, with Special Attention to Handling Inconsistency*.

Becoña, E., & Lorenzo, MDC (2001, December 31). Effective psychological treatments for bipolar disorder. *Psicothema*. Retrieved from <http://www.unioviedo.es/reunido/index.php/PST/article/view/7903>

Belló, M., Puentes-Rosas, E., Medina-Mora, ME, & Lozano, R. (2005, April 8). Prevalencia y diagnóstico de depresión en población adulta en México. Dirección General de Evaluación del Desempeño, Secretaría de Salud. Reforma 450, piso 12.col. Juárez. 06600 México DF, México. Retrieved from <http://localhost:8080/xmlui/handle/123456789/1204>

Benes, FM, Sorensen, I., Vincent, SL, Bird, ED, & Sathi, M. (1992). Increased Density of Glutamate-immunoreactive Vertical Processes in Superficial Laminae in Cingulate Cortex of Schizophrenic Brain. *Cerebral Cortex*, 2(6), 503–512. <http://doi.org/10.1093/cercor/2.6.503>

Bentall, R., David, AS, & Cutting, J. (1994). Cognitive biases and abnormal beliefs: towards a model of persecutory delusions. In *The neuropsychology of schizophrenia* (pp. 337–360). Lawrence Erlbaum Associates.

Blackwood, N., Ffytche, D., Simmons, A., Bentall, R., Murray, R., & Howard, R. (2004). The cerebellum and decision-making under uncertainty. *Brain Research. Cognitive Brain Research*, 20(1), 46–53. <http://doi.org/10.1016/j.cogbrainres.2003.12.009>

Bloch, MH, Landeros-Weisenberger, A., Kelmendi, B., Coric, V., Bracken, MB, & Leckman, JF (2006). A systematic review: antipsychotic augmentation with treatment refractory obsessive-compulsive disorder. *Molecular Psychiatry*, 11(7), 622–632. Retrieved from <http://dx.doi.org/10.1038/sj.mp.4001823>

Bloch, MH, Landeros-Weisenberger, A., Rosario, MC, Pittenger, C., & Leckman, JF (2008). Meta-analysis of the symptom structure of obsessive-compulsive disorder. *The American Journal of Psychiatry*, 165(12), 1532–42. <http://doi.org/10.1176/appi.ajp.2008.08020320>

Bloom, FE (1993). Advancing a Neurodevelopmental Origin for Schizophrenia. *Archives of General Psychiatry*, 50(3), 224. <http://doi.org/10.1001/archpsyc.1993.01820150074008>

Bustos, E. (2011). The creative function of abduction. In S. Castro & A. Marcos (Eds.), *The Paths of Creation* (First, Vol, pp. 47–61). Bern: Peter Lang.

Cannon, TD, van Erp, TGM, Bearden, CE, Loewy, R., Thompson, P., Toga, AW, ... Tsuang, MT (2003). Early and Late Neurodevelopmental Influences in the Prodrome to Schizophrenia: Contributions of Genes, Environment, and Their Interactions. *Schizophrenia Bulletin*, 29(4), 653–669. <http://doi.org/10.1093/oxfordjournals.schbul.a007037>

Caraveo-Anduaga, J., & Medina-Mora, M. (1996). La prevalencia de los trastornos psiquiátricos en la población urbana adulta en México. *Salud Mental*, 19(3), 14–21. Retrieved from <http://inprf.bi-digital.com:8080/handle/123456789/1683>

Carston, R. (2005). Relevance Theory, Grice and the neo-Griceans: a response to Laurence Horn's 'Current issues in neo-Gricean pragmatics. Retrieved January 24, 2012, from <http://www.phon.ucl.ac.uk/home/robyn/Carston-HornResponse-webpage-11August05.pdf>

Castaño, LC, & Pérez, NQ (2011). Validación del Cuestionario de Creencias Irracionales (TCI)

en población colombiana. *Revista de Psicología Universidad de Antioquia*, 2(1), 41–56.

Chamberlain, SR, Blackwell, AD, Fineberg, NA, Robbins, TW, & Sahakian, BJ (2005). The neuropsychology of obsessive compulsive disorder: The importance of failures in cognitive and behavioural inhibition as candidate endophenotypic markers. *Neuroscience and Biobehavioral Reviews*.

