

(Inter)Subjectivity and Set Theory: Order Relations.

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ABSTRACT.

Along the same line undertaken in a previous work, subjective processes are now studied with the “set theory”, in this case, through “order relations”. Cantor already pointed out the possible application of the latter to different disciplines.

As before, the material corresponds to the speech issued by individuals who reach out for help to the Psychopathology and Psychoanalysis Association of Seville (APPS) which has been faithfully registered during the interviews. The result of the application of the setist notions to the verbal material was revealing how the subject that makes the comparison, distances himself from the rest of the people, feeling “special”, which can be seen in how an “outstanding element of a set” is formed (“upper bound” or “lower bound”, as the case may be).

What is obtained are not mathematical metaphors, instead, it unveils the subjectivity that comes into play in human interactions. The knowledge that is attained escapes simple observation, which is usually quite short-sighted when it comes to discovering underlying structures; The knowledge of these is essential for the psychiatrist or psychologist to interpret more accurately the studied phenomena.

KEYWORDS. *Intersubjectivity. Set. Order relation Venn diagrams. Feeling of inferiority. Notable elements of an ordered set.*

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I. Introduction

The role of mathematics in the development of natural sciences has been key since it has helped by providing clarity and consistency to the information and presenting it adequately. Within psychiatry (and psychology) they have been employed with similar purposes, developing two principal lines: a) statistics, which are applied to the study of the distribution of mental disorders in a community (epidemiology) (1) and b) the psychological evaluation through scales and tests (psychometric) (2). Despite the utility they have shown for knowing the distributional population of mental disorders, none of them has provided information when approaching the subject and discovering his internal mechanisms (3,4).

This motivated us to look for a way to proceed with subjectivity, using new formal methods and this has been precisely what we have already started in a previous article (5). Such action has at least two difficulties in the field of psychiatry and psychology:

1°. Of subject. Currently, subjectivity shows a confusing status in both disciplines because it can not be directly observed, this means that its capture must be indirect, through the words and gestures of the person. Hence, its place is denied or, what is more common, it is confused with the brain, the behaviour, or the incorporation of certain social patterns.

2°. Of method. The methods that are employed for any scientific approach in these two fields have been assimilated to those used by the natural sciences, with physics as a model and therefore, they have adopted the same method that is qualitative.

These remarks have a fulfilled answer since not taking subjectivity into account goes against the clinical exercise given that the psychopathological examination and the realisation of the medical history are sustained in interviews, which are an attempt to capture the inner world of the patient, which includes: ideas, affections, beliefs, feelings, fantasies, certainties, hunches, etc. At the same time, quantification does not have a place in studies about the “inwardness” since the latter has been shown as a set of operations of immeasurable nature so if any numeric approximation was made, it would be a mere convention. Then, a one-to-one correspondence is established in advance between a quantity and a certain state of subjectivity (e.g. sadness or anxiety), which is not an authentic quantification since it lacks a unit of measurement. Bear in mind that Kant denied any natural character to psychology, precisely because he dealt with phenomena that were impossible to measure (6).

In the previous work, we approached the patients without using any test to avoid distorting the information that they provided, nor did we use any system of numeration. The type mathematics that we applied were part of the “set theory” and with them, we could approach the intersubjective relations (5). These were defined as “binary relations” and a graph was built that showed those contacts in which the patient was placed in an outstanding position regarding others. The hidden components of the problem were discovered with certain clarity, those with which we are going to work in psychotherapy sessions and which should be known.

The exposition that will take place hereunder represents an extension of what was already mentioned and, in this sense, we continue with the same theory, but this time using the “relations of order”, coming also from the mastermind, George Cantor. It is no coincidence that both developments (sets and order) came from the same mind, given that the origin of the first began with the research carried out about the infinite which, in turn, was originated to be able to work with derivatives and integrals, it was crucial to handle infinite sets clearly and precisely. Thus, Cantor devised these two territories of mathematical knowledge when attempting to create an arithmetic of infinite numbers (which he called “transfinite”), since working with such sets entailed a form of order (7).

