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# Sleep-Related Hallucinations

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**KEYWORDS**

• Classification • Hallucinations • Dream-like experiences • Hypnagogic • Hypnopompic • Hypnagogia

**KEY POINTS**

- Sleep-related hallucinations (SRH) refer to a diagnostic category within the ICSD-3 group of "Other Parasomnias" that comprises two symptoms: hypnagogic and hypnopompic hallucinations (HHH) and complex nocturnal visual hallucinations (CNVH).
- Some individuals may also experience clinical hallucinations during the day that are unassociated with SRS.
- HHH are extremely common and generally benign in the general population. They are also a nonspecific symptom for any sleep disorders, or psychiatric, medical, and neurologic conditions.
- Little information exists about CNVH, though their resemblance to visual hallucinations in Charles Bonnet syndrome and other neurologic conditions suggest that they reflect a marker for psychopathology.
- A categorical approach to assessment reliant solely on the presence of SRH is not helpful as a diagnostic aid as SRH frequently co-occur with other sleep disorders and medical conditions.

## INTRODUCTION

There has been a long-standing historical interest in the relationship between sleep and hallucinations. The American psychiatrist William Charles Dement (1928–2020) went so far as to suggest that "*there can be little question that dreams qualify as hallucinations.*"[1] This notion contrasts with the engrained distinction between sleep and waking states, but many researchers are intrigued by the possibility of a continuum.[2–4] In the second and third editions of the International Classification of Sleep Disorders (ICSD, 2005[5]; 2014;[6] 2023[7]), hallucinatory phenomena that occur in the context of sleep are included as a diagnostic group called sleep-related hallucinations (SRH). SRH refer to a class of hallucinations that occur at sleep onset or on awakening from sleep and are reported on after the transition to a waking state has occurred.

In the ICSD,[5] SRH are classed within the broader group of parasomnia disorders. They solely include two hallucinatory events, comprising (1) hypnagogic and hypnopompic hallucinations ("HHH," also referred to collectively as hypnagogia) occurring in the drowsy state at the time of falling asleep or waking in the morning, respectively and (2) complex

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nocturnal visual hallucinations (CNVH), following a sudden awakening during the night. The latter occurs mostly in the setting of visual and neurologic disorders. Some individuals may have hallucinations during the day, which are not associated with these sleep-related events.

The similarities between sleep-related events and "daytime" hallucinations have received much scrutiny, but a lot remains unknown about this new relatively category called "SRH." In any case, they can reveal fascinating insights into the activities of the sleeping brain that are not readily available to our conscious awareness. In addition, they can shed light on other types of hallucination, notably visual hallucinations occurring in the context of Charles Bonnet syndrome (deafferentation phenomena) and release phenomena.

The objective of this review is to facilitate an understanding of SRH. To achieve this, it will address the history, background, and descriptions of SRH and discuss the continuity between SRH and other conditions. Similarities and differences to daytime clinical hallucinations are outside of our scope (for a detailed discussion, see Ref[3]).

## HISTORY AND BACKGROUND

Although sleep has been a topic of philosophic and prescientific investigation since the time of Aristotle (384–322 BC) and beyond (Aristotle, 1984), the modern study of sleep only truly began with the application of the electroencephalogram (EEG) and eye movement detection techniques to the sleeping brain. These techniques revealed that human consciousness commutes between three naturally occurring and reversible neurophysiological and behavioral states called wakefulness, rapid eye movement (REM) sleep, and non-rapid eye movement (NREM) sleep.[2] These states are continuous and cyclical and quantifiable by the degree of complexity in which neurons interact within the central nervous system.[8] Far from being passive, these states of consciousness all involve active brain functions, although connectivity with prefrontal cortex and executive functions distinguishes wakefulness from NREM and REM.

Mental events occurring during sleep have a physiologic basis that can be recorded. For example, dreaming during sleep coincides with cyclically recurring periods of EEG-recorded sleep states and eye movements.[9] Although sleep electrophysiology progresses in a relatively uniform way across individuals, elements of REM and NREM sleep are not mutually exclusive. In some individuals, REM and NREM may dissociate and/or recombine to create undesirable experiences during sleep, which are termed "parasomnias."[10–12]

The first reference to hallucinations in sleep diagnostic manuals can be traced back to the initial edition of the ICSD (1990[13]) and its subsequent revision, the ICSD-R (2001[14]), under the category of Terrifying Hypnagogic Hallucinations. These were described as intensely frightening hallucinatory phenomena occurring only at sleep onset and a type of nightmare that interrupts the process of falling asleep and leads to a sudden return to full wakefulness.[15] These phenomena may be accompanied by a realistic awareness of the presence of someone or something, often causing a profound sense of fear or dread (**Table 1**). In these earlier versions of the ICSD,[13,14] they were described as extremely rare, and their clinical significance was rated using criteria based on severity (mild, moderate, severe) and duration (acute, subacute, chronic).

