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Current Psychiatric Perspectives on Intrusive Thinking

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Abstract

Various psychopathological symptoms share characteristics of intrusive thinking. Intrusive thoughts are part of the diagnostic criteria for posttraumatic stress disorder and obsessive-compulsive disorder but are also relevant in other psychiatric conditions, such as drug craving in addiction or rumination in depressive disorders. Intrusive thoughts must be differentiated from thought insertion observed in schizophrenia and related psychotic disorders. This chapter reviews the typical characteristics and content of intrusive thinking in the context of different psychiatric conditions and outlines current theories regarding the mechanisms of intrusive thinking.

Introduction

Intrusive thoughts can be characterized as repetitive, uncontrollable, distressing thoughts that enter conscious awareness unwantedly (Clark 2005). They are an important aspect of different psychiatric disorders, but they also manifest in the nonclinical, general population (Clark 2005; Garcia-Soriano et al. 2011). Prominent psychiatric examples include intrusions related to traumatic events in patients suffering from posttraumatic stress disorder (PTSD) as well as aggressive obsessions experienced by obsessive-compulsive disorder (OCD) patients (Heinz 2017). In schizophrenia or related psychotic disorders, the delusions, hallucinations, or thought insertions experienced by patients are repetitive, uncontrollable, and distressing (Heinz et al. 2016). In each of these conditions, the content of intrusive thoughts can be very different: in PTSD, the content may refer to a real autobiographic event whereas in OCD it may relate to an obsessive thought about contamination. Certain similarities do, however, exist: characteristic thoughts appear repeatedly (to a degree) and can interfere with normal functioning. A person perceives the thoughts to be unwanted and reports having no control over these thoughts; that is, they do not result from a deliberate or even effortful process, but appear involuntarily and

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automatically. Finally, intrusive thoughts create distress due to their content and/or characteristics.

In this chapter, we discuss intrusive thinking in the context of PTSD, OCD, addiction, and schizophrenia. For each of these psychiatric conditions, we outline the typical characteristics and content of intrusive thinking, together with the diagnostic criteria of the respective psychiatric condition. Discussion follows on current theories that aim to explain the mechanisms behind intrusive thinking, and we conclude by reviewing problems and open questions that require future attention.

Intrusive Thoughts in Psychiatric Conditions

Posttraumatic Stress Disorder

One prominent and required diagnostic criterion for PTSD is the presence of intrusion symptoms: a traumatic event is persistently reexperienced. According to DSM-5, Criterion B (American Psychiatric Association 2013), these intrusion symptoms encompass the following characteristics:

- Recurrent, involuntary, and intrusive memories of the traumatic event(s)
- Traumatic nightmares
- Dissociative reactions (e.g., flashbacks)
- Intense distress after being exposed to traumatic reminders
- Heightened physiologic reaction to trauma-related stimuli

To meet the full diagnostic criteria, a person must have been exposed to a life-threatening event and thereafter has to avoid trauma-related stimuli. Further, the person exhibits negative alterations in cognition and mood, which began or worsened after the traumatic event, and displays alterations in arousal and reactivity, such as hyperarousal.

The clinical characteristic of intrusive memory is that it "springs to mind unbidden—that is, against the person's will" (Visser et al. 2018). Such intrusive memories are forms of episodic memories of actually experienced autobiographical events, which are retrieved involuntarily. In its extreme form, the person intensely and vividly relives the traumatic event in the present. Such flashbacks involve the retrieval of detailed sensory features and are highly emotional. Typically, fragments and several distinct moments of the trauma are recalled, the so-called "hot spots," in a predominantly visual form (Visser et al. 2018).

Disturbance in memory seems to be the prominent feature of PTSD. It is widely agreed that multiple memory systems exist and that these rely, in part, on distinct neurobiological substrates (Henke 2010). "Declarative" memories are events and facts, which we can explicitly remember, and seem to depend on medial temporal lobe structures. "Nondeclarative" memories are implicit and

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not consciously accessible. They encompass procedural memory (e.g., aversive conditioning, motor skills, and habits) and are thought to be subserved by subcortical areas such as the amygdala (aversive conditioning) and striatum (skills and habit formation).

