Operational Classification of Seizure Types by the International League Against Epilepsy

Participants: Robert S. Fisher¹, J. Helen Cross², Jacqueline A. French³, Norimichi Higurashi⁴, Edouard Hirsch⁵, Floor E. Jansen⁶, Lieven Lagae⁷, Solomon L. Moshe⁸, Jukka Peltola⁹, Eliane Roulet Perez¹⁰, Ingrid E. Scheffer¹¹, Sameer M. Zuberi¹²

¹ Stanford Department of Neurology & Neurological Sciences, Stanford, CA, USA
² UCL-Institute of Child Health, & Great Ormond Street Hospital for Children, London, UK
³ Department of Neurology, NYU Langone School of Medicine, NY USA
⁴ Department of Pediatrics, Jikei University School of Medicine Tokyo, Japan
⁵ Unite Francis Rohmer, Strasbourg France
⁶ Department of Pediatric Neurology, Brain Center Rudolf Magnus, University Medical Center, Utrecht, The Netherlands
⁷ Pediatric Neurology, University Hospitals KULeuven, Leuven, Belgium
⁸ Albert Einstein University, Bronx, NY USA
⁹ Department of Neurology, Tampere University Hospital, Tampere, Finland
¹⁰ Unité de Neurologie et Neuroréhabilitation Pédiatrique CHUV-1011 Lausanne Switzerland
¹¹ Florey Institute and University of Melbourne, Austin Health and Royal Children’s Hospital, Melbourne, Australia
¹² The Paediatric Neurosciences Research Group, Royal Hospital for Children, Glasgow, UK & College of Medicine, Veterinary & Life Sciences, University of Glasgow, United Kingdom

Corresponding author:
Robert S. Fisher, MD, PhD
Neurology, Stanford Hospital, Room A343
300 Pasteur Drive
Stanford, CA 94305-5235
robert.fisher@stanford.edu
Phone: 650-498-3056
Fax: 650-498-6326

Running title: Operational classification of seizure types

Key Words: classification, seizures, focal, generalized, epilepsy (taxonomy)
Summary

Objectives: The International League Against Epilepsy (ILAE) presents a revised operational classification of seizure types. The purpose of such a revision is to recognize that some seizure types can have either a focal or generalized onset, to allow classification when the onset is unobserved, to include some missing seizure types and to adopt more transparent names.

Methods: Because current knowledge is insufficient to form a scientifically-based classification, the 2016 classification is operational (practical) and based upon the 1981 Classification, extended in 2010.

Results: Changes include: 1. “partial” becomes “focal”; 2. Seizures of unknown onset can still be classified; 3. Awareness is used as a classifier of focal seizures; 4. The terms dyscognitive, simple partial, complex partial, psychic, secondarily generalized are eliminated; 5. Focal tonic, clonic, atonic, myoclonic and epileptic spasms seizure types are recognized, along with bilateral versions of these seizure types. 6. Addition of new generalized seizure types: absence with eyelid myoclonia, myoclonic absence, myoclonic-atonic, clonic-tonic-clonic, epileptic spasms. Epileptic spasms can thus be focal, generalized or unknown. 7. Bilateral tonic-clonic seizure replaces secondarily generalized seizure.

Significance: The new classification does not represent a fundamental change, but allows greater flexibility and transparency in naming seizure types.

Introduction

The International League Against Epilepsy (ILAE), through the Commission for Classification and Terminology, has developed a working classification of seizures and epilepsy. Following the proposed reorganization in 2010 (Berg et al 2010), further clarification has been discussed and feedback sought from the community. One area that required further elucidation was the schema of seizure types. A Seizure Type Classification Task Force met in London on Feb. 16-17, 2015 and in Istanbul on Sep 4, 2015 to prepare recommendations for classification of seizure types, which are summarized in this document.
Descriptions of seizure types date back at least to the time of Hippocrates. Gastaut proposed a modern classification scheme in 1969. Various basic frameworks for seizure classification can be considered. Manifestations of certain seizures are age-specific and depend on maturation of the brain. Previous classifications have been based on anatomy, with temporal, frontal, parietal, occipital, diencephalic or brainstem seizures. Modern research changed our view of the pathophysiological mechanisms involved and has shown epilepsy to be a network disease and not only a symptom of local brain abnormalities. From a network perspective, seizures could arise in neocortical, thalamo-cortical, limbic, and brainstem networks. Although our understanding of seizure networks is evolving rapidly it is not yet sufficient to serve as a basis for seizure classification. In 1981, an ILAE Commission led by Dreifuss and Penry evaluated hundreds of video-EEG recordings of seizures to develop recommendations that divided seizures into those of partial and generalized onset, simple and complex partial seizures and various specific generalized seizure types. This scheme remains in widespread use today, despite revisions in terminology and classification of seizures and epilepsy by the ILAE; and with suggested insights, modifications and criticisms by others.

The intention of the 2001 and 2006 reports on reclassification was to identify unique diagnostic entities with etiologic, therapeutic, and prognostic implications, so that when a syndromic diagnosis could not be made, then the therapy and prognosis would be based on seizure type. Such a classification would permit grouping of reasonably pure cultures of patients for discovery of etiologies, including genetic factors, research into fundamental mechanisms, and even clinical trials. The ILAE Seizure Type Classification Task Force (hereafter called “the Task Force”) chose to use the phrase “operational classification,” in order to emphasize the necessity to update the classification based upon new insights generated by the ongoing science of epilepsy. In the absence of a full scientific classification, the Task Force chose to use the basic scheme initiated in 1981 and modified in 2010 as a starting point for the revised operational classification.

**Methods**

**What is a seizure type?**

The Task Force defines an operational seizure type as a useful grouping of seizure characteristics for purposes of communication in clinical care, teaching and research. Mention of a seizure type should bring to mind a specific entity, albeit sometimes with subcategories and variations on a theme. Choices must be made by interested stakeholders to highlight groupings of seizure characteristics that are useful for specific purposes. Such stakeholders include patients, families, medical professionals, researchers, epidemiologists, medical educators, clinical trialists, insurance payers, regulatory agencies, advocacy groups, and medical reporters. Operational (practical) groupings can be derived by those with specific interests. A pharmacologist, for example, might choose to group seizures by responsiveness to medications.
A surgeon might group by anatomy and the possibility for successful surgical therapy. A physician based in an ICU with predominantly unconscious patients might group seizures by EEG pattern. The classification in this article is meant to provide a communication framework for clinical use. Seizure types are relevant to clinical practice in humans; whereas, it is acknowledged that seizure types in other species, experimental and natural, may not be reflected in the proposed classification. One goal was to make the classification understandable by patients and families and broadly applicable to all ages, including neonates. The Commission on Classification & Terminology recognizes that seizures and epilepsies in the neonate can have motor manifestations or alternatively little or no behavioral manifestations. A separate Neonatal Seizure Task Force is working to coordinate the classification of neonatal seizures and the Seizure Type Task Force classifications. The guiding principle of the Seizure Type Task Force was a quotation from Albert Einstein: “Make things as simple as possible, but no simpler.”