Subsequent versions of ICSD (−2,[5] −3,[6] and 3 TR[7]) featured the newly identified group of SRH within the broader diagnostic cluster of the parasomnias. Thus, from 2005 onward, SRH have been defined as "Hallucinatory experiences that occur at sleep onset or on awakening from sleep," thereby expanding on the previous diagnostic category of Terrifying Hypnagogic Hallucinations. They can occur in the absence of other symptoms or disorders ("idiopathic type") or as a symptom of another sleep disorder. The specification for clinical significance states that this experience must be recurrent and that infrequent hallucinations of this type may be within the limits of normal sleep–wake transition.

## DESCRIPTION AND CLASSIFICATION

ICSD-3 criteria of SRH include (1) a complaint of recurrent hallucinations that are experienced just before sleep onset or on awakening; (2) prominently in the visual modality, and (3) the disturbance is not better explained by another sleep, mental, or medical disorder, medication, or substance use.[6,7]

SRH refer to two separate experiences: HHH and CNVH.

The first published descriptions of hypnagogic hallucinations in the general population can be traced back to almost 180 years ago to French neurologist and psychiatrist Jules-Gabriel Francois Baillarger (1809–1890).[16] By contrast, descriptions of CNVH are very recent.[17,18]

Since Alfred Maury's (1817–1892) observation in 1865[4] of a continuum in form and content with daytime hallucinations, the classification systems for all clinical and clinical subtypes of hallucinations have sought to chart their sensory modality, contents, form, and duration.[19,20]

**Table 1**
**Characteristics of sleep-related hallucinations in different sleep disorders categories and other conditions**

| | Time of the Night | Content that is Intense, Vivid and with an Array of Simple and Complex Forms | Negative Affective Content (Fright, Anxiety, Dread, Threatening) | Detailed Memory Recall | Type of Wakening | Clear Separation of Sleep and Wake States | Co-occurs with Other Parasomnias |
|---|---|---|---|---|---|---|---|
| Hallucinations in sleep disorders within the "Other Parasomnia" category | | | | | | | |
| Hypnagogic hallucinations[30] | Sleep onset, usually first third of the night (from NREM sleep, or from sleep onset REM period) | Sometimes Gradual progression from simple to complex multimodal with auditory component as sleep approaches REM | Rarely | Immediate recall if awoken but rapidly forgotten | Brief arousal from sleep may be followed by a return to sleep or progression to wake | Sometimes difficult to differentiate from sleep-onset dreams | Yes |
| Hypnopompic hallucinations[30] | On waking, usually in the 2nd half (out of a period of REM) | Sometimes complex, especially if occurring out of period of REM | Rarely | Immediate recall if awoken but rapidly forgotten | Brief arousal from sleep may be followed by a return to sleep or progression to wake | Sometimes difficult to differentiate from dreams | Yes |
| Terrifying hypnagogic hallucinations | Sleep onset Sudden awakening | Yes, similar to nightmares | Yes | Yes: immediate recall, and prominently remembered | Sudden and abrupt arousal With autonomic hyperactivity | No separation: Persist into wake state "Double consciousness" simultaneous recall of dreams and external environment | Yes |
| Complex nocturnal visual hallucinations[49] | During the night: Sudden awakening | Yes, complex visual images, sometimes superimposed on the environment | Yes | Yes: immediate recall, and prominently remembered | Sudden and abrupt arousal With autonomic hyperactivity | No separation: Persist into wake state Identified as separate from dreams | Yes |

(*continued on next page*)

