REVIEW

Hallucinations from a Cognitive Perspective

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Although the phenomenological diversity of hallucinations has been well documented, experimental investigations into their cognitive underpinnings have not yet reflected this complexity. Our goal in this review is to contrast the restricted set of experimental conditions that have been utilized in source-monitoring studies of hallucinations with their documented phenomenological diversity. In particular, we initially focus on the theoretical distinction between origin and source that has been recognized at the level of phenomenology, and then review the source-monitoring literature within this theoretical framework. In addition, we touch on several other aspects of the phenomenological diversity of hallucinations that have not yet been sufficiently investigated experimentally—namely, intentionality, affect, and motivational factors. Finally, we list other methodological problems that may have led to inconsistencies in the literature. We conclude with concrete recommendations for future source-monitoring investigations of hallucinations. (HARV REV PSYCHIATRY 2007;15:109–117.)

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Defining hallucinations has proven to be difficult in the past[1,2] and will probably continue to generate debate in the future. As Lowe[3] has pointed out in discussing "the variety in the manners in which hallucinations have been defined," the diversity "does not imply that any given definition is invalid, but it does confirm that hallucinations are complex phenomena, whose investigation almost certainly requires multi-dimensional research designs and multiple initial criteria." Recently, David[4] has provided the following definition: "A sensory experience which occurs in the absence of corresponding external stimulation of the relevant sensory organ, has a sufficient sense of reality to resemble a veridical perception, over which the subject does not feel s/he has direct and voluntary control, and which occurs in the awake state."

Hallucinations are complex, rich phenomena—which has a number of important clinical, theoretical, and empirical implications.[5] Our goal in this review is to contrast the restricted set of experimental conditions that have been utilized in source-monitoring studies of hallucinations with the diversity of their documented phenomenology. What follows is a (non-exhaustive) summary of that phenomenology, with a focus on the distinction between origin and source.* We then review the empirical literature within a source-monitoring framework in order to determine whether this distinction has been sufficiently considered in experimental designs. In addition, we review other important aspects of the phenomenological diversity of hallucinations that have not yet been thoroughly investigated

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*"Origin" refers to the degree to which a cognitive event is perceived as being produced by oneself or not, and "source" refers to the localization of a cognitive event in space. These two terms are explained in more detail in the section on the theoretical distinction between origin and source.

experimentally—namely, intentionality, affect, and the overlap between hallucinations and delusions—and also list other methodological problems that may have led to inconsistencies in the literature. We conclude with concrete recommendations for future source-monitoring studies of hallucinations.

Although this review will mainly concern memory (source-monitoring) studies (i.e., those involving tasks that include a delay between the presentation of a stimulus and its recognition), it would be wrong to infer that studies examining the role of immediate, or "on-line," attributional processes (such as self-monitoring) are unimportant. On the contrary, these studies[6–8] point to important variables that are involved in early stages of hallucination genesis, and the cognitive operations that are involved in on-line attributional processes presumably overlap with those underpinning source memory. We chose to focus on the memory studies because they come from a rich literature in basic cognitive psychology—which, in addition to its experimental designs and methods of analyzing data, provides a foundation for manipulating certain variables.

In their seminal work on source monitoring, Johnson, Hashtroudi, and Lindsay[9] define a source as "a variety of characteristics that collectively specify the conditions under which a memory is acquired (e.g., the spatial, temporal, and social context of the event; the media and modalities through which it was perceived)." They refer to source monitoring as "the set of processes involved in making attributions about the origins of memories, knowledge, and beliefs." In this context, hallucinations may be understood as attributable to difficulties in a subcategory of source monitoring—namely, reality monitoring, or the process by which a person attributes knowledge or a memorys or belief to an external (obtained through perceptual processes) or internal (e.g., by reasoning, imagination, and thought) source.[10] One influential cognitive model[11] proposes that hallucinations can be explained by a difficulty in reality monitoring and that hallucinating subjects might have a specific bias toward attributing their thoughts to an external source, or a so-called externalizing bias. Numerous studies have provided evidence for an externalizing bias in both clinical and nonclinical subjects.[12–14]

