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## Obsessive-compulsive disorder and thinking illusions

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### Summary

A growing amount of evidence suggests that obsessive-compulsive disorder (OCD) could be associated with cognitive deficits. OCD patients show mnemonic and executive dysfunctions and it is a common opinion that cognitive dysfunctions can play a relevant role in mnemonic alterations of OCD patients by means of the mediation of ineffective organization strategies.

Other authors evidenced different cognitive alterations in OC subjects, such as inferential confusion (O'Connor, 2002; Aardema et al., 2005) or cognitive flexibility deficits in problem-solving (Chamberlain et al., 2006; 2007).

Other researches in inductive and deductive reasoning (Pélissier and O'Connor, 2002; Simpson, Cove, Fineberg, Msetfi and Ball, 2007; Pélissier, O'Connor and Dupuis, 2009) showed that OC patients need more information and postpone the final decision.

In the present contribution we wish to underline the existence of some cognitive illusions that are normal and generalized within the population. Such illusions are able to facilitate the origin and the maintenance of OCD. We consequently will analyze, following the classification of Pohl (2004), illusions of thinking (conjunction fallacy, confirmation bias, illusory correlation, illusion of control, biases in deductive and causal reasoning), illusions of judgement (availability and representativeness, anchoring effect, validity effect), and memory illusions (associative memory illusions, effects of labelling and misinformation effect) and their relationships with OCD. In conclusion, we will draw some theoretical and clinical implications.

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**Keywords:** *obsessive-compulsive disorder, reasoning, thinking illusion, inferential confusion, inverse inference.*

### Riassunto

#### Disturbo ossessivo-compulsivo ed errori di pensiero

Un numero crescente di prove suggerisce che il disturbo ossessivo-compulsivo (DOC) potrebbe essere associato a deficit cognitivo. I pazienti DOC mostrano disfunzioni mnestiche ed esecutive ed è opinione comune che tali disfunzioni possano svolgere un ruolo importante nelle alterazioni mnestiche di tali soggetti attraverso la mediazione di strategie organizzative non efficaci.

Altri autori hanno posto in rilievo ulteriori alterazioni cognitive, come la confusione inferenziale (O'Connor, 2002; Aardema et al., 2005) o deficit nella flessibilità cognitiva nel *problem-solving* (Chamberlain et al., 2006; 2007).

Altri studi sul ragionamento deduttivo e induttivo (Pélissier e O'Connor, 2002; Simpson, Cove, Fineberg, Msetfi e Ball, 2007; Pélissier, O'Connor e Dupuis, 2009) hanno mostrato che i pazienti ossessivo-compulsivi necessitano di maggiori informazioni e rimandano la decisione finale. Nel presente contributo, si desidera porre in evidenza l'esistenza di alcuni errori cognitivi che sono normali e generalizzati nella popolazione non clinica. Tali errori sono in grado di facilitare l'origine e il mantenimento del disturbo. Di conseguenza, verranno analizzati, seguendo la classificazione di Pohl (2004), gli errori di pensiero (la fallacia della congiunzione, il bias della conferma, la correlazione illusoria, l'errore di controllo, i biases nel ragionamento deduttivo e induttivo), gli errori di giudizio (disponibilità e rappresentatività, effetto di ancoraggio, effetto di validità), e gli errori di memoria (errori di memoria associativa, effetti di etichettatura e *misinformation effect*) e il loro rapporto col DOC. In conclusione, verranno tratte alcune implicazioni teoriche e cliniche.

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**Parole chiave:** *disturbo ossessivo-compulsivo, ragionamento, errori di pensiero, confusione inferenziale, inferenza inversa.*

## INTRODUCTION

A growing amount of evidence suggests that obsessive-compulsive disorder (OCD) could be associated with cognitive deficits (Otto, 1992; Tallis, 1995; 1997; Cabrera, McNally and Savage, 2001; Deckersbach, Otto, Savage, Baer and Jenike, 2000; Savage, Keuthen, Jenike et al., 1996; Savage, 1998; Savage, Baer, Keuthen and Jenike, 1999; Savage, Deckersbach, Wilhelm et al., 2000).