**Table 1**
**(*continued*)**

| | Time of the Night | Content that is Intense, Vivid and with an Array of Simple and Complex Forms | Negative Affective Content (Fright, Anxiety, Dread, Threatening) | Detailed Memory Recall | Type of Wakening | Clear Separation of Sleep and Wake States | Co-occurs with Other Parasomnias |
|---|---|---|---|---|---|---|---|
| Exploding head syndrome (other parasomnias)[88] | Sleep onset or when waking up | Simple auditory hallucination of an abrupt loud noise, sometimes accompanied by a simple visual hallucination (noise, light) | Yes | Yes | Abrupt arousal | Recognized as dreams | n/a |
| Hallucinations in REM-related parasomnias and NREM disorders of arousal | | | | | | | |
| Nightmare Disorders (REM-related parasomnias) | Anytime during the night, often in the 2nd half and REM sleep | Yes: as vivid but less intense than sleep terrors | Yes | Yes | Full awakening With autonomic hyperactivity | Recognized as dreams Do not persist into wake state | Yes |
| Recurrent sleep paralysis (REM-related parasomnias)[47] | Anytime, but often early in the night, from sleep-onset REM | Multisensory with auditory, somatic, olfactory senses. Feelings suffocation | Yes | | Awakening with feeling of suffocation | Recognized as dreams | n/a |
| Sleep terrors (NREM disorders of arousal) | SWS, often in the early hours | Yes | Yes | Poorly recalled unless awakened during the episode | Sudden and abrupt arousal from NREM (fearful and with high autonomic hyporeactivity) | Recognized as dreams | n/a |
| Hallucinations in narcolepsy | | | | | | | |
| Hypnopompic and hypnagogic hallucinations in the setting of narcolepsy[76] | Can occur at any time during the night. | Intense, vivid, brief, and dream-like. Multisensory, visual, auditory and tactile, vivid | Yes | Yes | No awakening (hypnagogic) Normal awakening (hypnopompic) | Hallucinations may intrude into wakefulness and may be experienced in semiconscious state. | n/a |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sleep disorders associated with a medical condition | | | | | | | |
| Sleep-related epilepsy | Any, often during N2 | Multisensory; may involve somaesthetic (all sensory and somatic dimensions), auditory or visual depends on the localization of the epilepsy.<br>Usually brief, simple, but may be complex if parietal and temporal association areas are involved. | Sometimes | Unusual | Yes | Yes | n/a |
| Other neurologic and psychiatric disorders encountered in the differential diagnosis of sleep disorders | | | | | | | |
| Visual hallucinations in the setting of alpha synucleinopathies (Lewy body disease and Parkinson's disease) | Often in the evenings or at night, with darkness or reduced vigilance. | Primarily visual unimodal hallucinations of formed hallucinations.<br>People, animal, varying in intensity. | Sometimes | Yes | | Yes | Yes |
| Hallucinations due to a psychotic disorder | n/a | Primarily auditory-verbal, but visual, tactile hallucinations also occur in 30% of cases | Yes | Yes | n/a | Yes | Yes |
| Hallucinations due to CNS injury (Peduncular Hallucinations, Charles Bonnet syndrome) | May occur at night. Vivid dreams.<br>Occur with eyes open or closed | Primarily visual unimodal, simple or complex; Complex include detailed, complex and colourful images of people, objects or animals. Sometimes bizarre, deformed or panoramic | No | Yes | n/a | Yes | Yes |

(*continued on next page*)

**Table 1**
**(*continued*)**

| | Time of the Night | Content that is Intense, Vivid and with an Array of Simple and Complex Forms | Negative Affective Content (Fright, Anxiety, Dread, Threatening) | Detailed Memory Recall | Type of Wakening | Clear Separation of Sleep and Wake States | Co-occurs with Other Parasomnias |
|---|---|---|---|---|---|---|---|
| Delirium | May occur at night. Vivid dreams. | Visual hallucinations are typical, but multimodal hallucinations are also common.<br>Prolonged duration, and involving complex formed images. | Yes | Reduced insight, confusion, and altered consciousness | | | |
| Other hallucinations encountered in the differential diagnosis of sleep disorders | | | | | | | |
| Medications and substances | Increased abnormal dreams and nightmares | Dopaminergic medication; Anticholinergic therapy;<br>Also psychostimulants; dissociative anaesthetics and psychedelics.<br>Contents are usually complex and varied and depends on psychoactive contents and context | Sometimes | Reduced insight, confusion, and altered consciousness | n/a | Yes | Yes |
| Lucid dreams | n/a | Often visual, tactile, proprioceptive; complex; sometimes superimposed on the environment | No | Yes | n/a dynamic and voluntary; switch with conscious awareness | Sometimes, strategies include the use of cues to distinguish wake from lucid dream episodes | |

## Methodological Approaches

Daytime hallucinations and SRH are assessed using similar methods involving subjective reports.[21,22] In contrast to daytime experiences, however, SRH require individuals to think back retrospectively to an experience that occurred in a different state of consciousness. A common approach for assessing SRH includes epidemiologic and psychological methods such as surveys or interviews.[22]