Therefore, the “set theory” is an almost solo achievement of this mathematician based at the University of Halle, something unprecedented in the history of mathematics where almost every discovery was the product of the efforts of several authors. Initially, the “theory of order” was presented in the work titled: *Über die Ausdehnung eines Satzes aus der Theorie der trigonometrischen Reihen* (1872), where the author outlined the idea of transfinite cardinal numbers and which he finished in another work: *Über unendliche lineare Punktmannigfaltigkeiten*, in which almost every set notion was present and where the developed theory of cardinal numbers was included. By the end of 1884, the great German mathematician had already completed the types of order, going so far as to indicate that this discovery would have applications in different sciences, including chemistry and biology. After 1884, he became ill for the first time and his most fertile period had finished. Nevertheless, he wrote again about the “set theory” between 1895 and 1897.

“Order relations” can be applied to the study of interpersonal contacts, as it is a procedure that studies groupings, it is a matter of relationships between elements and it does not use any measurements. Just like “binary relations”, “order” relations are procedures easy to apply, not involving complex presentations and obtaining results that are easy to communicate.

We pretend that what is written here does not remain as merely theoretical knowledge and that it can help to understand the mental organisation that we are studying and, beyond that, provide keys on how to intervene psychologically.

II. Methods

To study (inter)subjectivity, we use the verbal expressions that the patients emitted during the interviews conducted at the Psychopathology and Psychoanalysis Association of Seville (APPS), which are spontaneous and, at the same time, revealing about how they experience certain circumstances. Such content is collected scrupulously employing the “Subjectivity Approach Method” (8,9), which has been of great service by revealing the personal aspects of the subjects that presented certain pathologies (depression, schizophrenia, dysmenorrhea, etc.) (10). We will use phrases that were obtained from seven consultants, although the rest of the studied individuals (in total: 20) used similar expressions. These patients are: **P-1**: 36-year-old male, married, **P-2**: 25-year-old woman, single, **P-3**: 22-year-old male, single, **P-4**: 32-year-old woman, single, **P-5**: 18-year-old woman, single, **P-6**: 36-year-old woman, divorced, **P-7**: 23-year-old woman, single and **P-8**: 25-year-old male, single.

Continually, the notions from “set theory” (11-15) are applied with which an attempt is made to formalise and carry out operations on the material contained in the protocols of each one of the studied subjects. From this theory, we are going to use the following elements (see Figure 1):

1. Partition of a set. It is the decomposition of a set A into n non-empty subsets, which we will call: $A_1, A_2, A_3, \dots, A_n$, in a way that any two of them are disjointed and that the reunion of all of them is the initial set A . Therefore, it is fulfilled that:

$$A_1 \cap A_2 = \emptyset, A_2 \cap A_3 = \emptyset, \text{ etc.} \\ A_1 \cup A_2 \cup A_3 \dots \cup A_n = A$$

2. Binary relations: A “binary relation” R is the correspondence of a set with itself, in a way that a series of ordered pairs (x,y) are formed, which meet the relation. The binary relation R on a set A is a subset of the Cartesian square $A \times A = A^2$ and, therefore, it is a graph of $A \times A$, so $R \subset A^2$.

Binary relations fulfil a series of properties that, in turn, define the type in question. We will detail them:

a) Reflective. For every element x of A , $x R x$ is verified, which means that the pair (x,x) belongs to the relation.

b) Anti-reflective. It is verified that $x \neg R x$, or also, that the pair (x,x) does not belong to the relation.

- c) Symmetric. If a pair (x,y) belongs to the relation, so does (y,x) This means that $x R y$ and that $y R x$.
- d) Antisymmetric. If a pair (x,y) belongs to the relation, its symmetrical (y,x) does not.
- e) Transitive. If the pair (x,y) belongs to the relation and so does (y,z), then (x,z) belongs too.
- f) Anti-transitive. The three pairs mentioned before (x,y) (y,z) and (x,z) never belong to the relation.

3. Types of binary relations. They are classified according to the properties that are fulfilled:

- a) Relation of preorder: reflective and transitive.
- b) Relation of equivalence: reflective, symmetric and transitive.
- c) Relation of order. With various forms:
 - Non-strict order: reflective, antisymmetric and transitive.
 - Strict order: anti-reflective, antisymmetric and transitive.

4. Relations of order: Given a binary relation R in a set A, it is said that two elements “x” and “y” of A are “comparable” if it is verified that “a R b” or “b R a”.

A relation of order defined on a set A is called “total order” if any two elements of the set are comparable by such relation. Otherwise, we talk about a “partial order” (e.g. the sequence of natural numbers is a “total” order, while the membership is conceived as a “partial” order since there are subjects who are at the same level and there is no relation of order between them).