Chamberlain, SR, Fineberg, NA, Menzies, LA, & Blackwell, Andrew D. Bullmore, Edward T. Robbins, Trevor W. Sahakian, BJ (2007). Impaired Cognitive Flexibility and Motor Inhibition in Unaffected First-Degree Relatives of Patients with Obsessive-Compulsive Disorder. *American Journal of Psychiatry*, 164(2), 335–338.

Chamberlain, SR, Menzies, L., Hampshire, A., Suckling, J., Fineberg, NA, del Campo, N., ... Sahakian, BJ (2008). Orbitofrontal dysfunction in patients with obsessive-compulsive disorder and their unaffected relatives. *Science (New York, NY)*, 321(5887), 421–2. <http://doi.org/10.1126/science.1154433>

Churchland, P. (2009). Inference to the Best Decision. In J. Bickle (Ed.), *The Oxford Handbook of Philosophy and Neuroscience* (First, pp. 419–430). New York: Oxford University Press. Retrieved from <http://www.oxfordhandbooks.com/10.1093/oxfordhb/9780195304787.001.0001/oxfordhb-9780195304787>

Costa Jr, PT, & McCrae, RR (1992). NEO-PR-R Professional Manual. Psychological Assessment Resources.

Davis, KL, Kahn, RS, Ko, G., & Davidson, M. (1991). Dopamine in schizophrenia: A review and reconceptualization. *The American Journal of Psychiatry*, 148(11), 1474–1486.

De Mantaras, RL, & Plaza, E. (1997). Case-based reasoning: an overview. *Ai Communications*, 10(1), 21–29. Retrieved from www.iiia.csic.es/Reports/1996/ReviewCBR.ps

Déficit cognitivos en parientes de primer grado no afectados de pacientes esquizofrénicos: revisión metaanalítica de posibles endofenotipos. (nd). Retrieved January 15, 2015, from

http://www.imedicinas.com/pfw_files/cma/ArticulosR/SchizophreniaBulletin/2007/V2.N.1/123010700380056.pdf

Dobbs, D. (2010). Schizophrenia: The making of a troubled mind. *Nature*, 468(7321), 154–6. <http://doi.org/10.1038/468154a>

Douven, I. (2011). Abduction. *Stanford Encyclopedia of Philosophy*. Retrieved from <http://plato.stanford.edu/entries/abduction/>

Drake, R., Haddock, G., Tarrier, N., Bentall, R., & Lewis, S. (2007). The Psychotic Symptom Rating Scales (PSYRATS): Their usefulness and properties in first episode psychosis. *Schizophrenia Research*, 89(1–3), 119–122. <http://doi.org/10.1016/j.schres.2006.04.024>

Ettelt, S., Ruhrmann, S., Barnow, S., Butzhz, F., Hochrein, A., Meyer, K., ... Grabe, HJ (2007). Impulsiveness in obsessive-compulsive disorder: results from a family study. *Acta Psychiatrica Scandinavica*, 115(1), 41–7. <http://doi.org/10.1111/j.1600-0447.2006.00835.x>

Evans, J. (2003). In two minds: dual-process accounts of reasoning. *Trends in Cognitive Sciences*, 7(10), 454–459. <http://doi.org/10.1016/j.tics.2003.08.012>

Evans, J. (2004). History of the dual process theory of reasoning. In K. Manktelow & MC CHUNG (Eds.), *Psychology of reasoning. Theoretical and Historical Perspectives* (pp. 241–266). Psychology Press.

Evans, J., & Over, D. (1996). A dual process theory of thinking (pp. 141–162). Psychology Press.

Evans, JSBT (2008). Dual-Processing Accounts of Reasoning, Judgment, and Social Cognition. *Annual Review of Psychology*, 59(1), 255–278. <http://doi.org/10.1146/annurev.psych.59.103006.093629>

Favrod, J., Rexhaj, S., Bardy, S., Ferrari, P., Hayoz, C., Moritz, S., ... Bonsack, C. (2014). Sustained antipsychotic effect of metacognitive training in psychosis: A randomized-controlled study. *European Psychiatry*, 29(5), 275–281. <http://doi.org/10.1016/j.eurpsy.2013.08.003>

Foa, EB, Huppert, JD, Leiberg, S., Langner, R., Kichic, R., Hajcak, G., & Salkovskis, PM (2002). The Obsessive-Compulsive Inventory: development and validation of a short version. *Psychological Assessment*, 14(4), 485–96. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/12501574>