In sleep medicine, subjective reports are combined with objective methods to examine the sleep stages in which SRH occur. Study participants are typically allowed to fall asleep according to their regular sleep schedule and then awoken at a predetermined interval coinciding with the sleep stage of interest. Sleep stages can be identified by real-time EEG recordings and/or eye movement detection and using analyses of EEG patterns, power, cortical distribution, and eye/head movements.[19,23,24] Participants are asked to report on their most recent experience before awakening. Multiple experimental sessions across one or multiple nights allow for repeated measurements for each individual.[19,25]

Self-reports are an essential conduit to human subjective experiences. However, mental processes in the sleeping brain are locked in a different state of consciousness, and the limited interactions between the sleep and wake states call for caution. As we fall asleep, mental functions gradually shut down, and memory transfers are interrupted contributing to anterograde amnesia on awakening.[26] Other factors compromising recall include the time elapsed between awakening due to memory interference and degradation.[27] In people with medical and neurologic conditions—who have elevated rates of HHH and especially CNVH—confusion, cognitive impairment, and memory difficulties may also affect the reliability of descriptions.

Of note, it has been suggested that some sleep stages may be more directly accessible to conscious memory than others. For example, the distinct neurophysiological features of REM sleep, in which the sleeper may experience vivid dreams, are closest to the waking state so that REM dreams may be better recalled.[22] Regardless, the interpretation of SRH studies should take into account the quality and accessibility of events that happened during sleep.

## Hypnagogic and Hypnopompic Hallucinations

### Hypnagogic hallucinations

Hypnagogic hallucinations are fleeting perceptual phenomena that occur around the moment of falling asleep (see **Table 1**). They are extremely common, usually non-pathological, and perhaps universal experiences. Lifetime prevalence rates range between 2% and 75% in the general population,[28,29] although these rates may be skewed due to differences in study design and the methodological limitations mentioned above. Results from epidemiologic surveys suggest that the prevalence follows a U-curve and is more likely to occur in younger people and older people,[30] whereas observations about gender effects are mixed.[31] Reportedly, hypnagogic hallucinations occur at elevated rates in people with psychiatric disorders, such as anxiety disorders, post-traumatic stress disorder (PTSD), psychotic disorders, and mood disorders (50%–80%[30]), and in those taking psychotropic medications.[30,32] However, the nature of the association with mental illness and medications is poorly understood, and poor sleep quality and frequent awakening may well contribute to more opportunities for the recall of sleep-related experiences rather than truly elevated rates.

Hypnagogic hallucinations are defined as occurring at sleep onset, although precise definitions of sleep onset vary.[33–35] Definitions typically include light sleep ("N1"), but may also refer to the second stage of NREM ("N2"),[19,36–38] or any other sleep stage immediately preceding REM.[17]

Studies describe a progression in the form and content of sleep mentation as sleep progresses from N1 toward REM sleep.[9,19,20,23] When awoken during N1, people typically provide vague and fragmentary reports of imagery, with primarily visual contents.[19,25] As sleep progresses, thought-like imagery acquires perceptual features (auditory–somatosensory components) and unusual contents that blend into dream features. The loss of reality monitoring and voluntary control resembles the characteristics of clinical hallucinations.[23] The affective intensity and complex narrative structure of some hypnagogic events can also be difficult to differentiate from the onset of REM dreams.[6,19]

The visual component is the most commonly emphasized and is possibly related to spontaneous activity that occurs in the occipital cortex in the transition to sleep.[39–41] Visual images comprise 55% to 86% of hypnagogic reports[35,42,43] and are described as kaleidoscopically changing (some of them possibly entoptic) phenomena such as geometric patterns, shapes, and light flashes.[3] Other visual images may involve a broad array of events ranging from simple (lights, patterns, designs, written text, formless shapes) to complex phenomena (human faces or figures, animals or objects, scenes involving landscapes and/or people).[20]

Hypnagogic hallucinations often feature sensations in multiple modalities, either concurrently or sequentially.[23] Auditory impressions, in 8% to 35% of hypnagogic events, can include sounds (radio, phone, doorbell, music) or voices.[35,44–46] Bodily sensations are also frequent occurrences (in 25% to 50% of reports)[19,29,42] and are described as a sense of touch and bodily distortions, or feelings of weightlessness, flying, or falling into an abyss. Affective contents occur in a minority of events (<5%), and examples include being caught in a fire, or being involved in an attack.[30] A final phenomenon is a sense of presence in the room, although this is associated more commonly with sleep paralysis.[47]

### *Hypnopompic hallucination*

Hypnopompic hallucinations accompany the departure from sleep for the duration of a few seconds to minutes[15] (see **Table 1**). They typically occur in the morning, although this is not always the case. They are reported to occur less frequently than hypnagogic hallucinations (7%–13%).[29] Here too, frequency rates are reportedly higher in people with psychiatric disorders (15%–36%) compared with the general population.[30]