**Motivation for change**

Adapting to change of terminology can be effortful and needs to be motivated by a desire for change. Motivations for revising the 1981 Seizure Classification are listed below.

1. Some seizure types, for example tonic or epileptic spasms, can have either a focal or generalized onset.
2. Lack of knowledge about the onset makes a seizure unclassifiable with the 1981 system.
3. A need to move away from preservation or alteration of awareness, responsiveness or consciousness as the only descriptor of a focal seizure, although it remains an important classifier.
4. Some terms in current use do not have high levels of community acceptance or public understanding, such as “psychic,” “partial,” “simple partial,” “complex partial”, and “dyscognitive.”
5. Some important seizure types are not included.

**Results**

**Classification of Seizure Types**
Figure 1: The ILAE 2016 Operational Classification of Seizure Types: Basic and Expanded Scheme

**ILAE Seizure Classification 2016 basic scheme**

- **Focal**
  - Motor
  - Non-Motor
  - aware
  - impaired awareness
  - unknown awareness
  - to bilateral tonic-clonic

- **Generalized**
  - Motor
  - Absence
  - aware
  - impaired awareness
  - unknown awareness

- **Unknown Onset**
  - Motor
  - Non-motor
  - aware
  - impaired awareness
  - unknown awareness

**ILAE Seizure Classification 2016 expanded scheme**

- **Focal**
  - Motor
    - tonic
    - atonic
    - myoclonic
    - clonic
    - epileptic spasms
    - hypermotor
  - Non-Motor
    - sensory
    - cognitive
    - emotional
    - autonomic
  - aware
  - impaired awareness
  - unknown awareness
  - to bilateral tonic-clonic

- **Generalized**
  - Motor
    - tonic-clonic
    - tonic
    - atonic
    - myoclonic
    - myoclonic-atonic
    - clonic
    - clonic-tonic-clonic
    - epileptic spasms
    - Absence
      - typical
      - atypical
      - myoclonic
      - eyelid myoclonia
  - aware
  - impaired awareness
  - unknown awareness

- **Unknown Onset**
  - Motor
    - tonic-clonic
    - tonic
    - atonic
    - epileptic spasms
    - Non-motor
  - aware
  - impaired awareness
  - unknown awareness
  - Unclassified
How to use the classification

The classification attempts first to determine whether the initial manifestations of the seizure are focal or generalized. The onset may be missed or obscured, in which case the seizure is of unknown onset. Subtypes are described in the glossary of terms below. The classification of an individual seizure can stop at any level. It may be designated a “focal” (or “generalized”) seizure, with no other elaboration, or a “focal sensory seizure,” “focal motor seizure,” “focal tonic seizure,” or any other listed combination. Additional classifiers are encouraged, but optional, and their use may depend upon the experience and purposes of the person classifying the seizure.

Focal seizures are subdivided as those with motor and non-motor signs and symptoms. If both motor and non-motor signs are present at the seizure start, the motor signs will usually dominate, unless non-motor (e.g., sensory) symptoms and signs are very prominent. Focal seizures can be associated with a variety of symptoms, signs, and behaviors, a key one of which is impairment of awareness, responsiveness, recall or consciousness. Impaired awareness is employed as shorthand for presence of any of these features. A “focal aware seizure” corresponds to the 1981 designation “simple partial seizure,” and it implies that awareness, recall, responsiveness and consciousness are all intact. Any significant impairment of these clinical states causes a focal seizure to be classified as having impaired awareness. It may be convenient to refer to this seizure type as “focal unaware,” but in doing so it is important to recognize that awareness may be impaired, rather than absent. A “focal seizure with impaired awareness” corresponds to the 1981 designation “complex partial seizure.” If the state of awareness is unknown, then the focal seizure is classified as being “with unknown awareness.” When a focal seizure presents with more than one of the classifiers under the focal heading, then the presumption is that the one presenting early and prominently will have primacy, since it reflects the most important involved regions or networks of brain. If more than one sequential feature is prominent, then it is best to consider a propagation pattern within one seizure type or among multiple sequentially developing seizure types. The exception is characterization of awareness, which can be added to any focal seizure. It is acceptable to omit the implied term “non-motor” for focal sensory, cognitive, emotional or autonomic seizures. The term “aware” may also be omitted for seizure types such as sensory for which awareness is implied. Order of terms is not crucial, such that “focal aware tonic seizure” means the same as does “focal tonic seizure with preserved awareness.” Where a word can be unambiguously assumed, it may be omitted, for example, “generalized tonic seizure,” rather than “generalized motor tonic seizure.”

The seizure type “focal to bilateral tonic-clonic” is a special seizure type, corresponding to the prior phrase “partial onset with secondary generalization.” Focal to bilateral tonic-clonic reflects a propagation pattern of a seizure, rather than a unitary seizure type, but it is such a common and important presentation that the separate categorization was continued. Other focal
seizure types, such as tonic or myoclonic may progress (propagate) to bilateral tonic-clonic seizures.

Generalized seizures are divided into motor and absence seizures. Further subdivisions are similar to those of the 1981 classification, with addition of myoclonic-ataxic seizures, common in epilepsy with myoclonic-ataxic epilepsy (Doose syndrome), clonic-ataxic seizures common in juvenile myoclonic epilepsy, myoclonic absence and absence with eyelid myoclonia seizures seen in the syndrome described by Jeavons and elsewhere.

“Unknown onset” seizures are not truly separate types of seizures, but rather placeholders for seizure types for which the onset is unknown. A wife may awaken to her husband’s first tonic-clonic seizure, which would be classified as an onset unknown tonic-clonic seizure. If a subsequent seizure is observed with a clear focal onset, then the seizure type would be reclassified as a “focal to bilateral tonic-clonic seizure.”

An “unclassified seizure” connotes a seizure with no specification as to nature of onset, presence of motor or non-motor features and no details about degree of awareness. If any of these features are known, then those details should be employed to partially classify the seizure. Not every seizure will fit into this classification, so a choice for “other” can be inferred in each category.