Fonseca-Pedrero, E., Paino, M., Santarén-Rosell, M., Lemos-Giráldez, S., & Muñiz, J. (2012). Psychometric properties of the Peters et al Delusions Inventory 21 in college students. *Comprehensive Psychiatry*, 53(6), 893–9. <http://doi.org/10.1016/j.comppsych.2012.01.007>

Gallo, DA, Roediger, HL, & McDermott, KB (2001). Associative false recognition occurs without strategic criterion shifts. *Psychonomic Bulletin & Review*, 8(3), 579–586. <http://doi.org/10.3758/BF03196194>

Gärdenfors, P. (1988). *Knowledge in Flux. Modeling the Dynamics of Epistemic States. Elements*. MIT Press.

Garety, PA, & Freeman, D. (1999). Cognitive approaches to delusions: A critical review of theories and evidence. *British Journal of Clinical Psychology*, 38(2), 113–154. <http://doi.org/10.1348/014466599162700>

Garety, P., Freeman, D., Jolley, S., Dunn, G., Bebbington, P., Fowler, D., ... Dudley, R. (2005). Reasoning, emotions, and delusional conviction in psychosis. *Journal of Abnormal Psychology*, 114(3), 373–384. Retrieved from <http://discovery.ucl.ac.uk/2167/>

Garety, P., Joyce, E., Jolley, S., Emsley, R., Waller, H., Kuipers, E., ... Freeman, D. (2013). Neuropsychological functioning and jumping to conclusions in delusions. *Schizophrenia Research*, 150(2–3), 570–4. <http://doi.org/10.1016/j.schres.2013.08.035>

Garibay, R. (2010a). *Alcances y limitaciones de los modelos de procesamiento dual: Extensión de una propuesta para integrar inferencias abductivas*. Universidad del País Vasco.

Garibay, R. (2010b). *Alcances y limitaciones de los modelos de procesamiento dual: Una propuesta para integrar inferencias abductivas*. Universidad Nacional Autónoma de México.

Glahn, DC, Almasy, L., Barguil, M., Hare, E., Peralta, JM, Kent, JW, ... Escamilla, MA (2010). Neurocognitive endophenotypes for bipolar disorder identified in multiplex multigenerational families. *Archives of General Psychiatry*, 67(2), 168–77. <http://doi.org/10.1001/archgenpsychiatry.2009.184>

Glahn, DC, Almasy, L., Blangero, J., Burk, GM, Estrada, J., Peralta, JM, ... Escamilla, MA (2007). Adjudicating neurocognitive endophenotypes for schizophrenia. *American Journal of Medical Genetics. Part B, Neuropsychiatric Genetics: The Official Publication of the International Society of Psychiatric Genetics*, 144B(2), 242–9. <http://doi.org/10.1002/ajmg.b.30446>

Glahn, DC, Ragland, JD, Abramoff, A., Barrett, J., Laird, AR, Bearden, CE, & Velligan, DI (2005). Beyond hypofrontality: a quantitative meta-analysis of functional neuroimaging studies of working memory in schizophrenia. *Human Brain Mapping*, 25(1), 60–9. <http://doi.org/10.1002/hbm.20138>

Goff, DC, & Coyle, J. . T. (2001). The Emerging Role of Glutamate in the Pathophysiology and Treatment of Schizophrenia. *American Journal of Psychiatry*, 158(9), 1367–1377. <http://doi.org/10.1176/appi.ajp.158.9.1367>

Gottesman, II (1991). Schizophrenia genesis: *The origins of madness. A series of books in psychology*. New York: Henry Holt and Co.