5. Notable elements of an ordered set. A total of six are defined: maximum (Max), upper bound (May), supremum (Sup), minimum (Min), lower bound (Mit), and infimum (Inf).

a) Maximum. We say that an element j of an ordered set A is maximum (Max A) when every element of A is prior or equal to j.

$$[\text{Max } A = j] \Leftrightarrow (\forall x) (x \in A) x \leq j$$

b) Upper bound. If in an ordered set A a part is considered, which we call B, we say that an element k of A is the upper bound of B when every element of B is prior or equal to k.

$$[\text{May } B = k, B \subset A] \Leftrightarrow (\forall x)(x \in B \Rightarrow x \leq k, k \in A)$$

c) Supremum. If in an ordered set A, part B is considered, we say that an element s of A is supremum of B when it is prior or equal to all upper bounds of B.

$$[\text{Sup } B = s, B \subset A] \Leftrightarrow (\forall x) (x \in B) (x \leq s) \wedge (\forall k) (k \text{ May } B) s \geq k$$

Note that to have an “upper bound” and a “supremum” there must be a part in set A; If not, there is the possibility of a “maximum”. On the other hand, for there to be a “supreme” there must be several upper bounds. We can summarise it as follows:

- There is no separate part in set A: maximum.
- There is a part in set A:
 - Only one upper bound: upper bound.
 - Several upper bounds: supremum (the prior of all upper bounds).

By changing the symbols “less than or equal to” for “more than or equal to”, it is possible to define the “minimum” (Min), the “lower bound” (Mit), and the “infimum” (Inf). The mathematical symbols that will be used in this work are presented in the next figure:

Sets.....	A, B, C, ...
Elements	a, b, c,
Indicator for sets.....	{ }
Complement of set.....	A', B', C'...
Ordered pair.....	(x,y)
Set membership.....	\in
Subset relation.....	\subset
Intersection of sets.....	\cap
Union of sets.....	\cup
Cartesian product.....	\times
Universal quantifier.....	\forall
Particular quantifier.....	\exists
Empty set	\emptyset
Binary relation.....	R
Inverse binary relation.....	R^{-1}
Relación binaria negative.....	-R
Maximum.....	Max
Upper bound	May
Supremum.....	Sup
Minimum.....	Min
Lower bound.....	Mit
Infimum.....	Inf

FIGURE 1. Set Theory symbols

III. Results

Properties of comparative binary relations.

Considering that each one of the pairs (a,b) means “a R b” (“a is related to be b”), in other words: (a,b) = a R b and that “a R b” expresses the comparative relation (5):

$$a R b = a < b$$

$$a R^{-1} b = a > b$$

From these, the “negative relations” are defined, that is to say, “not related to”, which we write as: “a - R b” and it means that the pair (a,b) is not part of the relation R.

The verification of one by one of the properties of the “binary relations” (see Methods), reveals that the following are fulfilled: reflective, antisymmetric, and transitive. We now move on with the corresponding demonstrations:

I. Reflective. For this to be fulfilled, the pair (a, a) must belong to the relation. The place that (a, a) takes is quite complicated to explain now and it goes beyond the content of this article because its location alludes directly to the relationship of the subject with himself (“intersubjectivity”). This point will be presented soon in another work, but for now, we will say that if the subject participates in the intersubjectivity and this has been defined as a “binary relation”, it has to be incorporated to the same, therefore, (a, a) must belong to the relation.

II. Antisymmetric. It is fulfilled that the pair (a,b) belongs to the relation, but the pair (b, a) does not, which is deduced easily from what has been said up to now.

III. Transitive. From what has been previously exposed, we have (from the inwardness of “a”) that:

$$(a < b) \wedge (b = c) \Rightarrow (a < c) \quad [1]$$

It is important to notice that the second term of this expression is (b=c) and not (b< c). It would look like this:

$$(a < b) \wedge (b < c) \Rightarrow (a < c)$$

This result has to do with the fact that in the reality of the comparative contacts, there is not a succession of steps between the subjects: $a < b < c < d$, but rather that “a” feels “inferior” to the rest and these are placed at the same level; all of them are superior (or inferior) to “a”, but the same between them, therefore: $b=c=d$.

This has been already seen when formulating that “a” was inferior to the rest, which was noted with the generalised expression: $\forall x (a < x)$ (**P-2**: “I always feel less than any of my friends”; **P-3**: “Many times I feel I’m more than anybody”, “I feel above of all of them”). At the same time, the comparison is made one by one (**P-4**: “When I’m in a new group, I go one by one comparing myself to each one of them: that one has that and I don’t, the other has other things I don’t...”).