**Reasons for decisions**

The terminology for seizure types is designed to be useful for communicating the key characteristics of seizures and to serve as one of the key components of a larger classification for the epilepsy syndromes, which is being developed by the separate ILAE Classification Task Force. The basic framework of seizure classification used since 1981 was maintained.

**Focal vs. partial**

In 1981, the Commission declined to designate as “focal” a seizure that might involve an entire hemisphere, so the term “partial” was adopted. But the word “partial” does not convey a sense of location. The current Task Force considers the term “focal” seizures to be more understandable.

**Focal vs. generalized**

In 2010 the ILAE defined focal as “originating within networks limited to one hemisphere. They may be discretely localized or more widely distributed. Focal seizures may originate in subcortical structures.” Generalized from onset seizures were defined as “originating at some point within, and rapidly engaging, bilaterally distributed networks.” Classifying a seizure as generalized does not rule out a focal onset obscured by limitations of our current clinical methods, but this is more an issue of correct diagnosis than of classification. A working
distinction between focal and generalized onset is a practical one, and may change with advances in ability to characterize the onset of seizures.

Clinicians have long been aware that so-called generalized seizures, for example, generalized absence with EEG generalized spike-waves, do not manifest equally in all parts of the brain. The Task Force emphasized the concept of bilateral, rather than generalized involvement of some seizures, since seizures can be bilateral without involving every brain network. The term “focal to bilateral tonic-clonic” was substituted for “secondarily generalized.” The term “generalized” was maintained for seizures generalized from onset.

Onset unknown

Clinicians commonly hear about tonic-clonic seizures for which the onset was unobserved. Perhaps, the patient was asleep, alone or observers were too distracted by the manifestations of the seizure to notice presence of focal features. There should be an opportunity to provisionally classify this seizure even in the absence of knowledge about its origin. The Task Force therefore allowed classification of any seizure type with the modifier “unknown onset.” It may be impossible to classify a seizure at all, either because of incomplete information or because of the unusual nature of the seizure. An example of incomplete information would be “The patient had an episode of staring for several seconds.” If the epilepsy type is known, then the onset can be presumed even if it is unwitnessed, for example, a generalized absence seizure in a child with known juvenile absence epilepsy.

Consciousness and awareness

The 1981 classification and the revision in 2010 suggested a fundamental distinction between seizures with loss or impairment of consciousness and those with no impairment of consciousness. Basing a classification upon consciousness (or one of its allied functions) reflects a practical choice that seizures with impaired consciousness should often be approached differently from those with unimpaired consciousness, for example, with respect to allowing driving in adults or impairing learning in children. The ILAE chose to retain impairment of consciousness as a key concept in the grouping of focal seizures. Consciousness is a complex phenomenon, with both subjective and objective components. Up to five different types of consciousness have been described for seizures. Surrogate markers for consciousness usually comprise measurements of awareness, responsiveness, and memory. The 1981 classification specifically mentioned awareness and responsiveness, but not memory for the event. The ILAE commission chose awareness or impairment of consciousness as a classifier for seizure types. The Task Force in 2015 reduced the key surrogate measure to “awareness” for classifying seizures. “Retained awareness” is considered to be an abbreviation for “seizures with no impairment of consciousness or memory during the event.” In several languages, “unaware” translates as “unconscious,” in which case changing the words from complex partial to unaware will emphasize the importance of consciousness by putting it directly in the seizure
In English, “focal aware” is shorter than is “focal seizure without impairment of consciousness” and possibly better understood by patients. The placeholder “awareness unknown” is available when the type of awareness cannot be ascertained.

Responsiveness may or may not be impaired during a focal seizure. Responsiveness does not equate to awareness, since some people may be immobilized and consequently unresponsive during a seizure, but still able to observe and recall their environment. Additionally, responsiveness often is not tested during seizures. For these reasons, responsiveness was not chosen as a primary feature for seizure classification, although when responsiveness can be tested it can be very helpful in classifying the seizure. The term “dyscognitive” was not carried into the current classification as a synonym for “complex partial” because of lack of clarity and negative public and professional feedback.

Awareness was not suggested as a classifier for generalized seizures, because the majority of generalized seizures present with impaired awareness. However, awareness and responsiveness can be at least partially retained during some generalized seizures, for example, brief absence seizures, including absence seizures with eyelid myoclonias or myoclonic seizures.

Etiologies

A classification of seizure types can be applied to seizures of different etiologies. For example, a post-traumatic seizure or a reflex seizure may be focal with or without impairment of awareness. Knowledge of the etiology can aid in classification of the seizure type. Any seizure can become prolonged, leading to status epilepticus of that seizure type.

Supportive information

As part of the diagnostic process, a clinician will commonly use supportive evidence to help to classify a seizure, even though that evidence is not part of the classification scheme. Such evidence may include EEG patterns, lesions detected by neuroimaging, laboratory results such as detection of anti-neuronal antibodies, gene mutations, or presence of an epilepsy syndrome known to be associated with either focal or generalized seizures. The seizures usually can be classified on the basis of behavior, provided that a good subjective and objective description is available. However, where supportive information is available, it should be used to secure the most accurate classification.

ICD 9, 10, 11, 12

The World Health Organization International Classification of Diseases (ICD) is used for inpatient and outpatient diagnoses, billing and many other purposes. Concordance between
ICD epilepsy diagnoses and ILAE seizure types is desirable for clarity and consistency. This is possible only to a limited extent with existing ICD terms, since ICD 9, 10, 11 are already formulated, even though ICD10 is just being introduced into US systems. The ILAE proposals will always lead ICD standards. ICD 9 and 10 make use of old seizure terminology, including terms such as petit mal and grand mal. ICD11 does not name seizure types at all, but focuses on epilepsy etiologies and syndromes, as do ILAE epilepsy classifications⁵. For this reason, there is no conflict between our proposed seizure type classification and ICD11. Efforts can be made to incorporate the new classification of seizure types and syndromes into the development of ICD12.

**Common Descriptors**

Focal seizures provoke a variety of potential sensations and behaviors too diverse to be incorporated into a classification. In order to facilitate a common language about seizures, the Task Force listed some common descriptors of behaviors during focal seizures (Table 1), but these are not intrinsic to the classification scheme. In other words, the common descriptors can be added to the seizure classification to clarify the manifestations of individual seizures, but the descriptors do not define unique seizure types. Note that some behaviors during focal seizures, for example, tonic or clonic, can also be seen in generalized seizures; there is no unitary match between behaviors and seizure types. The Task Force acknowledged the importance for diagnosis and management of a detailed individual free-text description of a seizure, in addition to the classification.

