

SPECIAL REPORT

Indications and expectations for neuropsychological assessment in routine epilepsy care: Report of the ILAE Neuropsychology Task Force, Diagnostic Methods Commission, 2013-2017*

Sarah J. Wilson¹, Sallie Baxendale², William Barr³, Sherifa Hamed⁴, John Langfitt⁵, Séverine Samson⁶, Masako Watanabe⁷, Gus A. Baker⁸, Christoph Helmstaedter⁹, Bruce P. Hermann¹⁰, and Mary-Lou Smith¹¹.

1. Melbourne School of Psychological Sciences, The University of Melbourne and Comprehensive Epilepsy Program, Austin Health, Melbourne, Australia
2. Department of Clinical and Experimental Epilepsy, UCL Institute of Neurology, NIHR University College London Hospitals Biomedical Research Centre, London, UK
3. Departments of Neurology & Psychiatry, NYU School of Medicine, New York, USA
4. Department of Neurology & Psychiatry, Assiut University Hospital, Assiut, Egypt
5. Departments of Neurology & Psychiatry, University of Rochester Medical Center, Rochester, New York, USA
6. Epilepsy Unit, la Pitié-Salpêtrière Hospital, Paris, France and Neuropsychology and Auditory Cognition, University Lille-Nord de France
7. Department of Psychiatry, The National Center of Neurology & Psychiatry, Tokyo, Japan
8. University Department of Neurosciences, Walton Centre for Neurology and Neurosurgery, Liverpool, UK
9. Department of Epileptology, University of Bonn, Bonn, Germany
10. Department of Neurology, University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin, USA
11. Department of Psychology, University of Toronto Mississauga and Neurosciences and Mental Health Program, The Hospital for Sick Children, Toronto, Canada

Running Title: Neuropsychological assessment in epilepsy

Address correspondence to Sarah J. Wilson, Melbourne School of Psychological Sciences, 12th Floor, Redmond Barry Building, The University of Melbourne, Parkville, 3010, Australia. Ph: +61 3 8344-6377; Fax: +61 3 9347-6618; E-mail: sarahw@unimelb.edu.au

Number of text pages: 17

Number of words: 3,658

Number of Tables: 1

Number of Figures: 1

* This report was written by experts selected by the International League Against Epilepsy (ILAE) and was approved for publication by the ILAE. Opinions expressed by the authors, however, do not necessarily represent the policy or position of the ILAE.

SUMMARY

The International League Against Epilepsy (ILAE) Diagnostic Methods Commission charged the Neuropsychology Task Force with the job of developing a set of recommendations to address the following questions: (i) What is the role of a neuropsychological assessment? (ii) Who should do a neuropsychological assessment? (iii) When should people with epilepsy be referred for a neuropsychological assessment? and (iv) What should be expected from a neuropsychological assessment? The recommendations have been broadly written for health care clinicians in established epilepsy settings as well as those setting up new services. They are based on a detailed survey of neuropsychological assessment practices across international epilepsy centres, and a formal ranking of specific recommendations for advancing clinical epilepsy care generated by specialist epilepsy neuropsychologists from around the world. They also incorporate the latest research findings to establish minimum standards for training and practice, reflecting the many roles of neuropsychological assessment in the routine care of children and adults with epilepsy. The recommendations endorse routine screening of cognition, mood and behaviour in new onset epilepsy, and describe the range of situations when more detailed, formal neuropsychological assessment is indicated. They identify a core set of cognitive and psychological domains that should be assessed to provide an objective account of an individual's cognitive, emotional and psychosocial functioning, including factors likely contributing to deficits identified on qualitative and quantitative examination. The recommendations also endorse routine provision of feedback to patients, families and clinicians about the implications of the assessment results, including specific clinical recommendations of what can be done to improve a patient's cognitive or psychosocial functioning and alleviate the distress of any difficulties identified. By canvassing the breadth and depth of scope of neuropsychological assessment, this report demonstrates the pivotal role played by this noninvasive and minimally resource intensive investigation in the care of people with epilepsy.

KEY WORDS: neuropsychology, assessment, training, minimum standards, adult, paediatric

The role of neuropsychology in the assessment and treatment of people with epilepsy is constantly evolving in response to new classifications of the disorder, rapid advances in neuroimaging and genetic techniques, the development of new treatments, and improved understanding of the nature, timing and causes of cognitive problems. At a meeting held in Washington DC in December 2013, members of the ILAE Diagnostic Methods Commission asked the Neuropsychology Task Force to create and disseminate recommendations to answer the following questions:

- i. What is the role of a neuropsychological assessment?
- ii. Who should do a neuropsychological assessment?
- iii. When should people with epilepsy be referred for a neuropsychological assessment?
- iv. What should be expected from a neuropsychological assessment?