Gottesman, II, & Bertelsen, A. (1989). Confirming Unexpressed Genotypes for Schizophrenia. *Archives of General Psychiatry*, 46(10), 867. <http://doi.org/10.1001/archpsyc.1989.01810100009002>

Gottesman, II, & Gould, TD (2003). The endophenotype concept in psychiatry: etymology and strategic intentions. *The American Journal of Psychiatry*, 160(4), 636–45. <http://doi.org/10.1176/appi.ajp.160.4.636>

Grace, AA, Moore, H., & O'Donnell, P. (1998). THE MODULATION OF CORTICOACCUMBENS TRANSMISSION BY LIMBIC AFFERENTS AND DOPAMINE : A MODEL FOR THE PATHOPHYSIOLOGY OF SCHIZOPHRENIA. *Advances in Pharmacology*, 42, 721–724. Retrieved from <http://cat.inist.fr>

Graff-Guerrero, A., Apiquian, R., Fresán, A., & Garcia-Anaya, M. (2001). Perspectiva neurobiológica de la esquizofrenia. *Salud Mental*, 24(6), 36. Retrieved from <http://www.medigraphic.com/pdfs/salmen/sam-2001/sam016e.pdf>

Gray, JA, Feldon, J., Rawlins, JNP, Hemsley, DR, & Smith, AD (2011). The neuropsychology of schizophrenia. *Behavioral and Brain Sciences*, 14(1), 1–20. <http://doi.org/10.1017/S0140525X00065055>

Grice, HP (1957). Meaning. *Philosophical Review*, (66), 377–88.

Gutiérrez Zotes, A., Valero, J., Cortés, MJ, Labad Alquézar, A., Ochoa, S., Ahuir, M., ... Salamero, M. (2012). Adaptación española de la Escala de Insight Cognitivo de Beck (EICB) en esquizofrénicos. *Actas Españolas de Psiquiatría*, ISSN 1139-9287, Vol. 40, No. 1, 2012, Págs. 2-9, 40(1), 2–9.

Harman, GH (1965). The Inference to the Best Explanation. *Philosophical Review*, 74(1), 88–95. <http://doi.org/10.2307/2183532>

Heider, F., & F. (1944). Social perception and phenomenal causality. *Psychological Review*, 51(6), 358–374. <http://doi.org/10.1037/h0055425>

Heinrichs, RW, & Zakzanis, KK (1998). Neurocognitive deficit in schizophrenia: A quantitative review of the evidence. *Neuropsychology*, 12(3), 426–445. <http://doi.org/10.1037/0894-4105.12.3.426>

Herrera, VA (2010). Generación y evaluación de explicaciones. *Criterio para el progreso científico: Un acercamiento desde la lógica abductiva*. Universidad Nacional Autónoma de México.

Hintikka, J. (1998). What is abduction.pdf. *Transactions of the Charles S. Peirce Society*, XXXIV(3), 503–533.

Hollander, E., Kaplan, A., Schmeidler, J., Yang, H., Li, D., Koran, LM, & Barbato, LM (2005). *Neurological soft signs as predictors of treatment response to selective serotonin reuptake inhibitors in obsessive-compulsive disorder. The Journal of neuropsychiatry and clinical neurosciences* (Vol. 17). <http://doi.org/10.1176/appi.neuropsych.17.4.472>

Johnson - Laird, PN (1995). Mental Models, Deductive Reasoning, and the Brain. In MS Gazzaniga (Ed.) (3rd ed., pp. 999–1008). THE MIT PRESS. Retrieved from http://www.cogsci.bme.hu/~babarczy/Orak/BMEpostgrad/semantics/2005spring/Johnson-Lairdmental_models.pdf

Judd, LL, Akiskal, HS, Schettler, PJ, Endicott, J., Maser, J., Solomon, DA, ... Keller, MB (2002). The Long-term Natural History of the Weekly Symptomatic Status of Bipolar I Disorder. *Archives of General Psychiatry*, 59(6), 530. <http://doi.org/10.1001/archpsyc.59.6.530>

Karam abc, EG, Hantouche, EG, Salamoun, MM, Mneimneh, ZN, & Karam, EG (nd). Temperament: Where Do You Set The Cutoff?

Kasai, K., Iwanami, A., Yamasue, H., Kuroki, N., Nakagome, K., & Fukuda, M. (2002). Neuroanatomy and neurophysiology in schizophrenia. *Neuroscience Research*, 43(2), 93–110. [http://doi.org/10.1016/S0168-0102\(02\)00023-8](http://doi.org/10.1016/S0168-0102(02)00023-8)

Ketler, K. (1993). Case-Based Reasoning : An Introduction. *Expert Systems with Applications*, 6, 3–8.