OCD patients show mnemonic and executive dysfunctions, as pointed out by several neuropsychological tests, such as the Rey-Osterrieth Complex Figure Test (RCFT), the Wisconsin Card-Sorting Test (WCST) and others (Cabrera, McNally and Savage, 2001; Deckersbach, Otto, Savage, Baer and Jenike, 2000; Savage et al., 1996; Savage, 1998; Savage, Baer, Keuthen and Jenike, 1999; Savage et al., 2000; Zielinski, Taylor and Juzwin, 1991; Kim, Park, Shin and Kwon, 2002; Park, Lee, Ha, Rho, Shin and Kwon, 2003).

Presently, it is common opinion that cognitive dysfunctions can play a relevant role in mnemonic alterations in OCD patients by means of the mediation of ineffective organization strategies (Savage, in; Savage, Baer, Keuthen and Jenike, 1999; Savage et al., 2000; Park, Lee, Ha, Rho, Shin and Kwon, 2003).

Neuroimaging data show dysfunctions in fronto-striatal structures in OCD and confirm the hypothesis according to which an executive dysfunction can be a primary factor in the mnemonic deficit (Shin et al., 2004; Kang et al., 2003; Shin, Ha, Kim and Kwon, 2004).

There are different cognitive alterations in OCD subjects, such as inferential confusion (O'Connor, 2002; Aardema, O'Connor, Emmelkamp, Marchand and Todorov, 2005), in consequence of which they confuse an imagined possibility with a real probability, or cognitive flexibility deficits in problem-solving (Chamberlain, Fineberg, Blackwell, Robbins and Sahakian, 2006; Chamberlain et al., 2007).

Other research in inductive and deductive reasoning (Pélissier and O'Connor, 2002; Simpson, Cove, Fineberg, Msetfi and Ball, 2007; Pélissier, O'Connor and Dupuis, 2009) showed that OC patients need more information and postponement of a final decision.

In the above brief review, we noticed the probable presence of specific cognitive distortions in OCD patients. But in the present contribution we wish to underline the existence of some cognitive illusions that are normal and generalized within population. Such illusions are able to facilitate the origin and the maintenance of OCD.

We will now analyze them, following the classification of Pohl (2004).

## ILLUSIONS OF THINKING

They involve the application of a certain rule (like Bayes' theorem, hypothesis testing, or syllogistic reasoning), derived from normative models (like probability theory, falsification principle, or logics), and their results usually serve as standards against which human performance is evaluated.

*Naïve* people usually don't know these rules and therefore behave rather intuitively.

### CONJUNCTION FALLACY

The conjunction fallacy arises when individuals assign probabilities to conjunctive events that exceed the probabilities assigned to the component events making up the conjunction.

Even if there still is not an adequate account of the fallacy, literature shows, for example, that in social judgment, where the conjunction combines a likely event with an unlikely one, the proportion of individuals committing the fallacy can very high, often exceeding 90% (Fisk and Pidgeon, 1996; Gavanski and Roskos-Ewoldsen, 1991; Tversy and Kahneman, 1983; Yates and Carlson, 1986).

Considering the presence of such a fallacy in OC subjects, we can now give an example: if I fear contracting HIV (Human Immunodeficiency Virus), walking in the street, and I am worried about treading on something; I fear that this something could be a syringe and that this syringe will be an HIV-infected one.

The event «treading on a syringe» appears very probable, even if it is less probable than any single event, as the conjunction rule can be formally expressed:

$$P(\text{treading on something and this something is a syringe}) = P(\text{treading on something}) \times P(\text{treading on a syringe given that I trod on something}).$$

But this is not enough. The OC subject fears that the syringe can also be an infected one and he/she sees the event highly probable; the OC subject doesn't consider a non infected syringe. On the contrary, obviously, an infected syringe is again a less probable event than any single event which composes the conjunction, and we can so show that:

$$P(\text{treading on an infected syringe}) = P(\text{treading on a syringe}) \times P(\text{treading on an infected syringe given that I trod on a syringe}).$$

In all these cases, the conjunction of two events is less probable than every single event, but it seems nevertheless highly probable.