The following recommendations have been written to be broad enough to assist health care clinicians in established epilepsy centres and community settings, as well as those who are involved in setting up new services. It is explicitly recognized that these recommendations may be difficult (if not impossible) to implement in certain low- and middle-income settings where specialist training is not available and there are large treatment gaps for basic health care interventions. In these settings, these recommendations should be viewed as aspirational and a resource for lobbying local health organizations to expand training and access for neuropsychological services.

Methods

The recommendations build on the work of the former ILAE Neuropsychology Task Force (2009-2013) that comprehensively examined models of neuropsychological care in people with epilepsy, and undertook a formal process of ranking a large set of specific recommendations for advancing clinical care in epilepsy generated by more than 50 epilepsy specialists from 13 countries with expertise relevant to adult and paediatric neuropsychology.¹ In addition, a detailed survey of neuropsychological assessment practices in epilepsy was conducted across 17 countries to identify common practices in the field.² The results endorsed assessment of a core set of cognitive and psychological domains in people with epilepsy that are directly reflected in the current recommendations.^{2,3} The recommendations are also informed by the latest research findings, and the outcome of detailed discussions between specialist epilepsy neuropsychologists from around the world serving on the current ILAE Neuropsychology Task Force (2013-2017), with the aim of providing a representative, consensus view.

The recommendations are broadly focused on the role of neuropsychological assessment in the routine care of children and adults with epilepsy across a diversity of health care settings. The long-standing role that neuropsychology has played in the diagnostic work-up of patients

admitted for surgical characterisation and associated specialized topics⁴ will be addressed in the second report in this series.

WHAT IS THE ROLE OF A NEUROPSYCHOLOGICAL ASSESSMENT?

The role of a neuropsychological assessment in the routine care of people with epilepsy is to provide a comprehensive and objective assessment of an individual's cognitive and psychological functioning. This is typically for the purpose of addressing a referral question, taking account of the patient's medical history and broader psychosocial functioning. At times this role may be diagnostic, given that impairments in cognition or behaviour can provide clues to the lateralisation or localisation of the seizure network, or the nature of the epilepsy syndrome. It may also involve differentiating the neurological, psychological and social processes impacting upon a patient's clinical presentation at a given point in time, to inform clinical decision-making and the provision of optimal treatment. At other times the role may be prognostic, with assessments used to monitor and estimate the impact of ongoing seizures or a particular treatment on the future cognitive and behavioural functioning of an individual. Moreover, the role typically involves psychoeducation of patients and families about the nature and implications of the assessment results, addressing the impact of epilepsy on the patient and family, management of cognitive or behavioural co-morbidities, and any educational, vocational or psychosocial difficulties. It may also extend to the provision of psychological, cognitive or behavioural treatments to assist patients with cognitive and psychosocial functioning in day-to-day life.

Given these many and varied roles, it goes without saying that neuropsychological assessment in epilepsy involves more than just the administration, scoring and interpretation of tests. It requires the training and background to synthesize information from the tests, combined with a carefully-taken biopsychosocial history, other neurodiagnostic test results, and behavioural observations to communicate the results and their implications effectively to patients, families and clinicians. Needless to say, this cannot be achieved just through the use of screening or computerized assessment batteries, or evaluations based primarily on patient self-report. While these procedures provide useful ways of identifying individuals who may require more detailed neuropsychological assessment, they should be considered adjunct procedures rather than a substitute for neuropsychological assessment. At the core of neuropsychological assessment in people with epilepsy is an understanding that epilepsy arises from a disease of brain networks that support normal developmental and aging processes through complex and dynamically changing cognitive and behavioural functions,⁵ the assessment of which lies at the interface of mind, brain and behaviour.

WHO SHOULD DO A NEUROPSYCHOLOGICAL ASSESSMENT?