**TABLE 1: Common Descriptors of Behaviors During Focal Seizures (alphabetically in English)**
### Cognitive
- acalculia
- aphasia
- attention impairment
- déjá vu
- dysphasia
- hallucinations
- illusions
- jamais vu
- memory impairment
- neglect
- forced thinking
- responsiveness impairment

### Emotional or affective
- agitation
- anger
- anxiety
- crying (dacrystic)
- fear
- laughing (gelastic)
- paranoia
- pleasure

### Autonomic
- asystole
- bradycardia
- cold
- erection
- flushing
- gastrointestinal
- heat
- hyperventilation
- hypoventilation
- nausea or vomiting
- pallor
- palpitations
- piloerection

### Automatisms
- aggression
- manual
- oral-facial
- perseveration
- sexual
- undressing
- vocalization
- walking/running

### Motor
- arrest
- astatic
- dysarthria
- dystonic
- fencer’s posture
- figure-4
- hypomotor
- hypokinetic
- hypermotor
- incoordination
- Jacksonian
- paralysis
- paresis
- pedaling
- pelvic thrusting
- versive

### Sensory
- auditory
- gustatory
- olfactory
- somatosensory
- vestibular
- visual
Mapping old to new terms

Table 2 provides mapping of old official and popular terms to the 2015 seizure type classification.

Table 2: Mapping of old to new seizure classifying terms
<table>
<thead>
<tr>
<th>Old Term for Seizure</th>
<th>New Term for Seizure [choice] (optional common descriptor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>absence</td>
<td>generalized absence</td>
</tr>
<tr>
<td>absence, atypical</td>
<td>generalized absence, atypical</td>
</tr>
<tr>
<td>absence, typical</td>
<td>generalized absence, typical</td>
</tr>
<tr>
<td>akinetic</td>
<td>generalized/focal/onset unknown atonic</td>
</tr>
<tr>
<td>astatic</td>
<td>generalized/focal/onset unknown atonic</td>
</tr>
<tr>
<td>atonic</td>
<td>generalized/focal/onset unknown atonic</td>
</tr>
<tr>
<td>aura</td>
<td>focal aware</td>
</tr>
<tr>
<td>clonic</td>
<td>generalized/focal/onset unknown clonic</td>
</tr>
<tr>
<td>complex partial</td>
<td>focal with impaired awareness</td>
</tr>
<tr>
<td>convulsion</td>
<td>[focal/generalized/onset unknown] motor [tonic-clonic, tonic-clonic], focal to bilateral tonic-clonic, tonic-clonic unknown onset focal [aware or impaired awareness] emotional (dacrystic)</td>
</tr>
<tr>
<td>dacrystic</td>
<td>focal impaired awareness</td>
</tr>
<tr>
<td>dialectic</td>
<td>generalized/focal/onset unknown atonic</td>
</tr>
<tr>
<td>drop attack</td>
<td>focal [aware or impaired awareness] motor (tonic)</td>
</tr>
<tr>
<td>fencer's posture</td>
<td>focal [aware or impaired awareness] motor (tonic)</td>
</tr>
<tr>
<td>figure-of-4</td>
<td>focal [aware or impaired awareness] motor (tonic)</td>
</tr>
<tr>
<td>freeze</td>
<td>focal [aware or impaired awareness] arrest</td>
</tr>
<tr>
<td>frontal lobe*</td>
<td>focal</td>
</tr>
<tr>
<td>gelastic</td>
<td>focal [aware or impaired awareness] emotional (gelastic)</td>
</tr>
<tr>
<td>grand mal</td>
<td>generalized tonic-clonic, focal to bilateral tonic-clonic, tonic-clonic unknown onset</td>
</tr>
<tr>
<td>gustatory</td>
<td>focal [aware or impaired awareness] autonomic (gustatory)</td>
</tr>
<tr>
<td>infantile spasms</td>
<td>generalized/focal/onset unknown epileptic spasms</td>
</tr>
<tr>
<td>Jacksonian</td>
<td>focal aware motor (Jacksonian)</td>
</tr>
<tr>
<td>limbic</td>
<td>focal impaired awareness</td>
</tr>
<tr>
<td>major motor</td>
<td>generalized tonic-clonic, focal to bilateral tonic-clonic</td>
</tr>
<tr>
<td>minor motor</td>
<td>focal motor, generalized myoclonic</td>
</tr>
<tr>
<td>myoclonic</td>
<td>generalized myoclonic</td>
</tr>
<tr>
<td>neocortical*</td>
<td>focal aware</td>
</tr>
<tr>
<td>occipital lobe*</td>
<td>focal</td>
</tr>
<tr>
<td>parietal lobe*</td>
<td>focal</td>
</tr>
<tr>
<td>partial</td>
<td>focal</td>
</tr>
<tr>
<td>petit mal</td>
<td>generalized absence</td>
</tr>
<tr>
<td>psychomotor</td>
<td>focal with impaired awareness</td>
</tr>
<tr>
<td>Rolandic</td>
<td>focal aware motor</td>
</tr>
<tr>
<td>salam</td>
<td>generalized/focal/onset unknown epileptic spasms</td>
</tr>
<tr>
<td>secondarily generalized tonic-clonic</td>
<td>focal to bilateral tonic-clonic</td>
</tr>
<tr>
<td>simple partial</td>
<td>focal aware</td>
</tr>
<tr>
<td>supplementary motor</td>
<td>focal motor tonic</td>
</tr>
<tr>
<td>Sylvian</td>
<td>focal motor</td>
</tr>
<tr>
<td>temporal lobe*</td>
<td>focal aware / with impaired awareness</td>
</tr>
<tr>
<td>tonic</td>
<td>generalized/focal/onset unknown tonic</td>
</tr>
<tr>
<td>tonic-clonic</td>
<td>generalized tonic-clonic, focal to bilateral tonic-clonic, tonic-clonic of unknown onset</td>
</tr>
<tr>
<td>uncinate</td>
<td>focal [aware or with impaired awareness] sensory (olfactory)</td>
</tr>
</tbody>
</table>

* Anatomical classification may still be useful for some purposes, for example in evaluation for epilepsy surgery.
Discussion

Discontinued terms

Simple/complex partial: After approximately 35 years of use, the terms “simple partial seizure” and “complex partial seizure” may be missed. The reasons for changing are three. First, a decision was previously made to globally change partial to focal. Second, “complex partial” has no intrinsic meaning to the public. The phrase “focal impaired awareness” can convey meaning to a lay person with no knowledge of seizure classification. Third, the words “complex” and ‘simple” can be misleading in some contexts. Complex seems to imply that this seizure type is more complicated or difficult to understand than other seizure types. Calling a seizure “simple” may trivialize its impact to a patient who does not find the manifestations and consequences of the seizures to be at all simple.