## CONFIRMATION BIAS

Information is searched for, interpreted, and remembered in such a way that it systematically impedes the possibility that the hypothesis could be rejected, so fostering the immunity of the hypothesis. The classical experiments conducted by Wason (1960), according to his interpretation, demonstrated that humans do not try at all to test their hypotheses critically but rather to confirm them.

These mechanisms are reinforced in OCD also by a logical error already evidenced by Aristotle: the «fallacy of the consequent» or «affirming the consequent». In such a form of reasoning error, we infer the existence of a cause from the affirmation of an effect: «if it's raining then the streets are wet; the streets are wet, therefore it's raining». Arntz, Rauner, and van den Hout (1995) identified it in anxiety disorders, considering it as a peculiar form of «emotional reasoning» and naming it «ex consequentia reasoning». This error tends to invert the correct direction of the causal reasoning applied to the emotions: I feel disgusted therefore there must be dirt (the reverse is the right causal sequence. O'Connor and Robillard (1995), defining it «inverse inference», amplify its importance: «...the OCD client, rather than revising the hypothesis in the face of evidence, revises the evidence in the face of the hypothesis» (p. 890). In OCD the reversed causality is peculiarly linked to the presence of frequent preventive compulsions, in other anxiety disorders this logical error is more dependent on the fact that the subject feels anxious or worried (Engelhard, Macklin, McNally, van den Hout et al., 2001).

## ILLUSORY CORRELATION

If we see a correlation that is not really there, there is a «illusory correlation». More generally, the term does not only apply to overestimations of zero correlation but to all kinds of systematic deviations or biases in subjective assessment.

This effect is usually explained in terms of «sample-size effect» (Fiedler, 1996): there is more opportunity to learn that most behaviors tend to be desirable in the majority of cases than in the minority, just as a matter of different sample size. We must also add the «positive testing» (Klayman and Ha, 1987), according to which in hypothesis testing people usually focuses on the occurrence of the critical event.

We can apply this to OCD.

If I am an OC patient with contamination fears, I want to test the hypothesis that washing my hands (after touching a perhaps contaminated object) produces the condition of «no disease». Consequently, according to the positive testing, I'll focus above all on cases in which I wash my hands, producing the following:

I touch and I wash my hands ⇒ No disease	1000 cases
I touch and I don't wash my hands ⇒ No disease	50 cases
I touch and I wash my hands ⇒ Disease	20 cases
I touch and I don't wash my hands ⇒ Disease	1 case

Thus, although the proportion of «No disease» is the same across washing conditions (i.e. = 98%), sample size is higher for the washing hands condition, due to positive test-

ing. As consequence, even if there is a zero correlation, washing hands is more strongly associated to «No disease».

## ILLUSION OF CONTROL

Illusion of control occurs when individual overestimate their personal influence over an outcome. From the pioneering study by Langer (1975), such an effect was confirmed by several authors (e.g. Alloy and Abramson, 1979; McKenna, 1993) in normal subjects.

In OCD patients we find an ambivalent situation: from one side these subjects have such a high illusion of control as to develop a Thought-Action Fusion (TAF); and on the other hand, they always doubt of their control, but in the hope of attaining the perfect form of it (which they think possible). It is also easy to note the relevance, in relation to this illusion, of the correlation illusion and its already underlined processes: an OC patient (but also a non clinical subject) judges his own control only by the positive testing of the large number of confirmatory cases that he selected.

## BIASES IN DEDUCTIVE AND CAUSAL REASONING

A well-known and much studied phenomenon in deductive reasoning research is that of belief bias (Evans, Barston and Pollard, 1983). This is typically viewed as a tendency to endorse arguments the conclusions of which are believed by a person regardless whether they are formally and logically valid or not.

