

Instrumental Learning Deficits in OCD: A Symptom Dimension Perspective

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Abstract. Obsessive-compulsive disorder (OCD) presents heterogeneous symptom dimensions, which involve contamination/cleaning, harm/checking, and symmetry/ordering. Despite their apparent similarities, compulsions probably have different dimensions maintained by separate cognitive and motivational mechanisms. OCD repetitive behaviors are often explained through instrumental learning deficits, most notably diminished goal-directed regulation and habitual responses. Evidence for threat-related compulsions comes from multiple paradigms, such as outcome devaluation, slips-of-action, avoidance learning, and Pavlovian-to-Instrumental Transfer tasks. However, these paradigms fall short in capturing ordering compulsions, which are motivated more by internal sensory discomfort and "not just right" experiences than by external threats. This review emphasizes the necessity for tasks that operationalize interior discomfort and criticizes the propensity to generalize instrumental-learning models across all dimensions. Theoretical models of OCD are advanced by acknowledging this variability, which also implies that treatments should be customized to different motivational profiles. For example, addressing internal discomfort in symmetry/ordering and concentrating on avoidance processes in contamination and checking are two examples of how this might be done.

Keywords: Obsessive-Compulsive Disorder (OCD), Instrumental Learning, Goal-Directed Control, Habitual Behavior, Symmetry/Ordering Dimension.

1. Introduction

Compulsive and repetitive behaviors represent one of the defining clinical characteristics of obsessive-compulsive disorder (OCD). These behaviors show up in several symptom dimensions, such as contamination/cleaning, harm/checking, and symmetry/ordering (DSM-V). The behavior might look similar. But research suggests that each dimension may come from different underlying mechanisms, which highlights the heterogeneity of OCD [1].

One of the most influential frameworks for understanding compulsive behaviors in OCD emphasizes instrumental learning deficits. This view suggests that compulsions appear when people struggle to use action-outcome (A-O) associations to guide their behavior. When this happens, they rely too much on stimulus-response (S-R) habits [2]. Research supports this idea. Studies show that patients with OCD struggle to stop responding when outcomes lose their value [3]. These findings

indicate that OCD patients display impaired goal-directed regulation alongside a heightened tendency to depend on habits.

Despite these insights, most experimental studies on instrumental learning in OCD treat the disorder as a single condition. They often do not separate different symptom dimensions. This approach creates a key problem. Deficits in instrumental learning may explain some repetitive behaviors, but it is unclear if they explain all of them. This raises an important theoretical question: can a single learning mechanism explain the full spectrum of repetitive behaviors in OCD, or are different symptom dimensions sustained by distinct cognitive and emotional processes? This review hypothesizes that instrumental learning deficits contribute primarily to compulsions in threat-related dimensions such as contamination/washing and harm/checking but may not adequately account for compulsions in the symmetry/ordering dimension. To investigate this, the present review synthesizes recent experimental and theoretical evidence on instrumental learning across OCD's heterogeneous symptom presentations.

2. OCD and its symptom dimensions

OCD is a clinically diverse condition. OCD symptoms cluster into several dimensions. Researchers often measure these dimensions with tools such as the Yale–Brown Obsessive–Compulsive Scale (Y–BOCS) and the Dimensional Y–BOCS (DY–BOCS). OCD symptoms are often categorized into dimensions such as contamination/cleaning, harm/checking, symmetry/ordering, and forbidden or taboo thoughts [1, 4]. Each dimension is associated with unique cognitive, affective, and neurobiological:

- Contamination/cleaning: characterized by fears of germs or contaminants and accompanied by compulsive washing rituals [5].
- Harm/checking: typified by fears of causing or failing to prevent harm, resulting in repetitive checking behaviors [4].
- Symmetry/ordering: defined by compulsions to align or arrange objects symmetrically, often driven by discomfort and NJREs when order is disrupted [6].
- Forbidden/taboo thoughts: marked by intrusive, aggressive, sexual, or blasphemous cognitions, which may trigger mental or behavioral rituals for neutralization [4, 5].

This review specifically concentrates on contamination/cleaning, harm/checking, and symmetry/ordering dimensions, as these symptom groups are characterized by overt repetitive behaviors that can be directly investigated through instrumental learning paradigms.

3. Instrumental learning in OCD

Instrumental learning refers to the process through which individuals form associations between their actions and the outcomes those actions produce [7]. This learning process is supported by two interrelated systems. The habitual system is grounded in S–R associations and operates relatively independently of outcome value. In contrast, the goal-directed system depends on action–outcome A–O associations. It uses the current value of outcomes to guide behavior [2, 8]. Researchers have designed several experimental paradigms to explore how these processes operate in OCD [1, 4]. Every paradigm targets a particular facet of how habitual tendencies and goal-directed regulation interact. Taken together, these studies provide strong evidence for impairments in goal-directed function. At the same time, the results highlight key limitations and raise doubts about whether such deficits appear in all symptom dimensions. For example, Lawrence et al. [9] demonstrated that decision-making impairments are especially linked to checking symptoms, whereas set-shifting

deficits are more associated with symmetry/ordering symptoms, suggesting that learning and flexibility impairments may not be uniform across OCD.