181

Kohn, R., Levav, I., Almeida, JMC de, Vicente, B., Andrade, L., Caraveo-Anduaga, JJ, ... Saraceno, B. (2005). Los trastornos mentales en América Latina y el Caribe: asunto prioritario para la salud pública. *Revista Panamericana de Salud Pública*, 18(4–5), 229–240. <http://doi.org/10.1590/S1020-49892005000900002>

Kolodner, JL (1992). An introduction to case-based reasoning. *Artificial Intelligence Review*, 6(1), 3–34. <http://doi.org/10.1007/BF00155578>

Kolodner, JL, & Leake, DB (1996). A Tutorial Introduction to Case-Based Reasoning. In DB

Leake (Ed.), *Case-based reasoning: Experience, lessons, and future directions* (pp. 31–65). California: MIT Press.

Kolodner, JL, & Wills, LM (1993). Case-Based Creative Design. *Artificial Intelligence and Creativity*, (Papers from the 1993 Spring Symposium), 95–102.

Korta, K., & Perry, J. (2011). Pragmatics. *Stanford Encyclopedia of Philosophy*. Retrieved from <http://plato.stanford.edu/entries/pragmatics/>

Kurtz, MM, & Gerraty, RT (2009). A meta-analytic investigation of neurocognitive deficits in bipolar illness: Profile and effects of clinical state. *Neuropsychology*, 23(5), 551–562.

Lawrie, SM, McIntosh, AM, Hall, J., Owens, DGC, & Johnstone, EC (2008). Brain structure and function changes during the development of schizophrenia: the evidence from studies of subjects at increased genetic risk. *Schizophrenia Bulletin*, 34(2), 330–40. <http://doi.org/10.1093/schbul/sbm158>

Leake, D. (1996). CBR in context: The present and future. In DB Leake (Ed.), *Case-based reasoning: Experience, lessons, and future directions* (pp. 3–30). The MIT Press. Retrieved from <http://www.cs.indiana.edu/~leake/papers/p-96-01.pdf>

Lichtermann, D., Karbe, E., & Maier, W. (2000). The genetic epidemiology of schizophrenia and of schizophrenia spectrum disorders. *European Archives of Psychiatry and Clinical Neuroscience*, 250(6), 304–310. <http://doi.org/10.1007/s004060070005>

Lipton, P. (2008). Inference to the best explanation. In S. Psillos & M. Curd (Eds.), *The Routledge Companion to Philosophy of Science* (First, pp. 193–202). New York: Routledge.

Loyola Alvarez, N. (2011). *Validez y Confiabilidad de la escala de impulsividad de Barratt Versión 11 en mujeres encarceladas*. Pontificia Universidad Católica del Perú.

Macdonald, PA, Antony, MM, Macleod, CM, & Richter, MA (1997). Memory and confidence in memory judgments among individuals with obsessive compulsive disorder and non-clinical

controls. *Behaviour Research and Therapy*, 35(6), 497–505. [http://doi.org/10.1016/S0005-7967\(97\)00013-2](http://doi.org/10.1016/S0005-7967(97)00013-2)

Maher, BA (2014). Anomalous experience in everyday life: Its significance for psychopathology. *Monist*, 82(4), 547–564. Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&db=hlh&AN=2716337&site=ehost-live>

Malloy, P., & Aloia, M. (1998). Frontal Lobe Dysfunction in Traumatic Brain Injury. *Seminars in Clinical Neuropsychiatry*, 3(3), 186–194. Retrieved from <http://europepmc.org/abstract/MED/10085206>

Manga, D., Ramos, F., & Morán, C. (2004). The spanish norms of the NEO five-factor inventory: new data and analyses for its improvement. *International Journal of Psychology and Psychological Therapy*, 4(3), 639–648.

Markman, A. (2002). Knowledge Representation. In H. Pashler & D. Medin (Eds.), *Stevens' Handbook of Experimental Psychology, Volume 2, Memory and Cognitive Processes* (Third, pp. 165–203). New York: John Wiley & Sons, Inc.

McDonald, C., Marshall, N., Sham, PC, Bullmore, ET, Schulze, K., Chapple, B., ... Murray, RM (2006). Regional brain morphometry in patients with schizophrenia or bipolar disorder and their unaffected relatives. *The American Journal of Psychiatry*, 163(3), 478–87. <http://doi.org/10.1176/appi.ajp.163.3.478>

Menzies, L., Achard, S., Chamberlain, SR, Fineberg, N., Chen, C.-H., del Campo, N., ... Bullmore, E. (2007). Neurocognitive endophenotypes of obsessive-compulsive disorder. *Brain : A Journal of Neurology*, 130(Pt 12), 3223–36. <http://doi.org/10.1093/brain/awm205>

Millikan, RG (2005). Semantics/pragmatics: Purposes and cross-purposes. In *Language: A Biological Model* (pp. 187–220). Oxford University Press.