To what degree do different aspects of intrusive aversive memories (e.g., visual imagery or physiological responses) relate to different memory systems? Physiological reactions to trauma-related cues, also listed as intrusive symptoms in DSM-5, Criterion B (American Psychiatric Association 2013), are nondeclarative memories triggered by stimuli. Conversely, "unwanted emotion-laden memories that spring to mind unbidden in the form of sensory imagery" (Visser et al. 2018; see also Figure 14.1, Holmes et al., this volume) belong to the declarative system. Therefore, different neurobehavioral mechanisms most likely underpin the heterogeneous intrusive symptoms that are observed in PTSD. It has been suggested that intervention strategies should specifically target involuntary rather than voluntary retrieval (Visser et al. 2018), both intrusive memory fragments of a trauma as well as the conditioned responses to trauma-related cues are experienced involuntarily. Thus, a successful therapeutic intervention should aim to modify the specific underlying memory traces, while preserving an individual's ability to deliberately recall episodes and facts about the trauma (e.g., for legal reasons).

Obsessive-Compulsive Disorder

The defining features of OCD are repetitive, distressing, and inappropriate thoughts (obsessions) and/or actions (compulsions). According to DSM-5, obsessions are "recurrent and persistent thoughts, urges, or images that are experienced…as intrusive and unwanted, and that in most individuals cause marked anxiety or distress" (American Psychiatric Association 2013). Common foci of obsessions include contamination, pathological doubt, need for symmetry, and aggressive or sexual content. Patients fail to ignore or suppress obsessions and instead attempt to neutralize them through other thoughts or actions, such as by compulsively performing ritualistic behavior to undo the alleged harm of the obsessive thought or intention. Compulsions are thus repetitive behavioral or mental acts, such as checking, washing, or counting. These acts aim to reduce anxiety or distress, but they lack a realistic connection between the act and the goal that a person should achieve. Patients are aware that their compulsions and obsessions are unreasonable and inappropriate. The symptoms are experienced as alien and disturbing (i.e., egodystonic); still, they are recognized as being caused by the afflicted patient and not by an external agent (Heinz 1999).

Cognitive theories state that dysfunctional beliefs are the core of OCD and that compulsions develop to reduce anxiety. Appraisal models, for instance, posit that subjects who appraise intrusions as significant and meaningful (based

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on their dysfunctional beliefs), can develop OCD by escalating intrusions into obsessions (Julien et al. 2007). This hypothesis is based on the observation that nonclinical individuals experience intrusive thoughts, images, or impulses similar in content to individuals with OCD. Other recent theories conceptualize OCD as a disorder of habitual control (Robbins et al. 2019), where post hoc rationalizations of habitual actions contribute to obsessions (Gillan and Robbins 2014). Dual-system theories state that human learning and adaptive behavior are governed by two interacting control systems: one mediates goal-directed actions while the other supports habits (Balleine and O'Doherty 2010; Dolan and Dayan 2013). Habits are performed autonomously and largely independent of their consequences and are, therefore, inflexible to changes in reward contingency. In contrast, goal-directed actions are performed because of anticipated outcomes; thus, they rely on forward planning and allow greater flexibility to changes in contingencies (Friedel et al. 2014). There is a striking similarity between compulsions and habits (Gillan and Robbins 2014): Compulsions are automatic behaviors experienced as irrational and not in line with current goals (i.e., they are ego-dystonic). Behaviors characterized as habits are insensitive to action–outcome contingency and outcome value. Intrusive thoughts are perceived as unintended and not as deliberate and instrumental mental acts; this suggests that a more implicit and nondeliberative way of information processing is involved in intrusive thinking, more akin to a habitual system than a goal-directed control system. Thoughts can be accompanied by sensory qualities (e.g., intrusions in PTSD), or they can be heard aloud, which traditionally has been distinguished from thought insertion and classified as acoustic hallucinations (Jaspers 1946).

The temporal sequence of OCD symptoms seems relevant for an etiological understanding of OCD: Do obsessions come first and compulsive acts follow to reduce negative emotional states, as put forth by the cognitive theories of OCD? Alternatively, do compulsions develop first such that obsessions are secondary rationalizations of the compulsions? There seems to be limited longitudinal data to answer these questions reliably. However, a large proportion of children with OCD deny that their compulsions are driven by obsessive thoughts (Robbins et al. 2019). On the other hand, adult OCD patients report that intrusive images of dirtiness or contamination evoke the urge to wash or neutralize (Coughtrey et al. 2012).