Trained personnel

Neuropsychological assessments should only be conducted by individuals who have undergone specialist training in clinical neuropsychology. This may involve the assistance of a psychometrician working under the supervision of a clinical neuropsychologist. In some parts of the world training is in addition to basic training as a clinical psychologist, whereas in other regions, neuropsychologists train separately. Neuropsychological training requires detailed knowledge of brain-cognition-behaviour relationships, based on rigorous training in brain anatomy and function as well as cognitive processes of the human mind and their disorders. It also requires a comprehensive understanding of the psychometric properties of standardised cognitive and behavioural assessments, their skilled delivery and clinical interpretation. This specialist training, combined with the experience of working with general neurological or psychiatric populations, forms the bedrock of core competencies within the profession. Additional epilepsy-specific training is then required to develop expertise in assessing the relative contributions of neurological, cognitive, psychosocial, and cultural factors to the neuropsychological profiles of people with epilepsy⁶ (Figure 1). In some, but not all parts of the world, epilepsy-specific training is associated with formal credentials and boarding procedures. Furthermore, for those working with children, training in developmental psychology and developmental neuropsychology is essential, because brain-behaviour relationships differ between adults and children.

(Insert Figure 1 about here)

WHEN SHOULD PEOPLE WITH EPILEPSY BE REFERRED FOR AN ASSESSMENT?

At epilepsy onset for routine screening of cognitive or behavioural difficulties

In children and adults, cognitive or behavioural difficulties may already be present at seizure onset, with a clinical history of problems or complaints preceding diagnosis. Research has clearly shown that approximately half of newly diagnosed children or adults with epilepsy have demonstrable cognitive or behavioural difficulties on testing.⁷⁻⁹ Thus, we recommend at a minimum routine screening for cognitive and behavioural difficulties in all children and adults newly diagnosed with epilepsy, accompanied by the provision of advice on the risks of cognitive and behavioural difficulties associated with the condition. As noted above, routine screening provides an efficient and relatively inexpensive method for identifying people who require a more detailed (and expensive) neuropsychological assessment. Given the insidious evolution of some epilepsies, it can also provide a minimal baseline from which to measure the cognitive course of the disease, or the effects of subsequent treatment. In addition to computerized assessment batteries or self-report questionnaires, screening may involve clinician questioning of the patient's subjective cognitive complaints, such as attention,

memory or word finding difficulties. Psychological adjustment problems or mood disorder may also be present at diagnosis, for which the patient and family may benefit from psychoeducation or psychological treatment.¹⁰ The benefits of brief or targeted interventions at onset may extend to longer-term medical outcomes, as mood and adjustment difficulties at the time of diagnosis have been shown to predict seizure recurrence.¹¹

When there are signs or symptoms of a focal cognitive impairment

When cognitive deficits are suspected, a neuropsychological assessment provides an objective measure of the extent to which these deficits are global or more focal and limited to particular domains. The primary purpose of the assessment can be to gauge a person's current cognitive functioning without consideration of aetiological factors. Alternatively, focal symptoms or signs of memory difficulties or other cognitive problems can be used to provide critical diagnostic information about the syndrome, lesion location, or seizure network underpinning the patient's epilepsy. The assessment may also be used to identify the presence of atypical cognitive organisation for particular functions (i.e., reversed language dominance), or to differentiate ictal from inter-ictal cognitive and behavioural effects.

In adults with well-controlled epilepsy, memory difficulties are often the only daily manifestation of their condition, and their subjective complaints may be frequent. These complaints may reflect psychological (depression or anxiety) or neurocognitive mechanisms depending on the location of the epileptogenic focus. Neuropsychological assessment may help differentiate between these two explanations and inform treatment decisions.¹² Moreover, while subjective memory difficulties may be the presenting complaint, oftentimes the fundamental cognitive problem may lie in other areas. For example, word finding difficulties may give rise to a subjective memory complaint that indicates pathology in the language network rather than the memory system per se.

In the absence of patient subjective complaints, family reports of difficulties with particular functions like memory, attention or disorganisation in daily life may trigger the need for an assessment, particularly in people with frontal lobe dysfunction who lack insight into their difficulties. Screening or formal assessment may also be indicated in patients with epilepsies that have been traditionally considered cognitively 'benign', such as the genetic generalized epilepsies and other syndromes.¹³⁻¹⁵ Alternatively, memory or other cognitive difficulties may become apparent upon assessment, providing an independent and objective basis for educating the patient and others about the neurologic basis of the problem and justifying a referral for intervention. Early referral and intervention is particularly pertinent in cases where difficulties may be reversible.

In children, attention and memory difficulties may be reported by family members and/or school staff and may also be apparent on clinical examination. Memory deficits are more likely to be apparent in adolescents than in younger children.^{16,17} Even in children with focal epilepsy, cognitive impairments may be diffuse and affect multiple domains, with similarities

in impairments noted between many epilepsy syndromes.¹⁸ Thus, it is important to ask about cognitive deficits, and not rely on the idea of syndrome-specific disorders. Because of developmental changes, the child's pattern of cognitive strengths and weaknesses may also change over time. Likewise, as the complexity of academic demands increases in higher grade levels, children who did well in school in earlier years may begin to struggle. For these reasons, repeat assessments over time may be warranted to provide the necessary supports for children and their families.