To explain the presence also in OCD of such a bias, some examples can be useful in showing how, starting from few concepts (typical of OCD forms, such as contamination and control) and applying some transformations of the classical propositional calculus, it is possible to produce characteristic OCD conclusions, which are able to activate prepared or unprepared phobias. In the following lines, we will propose the well known forms of syllogisms, first by means of abstract formulas and then substituting classic OCD themes to symbols, so it will be evident that typical OCD thoughts can be easily obtained.

Hypothetical syllogisms:

a) Modus ponens:

- If  $A \supset B$  and  $A$ , then  $B$
- If dirt implies danger and there is dirt, then there is danger
- If a perhaps open door implies danger and the door is perhaps open, then there is danger.

b) Modus tollens:

- If  $X \supset Y$  and  $\neg Y$ , then  $\neg X$
- If probably HIV infected blood implies a syringe and there is no syringe, then there probably is no HIV infected blood
- If an excessively full washbasin implies an open tap and there is no open tap, then there is no excessively full washbasin.

c) Pure hypothetical syllogism:

- If  $A \supset B$  and  $B \supset C$ , then  $A \supset C$
- If dirt implies danger and danger implies infections, then dirt implies infections
- If a perhaps, an open door implies danger and danger implies a thief in the house, then perhaps an open door implies a thief in the house.

In all the above instances, the syllogism is formally (syntactically) but not semantically correct (but it isn't necessarily true); if the subject can't discriminate such a difference, he will start a behaviour which facilitates the onset and the maintenance of OCD. The weak link in the chain is the major premise of the first hypothetical syllogism, which is not absolute but only in some circumstances, true (dirt is not always dangerous and the same can be said about a perhaps open door).

These mechanisms are reinforced in OCD by the already described logical errors, *ex consequentia* reasoning and inverse inference. In consequence, if the subject feels obliged to give into compulsions, a vicious circle is then produced: the OC subject sees himself engaged in preventive behaviours and consequently generates possible models of a world, which activates deductive reasoning, and processes formally correct but not necessarily true conclusions, which are confirmed by the *reasoning illusions*, in a vicious circle.

## ILLUSIONS OF JUDGEMENT

Persons are asked to subjectively rate a specific aspect of a given stimulus (e.g. its pleasantness, frequency, veracity or dangerousness). However, specific features of the situation may bias someone's judgment in a certain direction. Most important is that these are all cases of judgments under uncertainty: the person has no knowledge about the correct solution, but he or she is bound to rely on subjective impressions.

### AVAILABILITY AND REPRESENTATIVENESS

The heuristic of availability depends on the ease with which relevant instances of a class come to mind.

Consequently, in OCD patients whatever is much talked about becomes real and probable, and much more dangerous, if it is a possibly risky event. In such a way frequently the themes of worry are selected (for example AIDS for contamination obsessions) and this process, probably, contributes to the overestimation of the probability of the feared event and to the beginning of the OC cycle.

The heuristic of representativeness can be considered not a bias or an illusion, but a procedure for estimating probabilities by means of similarity or typicality judgments, that are often accurate, but which can occasionally lead to biased estimates.

In OCD patients it is frequently present: for example, an occasional event (as forgetting something not important) makes to the eyes of the OC patients more possible and probable all the class of forgetfulness cases (also of something important), so inducing and maintaining the typically OC doubts.

## ANCHORING EFFECT

This robust and ubiquitous effect (Tversky and Kahnemann, 1974) is present when a numeric estimate is assimilated towards a previously considered standard (the anchor). To understand this phenomenon, we have to distinguish its two stages (Mussweiler, English and Starck, 2004):

- the selection of a judgmental anchor;
- its subsequent comparison with the target.

