Improving the Methodology for Assessing Cognitive Impairment in People with Schizophrenia Spectrum Disorders

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Scientific environment

This thesis was written at the Faculty of Psychology at the University of Bergen, Norway, in collaboration with Harvard Medical School, Harvard University, Boston, MA, USA. I was affiliated with the Bergen Mood and Cognitive Function (MCF) research group at the Department of Biological and Medical Psychology (DBMP). The PhD training program was performed through the Integrated Neuroscience Research School (IGSIN). The data was collected at Bergen Psychiatric Hospital, Division of Psychiatry, Haukeland University Hospital, where I was employed as clinical neuropsychologist May 2013–December 2018.

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Abbreviations

ANOVA: Analysis of Variance

BRIEF–A: Behavior Rating Inventory of Executive Function–Adult Version

DSM-5: Diagnostic and Statistical Manual for Mental Disorders, 5th edition

EI: Effort Index

ES: Effort Scale

ICD–10: International Statistical Classification of Diseases. Tenth Revision

ICD–11: International Classification of Diseases. Eleventh Revision

IGSIN: International Graduate School in Integrated Neuroscience

NART: National Adult Reading Test

PANSS: Positive and Negative Syndrome Scale for Schizophrenia

PVI: Performance Validity Indicator

PVT: Performance Validity Test

RBANS: The Repeatable Battery for the Assessment of Neuropsychological Status

SPSS: Statistical Package for the Social Sciences

WAIS-IV: Wechsler Adult Intelligence Scale–Fourth Edition

B–CATS: Brief Cognitive Assessment Tool for Schizophrenia

SCIP: Screen for Cognitive Impairment in Psychiatry

EPICOG–SCH: Epidemiological Study of Cognitive Impairment in Schizophrenia test battery

BACS: Brief Assessment of Cognition in Schizophrenia

MATRICS: Measurement and Treatment Research to Improve Cognition in Schizophrenia

OECD: Organization for Economic Co-operation and Development

TNT: Texas Spanish Naming Test

IQ: Intelligence Quotient

FSIQ: Full Scale Intelligence Quotient

Abstract

Cognitive dysfunctions in patients with schizophrenia disorders are common, have prognostic value, informs treatment planning and rehabilitation, and provide a basis for targeted cognitive remediation. Consequently, current Norwegian guidelines recommend that neuropsychological assessments should be conducted as soon as possible for all patients with psychotic symptoms. This recommendation warrants a neuropsychological method that can be used to assess large numbers of patients having a broad spectrum of cognitive functioning, which is efficient and cost effective without compromising the quality of the assessment, and that is not too taxing for the most severely afflicted patients. A method that meets these criteria is the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS), primarily developed to detect and track cognitive decline over time in elderly people, and to identify neuropsychological deficits in acute care and rehabilitation settings. The main aim of this thesis is to examine the applicability and quality of the Norwegian version of the RBANS in assessing cognitive impairment in Norwegian young adults with schizophrenia spectrum disorders.

The first paper investigated how different normative systems influenced the accuracy of identifying cognitive impairment in 315 Norwegian younger adults with a schizophrenia spectrum diagnosis. Applying U.S. normative data resulted in underestimation of cognitive impairment in one out of five patients compared to applying Scandinavian normative data. Patients with comorbid substance abuse disorders did not differ in overall test performance compared to those not abusing substances regardless of normative systems applied. There were significant effects of gender, educational levels, and intelligence on test performance for both normative systems.

In the second paper, RBANS clinical normative tables for Norwegian patients with schizophrenia spectrum disorders were constructed, using a patient sample of 335 participants. Normative tables were stratified by educational attainment, by intelligence levels, and by gender. Normative tables were not stratified by substance abuse, as there

were no significant differences between these patients' test scores compared to those not abusing substances. The Norwegian clinical normative data did not differ from previous clinical norms derived from comparable patient groups in the U.S. and Canada. Tables of base rates of low scores on the RBANS indices were constructed, which facilitates interpretation of all five RBANS index scores simultaneously and can improve clinical judgement of patients' cognitive impairment.

The third paper investigated possible relationships between patients' self-report of motivational and effort problems with several RBANS embedded performance validity tests (PVTs). Decreased motivation and interest are common symptoms in schizophrenia spectrum disorders and might adversely affect test performance. Thus, indicators of invalid test performance may correspond to symptoms of the disorder and not to purposeful underperformance. Of 250 patients, 51% reported severe problems with initiation, as measured with the self-report version of the Behavior Rating Inventory of Executive Function–Adult Version (BRIEF–A) Initiate Scale, compared to 6–28% having PVT scores indicating invalid RBANS test performance. However, RBANS PVTs did not explain a significant amount of variance in self-reported initiation problems but had moderate to high correlations with measures of cognitive impairment. Thus, the RBANS PVTs are probably not good indicators of avolition and likely reflects degree of cognitive impairment in this patient group.

In sum, the findings from this thesis suggest that the Norwegian version of the RBANS is robust to effects of patients' self-reported motivational problems on test performance, and reliably assesses cognitive impairment and functions in younger Norwegian patients with schizophrenia spectrum disorders. The clinical normative data and base rates of low RBANS Index scores for Norwegian patients with schizophrenia disorders facilitate clinicians' judgment of patients' cognitive functions, enhancing the RBANS' clinical utility in assessing cognitive impairment in schizophrenia spectrum disorders.