This indicates that even if the transitive property is modified, it is still fulfilled.

Type of binary relation to which the comparison corresponds.

The study of the previous properties shows that the following consequences occur from subjectivity:

1. The subject “a” that compares himself, makes a partition in the set Y of the selves, between himself and the rest. This partition occurs in such a way that he enters a unitary subset, which we will call {a} and the rest of the subjects are left aside in another subset, which will be noted from now on as Y’ and which is defined as

$$Y' = \{b, c, d\} \quad [2]$$

A great distance is established between {a} and Y’ which means, mathematically, situating the others in a (sub)set different from the one “a” belongs to, the set Y’. Both {a} and Y’ are included in Y, since they are subsets of the latter.

The above indicates that these people do not approach others, although it may seem otherwise. Competition causes a distancing from the rest and an “encounter”, in Buber’s sense (16), can not occur between him and the others. (**P-6**: “Maybe I should talk more to my friends and get to know them a little because I know I distance myself from them because I can’t stand them being better than me at anything”. **P-7**: “I would like to get closer to people but I can’t because I’m always thinking that they are going to reject me or that I’m worthless”.) We can say that the patients that are studied are so immersed in their stories that they forget that others have one as well, as it is shown clearly in the examples.

If “a” approached the others, it would not cause the partition in the set Y; It is concluded that the subject drastically distances himself from others when comparing himself with them. The individual that suffers from the “feeling of inferiority” (or “superiority”) is incapable of feeling equal to others, therefore he will not be able to attain an emotional proximity. He establishes a step between him and others, which precludes the necessary rapprochement for a true emotional relationship to take place. Following what was said before, we can write:

$$Y' \cup \{a\} = Y \quad [3]$$

$$Y' \cap \{a\} = \emptyset \quad [4]$$

Both formulas clearly show how the conditions for the partition of a set are met.

2. Given the properties that we have proven to be met (reflective, antisymmetric, and transitive), we find a “relation of order” and, more specifically, a “non-strict order”. If we excluded the pair (a, a) we would have a “strict order” since the anti-reflective property could be satisfied. (see Methods)

3. We have seen the type of “binary relation” that prevails between the sets {a} and Y'; However, another very different relation is established in Y'. The subject states that he is less (or more) than others, but also expresses that the latter are equal to each other. Between the set {a} and the set Y' it is met that “a” is less (or more) than each one of them: $a < b$, $a < c$, $a < d$; On the other hand, there is equality between the elements in set Y': $b=c=d$.

In the set Y', the properties reflective, symmetric, and transitive will be satisfied (always from “a”), which leads us to think that it is an “equivalence relation”. These conclusions suggest that there is no “total order” among the elements of set Y since not all of them are comparable by the relation R which means “being less than” (or “being more than”). Indeed, it is not met that $b < c$, $c < d$, $b < d$. Therefore, we find a “partial order”.

The partition that “a” makes of the set Y can be represented using a Venn diagram, which clarifies what happens (Figure 2).

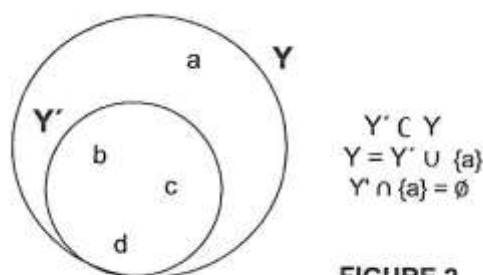


FIGURE 2

These results can be compared with what we observe in the clinic. The patient feels he is “below” (or “above”) others but, at the same time, he excludes himself from the group of others (Y'), he feels out of the group. In line with this, he has the (subjective) impression of being “unique” or “special” and considering others all the same; everyone is at the same level for him. None of them is more important than the others for “a”. This keeps him from establishing adequate intrapersonal relationships since these individuals have great difficulty considering themselves “one more”. We can affirm that, despite the suffering that they show in the sessions, there is a “narcissistic enjoyment”, that of being “special” and of not being confused with their equals, from whom they try to differentiate themselves; For them, being like the rest means being “mediocre”, “vulgar”, “lacking originality”,... (P-1. “I don't want to be like them, I like to differentiate myself from them because there is vulgarity in them”. P-8: “When I'm with people and I'm supposed to be one of the group, I feel terrible, It is as if it wasn't me or something. But the moment that I distinguish myself, the moment I realise that I have qualities that the others don't, my perception changes, then I feel elated because I realise I'm fantastic, I'm extraordinary and I have nothing to do with those around me”.