When there is a question of neurodevelopmental delay, behavioural or learning difficulties, or cognitive decline

In children with epilepsy, developmental delay may be obvious. In this case, longitudinal neuropsychological assessments can be used to quantify and track a child's progress across multiple domains (cognitive, behavioural, emotional, social) and ensure that appropriate educational, family and social supports are in place. In others with apparently normal development, problems at home or recent onset of learning difficulties at school may point to underlying cognitive decline, with a slowed rate of cognitive development and gradual falling behind, or a premature plateau in development.^{17,19} Here again, neuropsychological assessment can be used to characterise and quantify any difficulties and monitor development over time so that available treatments or supports may be implemented.

In adults, problems with work, memory, or adaptive skills may have an insidious onset, only gradually coming to the attention of the patient or family. Although the rate of normal age-related decline in cognitive function is similar in people with epilepsy to that in the healthy population, many start from a lower base and so develop disabling cognitive or behavioural problems earlier in life.¹⁷ Repeated head injuries, episodes of status, and atypical seizure clusters may also precipitate or exacerbate cognitive decline.²⁰⁻²² In these cases, serial neuropsychological assessments again ensure any decline is carefully documented, and provide backing for initiating appropriate treatment, and vocational and community supports.

When evaluating the effects of the disorder and its treatment

Serial neuropsychological assessments provide an invaluable tool for guiding and evaluating treatment effects, detecting clinically meaningful changes in cognition or behaviour associated with medication changes or following neurosurgery in adult and paediatric populations. For instance, in drug naïve patients with new onset epilepsy a baseline neuropsychological assessment forms the platform from which to reliably detect drug effects on repeat assessments.²³ The assessment may also be valuable in detecting non-compliance with treatment regimes, revealing the presence of a deficit in memory, language or executive function that prevents a patient from being able to follow the schedule of medication dosing prescribed by the physician. In this case the findings indicate that non-compliance is not a matter of will or motivation but rather an inherent limitation in the person's ability to

comprehend or follow instructions. Accelerated forgetting may also be evident in some patients, who perform well on standard neuropsychological assessment, but display rapid loss of newly learned information over the following days or weeks. Accelerated forgetting is a common, persistent memory complaint after transient epileptic amnesia (TEA), and may be best detected by repeat assessments targeting anterograde memory function over a short time interval.²⁴

When not to refer

Other than in certain circumstances, people are not routinely referred for a repeat neuropsychological assessment within six to nine months of a previous assessment. Practice effects can obscure deterioration on tests that would otherwise be sensitive to pathological decline. This is particularly true for measures of attention, memory, speed of information processing and higher-level executive functions.²⁵ Exceptions to this rule of thumb include when someone has experienced an episode of status epilepticus or other major event or illness that may have resulted in a significant stepwise deterioration of function.

Neuropsychological assessment may also be impractical and add limited information in the setting of an acute insult or illness that is expected to recover over a short period of time. This includes assessment of patients during the post-ictal phase, where diffuse cerebral dysfunction produced by a seizure provides limited diagnostic information. Rather, the level of impairment and evolution of recovery in the acute setting may be evaluated more efficiently by brief bedside examination of basic cognitive functions.²⁶ This type of assessment can also be useful when evaluating a patient's ability to provide informed consent in the acute setting.

WHAT CAN BE EXPECTED FROM AN ASSESSMENT?

Reliable and valid test results

Since this report focuses on the importance of neuropsychological assessment for addressing core clinical questions in people with epilepsy, we are not going to recommend specific cognitive tests or neuropsychological assessment batteries. Test batteries have been previously recommended,^{27,28} but are subject to regional variations and need to take cultural and linguistic factors into account.²⁹ Here, we recommend that at a minimum a neuropsychological assessment cover a core set of cognitive domains that are universal (Table 1). These domains should be tested using standardised measures with robust psychometric properties, and culturally specific, up-to-date norms. In some countries, standard tests of effort are also routinely used to ensure reliability of assessment results. For serial assessments, reliable change indices or standardised regression-based measures should be used to assess change over time.³¹ Whilst a core battery of tests can be valuable, an increasingly common approach is to use a flexible battery with additional tests tailored to the clinical referral question and the individual needs of the patient. This allows careful

assessment of the functioning of specific domains, based on hypotheses generated from clinical interview, observation of the patient, and review of medical records. Such flexibility is especially important for the approach to assessment with children, as tests need to be age-sensitive and appropriate for the child's developmental level.