At least three mechanisms may influence the initial stage of selection of standard:

- A particular value may be selected as an anchor because conversational interferences suggest it as relevant. For example, should an OC subject read that in Africa there is a very distinct probability of becoming seropositive, he/she could assimilate to this high value his estimate of becoming seropositive in his country, even if the situation is different and the risk is far less relevant.
- A value may be selected as an anchor because it is easily accessible and comes to mind during the evaluation of the target. In OCD, in the mind of the patients an overvaluation of the risk of the feared event is always present (as a consequence of the previously described biases and illusions), so the anchor, against which the target will be confronted, is always high and so will be the estimated probability of similar events.
- An anchor may be self-generated via an insufficient adjustment process. Even if an OC patient is provided with an implausible anchor (for example, an excessively high probability value), this value will be used as a starting point to generate a more plausible value, but this last one will be too high, via the anchoring effect.

## VALIDITY EFFECT

This well established effect (Hasher, Goldstein and Toppino, 1977) shows that, if information has been previously heard, people likely ascribe more truth or validity to it than if they are hearing it for the first time. The effect occurs regardless the type of information and whether it was originally believed to be true or false. In OCD, patients frequently substantiate their excessive fears citing information found in newspaper, books and other mass media, or heard from someone (more or less expert).

## MEMORY ILLUSIONS

They are those in which earlier encoded material has to be remembered later on, so involving recall or recognition.

### ASSOCIATIVE MEMORY ILLUSIONS

People can falsely remember nonpresented events that are associated with events that occurred. This effect was demonstrated in a robust way by means of word lists (Roediger

and McDermott, 1995), but as underlined by Roediger and Gallo (2004), similar processes occur whenever people try to comprehend the world around them.

In OCD, the retrieval of memories can be distorted by drawing inferences, making supposition, and creating possible future scenarios. For example, if a patient treads upon a little stone walking in a street, the retrieval of this event can be confused with the associations and the elaborations primed by such an event according to his associative processes and idiosyncratic sensibilities: the trodden upon stone in memory becomes a syringe and the touched object transforms in something dirty.

## **LABELLING AND MISINFORMATION EFFECT**

These two effects are similar. In the first case, a specific label is affixed to a stimulus and exerts its distorting influence in subsequent judgment or recall (Carmichael, Hogan and Walters, 1932); in the second the effect occurs when a person receives post-event information that interferes with the person's ability to accurately recall the original event (Loftus and Palmer, 1974; Loftus, 1975; Loftus, Miller and Burns, 1978).

An OC patient, for example, may be told (or may read) that a person can lose some memories in case of a traumatic event; so, his mind will generate the doubt that he could not remember some bad action he could have done in the near past. Consequently, he will be forced to check if he really committed some misdeed. After starting to check, he can label himself as oblivious at times and could begin to think that some specific bad actions are likely to be forgotten. Such a labelling will distort his mnemonic retrieval, prompting further doubting. We have to add that the frequent generation of checking compulsions could be a source of confusion in the retrieval of memories, so reinforcing the doubts in memory.

## **CONCLUSIONS**

These illusions could contribute to the origin of OCD and also be powerful maintenance and increase factors in the following sequence.

- A possible or potential risk or danger is highlighted by a casual external event or by a thought association.
- A doubt about the possibility of such a risk is primed by distorted reasoning, with the above-described illusions, so increasing, in an incorrect way, its subjectively perceived probability that is considered as a real probability (O'Connor et al., 2005; 2009; Grenier et al., 2010).
- The presence of such a risk is evaluated according to the moral system of the subject; if this system is a very sensible one and does not discriminate between acts of omission and commission (Siev et al., 2010), the subject's attention will be focused on the perceived risk with increased probability of initiating preventive and/or corrective behaviours.
- These preventive/corrective behaviours are reinforced by the lessening of negative emotions associated to the perception of risk and consequently they will become more frequent and probable in similar situations.

- The emission of these behaviours primes reasoning processes that further strengthen and consolidate the subjective risk perception by ex consequentia reasoning, inverse inference and other illusions. At the same time, repeated behavioural or mental checking causes distrust in memory and in perception (van den Hout et al., 2008; Dek et al., 2010; Radomsky and Alcolado, 2010). Both factors induce a more powerful motivation to check or to produce preventive/corrective behaviours.
- Finally, we have a self-sustaining vicious circle that maintains and aggravates OCD.

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