This makes it difficult for them to build personal relationships, in which one of the group could stand out and become special. That can not happen because the only ones they consider special are themselves.

Self-consideration of one's self as a notable element of an ordered set.

Several “notable elements” of an ordered set have been described before (see Methods); Hereafter we will try to find out which of these parameters correspond to the reality of our patients:

1°. In the case which “a” feels “inferior” to any “x” ($a < x$), we can say that he becomes the “lower bound” of set Y' for the following reasons:

- a) A partition was made in set Y, which separates Y' from the (unitary) set formed by “a” only.
- b) There is only one “lower bound”.

For the first reason, there can not be “minimum” and for the second, there can not be “infimum”. The conditions of “lower bound” are met, as established by its formal definition:

$$[\text{Mit } Y' = a, Y' \subset Y] \Leftrightarrow \forall x (x \in Y' \Rightarrow a < x, a \in Y) \quad [5]$$

This finding strengthens what was mentioned previously, since being a “lower bound” element places the subject in an inferior position regarding others and, naturally, completely apart from them.

2°. Similarly, in the case in that “a” feels “superior” to any x ($a > x$), the subject becomes the “upper bound” element of set Y' and for the same reasons that were given before, there is no sense in talking about “maximum” or “supremum”. The definition that was stated at its moment is met, which is:

$$[\text{May } Y' = a, Y' \subset Y] \Leftrightarrow \forall x (x \in Y' \Rightarrow x < a, a \in Y) \quad [6]$$

The fact of being the “upper bound” places the subject (from his subjectivity) in an superior and distanced position from others.

In the set Y' , since it is an “equivalence relation”, there are none of these parameters (“lower bound” or “upper bound”), which are typical of “order relations”. This is understood in the following way: “a” himself does not find differences between the other subjects (b, c, d) and there is no succession between them, as it occurs in the organisation established in any of the human groups, in which an specific ordenation is given (e.g a company, the army or a hospital). The equalisation of the subjects of set Y' , strengthens the narcissistic attitude of the relations that “a” establishes in the intersubjective space. In the next section, everything will become even more clear. Figure 3 shows the location of “a” as “lower bound” regarding set Y' .

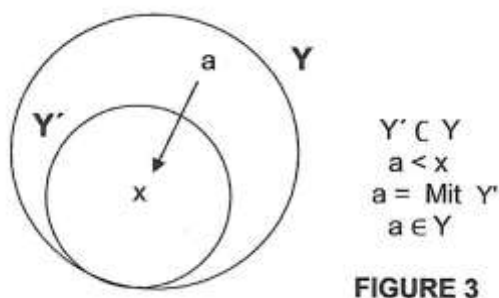


FIGURE 3

Differences between “subjective order” and “established order”.

An important conclusion resulting from the above, is that the order that the individual promotes, from his subjectivity (“subjective order”) has nothing to do with the order that exists in a certain social group (“established order”).

We will clarify the differences with an example. In the company where **P-1** works, there is a gradation from more to less, namely: general director (dg), head of section (ds), group manager (eg), secretaries (s), employees (a), delivery men (r) and cleaners (l), something that can be proven, besides the role they have, by the salaries they receive. This is the order given by the company, however, the “subjective order” that the patient builds is different since it indicates that he feels much more valuable than his manager and the head of section, whom he considers to be “unqualified”. That means that $a > eg$, $a > ds$ and also that both eg and ds, by being “unqualified”, are at the same level: $eg=ds$. At other times, the patient claims to be more qualified than some of his other superiors.

Furthermore, the patient believes that many of those who are in his company give themselves more importance than they have and he specifies this in the case of a secretary (“*She thinks she is more important than anyone*”). This consideration of the patient himself, which reveals the (subjective) position of this secretary, further highlights the existing separation between “subjective order” and “established order”.

Consequently, subjectivity does not respect the “established order”, primarily in two senses: a) it only considers two of the various levels of hierarchy, those above and those below and b) the subjective position that he adopts is not the same as in the “established order”, since he can place himself above someone to whom he is subordinate, as it happens to our patient.

IV. Discussion and conclusions

By the end of 1894, Cantor had already written a complete theory of the types of order, indicating that this finding would have applications in different sciences. What this genius never imagined was that his elaboration would be applied in psychiatry, as we have done in this work.