List of Publications

I. Raudeberg, R., Iverson, G. L., & Hammar, Å. (2019). Norms matter: U.S. normative data under-estimate cognitive deficits in Norwegians with schizophrenia spectrum disorders. *The Clinical Neuropsychologist*, 1–17. https://doi.org/10.1080/13854046.2019.1590641

II. Raudeberg, R., Iverson, G. L., & Hammar, Å. (2019). The importance of clinical normative data for conceptualizing neuropsychological deficits in people with schizophrenia spectrum disorders. *Applied Neuropsychology: Adult*. https://doi.org/10.1080/23279095.2019.1699098

III. Raudeberg, R., Karr, J. E., Iverson, G. L., & Hammar, Å. (2021). Examining the repeatable battery for the assessment of neuropsychological status validity indices in people with schizophrenia spectrum disorders. *The Clinical Neuropsychologist*. https://doi.org/10.1080/13854046.2021.1876169

Contents

1. INTRODUCTION

1.1 Purpose and scope of the dissertation

This PhD project aimed to improve the methodology for assessing cognitive impairment in people with schizophrenia spectrum disorders. A central aim was to test and confirm the applicability of the translated and re-normed Norwegian version of the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) in assessing cognitive functioning in Norwegian young adults diagnosed with schizophrenia spectrum disorders.

The aim of paper I was to investigate how different normative systems can influence accuracy in detecting cognitive impairment in people with schizophrenia spectrum disorders. The aim of paper II was to construct clinical normative tables for Norwegian patients with schizophrenia spectrum disorders. The aim of paper III was to investigate whether embedded RBANS Performance Validity Tests (PVTs) correspond to patients' self-reported problems with motivation and interest. An overview of the thesis and it's constituted papers is provided in table 1.

Table 1. Overview of thesis and research papers

Thesis aim	To improve the methodology for assessing cognitive impairment in people with schizophrenia spectrum disorders.		
Main research question	To test and confirm the applicability of a 20-minute neuropsychological screening battery in evaluating cognitive impairment in Norwegian young adults with schizophrenia spectrum disorders.		
Papers	**Paper 1**	**Paper 2**	**Paper 3**
Title	Norms matter: U.S. normative data under-estimate cognitive deficits in Norwegians with schizophrenia spectrum disorders.	The importance of clinical normative data for conceptualizing neuropsychological deficits in people with schizophrenia spectrum disorders.	Examining the repeatable battery for the assessment of neuropsychological status validity indices in people with schizophrenia spectrum disorders.

Journal	The Clinical Neuropsychologist (2019).	Applied Neuropsychology: Adult (2019).	The Clinical Neuropsychologist (2021).
Research questions	1) How does different normative data influence the accuracy of the RBANS in identifying cognitive impairment in young people with schizophrenia disorders? 2) Is there a relationship between RBANS test performance and co-morbid substance use?	1) How to construct high quality clinical normative data for the RBANS for younger Norwegian people with schizophrenia disorders? 2) Do comorbid substance abuse, educational attainment, level of intelligence, or gender affect RBANS test performance? 3) How will Norwegian normative tables compare to those from other countries?	1) What is the prevalence of scores exceeding cutoff of the RBANS embedded measures of test validity in Norwegian people with schizophrenia disorders compared to prevalence in other countries? 2) What is the prevalence of self-reported symptoms of motivational and effort problems exceeding clinical levels measured with the BRIEF–A? 3) Does RBANS performance validity tests predict patients' self-report of motivational problems?
Design	Cross-sectional.	Cross-sectional.	Cross-sectional.
Sample	315 patients.	335 patients.	250 patients.
Data material	Neuropsychological test scores.	Neuropsychological test scores.	Neuropsychological test scores, self-report questionnaire.
Independent variable(s)	Schizophrenia disorders, substance abuse, age, gender, intelligence, education levels.	Schizophrenia disorders, substance abuse, gender, intelligence, education levels.	Schizophrenia disorders, substance abuse, age, years of education, intelligence, self-reports of difficulties with executive functions.

Dependent variable(s)	Measures of cognitive functions (RBANS).	Measures of cognitive functions (RBANS).	Measures of test validity, cognitive functions (RBANS).
Analyses	Descriptive statistics, chi-square tests, *t*-tests, Cohen's Kappa statistic.	Descriptive statistics, chi-square tests, *t*-tests, bivariate correlational analyses, analysis of variance (ANOVA).	Descriptive statistics, chi-square tests, *t*-tests, bivariate correlational analyses, linear regression analysis.
Main findings	1) Using U.S. normative data on Norwegian people with schizophrenia disorders resulted in underestimation of cognitive deficits. 2) Patients with comorbid substance abuse did not differ in RBANS test performance from those without comorbid substance abuse other than for Language Index when U.S. norms were applied.	1) Clinical normative tables and tables for evaluating degrees of cognitive impairment were constructed. 2) Test performance was influenced by gender, educational attainment, and levels of intelligence but not with substance abuse. Normative tables were stratified by gender, education level, and by intelligence. 3) Norwegian clinical norms did not differ from previously published clinical norms in North America.	1) Prevalence of embedded RBANS Performance Validity Tests (PVTs) scores exceeding cutoffs were comparable to previous findings (3–28%). 2) Prevalence of self-reported effort problems exceeding clinical cutoff was 51%. 3) RBANS PVTs were substantially associated with cognitive impairment. PVT scores did not explain any significant amount of variance in self-reported initiation problems.
Conclusion thesis	The Norwegian version of the RBANS and can be used to assess cognitive functioning in most patients with schizophrenia spectrum disorders. The original U.S norms underestimate cognitive impairment in Norwegian patients, whereas Scandinavian norms yield expected prevalence of cognitive impairment. The stratified clinical normative tables and base rate tables of low RBANS Index scores facilitate clinicians' judgment of patients' cognitive functions. RBANS Validity Indicators are associated with cognitive impairment and not with patients' self-reported difficulties with engagement and motivational problems. Thus, the thesis has contributed to the clinical utility of the RBANS in assessing cognitive impairment in Norwegian patients with schizophrenia spectrum disorders.		