This literature provides researchers with a sophisticated, well-documented experimental paradigm that is entrenched within an equally sophisticated, well-documented theoretical framework. It is important, however, to underline that the goal of research carried out from this approach is not simply to conclude that hallucinations are related to a specific source-monitoring deficit, such as a reality-monitoring error (e.g., mistaking internal events as external events). Indeed, coming to such a conclusion would provide no helpful information; few would deny that hallucinations involve mistaking an internal event for something else. The essential point is that hallucinations and source monitoring share overlapping cognitive processes; that is to say, source monitoring on memory representations does not directly explain hallucinations, but it provides a rich framework for studying some of the cognitive processes that presumably contribute to hallucinations. Thus, the source-monitoring framework provides researchers with the possibility of examining *how,* in terms of underlying cognitive processes, a reality-monitoring error occurs.

THE PHENOMENOLOGY OF HALLUCINATIONS

Hallucinations are phenomenologically heterogeneous experiences. Both verbal and nonverbal auditory hallucinations may involve numerous different types of sounds, which furthermore vary in their complexity, including blowing, rustling, humming, rattling, shooting, thundering, crying, laughing, whispering, and talking.[15,16] Studies looking at nonauditory hallucinations have also found evidence of variations in complexity. Gauntlett-Gilbert and Kuipers[17] examined various phenomenological characteristics of visual hallucinations in a group of psychiatric patients and found, for example, that visual hallucinations with humanoid content could involve restricted features (e.g., faces, skulls), whole figures, or even groups of figures.

A growing number of studies have attempted to examine the phenomenological characteristics of hallucinations in a systematic and detailed manner.[15,17–27] Principal-components analysis was carried out on nonclinical subjects' responses on the Launay-Slade Hallucination Scale in the study by Waters and colleagues,[26] resulting in three factors characterized as (1) vivid mental events, (2) hallucinations with a religious theme, and (3) auditory and visual hallucinatory experiences. The authors consider this result to be evidence for a self/other dimension in hallucinations. They argue that whereas the first factor clearly involves mental events in which "the self is nominated as the agent and the experience is still recognized as one's own," the items included in the two other factors describe experiences that are "separate and distinct from the self." Moreover, upon further inspection of the other two factors, the second (hallucinations with a religious theme) seems to involve mental events whose attributions are clearly nonself and are attributed to a specific "source" such as God or the devil (e.g., "I have heard the voice of the devil" or "I have heard the voice of God"), whereas the experiences included in the third factor (auditory and visual hallucinatory experiences) do not involve attributions to explicitly nonself sources (e.g., "I often hear a voice speaking my thoughts aloud" or "I have often been troubled by hearing voices in my head"). Similarly, Junginger[27] reports that "a small number of subjects in our research . . . recognize a hallucinationed voice as their own but still make

attributions of nonself," suggesting that hallucinations may vary on a self/other dimension. It is also important to note that patients may describe auditory hallucinations as coming from inside their heads or outside their heads, and there are also some cases in which patients find it difficult to make this distinction.[15,21,24,28] Consequently, it would appear that hallucinations should be considered to vary along an inner-outer dimension in addition to the self/other dimension.

In a phenomenological study that integrated the inner/outer and self/other dimensions—and that therefore has important implications for cognitive investigations of hallucinations—Stephane and colleagues[23] interviewed a group of 100 psychiatric patients (with schizophrenia, schizoaffective disorder, or psychotic depression) regarding the phenomenological characteristics of their auditory/verbal hallucinations. Based on the literature and their own clinical experience, the authors identified a total of 20 phenomenological auditory/verbal hallucination variables. Multidimensional scaling was then performed to investigate the dimensional structure underlying 11 of these variables. Results revealed three dimensions: (1) linguistic complexity, (2) self/other attribution, and (3) inner/outer space location. The linguistic dimension ranged from low linguistic complexity (i.e., hearing words), to medium complexity (i.e., hearing sentences), to high complexity (i.e., hearing conversations). The self/other dimension ranged from attribution of the auditory/verbal hallucinations to self ("I hear my own voice") to attribution to others ("I hear someone else talking to me"). The inner/outer space dimension ranged from inner space location (e.g., "I hear the voice in my head") to outer space location (e.g., "The voice is coming from behind that plant"). Because this study provided the most structured account of the phenomenology of hallucinations, and because it generally agrees with other studies in the area, we use it as our primary reference point for the empirical review.

