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Doubt and the Decision-making Process in Obsessive-Compulsive Disorder

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Abstract

The diagnosis of obsessive-compulsive disorder (OCD) is based on the presence of specific symptoms and their consequence in the lives of those that exhibit them. It is likely that these symptoms emerge from a neurocognitive vulnerability in the mental life of the individual which has a basis in neurophysiology. The prominence of doubt/uncertainty/lack of confidence*, in the clinical presentation of many patients suffering from OCD leads to our consideration of the cognitive basis for this phenomenon. In this paper, we propose that OCD emerges from a perturbation in the decision-making process. Specifically, we hypothesize that there is diminished confidence, conviction, or certainty with regard to assimilating the information necessary to reach a decision. Recent advances in the neuroscience of decision-making provide an opportunity to further our understanding of the vulnerability underlying OCD.

Keywords

OCD/Obsessive-compulsive disorder; Decision-making; doubt; uncertainty

Introduction

Decision-making is a crucial process for effective adaptive functioning. A comprehensive body of recent research, based on empirical neurobiological studies in animals and humans and using developmental cognitive theories and mathematical models to interpret findings, provides the basis for understanding the neurobiology of decision-making. These provide the basis for identifying pathological variants in the process of decision making. We propose that obsessive-compulsive disorder (OCD) and related disorders are prototypic conditions that result from dysfunction in this domain.

*These terms are used interchangeably in this paper

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Specifically, we hypothesize that OCD is characterized by diminished confidence, conviction, or certainty in the ability to assimilate the information necessary to come to a decision. (Note: In this paper we employ the terms ‘doubt’, ‘uncertainty’, and ‘lack of confidence’ interchangeably.) We propose that this deficit is distinct from impairments in other aspects of the decision-making process such as those involved in “..error detection, response conflict, or reward prediction errors in which outcomes [detected by the Error Related Negativity (ERN) signal] are worse than expected.¹” We also suggest that this deficit is distinct from dysfunctional extinction recall, which has been posited as a deficit underlying anxiety disorders in general, as well as OCD.²

Since the earliest clinical descriptions of OCD, doubt has been described as a hallmark feature of the condition. Indeed, OCD has been called the “doubting disorder” (“*folie a doute*”; as well as labels of a similar intent in other languages). du Saulle (1875) was possibly the first to describe clinical patients who experienced feelings of doubt.³ William James (1890) attributed symptoms of the “questioning mania” to a pathological excess of doubt.⁴ Pierre Janet explained the “...exaggerated need for precision and perfection in perceptions and actions” in his patients as the means of “compensate(ing) for a lack of certainty.” Modern clinicians have also appreciated this aspect of their patients. Shapiro⁵ wrote that patients with OCD have an “inability to experience a sense of conviction, and doubt not only in their cognitions but also in other internal states.” Rappaport described patients as “disbelieving their senses” and thus “needing continuous reaffirmation.”⁶

Doubt is a central theme in the clinical appreciation of OCD and is overt in many of the typical symptoms with which patients present. For instance, “checking behaviors” involve insufficient conviction about the completion of a task, such as locking a door, despite presumed accurate information to the contrary; and contamination concerns involve insufficient conviction regarding the safety of a contacted object, despite recognition that it is truly harmless. These and other examples, burden individuals in whom there is no evidence of intellectual or memory impairment.

OCD-related phenomena

Doubt can be defined as a lack of certitude or confidence in one’s memory, attention, intuition, and perceptions, such that it is difficult to trust one’s internal experiences; hence retarding satisfactory responses to cues or possibly to information in general. This appears to occur at a reflexive level and often leads to indecision or even a sense of incompleteness or a ‘not-just-right’ feeling.

It is important to contrast doubt with several other OCD-related constructs, all of which are highly relevant in the clinical domain and have been, to a lesser or greater degree, studied in patients.

The construct of indecision is often considered equivalent to doubt (uncertainty) and often leads to the same behavioral result. We define indecision as the inability to choose a course of action given more than one option. Typically, choosing a course of action involves weighing the merits (value) of one choice over another and is a conscious thought process,

unlike doubt, the experience of which is more internal. A well-crafted self-report questionnaire to measure the construct has been developed.⁸ Indecision has been found to be associated with OCD in several studies;⁷ it is highly correlated with several OCD symptom dimensions and is particularly prominent in compulsive hoarding.^{9,10}

According to Summerfeldt, incompleteness is a “tormenting sense of dissatisfaction with (ones) current statethere is a drive to correct profound feelings of imperfection regarding the need for experiences to conform to exact, yet often inexpressible criteria.¹¹” This is a subjective experience of conditions not being in a “just right” state. This common experience among OCD sufferers is most often appreciated when the patient reports relief: the internal experience of something feeling acceptable or satisfactory, permitting them to desist from a compulsive ritual.