1.2 Schizophrenia spectrum disorders

The illnesses that is currently conceptualized as schizophrenia spectrum disorders has probably existed for a very long time (Jablensky, 2010; van Os & Kapur, 2009). The term schizophrenia was coined by the Swiss psychiatrist Eugene Bleuler at the turn of the 19th century and were considered a group of diseases form the start (Jablensky, 2010; Kahn et al., 2015). The diagnostic manual International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD–10; World Health Organization, 2004) describes schizophrenia as a group of severe mental disorders in which a person has trouble distinguishing between real and unreal experiences, thinking logically, having normal emotional responses to others, and behaving normally in social situations. Symptoms include seeing, hearing, feeling things that are not there, having false ideas about what is taking place or who one is, nonsense speech, unusual behavior, lack of emotion, and social withdrawal. The 11th revision of the diagnostic manual (ICD–11) states that schizophrenia spectrum and other primary psychotic disorders are illnesses characterized by impaired assessment of reality and behavior, and by the presence of positive symptoms (delusions, hallucinations, disorganized thinking and behavior, and experiences of passivity and control), negative symptoms (flattened or suppressed affect) and psychomotor disturbances (World Health Organization, 2018). In the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM–5), a diagnosis of schizophrenia spectrum disorder requires that two of the following symptoms are present: delusions, hallucinations, disorganized speech, grossly disorganized or catatonic behavior, and negative symptoms (i.e., diminished emotional expression or avolition) for at least a month (American Psychiatric Association, 2014).

Prevalence of schizophrenia is about 0.3% if the DSM–5 diagnostic criteria are used, but increase to 2.3% if broader diagnostic categories are included (e.g., psychotic disorder), and to 3.5% if other psychotic disorders, such as bipolar disorder and substance-induced psychotic disorders also are included (van Os & Kapur, 2009). Schizophrenia disorders are associated with broad symptom categories that are also found in other diagnostic categories, in attenuated form in biological relatives of

patients (Jablensky, 2010; van Os & Kapur, 2009) and in addition in healthy people; as many as 10% may experience auditory hallucinations at some time (Larøi, 2012). The similarities of symptoms across diagnoses and the heterogeneity in clinical expression, from mild symptoms in relatives, to sub-clinical forms, and mild to severe illness in patients, has led to the conceptualization of schizophrenia disorders as a spectrum, reflected in the terms used in both the DSM–5 and ICD–11 (Valle, 2020).

The etiology of schizophrenia spectrum disorders is not fully understood (Gaebel & Zielasek, 2015; Jablensky, 2010; Tandon et al., 2013; van Os & Kapur, 2009) but twin studies suggest that schizophrenia have a heritability of around 80% (Marder & Cannon, 2019; McCutcheon et al., 2020; van Os & Kapur, 2009). Current etiology models propose a genetic vulnerability of abnormal brain development, leading to alterations in brain structures and brain chemistry that in turn affects perception, emotions, cognition, and behavior, and that is influenced by environmental factors (Dietz et al., 2020; Marder & Cannon, 2019; McCutcheon et al., 2020; van Os & Kapur, 2009; Vaskinn et al., 2015), such as childhood trauma, migration, and use of psychoactive substances (Kahn et al., 2015; Rybakowski, 2020).

There are few qualitative studies describing the patients' perspective of the illness (Anda, 2020; Butcher et al., 2020). Generally, patients report that symptoms are distressing and debilitating, and point to childhood traumatic experiences, drug use, and lack of social support as important causes of their illness and symptoms (Butcher et al., 2020). Some describes a dreadful loss of self-identity, a feeling of dissolving, of being unsure whether they truly exists, and experiencing unclear boundaries from other people; not knowing whether their thoughts and emotions belong to themselves or are those of other persons (Møller, 2018; Parnas et al., 2011). The following is a patient description of what a psychotic episode can entail: "Words stopped making sense to me. I couldn't write anything, and I could barely form a regular sentence, let alone an academic one. I stood in front of my mirror for six to eight hours digging a hole into my chin because I thought something was hidden in there. […] I took a pair of scissors and started chopping chunks of my hair off. I stopped eating. I saw dark spots and bugs in places, and I would move around my room trying to kill them—but they didn't exist.

I didn't want to be in the dark, so I kept a light on every day and night. I felt like my body was being infiltrated with poison and toxic energy." (Miller, 2018).