THEORETICAL DISTINCTION BETWEEN ORIGIN AND SOURCE

Based on the phenomenological studies described above (and in particular, Stephane et al.),[23] we focus on two important phenomenological dimensions in hallucinations: (1) the self-generated/non-self-generated dimension, and (2) the inner/outer dimension. The former dimension refers to the perceived/subjective origin of a given cognitive event. For example, a cognitive event that is perceived as produced by the person him/herself is considered a self-generated event, but a cognitive event that is perceived as generated not by the person, but by an external agent, is characterized as a non-self-generated event. The second dimension refers to the localization of the cognitive event in space. An event that the person locates in inner space is referred to as an inner event. In contrast, an event that the person locates in outer space—that is, outside of the subject—is referred to as an outer event. It is important to underline that it is the *subjective* experience of an event being inner, outer, self-generated, or non-self-generated that is decisive. A combination of these two dimensions gives rise to four different types of cognitive events, presented in Table 1. The information contained in Table 1 is not new, but since it provides an essential framework for comparing the phenomenology of hallucinations to the source-monitoring literature, it will be referred to throughout the remainder of the discussion.

TABLE 1. Four Cognitive Events Based on Subjective-Origin and Subjective-Source Dimensions

Subjective source	Subjective origin	
	Self	**Nonself**
Outer	Outer, self-generated (OSG)	Outer, non-self-generated (ONG)
Inner	Inner, self-generated (ISG)	Inner, non-self-generated (ING)

Inner, self-generated cognitive events are healthy and normal, and may include a variety of experiences such as daydreams, memories, songs, imagery, pain, melodies, bodily sensations, images, voices, thoughts, ideas, sounds, and impulses. For all these events, the subjective origin is the person (i.e., self-generated) and the subjective spatial location is internal (i.e., inner). Consequently, the inner, self-generated (ISG) cell of Table 1 may not reflect a hallucination at all—a possibility not mentioned by Stephane and colleagues.[23]

For healthy inner, self-generated events (e.g., thoughts, memories, daydreams, sounds, and so on), the subjective origin is the person (i.e., self-generated), and the subjective spatial location is internal (i.e., inner). In fact, all hallucinations originate as inner, self-generated cognitive events, but are somehow altered such that they are experienced as one of the other three cells (OSG, ONG, or ING) in Table 1. That is, either because of changes in the person's description of the event's subjective origin (i.e., becomes less "self-generated") or due to changes in the event's subjective spatial location (i.e., becomes less internal or inner), or a combination of both, the inner, self-generated event is transformed into a hallucination. In this context, hallucinations may be viewed as inner, self-generated events that are erroneously attributed.

Based on this assumption, two steps underlie the onset of hallucinations: (1) the *alienation* of inner, self-generated events and (2) the *misattribution* of inner, self-generated events to some specific origin/location combination. The first type of cognitive process involves loss of the cognitive representations that code the inner, self-generated nature of

what will become a hallucination. In other words, an inner, self-generated event is (subjectively speaking) not clearly experienced as inner, self-generated, or both. The second type of cognitive process occurs when hallucinators attribute inner, self-generated events to the specific origin/location combination that determines their hallucinatory experience. These two steps will now be described in greater detail.