Mitchell, RLC, Elliott, R., & Woodruff, PWR (2001). fMRI and cognitive dysfunction in schizophrenia. *Trends in Cognitive Sciences*, 5(2), 71–81. [http://doi.org/10.1016/S1364-2813\(00\)01511-2](http://doi.org/10.1016/S1364-2813(00)01511-2)

Mondragón Maya, CA (2013). *Características neuropsicológicas y electrofisiológicas de sujetos en riesgo clínico de desarrollar esquizofrenia*. Universidad Nacional Autónoma de México.

Montoya, A., Lepage, M., & Malla, A. (2005). Disfunción estructural del lóbulo temporal en pacientes con un primer episodio psicótico de esquizofrenia. *Salud Mental*, 28(2), 33. Retrieved from <http://www.medigraphic.com/pdfs/salmen/sam-2005/sam052c.pdf>

Moritz, S., & Woodward, TS (2005). Jumping to conclusions in delusional and non-delusional schizophrenic patients. *The British Journal of Clinical Psychology the British Psychological Society*, 44(Pt 2), 193–207. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/16004654>

Moritz, S., & Woodward, TS (2007). Metacognitive training in schizophrenia: from basic research to knowledge translation and intervention. *Current Opinion in Psychiatry*, 20(6), 619–625.

Moritz, S., Woodward, TS, & Lambert, M. (2007). Under what circumstances do patients with schizophrenia jump to conclusions? A liberal acceptance account. *The British Journal of Clinical Psychology the British Psychological Society*, 46(Pt 2), 127–137. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1348/014466506X129862/abstract?systemMessage=Wiley+Online+Library+will+be+disrupted+9+July+from+10-12+BST+for+monthly+maintenance>

Moritz, S., Woodward, TS, Whitman, JC, & Cuttler, C. (2005). Confidence in errors as a possible basis for delusions in schizophrenia. *The Journal of Nervous and Mental Disease*, 193(1), 9–16. Retrieved from <http://content.wkhealth.com/linkback/openurl?sid=WKPTLP:landingpage&an=00005053-200501000-00003>

Mueser, KT, & McGurk, SR (2004). Schizophrenia. *Lancet*, 363(9426), 2063–72. [http://doi.org/10.1016/S0140-6736\(04\)16458-1](http://doi.org/10.1016/S0140-6736(04)16458-1)

Ochoa, S., Haro, JM, Huerta-Ramos, E., Cuevas-Esteban, J., Stephan-Otto, C., Usall, J., ... Brebion, G. (2014). Relation between jumping to conclusions and cognitive functioning in

people with schizophrenia in contrast with healthy participants. *Schizophrenia Research*, 159(1), 211–7. <http://doi.org/10.1016/j.schres.2014.07.026>

Olney, JW, & Farber, N. (1995). Glutamate Receptor Dysfunction and Schizophrenia. *Archives of General Psychiatry*, 52(12), 998. <http://doi.org/10.1001/archpsyc.1995.03950240016004>

Olney, JW, Newcomer, JW, & Farber, NB (1999). NMDA receptor hypofunction model of schizophrenia. *Journal of Psychiatric Research*, 33(6), 523–533. [http://doi.org/10.1016/S0022-3956\(99\)00029-1](http://doi.org/10.1016/S0022-3956(99)00029-1)

Ortuño, F., Soutullo, C., & Pla, J. (2005). Avances de la investigación biológica en la esquizofrenia: aportaciones de neuroimagen funcional. *Revista de Medicina Universidad de Navarra*, 49(2), 16–23. Retrieved from http://www.researchgate.net/publication/228516231_Avances_de_la_investigacion_biolgica_en_la_esquizofrenia_aportaciones_de_neuroimagen_funcional/file/d912f50a3ccee6cb02.pdf

Paez, F., H, N., B, O., M, S. de C., G, L., & JR, DLF (1996). Estudio de traducción y confiabilidad de la escala Yale-Brown en español para el trastorno obsesivo-compulsivo, 19(Suppl 3), 13–16.