Symptoms of hallucinations and delusions can, for most patients, be ameliorated by antipsychotic medications (Marder & Cannon, 2019; McCutcheon et al., 2020). Non-pharmacological interventions are also helpful, such as social skills training, crisis intervention, family interventions, supported employment, physical exercise, and cognitive remediation therapies (Kahn et al., 2015). Recovery rates and favorable outcomes varies considerably across studies, due to differences in samples, diagnostic criteria, and measures of outcome, but it is estimated that at least 20% of patients with schizophrenia disorders do not need antipsychotic medications five years after diagnosis (Volavka & Vevera, 2018). Improvement in psychosocial functioning in areas such as work, school, family life, friends, recreation, and independent living can be obtained by about half of patients (Vita & Barlati, 2018). Nevertheless, a substantial number of patients have partial remission of their symptoms. About 30% have persistent delusions, hallucinations, and disorganized behavior (Kane et al., 2019) and people with schizophrenia spectrum disorders have, on average 15–20 years shorter life expectancy compared to healthy people (Laursen et al., 2014; Lien et al., 2015; McCutcheon et al., 2020). Death by suicide is a main factor in early course of illness and cardiovascular disease in later stages (Kahn et al., 2015; Sher et al., 2019).

1.2.1 Cognition in schizophrenia spectrum disorders

Despite not a symptom in diagnostic manuals, the cognitive difficulties associated with schizophrenia spectrum disorders, particularly problems with sustained attention and memory, have prominence in patients descriptions (Butcher et al., 2020). It is well established that cognition is often affected in people with schizophrenia spectrum disorders (Anda, 2020; Barder et al., 2013; Iverson, Brooks, & Haley, 2009; Keefe, 2014; McCutcheon et al., 2020; Sheffield et al., 2018; Vaskinn et al., 2020; Wilk et al., 2004). On average, patients perform 1–2 *SDs* below healthy controls on tests of attention (Holmen et al., 2010), learning and memory (Barder et al., 2013; Egeland et al., 2003), processing speed (Schaefer et al., 2013), and executive functioning (Reichenberg et al., 2010). Although processing speed and psychomotor speed seem to

be important factors in explaining overall test performance (Bechi et al., 2019), the general finding is that cognitive deficits in schizophrenia spectrum disorders are broad in nature and affects many cognitive domains (Schaefer et al., 2013), and is related to disease severity and duration (Keefe, 2014; Rajji et al., 2014; Sponheim et al., 2010; T. Zhang et al., 2015), but stabilizes somewhat after onset (Barder et al., 2013; Juuhl-Langseth et al., 2014; Øie et al., 2021; Sheffield et al., 2018). Cognitive impairment in schizophrenia disorders has been associated with alterations in dopaminergic and glutamatergic pathways (McCutcheon et al., 2020; Stępnicki et al., 2018), and with disturbances in microglial functions, causing alterations in regulation of synaptic pruning and synapse plasticity, ultimately leading to reductions of neuronal cells in the brain (Corley et al., 2021; McCutcheon et al., 2020).

The prevalence of cognitive impairment in patients with schizophrenia spectrum disorders vary depending on the definition of cognitive impairment and cognitive measures (Brooks et al., 2009; Iverson, Brooks, & Haley, 2009; Keefe et al., 2005). If impairment is defined as test scores <−1 *SD* from normative means on normally distributed tests, about 73% of patients with schizophrenia spectrum disorders (and 15% of the general population) meet this definition (Keefe & Harvey, 2012). However, it is not uncommon for healthy people to have low scores on neuropsychological tests (Binder et al., 2009; Brooks et al., 2009; Holdnack et al., 2017). For example, as many as 78.4% of healthy people have two or more scores <−1 *SD* on the Neuropsychological Assessment Battery (NAB; Brooks et al., 2009). On the RBANS, about 45% of healthy people are expected to have one out of five index scores <−1 *SD* (Crawford et al., 2012), compared to 98% of patients with schizophrenia disorders (Iverson, Brooks, & Haley, 2009). Clearly, a definition of cognitive impairment that will include almost 50% of healthy people is too lenient. When using a definition of two RBANS index scores below the 5th %-tile, about 5% of healthy people are expected to exceed this cutoff, which seems a reasonable definition of cognitive impairment when using the RBANS (Crawford et al., 2012). This definition yields a prevalence of cognitive impairment in about 72% of patients with schizophrenia spectrum disorders (Iverson, Brooks, & Haley, 2009).

Defining cognitive impairment as performance below average normative means, or as a specific number of unusual low test scores, do not take into account that patients can have had superior premorbid functioning. Thus, tests scores in the average rage can still represent a substantial decline in cognitive functions from premorbid levels (Crawford et al., 2012). Patients with superior intellectual abilities have cognitive functions well above −1 *SD* of normative means (and are therefore not cognitively impaired using a definition of scores <−1 *SD*), but still scores about <−1 *SD* matched healthy controls on neuropsychological tests of fine motor function, attention, processing speed, verbal learning and memory, and on measures of executive functions (Vaskinn et al., 2014, 2020), indicating that cognitive deficits and decrements are present in most patients when levels of premorbid function and/or levels of IQ is considered. Indeed, studies have shown that as many as 98–100% of patients with schizophrenia spectrum disorders have cognitive impairment compared to healthy controls when level of education is accounted for (Bozikas et al., 2006; Keefe et al., 2005). This means that to fully understand patients' cognitive difficulties, assessment methods that can take patients' educational attainment into consideration when evaluating test scores is needed.