Alienation

Alienation requires that an inner, self-generated event be experienced as not inner or not self-generated, or as neither. The experience can no longer be placed in the ISG cell of Table 1. At present, the reasons for this perturbation are not clear and are certainly dependent upon the particular type of inner, self-generated event. In general (and apart from hallucinations), for inner, self-generated events that are generated in an intentional manner, a number of cognitive operations serve to signal the internal, self-generated nature of these events. Johnson and colleagues[9] suggest that memories originating in imagination ("self-generated") typically have more accessible information about the cognitive operations that occured when the memory was established; for example, people are more likely to recognize a recalled event as a self-generated thought if they remember the cognitive effort associated with generating the thought. Subsequently, for memories where information about cognitive operations (e.g., cognitive effort) is lacking or less accessible to the subject, these memories are more likely to be alienated. Also, the presence of vivid perceptual input[29–31] can lead the person away from experiencing the event as being either inner or self-generated (or both)—and presumably lead to the experience of a perception.

Nature of Misattribution of Inner, Self-Generated Events

The second step involves cognitive processes that lead to the attribution of inner, self-generated events to some specific origin/location combination (viz., shifts from the ISG cell to the OSG, ONG, or ING cell in Table 1). For example, shifts from the ISG cell to the OSG cell may occur if cognitive representations that code an event as localized inside one's own somatic space are transformed into representations coding an external localization. An example of a cognitive event that may underlie this ISG→OSG transformation is the addition of perceptual qualities to the inner voice (e.g., I was thinking in a female voice, but at the same time I hear it coming from that window). In contrast, ISG→ING transformations may occur if ownership of generating thoughts (e.g., I was thinking in a female voice) is attributed to another person (e.g., someone produced a female voice, and I hear it in my head). Finally, shifts from ISG to ONG events may occur if the generating thoughts (e.g., I was thinking in a female voice) are attributed to another person with respect to ownership and are also experienced with perceptual information (e.g., someone produced a female voice, and I hear it coming from that window).

IMPLICATIONS FOR CURRENT EMPIRICAL INVESTIGATIONS AND MODELS OF HALLUCINATIONS

How have source-monitoring memory studies examined the step of alienation or that of misattribution? With respect to alienation, which involves loss of the information tagging the cognitive event as self-generated, most source-monitoring studies ask participants to produce a word out loud when generating an event from the internal source. One problem with this methodology is that although the event is self-generated, it contains both inner *and* outer localization qualities. Specifically, the generation of the word is, indeed, an inner event, but the production of the word also leads to stimulation of sensory organs, thereby adding outer localization qualities. Thus, a purely inner, self-generated event that seems a basic requirement for the study of alienation is rarely used (see Böcker et al.[32] for an exception). Instead, the self-generated event is typically characterized by a mixture of inner and outer qualities.

With respect to the misattribution step (viz., shifts from the ISG cell to the OSG, ONG, or ING cell in Table 1), various studies have reported the ISG to ONG misattribution. However, even accepting the assumption that the experimental conditions do reflect pure inner and outer sources, most of these studies[6,33–41] included only *one* internal and *one* external source. Consequently, assuming alienation has taken place, ISG→ONG is the only misattribution possible. Said differently, if hallucinators take the alienation step, then the only choice for misattribution is the outer, non-self-generated source (ONG), and the frequency of ISG→ING and ISG→OSG misattributions cannot be measured.

A few source-monitoring studies employed tasks containing more than two sources. However, for all these studies, it was the number of *external* sources that was increased.[39,42–43] This method is valuable in that it provides a control condition for external/external source confusion (with which to compare the tendency for inner/outer confusions), but it does not address the problem that the possibilities for inner/outer confusion are limited. A more optimal experimental design would allow the possibility for alienation to result in misattributions from the ISG cell to all three of the other cells in Table 1. For instance, in order for all these misattribution possibilities (i.e., outer, nonself; outer, self; inner, nonself) to be examined in a task, participants could first be asked to generate an item such as a word (i.e., inner, self) and

then, during the recognition phase, be asked whether the word was their own or came from the experimenter (i.e., outer), or whether it was generated by someone else (i.e., nonself).

The pervasiveness of this restricted array of possible misattributions is reflected in studies that, although reporting only a significant decrease in the internality *ratings* made by the participants, conclude that there is evidence of an externalizing bias.[36,38,40] In other words, misattribution of self-generated items to an *external* source is imposed on the data, but direct evidence for this inference was not available. In fact, only evidence for step 1, the alienation step, was provided.

