

adaptive behaviors promoted within society, assisting communal coherence.

Overall, there are some issues raised by B&L that do not reflect our knowledge of OCD. In fact, the psychosocial treatment of choice for OCD includes exposure and response prevention, which was derived from cognitive and behavioral theories that do not describe the necessary features of B&L's model (Franklin & Foa 2002).

Many of our differences of opinion lie in their characterization of the features of OCD. Although many fears (OCD obsessions being no exception) have a level of preparedness (Seligman 1971), it seems that the OCD can take on modern concepts as well as capturing evolutionarily based threats. For example, fears of sin and damnation, as well as rituals such as checking stoves, light switches, appliances are common issues in OCD (Foa et al. 1995). In addition, the concept of *inferred* danger characterizes most anxiety disorders, whereas rituals are more exclusive to OCD. Thus, it is not clear from the model why individuals with other anxiety disorders do not typically engage in rituals. Furthermore, other cognitive characteristics, such as thought-action fusion and hyper-responsibility, may be more unique to OCD (Rachman 1993) than other anxiety disorders, but the model does not clearly account for such important features.

Rituals are not always conducted in a repeated, systematically rigid fashion. While caricatures of patients with OCD portray individuals engaging in explicit, repeated behaviors, the clinical picture is much more complex. Individuals with OCD often have varied responses to adapt to a situation. Thus, individuals who typically use tissues as a barrier to avoid contamination when opening doors may instead allow others to open the door or use a sleeve as a barrier when a tissue is not available. Alternatively, they may seek reassurance from others, mentally review reasons why they are not contaminated, or decide to delay their ritual while taking measures to limit further spread of the contaminant along with keeping track of which body parts or personal items will later need to be cleaned. Patients can be extremely creative in working to obtain relief from anxiety through subtle reassurance seeking or other means. Our clinical experience is that patients with OCD are in fact quite flexible with their utilization of rituals, and elimination of all of the potential responses is a key to treatment.

The idea that rituals necessitate action parsing, goal demotion, and swamping of working memory also does not reflect our clinical experience. Contrary to B&L's suggestion, patients are often unaware of some of their rituals precisely because they have become so habitual. Ritual monitoring is the first stage of treatment, and many patients state that the process of recording their rituals makes them more aware of the rituals in which they are engaged. For example, a recent patient whose rituals involved repeatedly saying "I am sorry" reported being quite surprised by the high frequency with which she was offering unnecessary apologies. Patients also frequently report engaging in rituals prior to being aware that they are doing them. Furthermore, many OCD patients appear to be quite clear about their goals and do not lose sight of those goals as they begin to ritualize. Indeed, they frequently view their rituals as direct attempts to achieve their goals. Even when action parsing occurs, the ultimate goal of removing danger usually remains very much at the forefront of their thoughts.

We contend that overt rituals are best understood as a part of a larger class of avoidance behaviors seen in OCD, along with mental rituals, overt avoidance, and other emotion regulation strategies such as thought suppression. All of these behaviors and mental manipulations promote immediate relief of anxiety but serve to maintain fear and obsessions over the long run (Franklin & Foa 2002). The psychosocial treatment of choice for OCD is the combination of exposure situations and thoughts that elicit obsession-related anxiety and response prevention of the various avoidance behaviors, both of which are important components to treatment (cf. Foa et al. 1980). However,

B&L omit the importance of exposure for treatment, and the mechanisms through which exposure is thought to work (Foa et al. 2006). Our view is that OCD, and other anxiety disorders, reflect the operation of a fear network which consists of pathological associations between neutral stimuli and representations of danger along with physiological, cognitive, and behavioral responses associated with fear (e.g., avoidance behaviors). Psychological treatment requires activation of the fear network and exposure to disconfirming information. In vivo exposure and imaginal exposure activate the fear network and the non-occurrence of feared consequences provides the disconfirming information. Rituals serve to reduce that activation through the inaccurate belief that the danger has been removed or eliminated, thereby maintaining anxiety. For example, a patient touching a doorknob without washing leads to learning that they did not get a disease and that relief occurred without ritualizing. The model offered by B&L seems to miss the importance of obsessions and the functional nature of compulsions in describing OCD. Consideration of the rich database on the psychological treatment of OCD serves to inform and constrain theories of OCD.