(Insert Table 1 about here)

It should be noted that most neuropsychological tests and their normative databases have been developed in upper-income settings. While there is a clear need to adapt them to other low- and middle-income settings, this needs to proceed carefully and deliberately. Test item content may be highly culture-bound. Some people in these settings may have limited experience in school and thus may be less familiar with the goals and processes of assessment. Whenever possible, validation studies should be carried out in local populations and local norms developed. Also relevant is the emerging global issue of an aging world population and the need for validation studies in elderly patients with epilepsy. Given the increased risk of both epilepsy and neurocognitive disorders with advancing age, we recommend routine neuropsychological assessment in elderly patients, particularly in those with new onset epilepsy.³²

Psychological assessment

It is important not to forget the 'psychological' in a neuropsychological assessment. This involves evaluating the impact that epilepsy is having on the individual and the family, including patient and family beliefs about the disorder, its perceived stigma, and available coping resources. Typically, this assessment will cover a range of psychosocial domains, including the patient's mood and psychological functioning, as well as physical, educational/vocational, family and social functioning (Table 1). Quantitative metrics derived from measures of health related quality of life, such as the Minimum Clinically Important Difference (MCID), assess the impact of epilepsy across these domains, including the extent of any change following treatment.³³ Dimensional measures of personality and mood, and behavioural symptom checklists can provide additional information about psychopathology and behavioural co-morbidities, including potential risk and protective factors relevant to individual patients. Given the high co-morbidity of depression and anxiety in epilepsy, risk for depression and its complications (such as suicide) should be screened for routinely.^{34,35} Such information is vital to disentangling the neurological, psychological and social factors contributing to a patient's clinical presentation, and in some instances, may lead to a recommendation for formal psychiatric evaluation as an outcome of the neuropsychological assessment.

Qualitative assessment

Qualitative approaches, such as clinical interview and careful observation of a patient's presentation and behaviour, form an integral part of the neuropsychological assessment,

informing case formulation and clinical recommendations. At the very least, a neuropsychological assessment should include a detailed history of cognitive and behavioural complaints, and an account of their subjective impact on everyday function. Careful characterisation and delineation of ictally-related as compared to inter-ictal changes in cognition and behaviour are imperative for providing an accurate neuropsychological assessment. Likewise, a clear history of the timing of cognitive or behavioural changes relative to seizure frequency and specific treatment interventions can be fundamental to guiding clinical decision-making and future treatments. For patients presenting acutely, or otherwise not amenable to psychometric testing, a qualitative assessment or bedside neurobehavioural examination may provide the only viable means of directly evaluating the patient's current cognitive and psychological status. Observer-based measures or detailed clinical interview with carers and/or family members provide other important perspectives. In the latter case, it is worth keeping in mind that family aggregation of cognitive or psychiatric issues may be pertinent to the attribution of difficulties observed in the patient.

Case formulation

A neuropsychological assessment should provide the referring clinician with an objective profile of cognitive function across multiple cognitive domains. This should include a clear description of the cognitive strengths and weaknesses of the patient relative to estimated premorbid levels of functioning. The case formulation should also address the patient's emotional and psychosocial profile, and identify factors likely contributing to any deficits identified on qualitative and quantitative examination. From mood to medication, these factors are heterogeneous and can be fixed or fluctuating, irreversible or remediable (Figure 1), informing clinical decisions relating to diagnosis, prognosis and treatment.

Feedback and clinical recommendations

A neuropsychological assessment should also provide clear advice about the clinical implications of the assessment results, including the need for any future reviews or other investigations and when these might best occur. Providing feedback to patients and families forms a key part of the assessment process and can have direct therapeutic benefits, enhancing cognitive and emotional wellbeing.³⁶ Feedback typically includes psychoeducation about the nature of perceived cognitive difficulties, their basis and relationship to the epilepsy, as well as any other psychological factors that are relevant. Specific clinical recommendations should be made about what (if anything) can be done to improve a patient's cognitive or psychosocial functioning to alleviate the distress of any difficulties identified. Evidence for neuroplasticity in the paediatric and adult brain underpins an expanding literature on neurorehabilitation and the use of cognitive retraining to assist patients with memory or other cognitive deficits after brain injury.³⁷ Whilst epilepsy research in this area is still in its infancy, a number of studies have demonstrated effective cognitive rehabilitation strategies

for impairments of attention and memory in patients with epilepsy.³⁸⁻⁴⁰ These strategies include cognitive retraining paradigms and compensatory strategies to circumvent difficulties in daily life, which can be recommended alongside of educational, vocational or community supports to assist patient and family psychosocial functioning.⁴¹ Where relevant, psychological treatments such as cognitive behaviour therapy or anxiety management, can also be recommended to assist patient and family adjustment to epilepsy, complementing medical therapies.⁴²⁻⁴⁴