Intrusive thoughts and compulsions present in OCD have been linked to dysfunction of frontostriatal circuits (orbitofrontal/anterior cingulated cortex, dorsolateral striatum/caudate, thalamus) (Robbins et al. 2019). Several neuroimaging studies of OCD revealed hyperactivity in these brain areas during rest (e.g., Baxter et al. 1987) and cognitive performance (e.g., van den Heuvel et al. 2005). Similar neurocircuits were activated during symptom provocation, mainly using visual stimuli to trigger OCD symptoms (Breiter and Rauch 1996). Moreover, tonic overactivity of this circuit seems to be associated with symptom severity (Adler et al. 2000) and predicts treatment response.

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Frontostriatal dysfunction normalizes after successful treatment with psychotropic medication (e.g., Swedo et al. 1992) or cognitive behavioral therapy (e.g., Nakao et al. 2005).

In light of these neurobiological findings, Heinz (1999) suggested that dopamine dysfunction in the dorsal striatum is associated with motor tics, whereas more complex compulsive behavior patterns are triggered by cognitive concerns processed in the orbitofrontal cortex, which persist obsessively due to impaired feedback processed in dorsal striatal-thalamic-frontocortical loops. This neurocircuit model may help unify current theories that focus on cognitive versus habitual aspects of OCD.

Depressive Disorders and Rumination

Rumination is a maladaptive form of self-reflection and recursive self-focused thinking. Like obsessions, rumination involves recursive thinking about particularly self-centered negative information. However, whereas obsessive thoughts are usually experienced as aggressive or otherwise inappropriate (and are hence "unwanted" by the afflicted person), rumination often focuses on threatening environmental conditions as well as inappropriate or unfavorable character traits of the person (and thus involve self-blame for not being able to cope with the situation). Rumination has been hypothesized as an important factor in developing depressive symptoms and has been shown to exacerbate depression, enhance negative thinking, and impair problem solving (Nolen-Hoeksema et al. 2008). Self-focused rumination in depressive disorders has been linked to self-referential processes and the brain's default-mode network, particularly involving the subgenual prefrontal cortex, a brain area implicated in the processing of aversive information and the modulation of negative mood states (Kühn et al. 2013; Hamilton et al. 2015). Accordingly, positron emission tomography studies have revealed increased metabolic activity in this brain area among subjects with major depression (Drevets et al. 2008).

Major depression and OCD appear to differ with respect to their neurobiological correlates, which may reflect differences in relevant pathological mechanisms: In major depression, rumination may result from a failure to regulate aversive information input and associated personal concerns. In OCD, compulsive behavior appears to be triggered by obsessive thoughts aimed at compensating for the aggressive or otherwise unwanted content of these obsessions, yet fails to dampen concerns, which triggers repetitive action, resulting in reverberating circular interactions. In depressive disorders, other instances of intrusive thinking include suicidal ideations; mental images of killing oneself ("flash-forward" thoughts) have been shown to be associated with suicidal behavior (for further examples of mental imagery, see Holmes and Mathews 2010).

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Addiction: Craving and Compulsivity

Intrusive thinking in addiction disorders includes thoughts related to drug consumption associated with a strong desire (craving) to consume a drug despite having reached a conscious decision to abstain from drug use (Heinz 2017). In this context, craving is defined as a strong desire or urge to use a drug or to engage in harmful activity, such as gambling for monetary reward. Further criteria for addiction include impaired control regarding substance intake, neglect of unrelated activities, tolerance, and withdrawal. Despite conscious decisions to do otherwise, recurrent substance use is a key characteristic of addiction, and it has been suggested that drug use becomes compulsive when subjects lose control over the powerful urge to consume a drug of abuse despite of aversive consequences (Everitt and Robbins 2016).

Indeed, a gradual shift from outcome-sensitive, goal-directed behavior to habitual behavior can contribute to automatic, habitual, or even compulsive drug intake, despite foregone positive outcomes and devastating (future) negative consequences. Drug-associated stimuli may acquire enhanced salience and act as appetitive Pavlovian cues that trigger automatic approach behavior (Robinson and Berridge 1993). Moreover, these environmental cues can impact (goal-directed) choice selection and behavioral adaptation through Pavlovian-instrumental transfer mechanisms, where affectively positive Pavlovian cues bias (unrelated) goal-directed behavior toward approach even when this is not useful in the instrumental context (Garbusow et al. 2016).