3.1. Action-outcome learning and slips-of-action

Different experimental tasks have been designed to assess how habitual processes and goal-directed regulation are balanced in OCD. In action–outcome (A–O) learning tasks, participants with OCD acquire contingencies at rates similar to controls (OCD: $72\% \pm 15.67$ vs. controls: $77\% \pm 11.56$). This finding suggests that basic learning remains intact. However, when outcomes are later devalued, individuals with OCD show reduced flexibility ($60\% \pm 18.80$ vs. controls: $72\% \pm 20.37$) and commit more errors on slips-of-action tests (OCD: $64\% \pm 19.18$ vs. controls: $40\% \pm 16.37$). These results suggest that while initial A–O learning is preserved, deficits emerge when goal-directed control is required. These outcomes demonstrate that patients are disproportionately dependent on habitual responding [3]. This paradigm clearly demonstrates how goal-directed control can break down in OCD, though it remains open whether the errors reflect a pure failure of goal-directed learning or additional cognitive factors.

3.2. Habitual avoidance

Avoidance-based paradigms have extended these findings into aversive contexts. In shock-avoidance tasks, participants are trained to respond to visual cues in order to prevent electric shocks. Other studies use avoidance learning tasks. After shocks are removed, healthy controls reduce their responding to devalued cues. In contrast, participants with OCD keep responding even when the threat is no longer present. Gillan et al [10] showed that this effect reflects a habit tendency that which compulsive avoidance persisted even when participants knew the shock was devalued, and no physiological arousal was present. Instead, it was related to a subjective urge to respond. This behavior shows a strong and maladaptive reliance on habitual avoidance [8]. The task is valuable because it resembles real OCD behaviors, which often center on avoiding fear or danger. But it is hard to tell whether people keep responding only because of habit, or because they still feel afraid even when the shock is gone. Future studies should include measures of fear or anxiety. These measures would help researchers tell the difference between the two explanations.

3.3. Pavlovian-to-Instrumental Transfer (PIT)

The purpose of PIT training is to investigate how instrumental responding is affected by Pavlovian stimuli. Studies have reported reduced PIT effects among individuals with OCD, especially when they are responding to negative conditioned stimuli (CS–). These findings suggest that people with OCD have trouble using environmental signals to guide goal-directed actions [11]. Taken together, results from these paradigms show a clear pattern: OCD is marked by weaker goal-directed control and stronger reliance on habitual processes [2]. This task is valuable for showing how cues bias instrumental behavior, but it is still uncertain why the PIT effect is weaker in OCD patients.

4. Heterogeneity of instrumental-learning models: ordering and related dimensions as an example

Why ordering and related dimensions may not be fully explained by current instrumental learning models is a question that highlights the limits of existing research. While most paradigms use

deficits linked to threat-based compulsions, they rarely address compulsions driven by internal discomfort, such as those seen in symmetry and ordering.

4.1. Feature of the symmetry/ordering dimension

The symmetry/ordering dimension is marked by an overwhelming need to arrange, align, or balance objects according to strict internal standards. Failure to achieve these standards typically produces intense discomfort, feelings of incompleteness, or NJREs [6, 12, 13]. Importantly, these compulsions are not driven primarily by the avoidance of environmental threats, but rather by the resolution of internal perceptual incongruity, such as asymmetry, uneven spacing, or spatial imbalance [5].

A robust body of evidence links perfectionism to compulsions in this domain. Martinelli et al. [14] demonstrated that perfectionistic traits, especially organizational tendencies and action-related doubt, strongly predicted ordering symptoms independent of other OCD dimensions. Earlier findings also emphasized the role of perfectionism and excessive responsibility in sustaining compulsive ordering [15]. These findings highlight the distinct motivational basis of this symptom cluster.

Additionally, individuals with severe symmetry symptoms often report a heightened sensitivity to perceptual imbalance, which triggers compulsive arranging behaviors even in the absence of explicit intrusive thoughts [16]. Building on these findings, Irwin and Jones [12] showed that NJREs are closely linked to both anxiety sensitivity and perfectionism. Their work suggests that compulsions in the symmetry/ordering dimension are mainly driven by internal discomfort rather than by external threat. Neurocognitive research provides further support for this view. Lawrence et al. [9] reported that set-shifting difficulties are more strongly tied to symmetry/ordering behaviors. In contrast, decision-making impairments appear more frequently in checking symptoms. This further emphasizes that these symptoms are caused by different processes. These features suggest a construct mismatch that manipulating external threat or reward may underrepresent the internally driven urges at the heart of symmetry/ordering. We make this constraint explicit next.

4.2. Instrumental learning and its constraints in explaining symmetry/ordering

Most of the evidence supporting instrumental-learning deficits in OCD stems from paradigms that manipulate external outcomes. This includes avoidance-learning tasks using shocks [8], outcome-devaluation and slips-of-action tasks employing food or monetary rewards [2, 3], and PIT tasks examining the impact of external cues [11]. Such paradigms are well suited to threat-related compulsions, where behavioral goals—such as preventing harm or contamination—are clearly defined and experimentally tractable. Indeed, avoidance studies show that OCD patients persist in responding even after shocks are devaluated, not because of persistent fear or elevated arousal, but because of a subjective need to act [10]. This finding illustrates that instrumental-learning models effectively capture maladaptive avoidance linked to external threats, yet they struggle to completely explain ordering-related compulsions.