CONCLUSIONS

Neuropsychological assessment is a noninvasive and minimally resource intensive investigation in people with epilepsy. There has been a long and productive relationship between neuropsychology and epilepsy, perhaps more so than in any other condition, and while this relationship has grown from the specific area of epilepsy surgery, it has now extended far outside this area. Given its breadth and depth of scope, neuropsychological assessment remains a pivotal investigation in the routine care of people with epilepsy that provides unique information about brain functioning, even in our current age of neuroimaging. Its strength lies in its consideration of the whole person embedded within a broader social and cultural context, bringing together complex, interacting processes of mind, brain and behaviour that directly inform diagnosis, prognosis and treatment. Considered in this light, the current challenges associated with treating epilepsy and its often broad psychosocial effects call for increased use of neuropsychological services across international epilepsy settings to complement the range of other diagnostic and treatment modalities required to improve the care of people with epilepsy in the 21st century.

ACKNOWLEDGEMENTS

The authors would like to thank Prof Ingmar Blümcke, Chair of the Diagnostic Methods Commission (2013-2017), and Professor Sam Wiebe, Treasurer of the ILAE, for their instructive comments on earlier drafts of this report.

DISCLOSURE OF CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

REFERENCES

1. Helmstaedter C, Hermann B, Lassonde M, Kahane P, Arzimanoglou A. Eds. *Neuropsychology in the Care of People with Epilepsy*. Progress in Epileptic Disorders (Vol. 11). France: John Libbey Eurotext, 2011.
2. Djordjevic J, Jones-Gotman M. Inquiry on assessments across epilepsy centres in different countries. In Helmstaedter C, Hermann B, Lassonde M, Kahane P, Arzimanoglou A. Eds. *Neuropsychology in the Care of People with Epilepsy*. Progress in Epileptic Disorders (Vol. 11). France: John Libbey Eurotext, 2011:13-26.
3. Jones-Gotman M, Smith ML, Risse GL, Westerveld M, Swanson SJ, Giovagnoli AR, Lee T, Mader-Joaquim MJ, Piazzini A. The contribution of neuropsychology to diagnostic assessment in epilepsy. *Epilepsy Behav* 2010;18:3-12.
4. Wilson SJ, Engel Jr J. Diverse perspectives on developments in epilepsy surgery. *Seizure* 2010;19:659-668.
5. Wilson SJ, Baxendale S. The new approach to classification: Rethinking cognition and behavior in epilepsy. *Epilepsy Behav*, 2014;41:307-310.
6. Baxendale S, Thompson P. Beyond localization: the role of traditional neuropsychological tests in an age of imaging. *Epilepsia* 2010;51:2225-2230.
7. Taylor J, Kolamunnage-Dona R, Marson AG, Smith PEM, Aldenkamp AP, Baker GA. Patients with epilepsy: cognitively compromised before start of antiepileptic drug treatment? *Epilepsia* 2009;51:48-56.
8. Witt JA, Helmstaedter C. Should cognition be screened in new-onset epilepsies? A study in 247 untreated patients. *J Neurol* 2012;259:1727-1731.
9. Witt JA, Werhahn KJ, Krämer G, Ruckes C, Trinka E, Helmstaedter C. Cognitive-behavioral screening in elderly patients with new-onset epilepsy before treatment. *Acta Neurol Scand* 2014;DOI:10.1111/ane.12260.
10. Velissaris SL, Wilson SJ, Saling MM, Newton MR, Berkovic SF. The psychological impact of a newly diagnosed seizure: losing and restoring perceived control. *Epilepsy Behav* 2007;10:223-233.
11. Velissaris SL, Saling MM, Newton MR, Berkovic SF, Wilson SJ. Psychological trajectories in the year after a newly-diagnosed seizure. *Epilepsia* 2012;53:1774-1781.
12. Rayner G, Wrench JM, Wilson SJ. Differential contributions of objective memory and mood to subjective memory complaints in refractory focal epilepsy. *Epilepsy Behav* 2010;19:359-364.
13. Loughman A, Bowden SC, D'Souza W. Cognitive functioning in idiopathic generalised epilepsies: A systematic review and meta-analysis. *Neurosci Biobehav Rev* 2014;43:20-34.