Aura: The term “aura” is and likely will remain in popular use, but it is problematic in a classification, because the aura itself represents a type of seizure, but it often is considered a prelude to a seizure rather than a seizure itself. This may not be obvious to patients, who may, for example, decide to discontinue medicines because they believe themselves to be seizure-free when they only experience auras. The 1981 classification described complex partial seizures with or without auras. The 2015 classification does not use “aura” as a classifier.

Convulsion: The term “convulsion” is a popular unofficial term used to mean substantial motor activity during a seizure. Such activity might be tonic, clonic or tonic-clonic. In some languages convulsions and seizure may be considered synonyms, and the motor component is not clear. The word “convulsion” is not part of the 2015 seizure classification.

Added terms

Aware/awareness impaired: As discussed above, these terms designate degrees of impairment of consciousness.

Hypermotor: added to focal motor seizure types and replaces “hyperkinetic”

Cognitive: This term partially replaces “psychic” and refers to specific cognitive impairments during the seizure, for example, aphasia.

Emotional: A focal non-motor seizure can have emotional manifestations, such as fear, laughing (gelastic) or crying (dacrystic).

New focal seizure types: Seizure types that previously were described only as generalized seizures now appear under seizures of focal, generalized and unknown onset. These include epileptic spasms, tonic, clonic, atonic and myoclonic seizures.
New generalized seizure types: Relative to the 1981 scheme, new generalized seizure types include: absence with eyelid myoclonia, myoclonic-atonic, and clonic-tonic-clonic. Epileptic spasms are seizures represented in focal, generalized and unknown categories.

Glossary

Table 3 provides a glossary of terms used in this paper. The definitions are not universal, but focused on the aspects of language pertinent to seizures. For example, sensory is defined in terms of sensory seizures, not all sensation. Wherever possible, prior accepted definitions from the ILAE glossary of 2001 were maintained, in order to support continuity of usage. Reference can be made to earlier literature for definitions of old terms.