The importance of recognizing the limitations of these experimental designs is accentuated by phenomenological studies of hallucinations—which show that patients do not necessarily externalize their hallucinations (although that may occur). Indeed, studies reveal that subjects may perceive their hallucinations as occurring not only "on the outside" (i.e., externalizing), but also "in their heads" or even both.[18,21,24] Finally, some subjects find it difficult to make this distinction when reporting hallucinations.[15] In other words, hallucinations do not necessarily have to be attributed to an external object to be a hallucination. Therefore, whether or not hallucinations are externalized or internalized may be no more important than whether they are experienced as "me"/self-generated or "not me"/non-self-generated.

OTHER ASPECTS OF PHENOMENOLOGY IN THE EMPIRICAL LITERATURE

Intentionality

An important factor that is not captured in Table 1 involves the degree of control that we experience over our inner, self-generated events. That is to say, the control that we experience over our inner, self-generated cognitive events is not all or none, but may vary along an intentionality dimension. For instance, while some inner, self-generated events are effortful experiences that are intentional and require the involvement of conscious activity (e.g., ideas, songs), others occur automatically and without effort (e.g., bodily sensations, impulses, intrusive thoughts). These possibilities demonstrate that self-originating, effortful cognitive processes are not required for healthy internal attributions, and that intentionality and subjective origin are not synonymous with each other.

This distinction between intentionality and subjective origin is not absolute. Intentionality plays an important role in determining if an event is experienced as self-generated or not, in large part because the absence of the experience of intentionality seems necessary, though not sufficient, for experiencing a cognitive event as not self-generated. Put differently, a large discrepancy between the prediction and the actual consequences of an action, thought, or event seems necessary, though not sufficient, for experiencing a cognitive event as not self-generated.[44] Similarly, the (illusionary) feeling of self-agency can arise whenever the conditions that imply intentionality are in place—namely, when a thought appears in consciousness just before an action, when it is consistent with the action, and when it is not accompanied by conspicuous alternative causes of the action.[45] Future studies could include an intentionality dimension by, for example, manipulating discrepancies between the prediction and actual consequences of a cognitive event in reality-monitoring tasks.

Affect

Phenomenological characteristics of hallucinations (such as affect) were not included in Table 1 but may play an important role in understanding the cognitive underpinnings for hallucinations. The presence of an affective dimension in hallucinations has been observed in a number of studies[17,19,46–58] and may include the emotional responses to hallucinations, the affective contents of hallucinations, or both. Emotion (especially anxiety and depression) has been found to be important in triggering hallucinations.[59] For instance, in a general population study,[60] nonclinical participants who reported hallucinatory experiences and who developed depressed mood were, when compared to those who did not, at significantly higher risk to develop clinical psychosis. However, the cognitive mechanisms underlying this relation are not known. Also, negative emotions associated with inner, self-generated cognitive events may make those events more personally significant or more intrusive, triggering the person to look for explanations of the experiences. Indeed, in a group of patients, Garrett and Silva[61] found that the presence of emotion was significantly correlated with a belief that the voices were real.

Emotional reactions, especially anxiety, associated with the presence of intrusive cognitive events may lead certain individuals to develop hallucinatory experiences. For instance, Morrison and colleagues[62] have argued that when the occurrence of intrusive thoughts does not comply with specific meta-cognitive beliefs (e.g., "Not being able to control my thoughts is a sign of weakness," or "I cannot ignore my worrying thoughts"), an aversive state of arousal or anxiety results, which the person tries to escape by externalizing the intrusive thoughts (resulting in hallucinations). In other words, a person who believes that one should control all thoughts but who nevertheless frequently experiences uncontrollable thoughts would tend to attribute these thoughts to something other than himself or herself. Numerous studies have found support for such a claim (for a brief review,

see Larøi & Van der Linden)[63]—in particular, that the presence of such meta-cognitive beliefs predicts the presence of hallucinations.