## Ritualized behavior in sport

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**Abstract:** We consider evidence for ritualized behavior in the sporting domain, noting that such behavior appears commonplace both before a competitive encounter and as part of pre-performance routines. The specific times when ritualized behaviors are displayed support the supposition that they provide temporary relief from pre-competition anxiety and act as thought suppressors in the moments preceding skill execution.

One domain in which a colorful raft of ritualized behaviors can be seen is sport. Superstitious behaviors are extremely common (Neil 1982) and many can be characterized as stereotyped, rigid, repetitive rituals, lacking in rational motivation. Performers may feel compelled to "gear up" in a particular order, to tie and retie their bootlaces, or to perform the same pattern of behavior each time they run onto the field of play.

Boyer & Liénard (B&L) explicitly contrast ritualized behavior with commonsense notions of rituals as actions that are performed routinely or without thinking. Ritualized behaviors are "recognizable by their stereotypy, rigidity, repetition, and apparent lack of rational motivation" (target article, sect. 1, para. 1), whereas routine actions are performed without thinking but with motivation. A defining feature of ritualized acts is that they do not seem to become automatic and remain subject to high-level cognitive control. B&L further note that ritualized acts in obsessive-compulsive disorder may swamp working memory and appear to result in a temporary reprieve from what may be extremely debilitating state anxiety.

In sport, the outcome of a competitive event – and with it the achievement of a status for which the performer will typically have invested many years and many thousands of hours of practice – often comes down to executing a skill successfully at a given moment. The resulting pressure leads many performers to "choke," or perform well below the level of which they are capable. There is considerable evidence that skill failure results from performers focusing on low-level units of behavior and, in particular, from attempting to exert conscious control over actions that normally "run off" automatically. Much evidence for this conscious processing hypothesis (Liao & Masters 2002; Masters 1992; Maxwell et al. 2003) has emanated from skills in

which the performer has time to think prior to executing the skill (e.g., golf putting), but there is also evidence from reactive skills, such as baseball batting (Gray 2004). It may even be the case that conscious processing of one's movements, described by Masters et al. (1993) as "reinvestment," is potentially a mode of ritualistic intrusive thought that, hypothetically, may eventually mutate to become obsessive compulsive. Golfers with type II "yips," for example, are highly compulsive and analytical (Smith et al. 2003), and "what should be an automatic unified movement, becomes a complicated problem of consciously coordinating many separate movements" (Cochran & Stubbs 1968, p. 135).

One of the predictions generated by B&L's account is that ritualized behavior may be functional insofar as the temporary swamping of working memory prevents performers from "reinvesting" conscious control (Masters et al. 1993), as well as resulting in a temporary reduction in anxiety. Ritualized behaviors should be evident in abundance in the period immediately preceding a competitive encounter, as performers attempt to gain control of their emotions. They should also be present as "moderately efficient forms of *thought-suppression*" (target article, sect. 7.2, para. 2; emphasis in original) in the moments immediately before skill execution, particularly in self-paced skills. Consistent with these predictions, many performers do appear to engage in ritualistic behaviors before a competitive event (Neil 1982) and often include ritualistic elements in pre-performance routines (Foster et al. 2005).

There are also many examples of performers displaying ritualized behavior during breaks in competition. In tennis, Raphael Nadal takes great care to position and align his fluid replacement bottles at each change of ends, after drinking from both. Another top player, Justine Henin-Hardenne, reputedly avoids stepping on the lines on the court between points. While behavioral aspects of pre-performance routines, such as their timing, appear to be controlled at a sub-conscious level (Jackson 2003), performers often include conscious elements that may suppress conscious control processes. For example, Foster et al. (2005) showed, in a study of superstitious behavior in basketball free-throws, that some of the behaviors players felt compelled to perform included tapping their head three times before shooting, and touching their heels alternately before each throw.

As well as displaying the characteristics of compulsion and rigidity, other activities also appear consistent with the concept of goal demotion. A golfer clearly needs to grip the club correctly but when the player ritually re-grips the club a set number of times, the behavior becomes divorced from the observable goal. Indeed, this type of behavior sometimes appears similar to that of obsessive-compulsive "checkers." Golfers may be aware that re-gripping the club over and over is unnecessary but feel they have little control over their behavior. Similarly, while it would appear eminently sensible to look at the golf ball when preparing to putt, focusing intently on each letter of the manufacturer's name is not a necessity, though it may well be an effective way to suppress anxiety provoking or performance disruptive thoughts. Indeed, B&L suggest that patients may intuitively produce behaviors that reduce anxiety, and Neil (1982) has argued that superstitious behavior provides a means by which performers can cope with the stress of competition under pressure.