Table 3: Glossary of Terms

<table>
<thead>
<tr>
<th>WORD</th>
<th>DEFINITION</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>absence, typical</td>
<td>a sudden onset, interruption of ongoing activities, a blank stare, possibly a brief upward deviation of the eyes. Usually the patient will be unresponsive when spoken to. Duration is a few seconds to half a minute with very rapid recovery. Although not always available, an EEG would show generalized epileptiform discharges during the event.</td>
<td>Adapted from 10</td>
</tr>
<tr>
<td>absence, atypical</td>
<td>an absence seizure with changes in tone that are more pronounced than in typical absence or the onset and/or cessation is not abrupt, often associated with slow, irregular, generalized spike-wave activity</td>
<td>Adapted from Dreifuss 1</td>
</tr>
<tr>
<td>activity arrest</td>
<td>pause of activities, freezing, immobilization</td>
<td>new</td>
</tr>
<tr>
<td>arrest</td>
<td>see activity arrest</td>
<td>new</td>
</tr>
<tr>
<td>atonic</td>
<td>sudden loss or diminution of muscle tone without apparent preceding myoclonic or tonic event lasting ~1 to 2 s, involving head, trunk, jaw, or limb musculature.</td>
<td>10</td>
</tr>
<tr>
<td>automatism</td>
<td>a more or less coordinated, repetitive, motor activity usually occurring when cognition is impaired and for which the subject is usually amnestic afterward. This often resembles a voluntary movement and may consist of an inappropriate continuation of ongoing preictal motor activity.</td>
<td>10</td>
</tr>
<tr>
<td>autonomic seizure</td>
<td>a distinct alteration of autonomic nervous system function involving cardiovascular, pupillary, gastrointestinal, sudomotor, vasomotor, and thermoregularity functions.</td>
<td>Adapted from 10</td>
</tr>
<tr>
<td>aura</td>
<td>a subjective ictal phenomenon that, in a given patient, may precede an observable seizure</td>
<td>10</td>
</tr>
<tr>
<td>awareness</td>
<td>an aspect of consciousness pertaining to knowledge of one’s surroundings.</td>
<td>new</td>
</tr>
<tr>
<td>bilateral</td>
<td>both left and right sides</td>
<td>new</td>
</tr>
<tr>
<td>clonic</td>
<td>jerking, either symmetric or asymmetric, that is regularly repetitive and involves the same muscle groups</td>
<td>Adapted from 10</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
<td>Source</td>
</tr>
<tr>
<td>------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td>clonic-tonic-clonic</td>
<td>one or a few jerks of limbs bilaterally, followed by a tonic-clonic seizure. The initial jerks can be considered to be either a brief period of clonus or myoclonus. Seizures with this characteristic are common in juvenile myoclonic epilepsy</td>
<td>new</td>
</tr>
<tr>
<td>cognitive</td>
<td>pertaining to thinking and higher cortical functions, such as language, spatial perception, memory, praxis. The previous term for similar usage was psychic.</td>
<td>new</td>
</tr>
<tr>
<td>consciousness</td>
<td>a state of mind with both subjective and objective aspects, comprising a sense of self as a unique entity, awareness, responsiveness and memory</td>
<td>new</td>
</tr>
<tr>
<td>dacrystic</td>
<td>bursts of crying.</td>
<td>10</td>
</tr>
<tr>
<td>dystonic</td>
<td>sustained contractions of both agonist and antagonist muscles producing athetoid or twisting movements, which may produce abnormal postures.</td>
<td>Adapted from 10</td>
</tr>
<tr>
<td>emotional seizures</td>
<td>seizures presenting with an emotion or the appearance of having an emotion as an early or prominent feature, such as fear, spontaneous joy or euphoria, laughing (gelastic) or crying (dacrystic)</td>
<td>new</td>
</tr>
<tr>
<td>epileptic spasms</td>
<td>a sudden flexion, extension, or mixed extension–flexion of predominantly proximal and truncal muscles that is usually more sustained than a myoclonic movement but not as sustained as a tonic seizure. Limited forms may occur: grimacing, head nodding or subtle eye movements. Epileptic spasms frequently occur in clusters. Infantile spasms are the best known form, but spasms can occur at all ages.</td>
<td>Adapted from 10</td>
</tr>
<tr>
<td>epilepsy</td>
<td>a disease of the brain defined by any of the following conditions 1. At least two unprovoked (or reflex) seizures occurring&gt;24 h apart; 2. One unprovoked (or reflex) seizure and a probability of further seizures similar to the general recurrence risk (at least 60%) after two unprovoked seizures, occurring over the next 10 years; 3. Diagnosis of an epilepsy syndrome. Epilepsy is considered to be resolved for individuals who had an age-dependent epilepsy syndrome but are now past the applicable age or those who have remained seizure-free for the last 10 years, with no anti-seizure medicines for the last 5 years.</td>
<td>19</td>
</tr>
<tr>
<td>eyelid myoclonia</td>
<td>jerking of the eyelids at frequencies at least 3 per second, commonly with upward eye deviation, usually lasting less than 10 seconds, often precipitated by eye closure. There may or may not be associated brief loss of awareness.</td>
<td>new</td>
</tr>
<tr>
<td>fencer’s posture seizure</td>
<td>a focal motor seizure type with extension of one arm and flexion at the contralateral elbow and wrist, giving an imitation of swordplay with a foil. This has also been called a supplementary motor seizure.</td>
<td>new</td>
</tr>
<tr>
<td>figure-4 seizure</td>
<td>see fencer’s posture seizure</td>
<td>new</td>
</tr>
<tr>
<td>focal</td>
<td>originating within networks limited to one hemisphere. They may be discretely localized or more widely distributed. Focal seizures may originate in subcortical structures.</td>
<td>5</td>
</tr>
<tr>
<td>focal to bilateral tonic-clonic seizure</td>
<td>a seizure type with focal onset, either motor or non-motor, with awareness or impaired awareness, progressing to bilateral tonic-clonic activity. The prior term was seizure with partial onset with secondary generalization.</td>
<td>5</td>
</tr>
<tr>
<td>gelastic</td>
<td>bursts of laughter or giggling, usually without an appropriate affective tone.</td>
<td>10</td>
</tr>
<tr>
<td>generalized</td>
<td>originating at some point within, and rapidly engaging, bilaterally distributed networks</td>
<td>5</td>
</tr>
<tr>
<td>term</td>
<td>definition</td>
<td>source</td>
</tr>
<tr>
<td>------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td>generalized tonic-clonic</td>
<td>bilateral symmetric tonic contraction and then bilateral clonic contraction of somatic muscles, usually associated with autonomic phenomena and loss of awareness. These seizures engage networks in both hemispheres at the start of the seizure.</td>
<td>Adapted from 10, 5</td>
</tr>
<tr>
<td>hallucination</td>
<td>a creation of composite perceptions without corresponding external stimuli involving visual, auditory, somatosensory, olfactory, and/or gustatory phenomena. Example: “hearing” and “seeing” people talking.</td>
<td>10</td>
</tr>
<tr>
<td>hypomotor</td>
<td>a decrease or cessation of motor activity. A hypomotor seizure is a focal motor seizure with arrest.</td>
<td>new</td>
</tr>
<tr>
<td>hypermotor</td>
<td>Prominent bimanual or bipedal motor activity such as kicking and thrashing, clapping and rubbing of both hands, hugging, sometimes with sexual automatisms and autonomic changes with or without preserved awareness</td>
<td>Adapted from 33</td>
</tr>
<tr>
<td>immobility</td>
<td>see arrest</td>
<td>new</td>
</tr>
<tr>
<td>impaired awareness</td>
<td>see awareness. Impaired or lost awareness is a feature of focal impaired awareness seizures, previously called complex partial seizures. Impaired awareness is also seen in other seizure types</td>
<td>new</td>
</tr>
<tr>
<td>impairment of consciousness</td>
<td>see impaired awareness</td>
<td>new</td>
</tr>
<tr>
<td>Jacksonian seizure</td>
<td>traditional term indicating spread of clonic movements through contiguous body parts unilaterally.</td>
<td>10</td>
</tr>
<tr>
<td>motor</td>
<td>involves musculature in any form. The motor event could consist of an increase (positive) or decrease (negative) in muscle contraction to produce a movement.</td>
<td>10</td>
</tr>
<tr>
<td>myoclonic</td>
<td>sudden, brief (&lt;100 ms) involuntary single or multiple contraction(s) of muscle(s) or muscle groups of variable topography (axial, proximal limb, distal).</td>
<td>10</td>
</tr>
<tr>
<td>myoclonic-atonic</td>
<td>a generalized seizure type with a myoclonic jerk leading to an atonic drop. This type was previously called myoclonic-astatic and it is often associated with epilepsy with myoclonic-atonic seizures.</td>
<td>new</td>
</tr>
<tr>
<td>non-motor</td>
<td>focal or generalized seizure types that do not involve motor activity.</td>
<td>new</td>
</tr>
<tr>
<td>propagation</td>
<td>spread of seizure activity from one place in brain to another or engaging of additional brain networks</td>
<td>new</td>
</tr>
<tr>
<td>responsiveness</td>
<td>ability to appropriately react by movement or speech when presented with a stimulus</td>
<td>new</td>
</tr>
<tr>
<td>seizure</td>
<td>a transient occurrence of signs and/or symptoms due to abnormal excessive or synchronous neuronal activity in the brain.</td>
<td>20</td>
</tr>
<tr>
<td>sensory seizure</td>
<td>a perceptual experience not caused by appropriate stimuli in the external world.</td>
<td>10</td>
</tr>
<tr>
<td>spasm</td>
<td>see epileptic spasm</td>
<td></td>
</tr>
<tr>
<td>tonic</td>
<td>a sustained increase in muscle contraction lasting a few seconds to minutes.</td>
<td>10</td>
</tr>
<tr>
<td>tonic-clonic</td>
<td>a sequence consisting of a tonic followed by a clonic phase.</td>
<td>10</td>
</tr>
<tr>
<td>unaware</td>
<td>lacking knowledge of one’s surroundings. The term unaware can be used as shorthand for impaired awareness</td>
<td>new</td>
</tr>
<tr>
<td>unclassified</td>
<td>referring to a seizure type that cannot be described by the ILAE 2015 classification either because of inadequate information or unusual clinical features</td>
<td>new</td>
</tr>
<tr>
<td>unknown awareness</td>
<td>a seizure for which the degree of awareness cannot be specified</td>
<td>new</td>
</tr>
</tbody>
</table>
unknown onset | a seizure for which the type of onset – focal or generalized – cannot be specified | new |
--- | --- | --- |
unresponsive | not able to react appropriately by movement or speech when presented with stimulation | new |
versive | a sustained, forced conjugate ocular, cephalic, and/or truncal rotation or lateral deviation from the midline. | 10 |

**Method for classifying a seizure**

Elicit a description of the initial subjective symptoms and early visible behaviors during the seizure. If available, combine that description of semiology with EEG, MRI, other neuroimaging, laboratory tests and genetic information to decide whether the seizure is likely originating in networks of one hemisphere (*focal*) or becoming initially manifest in both hemispheres (*generalized*). If this determination cannot be made, then the initial seizure classification is *onset unknown*.