Perfectionism is a trait characterized by striving for flawlessness and having excessively high standards. Often this is construed as “other related” i.e. the tendency to aspire to meet the highest standards of others, or “self-related” i.e. the tendency to seek the highest personal standards, which permits no measure of error. This involves some degree of conscious self-appraisal, although the criteria guiding one’s appraisal may be ensconced in mind, demanding little in the way of reflection. This characteristic is described in both OCD and obsessive-compulsive personality disorder. It may be considered fundamental to these disorders, or as an adaptive reaction to the experience of doubt to bolster the confidence that is lacking.

The final construct that may be confused with doubt is ‘intolerance of uncertainty’. This is defined as the unwillingness to tolerate the possibility that negative events may occur in the future, no matter how low the probability.¹² This construct has been found to occur in several anxiety disorders and depression. In contrast to doubt, intolerance of uncertainty involves unreasonable distress associated with uncertainty about circumstances out of the person’s control, rather than the decision at hand.

Each of the constructs described above is clearly evident in many patients with OCD. We propose that doubt is the primary cognitive process in the development and maintenance of OCD, and that the other constructs occur secondarily, perhaps employed by patients as a rationale to explain an experience that is not fully appreciated at a conscious level, nor makes complete sense to the patient. Further, we propose that doubt is the result of an aberration in the neural mechanisms involved in decision-making. Therefore, the methods developed and knowledge gained from recent studies of the neurobiology of decision-making may help further the neurobiological underpinnings of OCD.

OCD and Doubt: Empirical Studies

In addition to clinical experience suggesting the importance of doubt or uncertainty in OCD, results from empirical studies support the involvement of doubt in OCD. In a series of studies, Rueben Dar et al. provided evidence that individuals with OCD have diminished confidence in their decision-making abilities beyond their specific obsessional checking symptoms.^{13,14,15} In one study they showed that obsessional persons reported less

confidence in their answers to a general knowledge test compared to non-anxious participants, despite equal accuracy.¹⁴ In another study, OCD severity scores were positively correlated with response time in a neutral color judgment task¹³. Hermans et al. found that individuals with OCD distrust attention and memory.¹⁶ Incidentally, they also demonstrated that increased checking exacerbates distrust in memory. It is of note that it is typical to engender doubt in all individuals who are involved in checking and rechecking, regardless of psychopathology.¹⁷ In a study using the Random Dot Matrix tasks, Banca et al showed that, under conditions of high uncertainty, individuals with OCD had a delay in reaching the decision threshold, compared to healthy controls.¹⁸ Moreover, even under conditions of low uncertainty, they had difficulty acquiring information to make decisions. Of note, the patients responded to instructions, that monetary incentives could be garnered by increasing speed, with a reduction in their previously delayed reaction times. This suggests that the speed accuracy tradeoff (SAT) described in the decision-making literature overcomes the doubting, engendered in the decision-making process, in these patients.¹⁹

There have been investigations to identify the neural substrate of doubt/uncertainty in OCD. Stern et al. found that OCD patients rated themselves more uncertain than control subjects during a task that involved little ambiguity.²⁰ They also showed that these patients activated a network of limbic/paralimbic regions including ventromedial prefrontal cortex, parahippocampus, middle temporal cortex, as well as amygdala and orbitofrontal cortex/ventral anterior insula, and that there was an increased interconnectedness between these areas in the patients compared to controls. They postulate that this is related to internally-focused thought, and implicate differences in the function of the Default Motor Network (DMN) in the experience of doubt in these patients.

Olsen et al. provide additional insight into the relationship between OCD and doubt in the domain of memory retrieval.²¹ They found that individuals with OCD performed equivalently in memory tasks but activated different brain regions. They concluded that activation in the posterior cingulate cortex (PCC) and the premotor/Dorsolateral prefrontal cortex (DLPFC) was associated with greater pathological doubt in their memory experiments.