1.2.2 Substance abuse in schizophrenia spectrum disorders

Substance abuse is common in people diagnosed with schizophrenia spectrum disorder. Overall prevalence of substance abuse in patients with schizophrenia spectrum disorders in Norway is estimated to be about 25% (Nesvåg et al., 2015), comparable to 27% prevalence in the U.S. (Bahorik et al., 2014; Kessler et al., 2005). Substance abuse is highest in people in their mid-20s, ranging from 44% among men and 30% among women in Norway (Nesvåg et al., 2015), which is about ten times higher than in the general population (Skogen et al., 2019), and similar to most other countries regarding this patient population (Hunt et al., 2018). Substance abuse in this patient group is associated with adverse outcome, low treatment compliance and increased risk of violence and suicide (Hunt et al., 2018; Khokhar et al., 2018).

Many drugs might induce transient psychotic symptoms, as an effect of intoxication. If the symptoms persist after intoxication subsides, the ICD–10 mandates that a diagnosis

of substance induced psychosis should be considered (World Health Organization, 2016). The psychotic symptoms should resolve within about 4 weeks and symptoms lasting longer than 6 months should be re-diagnosed within the schizophrenia spectrum disorders. As many as 50% of patients with a diagnosis of substance-induced psychotic disorder transits to a diagnosis of schizophrenia within two years and 80% within five years (Alderson et al., 2017). In Finland, about 46% of patients with a diagnosis of cannabis induced psychosis and 30% with an amphetamine-induced psychosis were found to be re-diagnosed to a diagnosis within the schizophrenia spectrum within eight years; the majority within three years (Niemi-Pynttäri et al., 2013). This indicates that a substantial number of patients with substance induced psychosis will develop a schizophrenia spectrum disorder in three to five years.

Cannabis use is particularly frequent among patients with schizophrenia spectrum disorders, life time prevalence is 17–83% (Khokhar et al., 2018), and is considered a risk factor for developing schizophrenia disorders (Løberg & Hugdahl, 2009; Marder & Cannon, 2019). In Denmark, the use and potency of cannabis has increased, as have the diagnosis of cannabis-induced psychosis (Hjorthøj et al., 2021), supporting the link between cannabis use and schizophrenia spectrum disorders. Overall, schizophrenia spectrum disorders and cannabis use is associated with earlier onset and exacerbated symptoms (Hamilton, 2017; Helle et al., 2016; S. Patel et al., 2020), but also with better cognitive functions compared to patients not abusing substances (Løberg & Hugdahl, 2009; S. Patel et al., 2020).

The effect of substance abuse on cognition in schizophrenia spectrum disorders is equivocal. Current findings range from worse cognition, no difference, or better cognition among those patients abusing substances compared to those not abusing substances (Løberg & Hugdahl, 2009; Potvin et al., 2012). It is not clear whether substance abuse should be considered a contributing cause of the illness, whether the illness causes a vulnerability to abusing substances, or if there is a shared genetic vulnerability causing an increased risk of both conditions (Alderson et al., 2017; Khokhar et al., 2018).

1.2.3 Neuropsychological assessment in schizophrenia spectrum disorders

In people with schizophrenia spectrum disorders, cognitive deficits are associated with worse outcome, such as poorer social functioning, unemployment, decreased quality of life, and institutionalization (Keefe & Harvey, 2012; Lysaker et al., 2005; Øie et al., 2011, 2021; Rajji et al., 2014; Rosenheck et al., 2006) and is an important target for rehabilitation and treatment programs (Bowie et al., 2020; Kahn et al., 2015). Because cognitive impairment is common in patients with schizophrenia spectrum disorders, is detrimental to patients' quality of life and has prognostic value, current Norwegian guidelines for Assessment, Treatment, and Follow-up of People with Psychosis Disorders recommends neuropsychological assessment as an integrated part of diagnostic evaluation (The Norwegian Directorate of Health, 2013). These guidelines recommends that patients should be assessed for cognitive difficulties with a test battery that assesses as many relevant cognitive functions as possible. This recommendation warrants a neuropsychological assessment method that can be used to effectively assess large numbers of patients having a broad spectrum of cognitive functioning, without compromising the quality of the assessment. Because cognitive dysfunctions in psychotic illnesses may fluctuate somewhat in the course of illness and recovery (Anda et al., 2016), the method should allow for repeated assessments. Neuropsychological test methods for this patient group should thus ideally: (a) have excellent validity and reliability, (b) cover a sufficiently broad spectrum of cognitive abilities, (c) have alternate forms enabling repeated assessments, and (d) be brief and easy to administer.