They can arise from a period of REM sleep, with their features more closely resembling the continuation of a dream sequence than sleep-onset hypnagogic hallucinations. They are described as vividly real and intense, and sometimes involving a narrative, albeit rarely frightening (30% of cases). Individuals may be uncertain whether they represent waking or dream-related experiences (ICSD-3). A typical example is a person with whom we were conversing in a dream, who is still being seen and heard when the eyes are open and perceived as actually present in the bedroom. Examples may include relatives or acquaintances, children, and varied animals.[17] The dreamer may be in the middle of a conversation, although the hallucinated people rarely reply and disappear with the transition of awakening. Forgetting appears less rapid than with hypnagogic hallucinations, and they can linger in the mind after awakening.

## *Complex Nocturnal Visual Hallucinations*

CNVH are differentiated from hypnagogia as occurring during the night and representing a distinct form of SRH.[5,6] The mental imagery and perceptual forms of CNVH closely resemble normal dreams. However, the episodes are distinguished from dreams because they occur during a state resembling an intermediate state of consciousness, and they are associated with behavioral acting out. The episode also terminates with a sudden waking[6,7] (see **Table 1**) associated with the recollection the vivid "dream like" imageries.[18,48,49] The eyes may be open and visually tracking the object's change across space.[48] One case study describes the patient as sitting up on the bed yellow, looking around mumbling unintelligible words and/or pointing to nonexisting objects.[49] The presence of emotional content within a narrative structure may cause fright or alarm. **Fig. 1** shows a patient sitting up in bed, acting out on the hallucination by pointing and displaying facial emotional.

CNVH have so far only been reported in small case series,[17,49] small cohorts,[18] and in patients with documented sleep disorders,[48] rather than at the population level. Descriptions include complex contents such as small animals (insects, rodents), persons, or distorted forms,[17,18] which may be superimposed on the perceptual word and disappear when the ambient illumination is increased. The contents may take varied and multicolored forms of vivid, intricate, relatively immobile images sometimes distorted in shape or size and superimposed on veridical perceptions similar to the daytime hallucinations typical of Charles Bonnet

**Fig. 1.** (*A*) During this episode, the patient sat on the bed staring at a nonexistent presence or object with a scared expression. (*B*) During this episode, the patient laughed and displayed positive emotions. (*C*) During this episode, the patient stared and pointed toward an invisible object in the room with his finger, as if hallucinating. (*From* Castelnovo A, Loddo G, Provini F and Manconi M. Frequent, complex and vivid dream-like/hallucinatory experiences during NREM sleep parasomnia episodes. Sleep medicine 2021; 82: 61–64.)