Decision-making process

Fundamentally, as described above, doubt is the inability to make decisions because of a lack of certainty or confidence in the information available, both external, as in the sensory inputs, and internal, as in the integration of prior information. Hence, it can be construed as dysfunction in the decision-making process. There are several elements involved in this decision-making process. First is the accumulation of information necessary to establish a decision. Related to this, is the point at which a threshold is exceeded and the behavioral response is initiated, typically the “decision threshold.” The critical element in this phase is the value attributed to the choices. Most models of decision-making also include the possibility for “response or choice bias,” allowing for an *a priori* influence on the final response. These elements include ‘life story’ influences, dimensions of personality, and emotional valence of the information. Together these can be construed as a metacognitive appraisal of the information and context. Finally, there is the simultaneous monitoring

process, by which the organism is attuned to recognizing whether the decision was accurate or not, and when additional strategies are necessary to maximize performance. It is at the stage of information accumulation, to the point of the decision threshold, that confidence/certainty/lack of doubt is appreciated (consciously or unconsciously). This affects the duration of the process (decision). There are several mathematical models that approach the process, each is marginally different, but most consider the elements above as the basic processes.

There is a relatively extensive literature applying mathematical models and theories to the neural basis of the decision-making process in primates and humans. Consequently, a great deal of knowledge has been accrued relative to brain regions involved in the various elements of the perceptual decision-making pathway. In a review, Mulder et al. summarize the neural correlates in different cortico-subcortical networks, of model-based perceptual decision-making in humans, across the pathway.²² They report that in most studies the fronto-parietal network, and prominently the lateral prefrontal cortex (LPFC) (dorsal and ventral) and the insula, are involved in the accumulation processes driving a perceptual decision. This is typically studied using the Drift Diffusion Model in which the duration and slope of the 'drift' determines the rate of information accumulation, which is correlated with the BOLD signal in the fMRI.²³ There are caveats to this design that require further clarification; for instance, there is probably a strong influence based on the relative difficulty of the signal which would then result in the accrual of additional attention, affecting additional brain regions. The pre-SMA, ACC, and striatal regions are associated with the level of the decision threshold. This threshold can be viewed as a speed accuracy tradeoff (SAT); in which these brain regions are modulating one another to maximize efficiency under these two conditions. Response or choice bias reflects *a priori* individual factors that influence the decision-making process, independent of the stimulus. Both the fronto-parietal and fronto-basal ganglia networks have been shown to be involved in this aspect. The posterior medial frontal cortex, especially the supplementary eye field and the rostral cingulate motor area have been implicated in performance monitoring and signaling the need for adjustments of behavior in neurophysiological studies in monkeys.²⁴

Our hypothesis is that an underlying vulnerability for the development of the symptoms of OCD and related conditions is the experience of doubt /uncertainty at the point in time when synthesis of immediate perceptual information and the *a priori* internal/personal knowledge prevent the fluid execution of an unfettered decision-making process. To examine this hypothesis it is fundamental to establish the presence of aberrant processing of information leading to impairment in the decision threshold among individuals with these obsessions and related symptoms compared to others. This test should investigate the properties of the decision-making process; specifically, the ease and speed of acting on a choice. The hypothesis would predict that an individual suffering from the condition would take longer to arrive at the decision (act), feel uncomfortable with the decision, and that these emotional and behavioral responses will be reflected in a distinct brain activation pattern.

Doubt and decision-making

Two intersecting lines of research provide the basis for understanding the nature of uncertainty and its importance in OCD and related disorders. As discussed above, the work by Stern et al. has addressed the presence of uncertainty in OCD and have emphasized the importance of the decision making process even under circumstances of unambiguous choices.¹⁹ This group highlights the importance of the over activity of the DMN and proposes the inability to disconnect from this circuit when making easy choices. It is of interest that under more arduous choice circumstances, the distinction between cases and controls in their study becomes less evident. This is entirely in sync with the experience of OCD patients, who, when in critical situations are able to overcome their obsessional symptoms. This group identified brain regions that are relevant to this process, in particular the mDMPC. Their work is supported by findings from Beuke et al.;²⁵ these investigators showed that there was reduced connectivity within the dMPFC self-subsystem of the DMN in OCD patients and greater interconnectivity with dorsal attention and salience networks. Symptom severity correlated positively with the dMPFC connectivity to striatal and anterior cingulate cortex areas.