Finally, the emotional salience of stimuli may also have a disruptive effect on source-monitoring performance in participants with hallucinations. For instance, hallucination-prone (i.e., nonclinical) participants have been shown to commit significantly more source-discrimination errors for self-generated items (i.e., words) compared to non-hallucination-prone participants, and this effect is especially marked with emotionally charged words (in contrast to neutral words).[41] Similarly, two studies observed that their groups of schizophrenic patients with hallucinations, compared to non-hallucinating patients and normal controls, revealed decreased internality ratings for emotionally charged (compared to neutral) self-generated words on a reality-testing task.[36,38] Some of these studies have also confirmed that source-discrimination errors are significantly associated with the presence of meta-cognitive beliefs.[38,41]

These findings point to the importance of including various measures of affect in future studies. First, studies should include emotionally charged stimuli (in addition to neutral stimuli) in their source-monitoring tasks. The hypothesis here is that emotionally charged stimuli will increase reality-monitoring errors in participants with hallucinations, as the emotional charge of material may disrupt normal encoding processes that bind source-specifying cues to the memory,[64] resulting in increased source-memory errors. Second, studies should evaluate the level of emotional disturbance (especially anxiety) in participants. For instance, hallucinating participants with high levels of anxiety may reveal increased reality-monitoring errors because high levels of anxiety render self-generated events more personally significant or more intrusive. Alternatively, high levels of anxiety in hallucinating participants may reflect a discord between self-generated events and specific meta-cognitive beliefs.

Overlap Between Hallucinations and Delusions

Hallucinations may be viewed as incomprehensible experiences that the person describes or interprets as best as he or she can. For example, Junginger and Frame[18] have argued that the important characteristic of voices perceived as outside the head is not their location per se, but rather the person's delusional attribution that they are alien. Thus, an internal voice can be equally disturbing as an external voice (e.g., in terms of the degree of reality distortion). In this context, relations between hallucinations and delusions need to be examined more carefully. One might claim, for example, that the majority of hallucinations are also examples of secondary delusions since the person is always trying to interpret or make sense of the anomalous experiences; explanations such as "the voice in the next room is coming from an alien," "my voice is evil," "my voice is very powerful," or "it is the voice of the devil" may all may be viewed as potential interpretations of their anomalous experiences and consequently as examples of secondary delusions.

Similarly, interpretations of hallucinations may form the basis of delusions. Bentall[65] reports the case of a schizophrenic patient suffering from auditory hallucinations that consist of voices saying "Give cancer to the crippled bastard." This hallucination becomes more understandable when details concerning the patient are revealed: at the time, the patient was sitting in a wheelchair, having crushed his legs in a failed suicide attempt ("crippled bastard"), and the patient's mother had recently died from cancer ("give cancer"). Particularly when hallucinations are frequent or predominantly intrusive or unpleasant, further beliefs may result and often take on a paranoid form: "They are after me," "God is unhappy with me," or "The doctors want to poison me."

An additional topic that needs investigation is the apparent overlap between hallucinations and (Schneiderian) delusions, which tend to co-occur.[43,66–70] Evidence of the coexistence of hallucinations and delusions suggests that these two symptoms may share common ground in terms of the psychological factors underlying their presence, such as disturbances in the regulation of cognition.[11,62,71–73]

In order to take into account the possible overlap between hallucinations and delusions, at least some future studies should include patients not only with hallucinations alone, but also with delusions alone and with both hallucinations and delusions. Such a study design would enable an exploration of whether these two types of symptoms share common ground in terms of source-monitoring processes.

Methodological Considerations

Small sample sizes lead to Type II errors, and some studies that report no association between a reality-monitoring deficit and hallucinations may reflect low power due to small samples. In the study by Brébion and colleagues,[39] for example, the tendency to misattribute self-produced items to an external source reached significance only when hallucinators were compared to normal controls, and not when hallucinating and non-hallucinating patients were compared. This result may be due, however, to the small size of the patient subgroups (i.e., non-hallucinating group, $n = 18$; hallucinating group, $n = 22$) compared to the healthy controls ($n = 40$).