While healthy controls are able to arbitrate control between the habitual and the goal-directed system, a loss of control over certain behaviors (e.g., drug intake) might be due to a shift from goal-directed toward habitual control (Balleine and O'Doherty 2010; Dolan and Dayan 2013; Voon et al. 2015). Computational neuroscience uses "model-based" and "model-free" algorithms to explain goal-directed and habitual learning during, for example, sequential decision-making tasks (e.g., Friedel et al. 2014). A model-based algorithm views the environmental (or task) structure used for deliberative forward planning as a hallmark of goal-directed behavior, which in the case of sequential decision making refers to the transition from one environmental state to another. Model-free reinforcement learning algorithms reflect a retrospective and more rigid strategy that neglects environmental structures and relies solely on repeating previously rewarded actions. Initial studies in patients with different addictive disorders, including dependence on psychostimulants and alcohol, suggest impaired model-based control, thus shifting the behavior toward a model-free response (Sebold et al. 2014; Voon et al. 2015). However, in a more recent study, Sebold et al. (2017) found neither a general bias toward model-free (supposedly habitual) decision making in patients with alcohol dependence nor a poor treatment outcome associated with impaired model-based decision making. Instead, the balance between habitual (supposedly model-free) and goal-directed decision making differentiated alcohol-dependent patients

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(who later relapsed) from abstainers and controls only when individual alcohol expectancies were considered. This suggests that habitual behavior does not generally increase in addicted patients during choice behavior tests for non-drug-related rewards in a laboratory context; addiction-related habits appear to be triggered by specific cues and contexts in conjunction with previous experiences. In line with this hypothesis, a patient suffering from OCD, pathological gambling, and drug addiction described constant urges to perform habits compulsively related to his obsessions, while craving for gambling and drug intake was triggered only during certain time periods by specific drug or gambling-related stimuli (Schoofs and Heinz 2013). In light of these findings, compulsions in OCD appear to differ significantly from "compulsive" urges to consume drugs of abuse, warranting further phenomenological and neurobiological specifications (Heinz 2017).

Schizophrenia and Related Psychotic Disorders and Thought Insertions

Thought insertion is a positive symptom of schizophrenia and is regarded as a "first rank symptom" of the disease (Schneider 1959; Heinz et al. 2016). Not only does thought insertion constitute one of the most astounding positive symptoms of schizophrenia, it is frequently expressed. It occurs in approximately half of all patients diagnosed with schizophrenia (Sartorius et al. 1977), but appears to be absent in organic psychoses (Marneros 1988; Heinz et al. 1995).

In psychosis, patients typically report that thoughts are being "inserted" (in verbal form) by another agent into their head. Patients thus lose the feeling of "mineness" for a given thought; this marks a distinct difference between obsessions in OCD, ruminations in major depression, or drug cravings in addiction, all of which are "unwanted" and uncontrolled by the afflicted subject but not experienced as "alien" and attributed to outside agents. Vosgerau and Voss (2014) highlight the distinction between control, ownership, and authorship of thoughts. They argue that it is a conceptual truth that introspected thoughts are necessarily owned by the introspector (therefore ownership of thoughts cannot be disturbed), whereas lack of authorship over thoughts can be experienced in everyday phenomena (thinking "communicated thoughts," i.e., thoughts clearly formulated by another person) as well as in pathological conditions such as psychosis. By introducing another factor (e.g., control over thoughts), Vosgerau and Voss (2014) argue that the phenomenon of thought insertion is caused by a combination of these two factors—lack of control and lack of authorship—and that there is a double dissociation between both factors.

In an attempt to reveal the neurocognitive mechanisms underlying thought insertion, Campbell (1999) drew an analogy between thoughts and motor control processes and explained thought insertion in relation to the comparator model, originally developed for motor control (Frith et al. 2000). Campbell assumed that thoughts are comparable to motor processes (similar views were

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expressed by Feinberg 1978 and Ito 2008) and that every thought is preceded by an intention to think this thought. The actual thought occurring in one's stream of consciousness is then compared with the intention to think. When these two processes match, a feeling of authorship results; when they do not, attribution to another agent may occur.

While this offers an appealing framework to explain passivity phenomena, such as delusions of control or hallucinations, several problems arise when the comparator model is used to explain thought insertion (for a detailed critique, see Vosgerau and Synofzik 2010). One problem is that the account does not distinguish thinking (as a process to generate thoughts) from thoughts (as a result of thinking), making it difficult to pinpoint the difference between "influenced" thinking and "inserted" thoughts. Furthermore, it remains unclear what an intention to think a specific thought could be and how it can be distinguished from the actual thoughts; that is, why the intention to think is not naturally conceived of as the thought itself. Indeed, if every thought were to be preceded by an intention to think, we would run into an infinite regress: for each thought, we need a thought to get the process started, which in turn presupposes another thought, and so on.