The second promising approach takes a different line; in this case uncertainty or confidence is based more on a theoretical model of decision-making that concerns the confidence and certainty of the process. Kopecs construes this as a metacognitive conception in which “confidence (reports) are generated by a second-order monitoring process based on the quality of internal representations about beliefs.”²⁶ This group has conducted fascinating studies in rats that have identified the importance of specific neurons in the orbito-frontal cortex (OFC) as responsible for this appraisal. Interestingly, in this model the inactivation of the OFC does not impair accuracy of decision making. They go on to propose that several brain regions are involved in this process and that the OFC integrates the inputs from these regions. This work is important from several vantage points. First, it provides a hitherto unexpected animal model of the process (uncertainty) in small rodents. Further investigation of this model could provide additional insights into this metacognitive process. Second, the model identifies involvement of brain regions and circuits that have been determined to be involved in OCD, providing support that this condition is related to a dysfunction in this aspect of the decision-making process.

Gherman and Philiastides showed evidence for neural representation of confidence using a paradigm that discriminated between electroencephalographic signals associated with certain-vs.-uncertain trials.²⁷ They reported that choice confidence and decision-making occurred simultaneously and involved the same mechanism as decision making itself, and in the previously implicated brain regions, prefrontal and parietal cortices.^{28,29,30,31} They conclude that their findings coincide with those of Kiani and Shadlen in that neurons in the lateral intraparietal regions of the primate brain represent both the decision-making process and confidence in the decision itself.³²

Together, these findings lend support to the idea that there exists a general-purpose decision-making network involved in accumulating evidence for a decision while simultaneously encoding the confidence in that decision.

As mentioned, there appears to be simultaneous self-monitoring during the decision making process, by which the organism is attuned to recognizing whether the decision was accurate or not, in order to avail itself of additional strategies to maximize performance. There is evidence that individuals with OCD have enhanced activity in this domain, most notably evidenced in differences in the measurement of error related negativity (ERN).³³ This has been a consistent finding in patients regardless of symptom severity or nature of the symptoms, as well as in their unaffected relatives. In fact it has been proposed as a potential endophenotype for OCD. The ACC has been implicated in this process. The basis of the relationship between confidence in decision-making, as we are proposing in this manuscript, and the enhanced monitoring will need to be established.^{1,32}

Conclusion

Experience of certainty is an important process for adaptive functioning, and impairment in this process may be important in the development of psychopathology. As Kepecs notes “... knowing one’s degree of uncertainty confers benefits for a broad range of activities from the sophisticated to the mundane: from managing a stock portfolio or deciding whether to carry an umbrella. Conversely, the pathological miscalculation of uncertainty contributes to a wide range of neuropsychiatric conditions, including anxiety, obsessive-compulsive disorder and addiction” (Kepecs).²⁶

Focusing on doubt/uncertainty provides a potentially useful framework for the study of OCD and related conditions. Doubt is a well-established clinical observation, with unambiguous exemplars in clinical practice. Findings from several approaches for OCD investigation are consistent with brain regions and circuits that are presumed involved in decision-making. Thus it provides a useful paradigm for further research into these disorders.

In this paper we hypothesize that there is variability among individuals with respect to their confidence in their own appraisal of the information necessary to arrive at a decision. Difficulty in this process appears to be most evident in persons with OCD, but can also occur in individuals with other disorders. We hypothesize that this trait is distributed across the population and is not unique to individuals with psychopathology. There will be longer response times in OCD persons in the process of decision-making, and this will be more evident in less ambiguous decisions; that is, if a time limit is placed upon the need to respond, the distinction between cases and controls will diminish; likewise, if the decision is immensely critical the response time will differ little between cases and controls. Furthermore, value-based choice will not be a major distinguishing cases and controls.

We are in the process of investigating this hypothesis. We have developed a questionnaire to measure the subjective experience of “doubting” in everyday decision-making situations. We have adapted a behavioral task to measure reaction-time as an objective measure of the decision-making process. We plan to investigate the neural mechanisms that underlie this individual variation.

From a clinical perspective, doubt is important to the psychiatrist because it enriches our understanding of our patients’ experience. It provides a specific clinical trait and cognitive

behavioral task to define the psychopathology and study the pathophysiology. It has the potential to reduce heterogeneity within the OCD syndrome and explain the high frequency of comorbidity. Finally, it provides potential targets for focused psychological and somatic treatments.

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