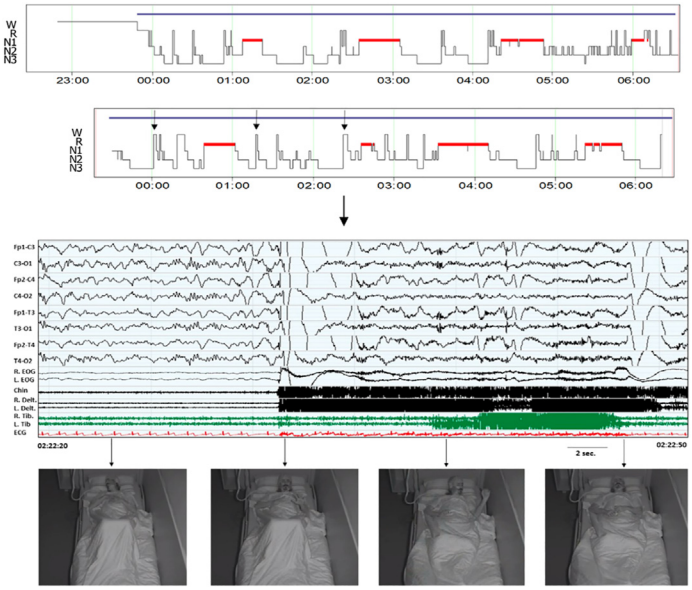


**Fig. 2.** Upper panel: Hypnograms of the first and second polysomnography (PSG) nights. Black arrows indicate minor NREM sleep parasomnia episodes. Sleep architecture was preserved on both nights (N1 proportion 12% and 10%, N2 = 39% and 39%, N3 = 26% and 26%, REM = 23% and 25%, sleep efficiency = 94% and 93%, REM sleep latency = 70 and 69 minute—in the first and night, respectively), but characterized by several abrupt awakenings out of NREM sleep (21 and 12 awakenings—with and arousal index (AI) of 13.6 and 11.5—in the first and second night, respectively). Central panel: 30 s-epoch of the v-PSG during a Type 1B episode, illustrating the dissociated sleep–wake state. The PSG montage included eight EEG bipolar traces from fronto-polar (Fp), temporal (*T*), central (*C*), occipital (*O*) leads, two electrooculograms (EOG), electromyograms from the chin, left and right deltoids (L and R Delt), and left and right tibialis anterior muscles (L and R Tib). The EEG shows diffuse slow wave activity (N3 stage) before the activation of EMG, then a movement artifact, followed by slow waves of small amplitude in the frontal leads, mixed with higher mixed and largely artifactual frequencies in the central, temporal, and occipital leads. Lower panel: The black vertical line indicates the time of the picture shown in the bottom-right corner. In the first picture, the subject was still sleeping, and in the second picture, he opened his eyes and flexed his neck, his arms, and extended his fingers, and stared perplexedly at his hands. In the third picture, he turned his head and partially his trunk to the left and in the last picture he went back lying in the bed. The episode lasted about 20 s and the patient gradually woke up soon after it. He described having had a dream but could remember only brief sketches of it. (*Adapted from* Castelnovo A, Loddo G, Provini F and Manconi M. Frequent, complex and vivid dream-like/hallucinatory experiences during NREM sleep parasomnia episodes. Sleep medicine 2021; 82: 61–64.)

syndrome.[17] CNVH have been described as rare with a frequency that can average four times a week in affected individuals.[18,29]

Some individuals may report both HHH and CNVH at different times.[17] Descriptions point to differences between CNVH and HHH in the timing during sleep and electrophysiological features. Their epidemiologic and clinical profiles also point to important differences:

- CNVH interrupt sleep, which differs from HHH which occur in the borderlands between sleep and wake.
- CNVH are characterized by a distinct EEG and behavioral patterns consisting of low-voltage, mixed-frequency signals[48] during NREM sleep[18,50] (**Fig. 2**, showing CNVH during NREM REM).
- CNVH have a mean onset age of 40 years and are associated with increased age,[18] whereas HHH can occur in healthy and unmedicated people in the context of normal sleep and in both younger and older people.[29,31]
- CNVH are commonly associated with neurologic conditions and visual disorders[18,51,52] (although they have also been described in groups of people without diagnosed pathology[51]).

There are striking similarities between CNVH and daytime visual hallucinations in disorders associated with visual pathways or brain stem lesions. These include visual hallucinations in Charles Bonnet syndrome.[17] Both types include visual percepts (highly detailed, colorful, and at times grotesque images of people or animals) and rapid transformations of images, although an affective component is often lacking in CBS, but not for CNVH.[53,54] Explanations of CNVH involving visual release overlap with those of Charles Bonnet syndrome, which is attributed to lesions of the afferent visual pathway,[53–55] both resulting in the visual cortex generating aberrant images.

CNVH also resemble visual hallucinations associated with brainstem or thalamic lesions, such as neurodegenerative disorders associated with alpha-synucleinopathies pathologies, such as Lewy body disease and Parkinson's disease,[56–58] in which oculo-visual problems are common.[59–61]

Visual hallucinations in Parkinson's disease also change with darkness or illumination.[62]

Peduncular hallucinosis in brainstem disorders with midbrain and diencephalic pathology also resemble CNVH[63,64] where the hallucinations are described as complex, vivid, and colorful and are sometimes associated with auditory content and retention of insight.[63]

The resemblance of CNVH to the typical complex visual hallucinations of these disorders has led to suggestions of common neurophysiological substrates, with separate neural system involvement.[52,56,65]

Although previous studies have linked complex hallucinations to "REM" dysfunctions or intrusions[17,66–69] NREM sleep.[50] In an attempt to reconcile these mixed findings, Gnoni and colleagues[48] suggested that CNVH may involve multiple coexisting states of consciousness (wake, NREM, and REM) which have been decoupled and reassembled. It is proposed that the unique combination of co-occurring wake, NREM, and REM elements manifests as hallucinatory experiences in CNVH. Other evidence of parallel processing of multiple states includes neurobiological evidence of nighttime EEG microstates of alpha band activity that are indistinguishable from waking conscious states.[70] Micro-wake "fragments" activity, recorded during slow-wake sleep (SWS) and REM,[71,72] are localized in the midbrain regions including the pedunculopontine nucleus[64,73] which is a region of interest given that virtually every sensory system projects onto the brain stem. Furthermore, lesions in this area produce visual hallucinations that closely resemble CNVH.[63] In the next decades, technological advances can hopefully further build on this new knowledge about biological explanations of SRH.