Several test batteries are constructed specifically for cognitive assessment of patients with schizophrenia spectrum disorders. Some are very short, such as the Brief Cognitive Assessment Tool for Schizophrenia (B–CATS), using performance on the Trail Making Test B, Category Fluency, and Digit Symbol Substation to compute an overall composite score reflecting overall cognitive functioning, taking about 10 minutes to complete (Hurford et al., 2011). The Screen for Cognitive Impairment in Psychiatry (SCIP) has three alternative forms, takes about 15 minutes to administer and was designed to detect cognitive deficits in psychotic and affective disorders. It consists

of tests of verbal learning and memory, working memory, verbal fluency, and processing speed (Rojo et al., 2010). The Epidemiological Study of Cognitive Impairment in Schizophrenia test battery (EPICOG–SCH) consists of four tests measuring processing speed, executive functioning and working memory, and verbal memory, and takes about 20 minutes (Zaragoza Domingo et al., 2017). The Brief Assessment of Cognition in Schizophrenia (BACS) was developed to assesses cognitive functions found to correlate with outcome in patients with schizophrenia and takes less than 35 minutes to complete (Keefe et al., 2004) The BACS consists of tests of verbal memory, working memory, motor speed, verbal fluency, attention and speed of information processing, and executive functions. In the U.S., the Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) initiative (M. F. Green et al., 2004), suggested a standard test battery for research and clinical trials in schizophrenia spectrum disorders, comprised of 10 co-normed neuropsychological tests (Nuechterlein et al., 2008) that takes about 60 minutes to complete (Kern et al., 2008). The MATRICS battery has been translated to Norwegian and have retained most psychometric proprieties compared to the original U.S. version (Mohn et al., 2012), though Norwegians have in general poorer performance on the MATRICS battery, performing about 0.2–0.6 *SDs* below U.S. normative means. For adolescents, Norwegian regression based norms are available (Smelror et al., 2019) but for older age groups only the original U.S. norms are available.

Due to the scarcity of Scandinavian co-normed tests (Egeland et al., 2016), the RBANS stands out as a viable option as a screening battery for Norwegian patients with schizophrenia spectrum disorders, being currently the only short neuropsychological test battery having Scandinavian norms and with alternate forms for repeated assessment. The RBANS have been extensively used in research and a large international research data base of studies of cognition in schizophrenia spectrum disorders is available.

1.2.4 Effort and test performance in schizophrenia spectrum disorders

Schizophrenia spectrum disorders affects many patient's motivation and engagement (Dollfus & Lyne, 2017; Galaverna et al., 2014; McCutcheon et al., 2020; Morra et al., 2015; Strauss et al., 2013, 2015). About 40% of patients experience amotivation, reduced activity, flattened affect, and social withdrawal; of these about 50% have predominately negative symptoms and the other 50% have hallucinations and delusions as well (R. Patel et al., 2015; Rabinowitz et al., 2013; Schennach et al., 2015).

The patients' problems with motivation and engagement might affect their ability to exert sufficient effort when presented with cognitive tasks, such as neuropsychological tests (Barch, 2005). There is some evidence that motivational problems affects test results in as much as 70% of patients and can account for 35% of the variance in patients' test scores (Gorissen et al., 2005), but most studies reports much lower prevalence, generally not exceeding 20% (Morra et al., 2015; Strauss et al., 2015). In studies using neuropsychological performance validity tests (PVTs) to investigate patients' problems with effort and engagement, and how these problems might affect test performance, a general finding is that insufficient test performance is associated with cognitive impairment, negative symptoms (i.e., apathy, anhedonia, and avolition), and negative expectancy appraisals and defeatist performance beliefs (Strauss et al., 2015). This suggests that PVTs may indicate the effects of apathy and avolition on test performance in this patient population, rather than purposeful underperformance (Morra et al., 2015; Strauss et al., 2015). To clinicians, PVTs are of particular interest if they can serve as a measure of patients' problems with motivation and engagement during the assessment and thus provide a measure of the possible impact of these problems on test results. It has also been suggested that PVTs can be used to identify patients that might benefit from treatment programs that includes incentives to maximize effort (Morra et al., 2015; Strauss et al., 2015).

To gain an in-depth understanding of the strength and weaknesses of an individual patient's cognition, it might be necessary to use large test batteries, comprised of many different tests. Such test batteries can be lengthy, and increases the possibility of

incidental low test scores as the number of tests included rises (Brooks et al., 2009). In Norway, the most commonly used neuropsychological test batteries takes about 4–6 hours to complete (Egeland et al., 2016). These batteries are comprised of multiple independently developed tests, and normative information of base rates of test score differences, test score variance, and covariance, is not available (as opposed to co-normed test batteries), making interpretation of test results more difficult (Kern et al., 2008; Russell et al., 2005). Thus, striking the right balance of the assessment's comprehensiveness, psychometric qualities, administration time, and patients' ability to engage in the assessment, can be challenging.

In instances where lengthy testing is too taxing for the patient, a brief cognitive screening test battery, such as the RBANS, can be used to gain some insight into patients' cognitive functioning. Furthermore, several embedded PVTs have been constructed for the RBANS: the Effort Index (EI; Silverberg et al., 2007), the Effort Scale (ES; Novitski et al., 2012), and the Performance Validity Indicator (PVI; Paulson et al., 2015). This allows for concurrent assessment of cognitive deficits and motivational problems in patients with schizophrenia spectrum disorders.

1.3 The importance of clinical norms

Clinical normative tables are constructed using patient groups as the normative sample, as opposed to a representative sample of the general population. When evaluating patients scores, clinical normative tables are valuable in allowing assessment of whether patients' test performance differs from expected levels for a condition or illness. Standard normative tables allow comparison with a healthy population norm, and a clinician can thus readily assess whether the patients scores deviate from the healthy population, whereas clinical norms show how much scores differ from—or aligns with—the distribution of scores in the patient population. Consider, for example, that an average RBANS Total Scale score for people with schizophrenia spectrum disorders is 68 index points (Iverson, Brooks, & Haley, 2009), which is an exceptionally low score in a normative sample (Guilmette et al., 2020). Without clinical norms a clinician cannot readily know that a RBANS Total Scale score ranging from

56–79 index points is within average performance for people with schizophrenia disorders or that a RBANS Total Scale Score of 88 points is a superior score in this patient population (Iverson, Brooks, & Haley, 2009), whereas a corresponding score at superior level for healthy people is 120–129 points (Guilmette et al., 2020).