Patton, JH, Stanford, MS, & Barratt, ES (1995). Factor structure of the Barratt impulsiveness scale. *Journal of Clinical Psychology*, 51(6), 768–74. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/8778124>

185

Pauls, DL, Abramovitch, A., Rauch, SL, & Geller, DA (2014). Obsessive-compulsive disorder: an integrative genetic and neurobiological perspective. *Nature Reviews. Neuroscience*, 15(6), 410–24. <http://doi.org/10.1038/nrn3746>

Peirce, CS (1877). The fixation of belief. *Popular Science Monthly*, 12, 1–15. Retrieved from <http://www.unav.es/cep/FixationBelief.html>

Peirce, CS (1931). *The Collected Papers of Charles Sanders Peirce*. (C. Hartshorne, P. Weiss, & AW Burks, Eds.), Search (Vol. r•). Harvard University Press. Retrieved from <http://alias>

Peters, E., Joseph, S., Day, S., & Garety, P. (2004). Measuring delusional ideation: the 21-item Peters et al. Delusions Inventory (PDI). *Schizophrenia Bulletin*, 30(4), 1005–22. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/15954204>

Peters, ER, Joseph, SA, & Qarety, PA (1999). Measurement of Delusional Ideation in the Normal Population: Introducing the PDI (Peters et al Delusions Inventory). *Schizophrenia Bulletin*, 25(3), 553–576.

Peterson, C., Semmel, A., von Baeyer, C., Abramson, LY, Metalsky, GI, & Seligman, MEP (1982). The attributional Style Questionnaire. *Cognitive Therapy and Research*, 6(3), 287–299. <http://doi.org/10.1007/BF01173577>

Pfefferbaum, A., & Marsh, L. (1995). Structural brain imaging in schizophrenia. *Clinical Neuroscience* (New York, NY), 3(2), 105–11. Retrieved from <http://europepmc.org/abstract/MED/7583616>

Pons, S. (2004). *Conceptos y aplicaciones de la Teoría de la Relevancia*. Madrid: Arco / Libros.

Popper, K. (1962). *La Logica de la Investigación Científica* (Tecnos). Madrid: Tecnos.

Quintero Gutiérrez del Alamo, FJ, Baca García, E., Correas Lauffer, J., Pérez Rodríguez, MM, & González de Rivera, JL (2004). Genética y esquizofrenia. *Psiquis*, 25(5), 16–22. Retrieved from <http://europa.sim.ucm.es/compludoc/AA?articuloid=348500>

Randolph, C., Goldberg, TE, & Weinberger, DR (1993). The neuropsychology of schizophrenia. In M. Kenneth & E. Valenstein (Eds.), *Clinical neuropsychology* (3rd ed., pp. 499–522). New York: Oxford University Press.

Raz, S., & Raz, N. (1998). Structural brain abnormalities in the major psychoses: A quantitative review of the evidence from computerized imaging. *Psychological Bulletin*, 108(1), 93–108. <http://doi.org/10.1037/0033-2909.108.1.93>

Rissland, E., & Skalak, D. (1989). Combining case-based and rule-based reasoning: A heuristic approach. *Proceedings of the Eleventh International Joint* Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.75.6221&rep=rep1&type=pdf>

Roediger, HL, & McDermott, KB (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 21(4), 803–814. <http://doi.org/10.1037/0278-7393.21.4.803>

Rosa-Alcázar, AI, Sánchez-Meca, J., Gómez-Conesa, A., & Marín-Martínez, F. (2008). Psychological treatment of obsessive-compulsive disorder: a meta-analysis. *Clinical Psychology Review*, 28(8), 1310–25. <http://doi.org/10.1016/j.cpr.2008.07.001>

Rund, BR, & Borg, NE (1999). Cognitive deficits and cognitive training in schizophrenic patients: a review. *Acta Psychiatrica Scandinavica*, 100(2), 85–95. <http://doi.org/10.1111/j.1600-0447.1999.tb10829.x>

Schurz, G. (2007). Patterns of abduction. *Synthese*, 164(2), 201–234. <http://doi.org/10.1007/s11229-007-9223-4>

Shafir, E., & LeBoeuf, RA (2002). RATIONALITY. *Annual Review of Psychology*, 53(1), 491–517. <http://doi.org/10.1146/annurev.psych.53.100901.135213>

Simpson, HB, Huppert, JD, Petkova, E., Foa, EB, & Liebowitz, MR (2006). Response versus remission in obsessive-compulsive disorder. *Journal of Clinical Psychiatry*, 67(2), 269–276.