## Association with Other Sleep Disorders

Within the parasomnia cluster of ICSD-3, SRH are grouped under "Other Parasomnias." This residual category encompasses a range of unusual sleep-related conditions with diverse presentations, loose boundaries, and assorted pathophysiological bases for which there is insufficient or inadequate information to substantiate their unequivocal existence.

Other parasomnias are distinguished from NREM- and REM-related parasomnias (the two main categories of this classification), although they frequently co-occur with these other parasomnias and other sleep disorders. HHH and CNVH can occur either at the same time or on different nights as other behavioral symptoms of sleep disorders, making them difficult to identify and isolate.

### Narcolepsy

SRH commonly occur in individuals with narcolepsy, which is a disorder of somnolence, with frequency rates of approximately 33% to 80%.[74,75] Unlike CNVH which intrude on nighttime sleep, narcolepsy comprises sleep episodes intruding on daytime functions. Narcolepsy typically begins in youth between the ages of 10 to 20 years, unlike CNVH which is associated with older age.[76] In addition, narcolepsy is associated with a paralysis of the skeletal muscles, whereas CNVH is associated with sitting up or sudden movements.

### Rapid eye movement-related parasomnias

Among all parasomnias, this category of parasomnias is the most commonly associated with vivid and prominent perceptual events, although their symptom presentation differs somewhat from SRH descriptions.

- In REM sleep behavior disorders, where the patient acts out dreams during REM sleep, the event ceases when the person is awoken, while CNVH tend to persist into wakefulness.[77]
- Nightmares share features with both hypnagogic hallucinations and CNVH. The emotive and frightening contents resemble hypnagogic hallucinations, but nightmares are recognized as dreams and are vividly remembered. One point of difference between CNVH and nightmares is that the individual is usually fully orientated when awakened during the nightmare.[6] The person with nightmares also usually remembers the dream content in vivid detail. Finally, nightmares also generally occur out of REM-sleep stage, whereas SRH are commonly associated with NREM.
- Sleep paralysis commonly co-occurs with SRH, especially in the context of hypersomnia or insufficient sleep (4% to 40%).[6,47] Sleep paralysis involves the disturbing temporary inability to move voluntary muscles at sleep–wake transitions. It can be accompanied by hallucinations (25%–75% of patients, ICSD-3), including the incubus phenomenon (ie, a hallucinated figure that presses down on one's chest).[78] Apart from the visual and tactile components of this phenomenon, hallucinations in the context of sleep paralysis may have auditory, visual, and kinesthetic components, or involve the sense of a presence in the room, either concurrently or at separate times from episodes of paralysis. They have strong dream-like surreal contents, with auditory and bodily elements that are perceived to be real and ominous.[79–81] In contrast to simple hypnagogic experiences,

the person feels awake and conscious but unable to move. Episodes of sleep paralysis elicited by awakening patients from nocturnal sleep seem to arise from REM sleep, but almost always correspond with mixed REM and waking EEG.[82,83]

***Non-rapid eye movement-related parasomnias***

Disorders of arousal from NREM (eg, confusional arousals, sleepwalking, and sleep terrors)[50] can also be associated with SRH, but those events are frequently recognized as dreams which do not persist into wakefulness.

Sleep terrors commonly feature SRH, too. Sleep terrors are characterized by sudden arousal, intense fear, or panic and accompanied by autonomic and behavioral manifestations including piercing screams or cries, sitting up in bed, and attempts to "escape" from terrifying dream-like contents. The patient is usually unresponsive to external stimuli, and, if awakened, is confused and disoriented. Amnesia for the episode occurs frequently, although sometimes there are reports of fragments or very brief vivid dream images or hallucinations. They occur out of N2, often at the beginning of the night, or in slow wave sleep (SWS, N3) at any time during the night. Studies of CNVH also suggest a contribution of NREM sleep.[48,50]

***Other parasomnias***

Finally, there is some overlap with other categories within the cluster of other parasomnias. Exploding head syndrome consists of a sudden loud bang, usually at sleep onset and sometimes accompanied by a flash of light. A point of difference with SRH is that it does not involve complex visual imagery and lasts only a fraction of a second. Also, exploding head syndrome has a lower prevalence than hypnagogic states.[84]

## SUMMARY AND DISCUSSION

Our current state of knowledge is that SRH is a diagnostic category that features in ICSD alone and solely comprises HHH and CNVH. These phenomena are thought to represent a single symptom cluster with distinctive presentations, but it is not yet clear whether they have a single underlying mechanism or perhaps different ones.