By combining standard and clinical normative data, a clinician can evaluate a patient's test scores regarding level of cognitive abilities considered common or expectant of most healthy people, and the level that is reasonable to expect for patients. Say, for example, that a patient with schizophrenia spectrum disorder has five RBANS Index scores <−1 *SD* from the normative mean; this informs the clinician that the patient most likely will have some problems meeting cognitive expectations considered within the capabilities of most healthy people. Although this information is essential and useful in understanding the patient's cognitive difficulties, a clinician cannot know if this particular result is worse, average, or better than most patients' performance, if the clinician does not have extensive personal experience with the patient population. Such levels of expertise take a long time to acquire, and even though the clinician's evaluation will be an expert opinion grounded in long-time clinical experience, it will nevertheless be a subjective and personal evaluation. Clinical norms, on the other hand, allows any clinician to look up scores in the tables and to readily see that having all five RBANS indices <−1 *SD* occurs in about 30% of patients with schizophrenia disorders, meaning that about 70% of patients have better scores (Iverson, Brooks, & Haley, 2009). Thus, a patient with such a configuration of RBANS scores have more cognitive difficulties than most patients, which is important to know when planning treatment and rehabilitation programs (Hoffmann et al., 2003), and which also has prognostic value (Gold et al., 1999, 2002; M. F. Green, 2016; Milev et al., 2005). Furthermore, if a patient's RBANS test scores deviate from expected clinical norms, this might prompt the clinician to explore the patient's cognitive functions in more detail, investigating for other possible causes underlying the impairment.

Until the present thesis, clinical normative tables for schizophrenia spectrum disorders had been constructed form two patient samples, one from the U.S. (Wilk et al., 2004) and one from Canada (Iverson, Brooks, & Haley, 2009). As these countries have many

similarities with Norway (e.g., all are considered industrialized high-income countries with excellent education and health care; *OECD Better Life Index*, n.d.), it seems reasonable that clinical normative tables from North America can be applied to Norwegian patients with schizophrenia spectrum disorders. In particular, the Canadian norms may be especially well suited for Norwegian patients. The prevalence of schizophrenia is comparable: estimated to 0.39% in Canada (Dealberto, 2013) and to 0.34% in Norway (Nesvåg et al., 2015). Canada and Norway are at much the same latitudes, which seem important, as prevalence of schizophrenia is higher in the higher latitudes (Saha et al., 2006). In the U.S., prevalence is estimated to between 0.26%–0.51% (Kessler et al., 2005; Wu et al., 2006), which yields an average of 0.39%. Taken together, these arguments support the use clinical norms derived from North American patient samples when evaluating RBANS performance of Norwegian patients with schizophrenia disorders.

However, studies from Norway finds that patients with schizophrenia spectrum disorders have better RBANS performance (Anda et al., 2016; Helle et al., 2014) compared to studies from the U.S. and Canada (Dickerson et al., 2004; Gold et al., 1999; Iverson, Brooks, & Haley, 2009; Wilk et al., 2004). For example, Norwegian patients have RBANS Index and Total Scale scores that are, on average, about 1 *SD* higher than those reported in studies from North America, a considerable difference. Conversely, Canadian and U.S. patients differ no more than averagely 1.5 index points (Iverson, Brooks, & Haley, 2009; Wilk et al., 2004). Thus, the result from the Norwegian studies warrants caution in applying clinical norms form other countries to Norwegian patients' RBANS test results. Consider also that, on average, Scandinavians have better performance than people from the U.S. on 10 out of 12 RBANS subtests (Randolph, 1998, 2013), indicating that Scandinavians in general might have better cognitive functions than people in the U.S. Taken together, these findings suggest that the clinical norms based on schizophrenia patient samples from North America cannot be directly applied to Norwegian patients, and perhaps not to patients from other countries as well. Norwegian patients have quite similar RBANS performance as patients from Australia (Gogos et al., 2010), whereas patients from China (T. Zhang et

al., 2015) and Spain (De la Torre et al., 2016) have results that are somewhat intermediate between the North American, Norwegian and Australian patients' results. This suggest that other factors, such as health care and treatment options, educational systems, ethnicity, and culture is of importance (Heaton et al., 2004; Manly et al., 2002), and that clinical norms should be constructed using local patient samples.

1.3.1 Effects of culture differences and ethnical diversity on test performance

It seems reasonable that countries sharing many cultural and demographic similarities can use cognitive tests developed and normed in another country without costly re-norming. It is perhaps not very surprising that patients with schizophrenia disorders have similar test scores on the RBANS in Canda (Iverson, Brooks, & Haley, 2009) and the U.S. (Wilk et al., 2004), considering the many similarities between these countries.