Sperber, D., & Wilson, D. (1994). *La relevancia*. Madrid.

Staal, W., Hulshoff, HE, Schnack, HG, Hoogendoorn, Mechteld LC Jellema, K., & Kahn, R. (2000). Structural Brain Abnormalities in Patients With Schizophrenia and Their Healthy Siblings. *American Journal of Psychiatry*, 157(3), 416–421. <http://doi.org/10.1176/appi.ajp.157.3.416>

Stanovich, K., & West, R. (2000). Individual differences in reasoning: implications for the rationality debate? *The Behavioral and Brain Sciences*, 23(5).

STEVANOVIC, D. (2011). Quality of Life Enjoyment and Satisfaction Questionnaire - short form for quality of life assessments in clinical practice: a psychometric study. *Journal of Psychiatric and Mental Health Nursing*, 18(8), 744–750. <http://doi.org/10.1111/j.1365-2850.2011.01735.x>

Torres, AR, Shavitt, RG, Torresan, RC, Ferrão, YA, Miguel, EC, & Fontenelle, LF (2013). Clinical features of pure obsessive-compulsive disorder. *Comprehensive Psychiatry*, 54(7), 1042–52. <http://doi.org/10.1016/j.comppsych.2013.04.013>

Tost, H., Alam, T., & Meyer-Lindenberg, A. (2010). Dopamine and psychosis: theory, pathomechanisms and intermediate phenotypes. *Neuroscience and Biobehavioral Reviews*, 34(5), 689–700. <http://doi.org/10.1016/j.neubiorev.2009.06.005>

Trejo Contreras, A., & Velásquez Pérez, L. (2006). Prevalencia y tendencia de trastornos mentales en el Instituto Nacional de Neurología y Neurocirugía. *Rev Ecuatoriana* ..., 15(2–3). Retrieved from http://medicosecuador.com/revecuatneurol/vol15_n2-3_2006/articulos_originales/prevalencia.htm

Tsai, G., Passani, LA, Slusher, BS, Carter, R., Baer, L., Kleinman, JE, & Coyle, JT (1995). Abnormal excitatory neurotransmitter metabolism in schizophrenic brains. *Archives of General Psychiatry*, 52(10), 829–836.

Van Ameringen, M., Simpson, W., Patterson, B., Dell'Osso, B., Fineberg, N., Hollander, E., ... Zohar, J. (2014). Pharmacological treatment strategies in obsessive compulsive disorder: A cross-sectional view in nine international OCD centers. *Journal of Psychopharmacology* (Oxford, England), 28(6), 596–602. <http://doi.org/10.1177/0269881113517955>

Van Fraassen, BC (1989). *Laws and Symmetry*. *Philosophical Review* (Vol. 102). Oxford University Press. <http://doi.org/10.1093/0198248601.001.0001>

Van Horn, JD, & McManus, IC (1992). Ventricular enlargement in schizophrenia. A meta-analysis of studies of the ventricle:brain ratio (VBR). *The British Journal of Psychiatry*, 160(5), 687–697. <http://doi.org/10.1192/bjp.160.5.687>

Walker, E., & Bollini, AM (2002). Pubertal neurodevelopment and the emergence of psychotic symptoms. *Schizophrenia Research*, 54(1–2), 17–23. [http://doi.org/10.1016/S0920-9964\(01\)00347-4](http://doi.org/10.1016/S0920-9964(01)00347-4)

Watson, I. (1999). Case-based reasoning is a methodology not a technology. *Knowledge-Based Systems*, 12(5–6), 303–308. [http://doi.org/10.1016/S0950-7051\(99\)00020-9](http://doi.org/10.1016/S0950-7051(99)00020-9)

Wilson, D., & Sperber, D. (2004). La Teoría de la Relevancia. *Revista de Investigación Lingüística*, VII, 237–286.

Zumalde, EC, & Ramírez, OC (1999). Creencias y síntomas depresivos: Resultados preliminares en el desarrollo de una Escala de Creencias Irracionales abreviada, 15(2), 179–190.