Using this form of mathematics as a method has been extremely enlightening for the analysis of the subjective processes of those who come for consultation with us, hoping to free themselves from the suffering they go through. What was found are not simple mathematical metaphors, the formalisation of the spontaneous material collected during the different sessions has brought into light hidden elements in the relations, avoiding descriptions of obvious nature.

When dealing with “binary relations” it was seen that the patient placed himself in an outstanding position (first element of the ordered pair), which indicated that, in the social contacts, he acted with one thing in his mind, the way he could be in the foreground. Now, when using the “order relations”, the previous findings gain further strength. In this sense, we verify that the individual that compares himself drastically

distances from others (forming of the unitary set $\{a\}$), feeling “special” or “unique” while placing the others at the same level (equivalence relation). It is not a surprise that taking an undeserved central position in contact with others can cause certain suspicions, such as: feeling the object of stares, criticism, ridicule, disdain, contempt, etc., without necessarily being delirious.

At the same time, being the “lower bound” or “upper bound” of a set (depending on whether we consider “inferiority” or “superiority” respectively) means placing oneself as a “notable element” of set Y. Meanwhile, there is no outstanding element in the group of others (set Y); For him, they are all the same. This suggests that there is no special person in the eyes of the studied subject, which makes it impossible for them to have authentic relationships and fall into mere appearance contacts.

These events are demonstrable in the clinic because we often observe that if someone diminishes or grows himself in front of others, he does not connect with them, there is no necessary complicity to display feelings. At the same time, for the patient, to be one of others is a problem since when trying to, he feels depersonalised. Therefore, it is preferable to get out of this situation even if it implies diminishing himself. Notice that it does not matter whether it is “superiority” or “inferiority” because in both cases the subject stands out from the rest.

From the analysis that was done, we have obtained a formalised language that allows us to understand the psycho(patho)logical phenomena as long as we keep in mind that the symbols that are employed can be translated in many ways. In this sense, Lacan said once: “A formal language without the support of a common language would be only a cryptogram without figure. The hieroglyphics of the formalities must be mentioned to be understood”. Thus, formulas contain a lot of information and each expression has many readings. If we say that: “a does not belong to Y”, it can be translated into the following statements about the studied subject: “he is out of his group”, “he does not fit in”, “he does not feel like one more”, “he feels special”, “he believes he is unique”... In this way, the application of mathematics does not entail the loss of the richness of the psychological material but rather the opposite, since associations that often go unnoticed can be found. Also, it must be considered that the formulas that were used represent the condensation of multiple individual cases, making their application more extensive.

We must make a remark for the results to be understood correctly: when we talk here about “narcissism” we are not referring to what the International Classifications of Mental Disorders call “narcissistic personality disorder” (1,17), characterised by the following traits: grandiosity, need for admiration, lack of empathy, a feeling of self-importance, having the belief of deserving special treatment, being exploitative, overvaluing achievements, etc. and which can coincide with the “pathological narcissism”. The one that is seen here, is the narcissism implicit in ordinary relationships that, more or less displayed, is found in every human being as Freud showed in his work *On Narcissism* (18).

The undertaken attempt has limits since it can not be carried out with all the phenomena of subjectivity. This is not a surprise considering that it is not possible with all physical phenomena or with all mathematics either. In this sense, formal systems have limitations, just as Gödel (“incompleteness theorem”), Tarski (“undefinability theorem”), or Church (“undecidability theorem”) stated. In this line, Lacan refers to the “not-everything” (19), which goes through all the sciences, including the natural, the human and the exact ones, and even the human thought. Nevertheless, despite the real restrictions, what has been achieved here is of great value.

We must add that the subject, disregarding any given organisation from the social reality (work, friends, school, university, etc), only has two levels in his “subjective order”. This aspect will be especially relevant for future research since the numerical order is discarded once again. Therefore, subjectivity despises what occurs on the outside, following its own deliberations.

It is usually thought that comparisons and their products “being more” or “being less” are mere wastes of the human condition and that they should be eliminated at all costs but it has been seen that they fulfil a very important function: they structure the inner world. There is a kind of organiser in the individual himself, which leads to restructuring all intersubjective relationships. To conclude, we have to agree with Fernando Savater when he states that: “What differentiates us from animals is our ability to feel complexes, whether they are of superiority, inferiority or identification”.

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