In addition, it is important to note that in most studies the number of items per condition/source combination did not exceed 20.[34,36,37,39,41,42,74–78] Because the estimated sample error associated with a mean increases as the number of items per condition decreases (a consequence of the central

limit theorem), this concern is especially pronounced when specific error types (e.g., externalizations and internalizations) are the measures of interest.

Finally, guessing strategies influenced most previous studies but were not appropriately taken into account. As one example (for many others see Batchelder & Riefer),[79] when participants notice that they are recognizing too few items from the (less memorable) external source, they tend to compensate by increasing the number of external-source guesses. Therefore, in order to accurately measure externalizations, increases in strategic "external" guesses must be excluded. If such confounds are not properly accounted for, inaccurate conclusions can be reached; for example, a hallucinating-group externalization bias for recognized items may be hidden by a comparison-group increase in external-source guesses for unrecognized items. Using appropriate statistical techniques, distinct cognitive processes such as pure guessing and cognitive biases can be disentangled.[42,43,80]

CONCLUSION AND RECOMMENDATIONS

Although the phenomenological diversity of hallucinations has been well documented, source-monitoring studies that examine the cognitive underpinnings of hallucinations have not yet integrated this complexity into the experimental designs. Our goal in this review of the descriptive and experimental literature was to demonstrate the restricted set of experimental conditions that have been utilized in source-monitoring studies of hallucinations relative to their documented phenomenological diversity. Our review of the empirical literature within this framework exposed various shortcomings in integrating the full range of underlying phenomenological factors such as origin, source, intentionality, affect, and overlap with delusions. Other methodological considerations were also reviewed.

The theoretical framework employed in this review is novel for several reasons. It is integrative in that findings from previous phenomenological studies (e.g., Stephane et al.)[23] and from previous cognitive models (e.g., Frith)[71] are included in the same theoretical framework. Although previous articles (e.g., Ditman & Kuperberg)[12] have reviewed the source-monitoring literature, these findings have not been united with phenomenological studies of hallucinations. Furthermore, the present theoretical framework promotes neither a single-deficit[11,71,81] nor a multiple-deficit account,[82] but rather suggests that a multiple-dimensional cognitive account of hallucinations may be required to explain the multidimensional phenomenology. Also, although numerous previous models[4,14] have advanced variations of Frith's initial model,[71] the present model considers aspects that have not been previously proposed in theoretical frameworks—in particular, the range of possible misattributions of inner, self-generated cognitive events.

Six main recommendations can be derived from this review. First, the full range of origin/source combinations should be integrated into the experimental design of cognitive investigations of auditory hallucinations. In this context, the two principal steps described in the present article (i.e., alienation and misattribution) should be considered in future studies. Second, other important dimensions and variables that should be integrated into experimental designs include affect and intentionality. Third, it is important that future source-monitoring studies include enough trials to measure reliably the error types of theoretical interest. Fourth, it is recommended that studies use a statistical methodology that enables one to separate guessing from cognitive biases. Fifth, future source-monitoring studies on hallucinations should contain pure internal generation events (i.e., thoughts, images) that are not confounded by the external location quality that results from saying a word. Sixth, future studies should explore a possible overlap between hallucinations and delusions in terms of the various dimensions and variables described in this article. Although it would be difficult to integrate all of these recommendations into a single experimental design, we hope that they lead to empirical cognitive investigations of hallucinations that better reflect their phenomenological diversity.

Finally, it is important to note that the studies included in this review concerned hallucinations observed in patients with schizophrenia. There are, indeed, far too few studies (especially cognitive studies) that include hallucinations from nonschizophrenic patients, even though hallucinations may be reported by patients with other psychiatric disorders or various neurological disorders, or may be drug-induced. Similarly, the majority of studies covered in this article examined auditory/verbal hallucinations, although patients may experience hallucinations in other modalities. Therefore, in order to understand the role of cognitive processes underlying hallucinations across clinical populations and across modalities, future studies should include nonschizophrenic patients and non-auditory/verbal hallucinations.

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