By contrast, compulsions in the symmetry/ordering dimension are not primarily concerned with preventing external consequences but are motivated by the pursuit of internal equilibrium [6, 12]. Internal discomfort is not readily manipulated through outcome-devaluation paradigms, and PIT tasks relying on cues with explicit affective valence may not capture the subtle sensory incongruities central to this dimension.

Unlike contamination or checking symptoms, where maladaptive behaviors can be directly tied to concrete threat expectations (e.g., fear of illness or danger), ordering compulsions are often triggered

by perceptual imbalance or a “not just right” experience. For example, a slightly crooked object or uneven spacing can cause strong tension, even when no real harm exists. This shows that the main drive behind symmetry and ordering is the need to reduce inner discomfort, not to avoid clear external outcomes. Current instrumental-learning tasks rely on rewards or punishments, so they cannot fully capture the true triggers of these compulsions [17].

Moreover, because existing paradigms emphasize outcome valuation, they risk misclassifying ordering behaviors. If a patient continues to rearrange objects despite the absence of external consequences, such behavior might superficially resemble habit-driven responding. However, the underlying driver may not be habit alone; it may be the active regulation of inner states, such as reducing perceptual imbalance or easing NJREs. This leads to a new question: are ordering symptoms caused by weak goal-directed learning, or do they come from a separate process focused on regulating internal feelings?

In sum, instrumental-learning models explain threat-based compulsions well. But they do not fully capture the internal motivations that fuel symmetry and ordering behaviors. This gap shows the need for new paradigms that directly measure internal discomfort and its role in compulsive actions.

5. Limitation

A central limitation in the current literature is the tendency to generalize instrumental-learning findings across all OCD dimensions, despite substantial heterogeneity in symptom presentation. Much of the evidence has been generated from paradigms focusing on contamination/cleaning and harm/checking, where external outcomes are easily manipulated. It is still unclear whether these mechanisms apply to other symptom dimensions, such as symmetry and ordering, which are mainly driven by internal discomfort. Overgeneralization may hide important differences across dimensions. This problem limits both theoretical progress and clinical practice [4, 18].

A second limitation involves the absence of paradigms tailored to dimension-specific motivational features. Most current designs do not include internally driven states such as NJREs or perceptual imbalances, even though these are central to ordering compulsions. As a result, it is uncertain whether the observed deficits in goal-directed control are common across all of OCD or if they are limited to threat-related symptoms.

Another limitation comes from methodology. Many studies use small and mixed clinical samples. They often group all subtypes together without careful separation. This approach makes it hard to know if the deficits truly apply to OCD or mainly to certain symptom profiles. Researchers also rely heavily on lab tasks that use artificial reinforcers like food points or abstract monetary rewards. These rewards may lack real emotional impact. Because of this, the tasks may not reflect the true motivational power of compulsions in daily life. This weakens ecological validity and may misrepresent the underlying mechanisms.

6. Future directions

Future research should develop experimental paradigms that explicitly incorporate internal sensory discomfort as a motivating factor. For example, tasks could present participants with deliberately misaligned or asymmetrical stimuli and allow them to reorganize these stimuli according to personal preferences.

Such paradigms should gather multi-level data by combining subjective reports of discomfort intensity with behavioral indices, such as response latency, adjustment persistence, and corrective accuracy, as well as physiological markers including heart rate variability and pupillometric

responses. Together, these measures would provide a fuller picture of how internal discomfort shapes decision-making and behavior.

Furthermore, it is also important to compare across subtypes. Studies should recruit people with different symptom profiles and test them on the same type of task. This approach would show whether compulsions based on internal discomfort, like symmetry and ordering, are truly different from those driven by external threat.

If these differences are confirmed, the clinical impact would be significant. Treatments could be tailored to match motivational profiles. For example, cognitive reappraisal could reduce the impact of NJREs. Perceptual retraining could help people tolerate asymmetry. Graded exposure could target internal discomfort rather than external threat.

7. Conclusions

This review evaluated whether instrumental-learning deficits can account for repetitive behaviors across OCD symptom dimensions. Across paradigms, including outcome devaluation, slips-of-action, avoidance learning, and PIT, converging evidence points to pronounced impairments in goal-directed regulation combined with excessive reliance on habits, particularly in threat-related dimensions like contamination/cleaning and harm/checking.

However, generalizing these mechanisms to all dimension's risks oversimplification. The symmetry/ordering dimension appears to be sustained by internal sensory discomfort and NJREs, which are not adequately captured by existing paradigms centered on external outcomes.

Future research must therefore aim to operationalize internal discomfort, systematically compare its effects with external threat, and design dimension-specific models and treatments. This approach can refine theoretical models while simultaneously guiding the creation of more tailored interventions.

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