Although much of the evidence is anecdotal, there appear to be many examples of ritualized behavior in sport that are consistent with B&L's account. Sporting competition heightens anxiety, and skill failure often results from attempting to consciously control actions. Pre-competition ritualized behaviors may provide temporary relief from heightened anxiety while ritualized elements of pre-performance routines may help prevent the performer from "reinvesting" conscious control of the skill itself, a process that is implicated in "choking" or skill failure under pressure.

## Spectrum of child psychiatric disorders and ritualized behavior: Where is the link?

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**Abstract:** There is a spectrum of child psychiatric and neurological disorders, in all of which a comorbidity with obsessive-compulsive disorder and ritualized behavior is very common. Therefore, they may appear as a basis for the rituals in children that cross into adolescence and adulthood. Resolving the nature of these disorders may help us to better understand "Why ritualized behavior?"

The model proposed by Boyer & Liénard (B&L) is essential in several respects. First, in that it takes into consideration an extended data base by engaging diverse domains of ritualization. Combining evidence from different fields of science, B&L suggest that a unitary "evolved Precaution System" is responsible for ritualized behavior, in particular in obsessive-compulsive disorder (OCD). Second, the authors' efforts to conceptualize and model the neural basis of ritualized behavior should be appreciated; their model can certainly enhance the understanding of this aspect of human behavior in both normal and pathological conditions.

What deserves particular attention from fundamental and clinical points of view, and may require further refinement, are the neural mechanisms responsible for the evolved Precaution System suggested by B&L. As emphasized by the authors, OCD is likely to underlie the pathophysiological mechanisms leading to deficits of that system in both children and adults. In this regard, it is of special interest that there is a spectrum of child psychiatric and neurological disorders such as attention deficit/hyperactivity disorder (ADHD), tic disorder (TD) and/or Tourette syndrome (TS), oppositional-defiant disorder (ODD), pervasive developmental disorder (PDD), nocturnal enuresis, learning disability, separation anxiety, and depression, in all of which comorbidity with OCD is very common (Banaschewski et al. 2003; Becker et al. 2003; Biederman & Faraone 2005; Biederman et al. 1992; Geller 2006; Geller et al. 2004; Hounie et al. 2004; Leckman 2002; Leckman et al. 1997; Lewin et al. 2005; Masi et al. 2004; Nestadt et al. 2001; Peterson et al. 2001; Rothenberger & Banaschewski 2006; Rothenberger et al. 2000; Swanson et al. 1998; Yuen et al. 2005). Ritualized behavior is also frequently observed in girls with anorexia and abulia nervosa (Kaye et al. 2004; Sodersten & Bergh 2006; Yohanan et al. 2006).

Therefore, a broad continuum of child psychiatric disorders appears associated with rituals that may further cross into adolescence and adulthood. However, although still under research, the neurochemical and neurophysiological mechanisms of particular disorders are recognized to differ substantially. Various studies have provided converging evidence that the neuronal substrate underpinning ADHD is the dopamine deficit in the mesolimbic and meso-cortical circuits, with the norepinephrine system also being involved (Biederman & Faraone 2005; Castellanos & Tannock 2002; Sagvolden et al. 2005; Swanson et al. 1998). In contrast, tic disorder (TD, TS) is supposed to originate from an enhanced dopaminergic neurotransmission and a hypersensitivity of dopamine receptors in the striatum (Leckman 2002; Leckman et al. 1997). Motor system excitability also differs in these two disorders (ADHD and TD). The application of transcranial magnetic stimulation has revealed a reduced intracortical inhibition in children with ADHD (Moll et al. 2000), whereas a deficient inhibition of sensorimotor cortico-subcortical circuits is found in children with TD (Zieman et al. 1997). In this line, although not definitely known, dissimilar pathophysiological mechanisms seem to be activated in ODD, PDD, nocturnal enuresis, learning disability, anorexia nervosa, and separation anxiety, all combined with ritualized