There has been an evolution in the conceptualization of SRH over time. Although SRH are interesting to study in their individual forms, there are a number of distinctive questions that remain to be answered.

1. What is the link between CNVH and Terrifying Hypnagogic Hallucination described in the ICSD-R?

CNVH closely resembles THH, except in the timing of sleep. THH occur at sleep onset, whereas CNVH can occur at any time during sleep.

Similarities between CNVH and THH are that: their contents resemble nightmares, and the accompanying emotional effect includes fear, foreboding, and threatening contents; both are associated with body movements (vocalization and screaming for THH; sitting up and eyes open with CNVH); both are associated with intact recall and may in fact represent a continuation into wakefulness; and THH have sometimes been described as a "double consciousness" simultaneous recall of dreams and external environment, which resemble descriptions of CNVH. Another common and distinctive feature of both is that they terminate with sudden awakening, and they persist into awakenening. This separates them from other SRS that are associated with a brief arousal and a subsequent return to sleep.

2. Do HHH and CNVH represent the same or distinct phenomena within the SRH category:

HHH are extremely common and, mostly benign, in the normal population. The upgrading of their clinical significance from benign phenomena to the status of sleep disorders across successive ICSD versions raises questions about unsubstantiated pathologization. HHH are now labeled as sleep disorders, although they are not identified as symptoms with substantial clinical merit. Their clinical significance is identified if they are "recurrent," and because they are common symptoms of other sleep disorders, especially parasomnias and other psychiatric conditions.

By contrast, evidence for CNVH comes from descriptions of patients with sleep disorders or medical conditions, in whom they may be a symptom of a clinical condition. CNVH are also differentiated from HHH (and other different parasomnia-related events) by the timing, complex visual contents, sudden arousal, affective contents, and good memory recall of events.

There are therefore questions about whether they represent the same or different phenomena, and they should be combined under the same category of SRH. A commonality is that many EEG studies link both to NREM.[85] However, other evidence links them to all states of consciousness, including waking, sleep onset, sleep offset, and REM sleep, and it is not clear whether they have distinct neurophysiological basis or polysomnography (PSG) features.

One possibility is that SRH can be represented along a continuum of severity, with normal variants of HHH at one end, and CNVH as a pathologic

entity at the other. If this is the case, a better explication of the threshold of clinical significance would be useful to clinicians. A continuum of presentation, however, does not necessarily imply a continuous of mechanisms. Notwithstanding their similarity, evidence from their demographic profile and clinical course suggests different mechanisms between HHH and CNVH. CNVH are a common feature of neurologic disorders, whereas HHH occur in a non-pathological form in the majority of cases. Many questions remain about their association with other sleep disorders. Their lack of specificity to any that one sleep disorder or a specific somatic or psychiatric condition should remain at the forefront of all clinical assessments.

## SUMMARY

In conclusion, perceptual phenomena which occur around and during sleep represent a fascinating topic for study as they reveal a world that is not easily accessible to our waking state. One suggestion is that they are a mirror image of each other, with the dreaming brain being an "offline" virtual reality simulation of the "online" waking world.[86] However, our knowledge of sleep states and associated perceptual phenomena is still rather limited. Methodological issues are important barriers that constrain our understanding of the nature, causes, and significance of SRH. Advances in the conceptualization of the wake versus sleep dichotomy may also help to facilitate direct comparisons between phenomena with similar clinical features.

## CLINICS CARE POINTS

- Sleep-related hallucinations (SRH) have been documented in all stages of sleep (non-rapid eye movement [NREM] and rapid eye movement [REM]), in healthy individuals, and in people with a variety of general medical, neurologic, and psychiatric disorders.
- Not all hallucinations require interventions. Infrequent hallucinations may be within the limits of normal sleep–wake transitions.
- SRH can occur independently from, but are frequently associated with, other sleep disorders. The presence of other symptoms that occur concurrently with SRH may therefore be indicative of narcolepsy or other disorders.
- SRH cannot be understood in isolation, and it is inadvisable to give excessive weight to individual features of SRH.[87] The combination of features accompanying complex nocturnal visual hallucinations is an important factor that can assist in diagnosis and help to determine whether treatment is needed.
- Future research should focus on the development of reliable assessment tools that can differentiate between different features of daytime and SRH outside of the simple wake–sleep dichotomy.

## DISCLOSURE

The authors have nothing to disclose.

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