A more recent attempt to conceptualize the phenomenon of thought insertion treats inserted thoughts as sensory events rather than motor processes (Sterzer et al. 2016). Building on detailed phenomenological descriptions from the early Heidelberg school in the first half of the twentieth century, which described thoughts that "become sensory" as being experienced as inserted, more recent studies explain thought insertion within the framework of predictive coding and Bayesian inference (Sterzer et al. 2016). Here, thought insertion is viewed not as the failure of introspection in a comparator process (Campbell 1999) but rather as the failure (or imprecision) of prior beliefs in a Bayesian inference process thought to be at the core of thought insertion (Sterzer et al. 2016). In analogy with aberrant salience attribution to external events, which could lead to the emergence of delusional mood and fixed beliefs (Heinz 2002; Kapur 2003; Heinz and Schlagenhauf 2010), internal events (e.g., verbalized thoughts) may also be experienced as overly salient, and therefore unusual, as well as surprising due to a lack of context and unusual structure (with a possible link to formal thought disorder). The individual's attempt to explain the aberrant salience and unusual character of such verbalized thoughts could result in their interpretation as being externally caused. Nonetheless, unintended or semantically inappropriate verbalizations can also be expressed in aphasia (e.g., due to a stroke) but are not accompanied by reports of "alien" involvement (Heinz 2017). Therefore, additional steps may be required to convince a person that a thought is "alien" and thus "must" be inserted by an external agent. In this context, it has been suggested that low precision of prior beliefs and/or increased sensory precision, both inaccessible to introspection, may render some thoughts so unpredictable that they are experienced as inserted (Heinz et al. 2019). Whereas

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beliefs and desires may have a role in prior beliefs regarding our own thoughts (Stephens and Graham 2000), what makes a thought feel alien is not that they are simply unwanted or "immoral" (in the sense of higher-level introspection), but rather that patients directly notice or perceive a thought to be "alien," thus pointing to unconscious mechanisms causing this experience. Such mechanisms may be usefully described by a Bayesian account of information processing in the central nervous system (Adams et al. 2013): during psychotic episodes, if prior beliefs are indeed imprecise in comparison to sensory input-driven posteriors, frequent prediction errors are made, which may trigger phasic dopamine release and cause salience to be attributed to otherwise irrelevant cues, including verbalized thoughts (Sterzer et al. 2016; Heinz et al. 2019).

If these considerations are correct, they may help to explain the difference between "alien" thought insertion and other forms of unwanted or intrusive thought content. In psychosis, impaired precision of prior beliefs may affect the whole experience of the world and self, which are experienced as unusual, alien, and often threatening. Thus, thought insertion in psychosis goes beyond the experiencing of unusual verbalizations (as in aphasia), unwanted cravings (in addiction), self-centered concerns (in major depression), intrusive memories (in PTSD), or obsessive thoughts (in OCD). The entire relationship between the individual and the real world is affected: that which was well known for a long time suddenly carries hidden meanings, harmless situations are imbued with a sense of danger, and longtime friends and family members become deeply alienated and may no longer be trusted. Since Bayesian accounts are supposed to reflect general functions of the central nervous system, such computational frameworks will have to explain how more restricted alterations in information processing, particularly with respect to verbalized thoughts, differ from the more fundamental alterations experienced in psychotic states.

Open Issues

To guide future enquiry, we conclude our discussion by highlighting unsolved problems that await clarification through future research. First, despite striking phenomenological differences between negative verbal thoughts, intrusive visual images, and memories, we need to know whether the underlying psychological and neurobiological mechanisms involved in intrusive thinking are similar across diagnostic categories. In support of shared transdiagnostic mechanisms, Gillan et al. (2016) has shown that reduced goal-directed control is associated with compulsive behaviors and intrusive thoughts.

Second, the relation between intrusive thinking and the concept of compulsivity needs to be elucidated, where compulsivity is defined as "a hypothetical trait in which actions are persistently repeated despite adverse consequences" (Robbins et al. 2012:82). Are intrusive thoughts one manifestation of compulsivity? If so,

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when is it expressed in maladaptive actions and when in intrusive thoughts? Can intrusions be understood as mental habits?

Finally, in psychosis, how can we mechanistically isolate disturbed authorship (or disturbed "mineness") from disturbed control over thoughts? Importantly, measurement instruments have to be harmonized on the clinical, psychopathological, behavioral, and neurobiological levels.

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