A seizure classification may stop at *focal*, *generalized* or *onset unknown*. If more information is available, further levels of classification will be possible. For *focal* seizures, ask the patient whether they had retained awareness and memory for events occurring during the seizures, even if they could not respond or understand language. If someone walked into the room during a seizure, would they later recall that person’s presence? Be careful to distinguish the ictal versus the postictal state, since awareness returns during the latter. A seizure is classified as *with impaired awareness* if there is unawareness for any part of the seizure. If the state of awareness is uncertain, then the seizure is classified as *focal with awareness unknown*. Questioning witnesses may clarify the nature of behavior during the seizure.

A *focal* seizure with or without awareness can have further manifestations that place it in motor or non-motor categories. Motor behaviors include tonic (sustained stiffening), clonic (rhythmic jerking), myoclonic (irregular, brief jerking), atonic (limp), hypermotor (pedaling, thrashing) or epileptic spasm manifestations. A focal aware seizure can produce somatosensory, olfactory, visual, auditory, gustatory, or vestibular sensations, each of which can be added as common descriptors. The common descriptors do not designate formal seizure types, but are just suggested terms to encourage uniformity. Most sensory seizures will be focal aware, at least at the onset of the seizure. In analogy to the old terminology of an aura followed by a complex partial seizure, the ILAE 2015 terminology might list a focal sensory seizure with impaired awareness.

An automatism is a common descriptor indicating repetitive, motor activity usually occurring when awareness is impaired and for which the subject is usually amnesic afterward. Ascertain from observers whether the subject is demonstrating repetitive purposeless fragments of behaviors that might appear normal in other circumstances. Table 1 lists several common automatisms, but the actual number of possible automatisms is as large as the number of possible human behaviors. Some automatisms could have been classified under the automatism or motor
category, for instance, pedaling or hypermotor. Automatisms may be seen in both focal and generalized absence seizures.

A focal [aware/impaired awareness] motor seizure with the common descriptor “arrest of activity” involves cessation of motor activity and unresponsiveness. The associated immobility can be a component of seizures with retained or impaired awareness. Activity arrest can be seen in a focal impaired awareness or a generalized absence seizure and this distinction may be difficult in a clinical setting. Generalized absence seizures (or more succinctly absence seizures) tend to be briefer, have quicker recovery and more frequently occur in childhood, but not with sufficient regularity to assure correct diagnosis. If available, EEG can help, showing focal discharges with focal seizures and generalized spikes, spike-waves or polyspike-waves with generalized seizures.

Focal [aware/impaired awareness] autonomic seizures present with gastrointestinal sensations, sense of heat or cold, flushing, piloerection (goosebumps), palpitations, respiratory changes or other autonomic effects.

Focal (aware) cognitive seizures can be diagnosed when the patient reports or exhibits symptoms of impairment of thinking, memory or associated higher cortical functions during seizures and when these symptoms outweigh other manifestations of the seizure.

Focal (aware) emotional seizures present with emotional changes, including fear, anxiety, agitation, anger, paranoia, pleasure, laughing (gelastic), crying (dacrystic). These phenomena are all subjective and must be recalled and reported by the patient.

Generalized tonic-clonic seizures can be hard to distinguish from some focal to bilateral tonic-clonic seizures when the focal component is not prominent. A nonspecific sense of a seizure coming on or turning head or eyes to one side at seizure onset may not rule out generalized onset.

The Task Force retained the distinction between absence typical and absence atypical, because the two types of seizures usually are associated with different epilepsy syndromes, therapies and prognoses. According to the 1981 classification 1, absence seizures are considered atypical when they are associated with changes in tone that are more pronounced than in typical absence or the onset and/or cessation is not abrupt. A myoclonic absence seizure includes an absence and myoclonic movements of the limbs. Eyelid myoclonia are myoclonic jerks of the eyelids and upward deviation of the eyes, often precipitated by closing the eyes or by light. Eyelid myoclonia can be associated with absences. Absence seizures with eyelid myoclonia, seizures or EEG paroxysms induced by eye closure and photosensitivity constitutes the triad of Jeavons’ syndrome.

Generalized myoclonic seizures can occur in isolation or in conjunction with tonic or atonic activity. Myoclonus differs from clonus by being briefer and not regularly repetitive. Myoclonus as a symptom has possible epileptic and non-epileptic etiologies.

Generalized tonic seizures manifest as stiffening of one or more limbs or of the neck. The classification presumes that the tonic activity is not followed by clonic movements. The tonic activity can be a sustained abnormal posture, either in extension or flexion, sometimes
accompanied by tremor of the extremities. Tonic activity can be difficult to distinguish from dystonic activity, defined as sustained contractions of both agonist and antagonist muscles producing athetoid or twisting movements, which, when prolonged, may produce abnormal postures.

Atonic means without tone. When leg tone is lost during a generalized atonic seizure, the patient falls on the buttocks or sometimes forward onto the knees and face. Recovery is usually within seconds. In contrast, tonic or tonic-clonic seizures more typically propel the patient into a backwards fall.

Generalized clonic-tonic-tonic seizures begin with a few rhythmical clonic jerks and then tonic-clonic activity. Such seizures are commonly seen in patients with juvenile myoclonic epilepsy, and occasionally other generalized epilepsies.

Epileptic spasms, previously referred to as infantile spasms, present as a sudden flexion, extension, or mixed extension–flexion of predominantly proximal and truncal muscles. They commonly occur in clusters and can be seen after infancy.

Seizures that present hallmarks of tonic-clonic seizures or epileptic spasms, but with origin obscured are classified as unknown onset tonic-clonic or unknown onset motor or epileptic spasms seizures. Subsequent information may allow reclassification of the seizures as focal or generalized in onset.

**What is different from the 1981 scheme?**

Table 4 summarizes the changes in the ILAE 2015 seizure type classification from the 1981 classification. Note that several of these changes were already incorporated into the 2010 revision of terminology and subsequent revisions. 5,32.

Table 4: Changes in Seizure Type Classification from 1981 to 2015 Scheme
1. Change of “partial” to “focal”
2. Certain seizure types can be either focal, generalized or onset unknown
3. Seizures of unknown onset can still be classified
4. Awareness is used as a classifier of focal seizures
5. The terms dyssynergic, simple partial, complex partial, psychic, secondarily generalized were eliminated.
6. Focal (unihemispheric) tonic, clonic, atonic, myoclonic and epileptic spasms seizure types are recognized, along with bilateral corresponding seizure types.