14. Caplan R, Siddarth P, Stahl L, Lanphier E, Vona P, Gurbani S, Koh S, Sankar R, Shields WD. Childhood absence epilepsy: Behavioral, cognitive, and linguistic comorbidities. *Epilepsia* 2008;49:1838-1846.
15. Overvliet GM, Aldenkamp AP, Klinkenberg S, Nicolai J, Vles JSH, Besseling RMH, Backes W, Jansen JFA, Hofman PA, Hendriksen Jos. Correlation between language impairment and problems in motor development in children with rolandic epilepsy. *Epilepsy Behav* 2011;22:527-531.
16. Gascoigne MB, Smith ML, Barton B, Webster R, Gill D, Lah S. Accelerated long-term forgetting in children with temporal lobe epilepsy. *Neuropsychologia* 2014;59C:93-102.
17. Helmstaedter C, Elger CE. Chronic temporal lobe epilepsy: a neurodevelopmental or progressively dementing disease? *Brain* 2009;132:2822-2830.
18. Jackson DC, Dabbs K, Walker NM, Jones JE, Hsu DA, Stafstrom CE, Seidenberg M, Hermann BP. The neuropsychological and academic substrate of new/recent-onset epilepsies. *J Pediat* 2013;162:1047-1053.
19. Blume WT. The progression of epilepsy. *Epilepsia* 2006;47(Suppl. 1):71-78.
20. Neligan A, Shorvon SD. Prognostic factors, morbidity and mortality in tonic-clonic status epilepticus: a review. *Epilepsy Res* 2011;93:1-10.
21. Helmstaedter C. Cognitive outcome of status epilepticus in adults. *Epilepsia* 2007;48(Suppl. 8):85-90. Erratum in: *Epilepsia* 2007;48:2384.
22. Tinuper P, Cerullo A, Marini C, Avoni P, Rosati A, Riva R, Baruzzi A, Lugaresi E. Epileptic drop attacks in partial epilepsy: clinical features, evolution, and prognosis. *J Neurol Neurosurg Psychiatry* 1998;64:231-237.
23. Baker GA, Taylor J, Aldenkamp AP. Newly diagnosed epilepsy: cognitive outcome after 12 months. *Epilepsia* 2011;52:1084-1091.
24. Butler CR, Zeman A. Recent insights into the impairment of memory in epilepsy: a systematic review of transient epileptic amnesia, accelerated long-term forgetting and remote memory impairment. *Brain* 2008;131:2243-2263.
25. Calamia M, Markon K, Tranel D. The robust reliability of neuropsychological measures: meta-analyses of test-retest correlations. *Clin Neuropsychol* 2013;27:1077-1105.
26. Strub RL, Black W. *The Mental Status Examination in Neurology* (4th edition). Philadelphia: FA Davis Company, 2000.
27. Jones-Gotman M, Smith ML, Risse GL, Westerveld M, Swanson SJ, Giovagnoli AR, Lee T, Mader-Joaquim MJ, Piazzini A. The contribution of neuropsychology to diagnostic assessment in epilepsy. *Epilepsy Behav* 2010;18:3-12.
28. Loring DW, Lowenstein DH, Barbaro NM, Fureman BE, Odenkirchen J, Jacobs MP, Austin JK, Dlugos DJ, French JA, Gaillard WD, Hermann BP, Hesdorffer DC, Roper SN, Van Cott AC, Grinnon S, Stout A. Common data elements in epilepsy research:

- development and implementation of the NINDS epilepsy CDE project. *Epilepsia* 2011;52:1186-1191.
29. Helmstaedter C, Witt J. Clinical neuropsychology in epilepsy: theoretical and practical issues. In Stefan H, Theodore WH. Eds. *Part 1: Epilepsy*. Handbook of Clinical Neurology (3rd series, Vol. 107). Elsevier, 2012:437-459.
 30. Giovagnoli AR. Theory of mind in epilepsy patients and implications for behaviour. In Helmstaedter C, Hermann B, Lassonde M, Kahane P, Arzimanoglou A. Eds. *Neuropsychology in the Care of People with Epilepsy*. Progress in Epileptic Disorders (Vol. 11). France: John Libbey Eurotext, 2011:263-271.
 31. Hermann BP, Seidenberg M, Schoenfeld J, Peterson J, Leveroni C, Wyler AR. Empirical techniques for determining the reliability, magnitude, and pattern of neuropsychological change after epilepsy surgery. *Epilepsia* 1996;37:942-950.
 32. Hermann B, Seidenberg M, Sager M, Carlsson C, Gidal B, Sheth R, Rutecki P, Asthana S. Growing old with epilepsy: the neglected issue of cognitive and brain health in aging and elder persons with chronic epilepsy. *Epilepsia* 2008;49:731-740.
 33. Wiebe S, Matijevic S, Eliasziw M, Derry PA. Clinically important change in quality of life in epilepsy. *J Neurol Neurosurg Psychiatry* 2002;73:2116-2120.
 34. Hesdorffer DC, French JA, Posner K, DiVentura B, Pollard JR, Sperling MR, Harden CL, Krauss GL, Kanner AM. Suicidal ideation and behavior screening in intractable focal epilepsy eligible for drug trials. *Epilepsia* 2013;54:879-887.
 35. Jones JE, Siddarth P, Gurbani S, Shields WD, Caplan R. Screening for suicidal ideation in children with epilepsy. *Epilepsy Behav* 2013;29:521-526.
 36. Gorske TT, Smith SR. Collaborative Therapeutic Neuropsychological Assessment. New York: Springer Publications, 2009.
 37. Kleim JA, Jones TA. Principles of experience-dependent neural plasticity: Implications for rehabilitation after brain damage. *J Speech, Lang, Hear Res* 2008;51:S225-239.
 38. Engelberts NHJ, Klein M, Adèr HJ, Heimans JJ, Kasteleijn-Nolst Trenité DGA, Van der Ploeg HM. The effectiveness of cognitive rehabilitation for attention deficits in focal seizures: A randomized controlled study. *Epilepsia* 2002;43:587-595.
 39. Helmstaedter C, Loer B, Wohlfahrt R, Hammen A, Saar J, Steinhoff BJ, Quiske A, Schulze-Bonhage A. The effects of cognitive rehabilitation on memory outcome after temporal lobe epilepsy surgery. *Epilepsy Behav* 2008;12:402-409.
 40. Kerr EN, Alavie N, Blackwell M. The impact of intervention on working memory in children with intractable epilepsy: preliminary results from a repeated measure study. *Epilepsia* 2013;54(S3): 27.
 41. Thorbecke R, May TW, Koch-Stoecker S, Ebner A, Bien CG, Specht U. Effects of an inpatient rehabilitation program after temporal lobe epilepsy surgery and other factors on employment 2 years after epilepsy surgery. *Epilepsia* 2014;55:725-733.

42. Blocher JB, Fujikawa M, Sung C, Jackson DC, Jones JE. Computer-assisted cognitive behavioral therapy for children with epilepsy and anxiety: a pilot study. *Epilepsy Behav* 2013;27:70-76.
43. Wagner JL, Smith G, Ferguson P, van Bakergem K, Hrisiko S. Feasibility of a pediatric cognitive-behavioral self-management intervention: Coping Openly and Personally with Epilepsy (COPE). *Seizure* 2011;20:462-467.
44. Walker ER, Obolensky N, Dini S, Thompson NJ. Formative and process evaluations of a cognitive-behavioral therapy and mindfulness intervention for people with epilepsy and depression. *Epilepsy Behav* 2010;19:239-246.

Table 1. Core cognitive and psychological domains	
Cognitive Domains	
General level of intellect	Estimated premorbid intellect Current intellectual function
Memory	Learning, short- and long-term recall, recognition Autobiographic, prospective and semantic memory Different types of verbal and nonverbal material
Language	Receptive and expressive oral and written functions
Numeracy	Mental arithmetic, numerical calculations
Spatial functions	Visuoperceptual and visuoconstructional abilities
Executive functions	Attention, working memory, processing speed, idea generation (fluency), planning, cognitive flexibility (switching), response inhibition, social cognition*
Somatosensory and motor functions	Sensory-motor perception and response, speed, praxis
Psychological Domains	
Personality	Dimensional personality traits
Mood	Depression, anxiety
Behaviour	Illness beliefs, coping strategies Quality of life and daily psychosocial functioning Screening of other psychiatric disorders and behavioural co-morbidities

*While not routinely tested, social cognition is being increasingly recognised as relevant to the assessment of people with epilepsy.³⁰

Figure captions**Figure 1.**

Factors influencing performance on neuropsychological tests in epilepsy (from Baxendale & Thompson, 2010).