The net effect of updating the Classification of Seizures should be the following: 1. Render the choice of a seizure type easier for seizures that did not fit into any prior categories; 2. Clarify what is meant when a seizure is said to be of a particular type; 3. Provide more transparency of terminology to the nonmedical community.

**Examples**

1. **Tonic-clonic:** A woman awakens to find her husband having a seizure in bed. The onset is not witnessed, but she is able to describe bilateral stiffening followed by bilateral shaking. EEG and MRI are normal. This seizure is classified as *bilateral tonic-clonic, onset unknown*. There is no supplementary information to determine if the onset was focal or generalized. In the old classification, this seizure would have been unclassifiable.

2. **Focal to bilateral tonic-clonic:** In an alternate scenario of case #1, the EEG shows a clear right parietal slow wave focus. The MRI shows a right parietal region of cortical dysplasia. In this circumstance, the seizure can be classified as *focal to bilateral tonic-clonic*, despite the absence of an observed onset, because a focal etiology has been identified, and the overwhelming likelihood is that the seizure had a focal onset. The old classification would have classified this seizure as partial onset, secondarily generalized.

3. **Absence:** A child is diagnosed with Lennox-Gastaut syndrome of unknown etiology. EEG shows runs of slow spike-wave. Seizure types include absence, tonic, and focal motor seizures.
In this case, the absence seizures are classified as *generalized, atypical absence* due to the EEG pattern and underlying syndrome. The absence seizures would have had the same classification in the old system.

4. **Tonic**: The same child as in #3 has seizures with stiffening of the right arm and leg, during which responsiveness and awareness are retained. This seizure is a *focal aware tonic seizure* (the word “motor” can be assumed). In the old system, the seizure would have been called *tonic*, with a perhaps incorrect assumption of generalized onset.

5. **Focal with impaired awareness**: A 25 year old woman describes seizures beginning with 30 seconds of an intense feeling that “familiar music is playing.” She can hear other people talking, but afterwards realizes that she could not determine what they were saying. After an episode, she is mildly confused, and has to “reorient herself.” The seizure would be classified as *focal with impaired awareness*. Even though the patient is able to interact with her environment, she cannot interpret her environment, and is mildly confused.

6. **Autonomic**: A 22 year-old man has seizures during which he remains fully aware, with the “hair on my arms standing on edge” and a feeling of being flushed. These are classified as *focal aware nonmotor autonomic*, or more succinctly *focal aware autonomic*. The old classification would have called them simple partial autonomic seizures.

7. **Myoclonic-atonic**: A 4 year-old boy with myoclonic-atonic epilepsy (Doose syndrome) has seizures with a few arm jerks, then a limp drop to the ground. These are now classified as *generalized myoclonic atonic seizures*. The old classification would have called these myoclonic astatic seizures.

8. **Clonic-tonic-clonic seizures**: A 35 year-old man with juvenile myoclonic epilepsy has seizures beginning with a few regularly-spaced jerks, followed by stiffening of 4 limbs and then rhythmic jerking of all 4 limbs. This would be classified as *generalized clonic-tonic-clonic seizures*. No corresponding single seizure type existed in the old classification, but they might have been called myoclonic seizures followed by a tonic-clonic seizure.

9. **Focal epileptic spasms**: A 14-month old girl has sudden flexion of both arms with head flexing forward for about 2 seconds. These seizures repeat in clusters. EEG shows hypsarrhythmia with bilateral spikes, most prominent over the left parietal region. MRI shows a left parietal dysplasia. Because of the ancillary information, the seizure type would be considered to be *focal epileptic spasms* (the term “motor” can be assumed). The previous classification would have called them infantile spasms, with information on focality not included.

10. **Unclassified**: A 75 year-old man reports an internal sense of body trembling. No other information is available. EEG and MRI are normal. This event is *unclassified* and may or may not even be a seizure.
Key Points

- The ILAE has constructed a revised classification of seizure types. The classification is operational and not based on fundamental mechanisms.

- Reasons for revision include clarity of nomenclature, ability to classify some seizure types as either focal or generalized, and classification when onset is unknown.

- Seizures are divided into focal, generalized, onset unknown, with subcategories of motor, non-motor, with retained awareness, impaired or unknown.

- Glossaries of new seizure terms, of common descriptive terms for behaviors during seizures and mapping tables of old to new terms are provided, along with examples.

Acknowledgements

Funding for this study was provided by the International League Against Epilepsy. The lead author (RSF) was supported by the Maslah Saul MD Chair, the James & Carrie Anderson Fund for Epilepsy, the Susan Horngren Fund and the Steve Chen Research Fund.

Disclosures

Disclosures relevant to classification: Dr. Fisher has stock options from Avails Pharmaceuticals, Cerebral Therapeutics, Applied Neurometrics, Zeto, SmartMonitor and research grants from Medtronic. J. A. French discloses support via The Epilepsy Study Consortium, which pays Dr French’s university employer for her consultant time related to Acorda, Alexza, Anavex, BioPharm Solutions, Concert, Eisai, Georgia Regents University, GW Pharma, Marathon, Marinus, Neurelis, Novartis, Pfizer, Pfizer-Neusentis, Pronutria, Roivant, Sage, SciFluor, SK Life Sciences, Takeda, Turing, UCB Inc., Ultragenyx, Upsher Smith, Xenon Pharmaceuticals, Zynera grants and research from Acorda, Alexza, LCGH, Eisai Medical Research, Lundbeck, Pfizer, SK Life Sciences, UCB, Upsher-Smith, Vertex, grants from NINDS, Epilepsy Therapy Project, Epilepsy Research Foundation, Epilepsy Study Consortium; She is on the editorial board of Lancet Neurology, Neurology Today and Epileptic disorders, and was an Associate Editor of Epilepsia, for which she received a fee. Dr. Moshé receives from Elsevier an annual compensation for his work as Associate Editor in Neurobiology of Disease and royalties from 2 books he co-edited. He received a consultant’s fee from Lundbeck, Eisai and UCB. The remaining authors listed no disclosures relevant to the classification of seizure types.
References


Bergen DC, Beghi E, Medina MT. Revising the ICD-10 codes for epilepsy and seizures. Epilepsia 2012;53 Suppl 2:3-5.


Centeno M, Carmichael DW. Network Connectivity in Epilepsy: Resting State fMRI and EEG-
fMRI Contributions. Front Neurol 2014;5:93.


Porter RJ, Penry JK. Responsiveness at the onset of spike-wave bursts. Electroencephalogr Clin
Neurophysiol 1973;34:239-245.