However, sharing the same language and many other cultural similarities does not guarantee that a neuropsychological test measures the same construct, have the same gender or educational effects, or have the same sensitivity and specificity in identifying neuropsychological impairment. For example, the Texas Spanish Naming Test (TNT), a Spanish naming test using depicted objects that are relevant and familiar to Spanish-speakers, have been demonstrated to discriminate patients with dementia form healthy older people in the U.S. and Colombia, but not in Spain (Marquez De La Plata et al., 2009). On the Stroop Color and Word Test (Golden, 1978), performance is positively associated with education in Mexico, Paraguay, Argentina, Bolivia, Chile, Cuba, and Guatemala; but not in Peru, Honduras, Puerto Rico, or El Salvador; all Spanish speaking countries (Rivera et al., 2015). In Scandinavia, people from Danmark outperform Norwegians on the Veral Fluency subtests on the RBANS (Randolph, 2013), notwithstanding the similarities in languages spoken, in educational and political systems, and ethnical composition. In Australia, healthy controls perform better on the RBANS than U.S. average means (A. Green et al., 2008), despite being English speaking countries and having a westernized culture. The cultural influences on test performance further cautions that standard test norms and clinical norms from

the U.S. might not be applicable to Norwegians and suggests that research investigating this is warranted.

1.4 Summary of introduction

Cognitive deficits affect most patients with schizophrenia spectrum disorders and persist for a long time in most cases. The severity of cognitive impairment is associated with treatment outcome and recovery and is important to consider in treatment and rehabilitation planning. Substance abuse is common and affects treatment outcome negatively, but it is unclear how and to what extent substance abuse affects cognition in patients with schizophrenia spectrum disorders. Reduction of motivation and engagement can be an obstacle to lengthy neuropsychological assessment and is important to consider when evaluating patients' test scores. Clinical normative data can contribute to more precise evaluations of the nature and severity of patients' cognitive deficits, but it is unclear whether clinical norms from North America are applicable when evaluating cognitive deficits in Norwegian people with schizophrenia spectrum disorders.

2. STUDY AIMS

The overall aim of this project was to improve the methodology of assessing cognitive deficits in patients with schizophrenia spectrum disorders. More specifically, this was approached by testing and confirming the applicability of the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) in assessing cognitive impairment in Norwegians with schizophrenia spectrum disorders. The RBANS has been used in many clinical and research studies of schizophrenia spectrum disorders, but it is unknow whether results from studies in other countries and cultures are applicable to Norwegian patients. Whether patients with comorbid substance abuse have more, less, or different cognitive problems compared to patients without comorbid substance abuse, is largely unresolved, in Norway and elsewhere, and should be considered. It is well known that patients' problems with motivation and engagement can affect test performance, but no studies have investigated how the measures of test validity embedded in the RBANS corresponds to patients' own appraisal of these problems and/or symptoms. The thesis aims to shed light on these issues.

2.1 Research questions

1) Do the RBANS Scandinavian normative data differ from the original U.S. normative data in identifying cognitive impairment in Norwegians with schizophrenia disorders (paper I)?
2) Does comorbid substance abuse, educational attainment, intelligence, or gender influence RBANS test performance in Norwegian patients equally to findings in other countries (paper I and II)?
3) How will clinical normative tables derived from a Norwegian patient sample compare to clinical normative tables from Canada and the U.S. (paper II)?
4) Does RBANS performance validity indicators (PVTs) correspond to patients' self-reported problems with motivation and interest (paper III)?

3. METHODS

3.1 Research project, design, and setting

This PhD thesis was designed as a clinical site quality assurance project, using anonymized data from the neuropsychological services at Bergen Psychiatric Hospital, Division of Psychiatry, Haukeland University Hospital, in Bergen, Norway. The project aimed to describe characteristics of a patient population and to assess relationships between variables and was thus designed to meet the requirements of descriptive and correlational studies.

3.1.1 Funding, approvals and ethical considerations

No funding was available for this project; it was integrated into the existing day-to-day work at the Bergen Psychiatric Hospital and at the Faculty of Psychology at the University of Bergen. The project was evaluated by the he Regional Committee for Medical and Health Research Ethics in July 2016. The Committee noted that the aim of the project was to validate clinical instruments already established in clinical practice and thus outside the scope of the Health Research Act (document #2016/1330). The Regional Data Protection Official approved the project January 13, 2017 (document #2017/575), contingent on patient data were fully anonymized. The Norwegian Data Protection Authority's guidelines of anonymization of data (Norwegian Data Protection Authority, 2015) were used to ensure anonymization.

All patients were informed that the neuropsychological assessment was standard routine at the hospital and that the results were to be used in diagnostic evaluations and for treatment and rehabilitation planning. They were informed that participation was voluntary and that they could withdraw from the assessment procedure at any time. All patients were offered a feedback session and a written neuropsychological report of the assessment findings. Clinical interviews, analysis and evaluation of test results, and feedback sessions were conducted by the PhD candidate, whereas neuropsychological testing was conducted by either the PhD candidate or a psychiatric nurse with special training in neuropsychological testing procedures.

3.1.2 Procedures, data and participants

Data were collected from neuropsychological assessments from September 2013 to October 2018. In this period, 462 patients underwent 534 assessments, of which 72 were re-assessments. Data was recorded from hand scored test protocols to a Microsoft Excel spreadsheet file in June and July 2017 and consecutively thereafter. All patients completed the Norwegian version of the RBANS (Randolph, 2013), 273 completed the Norwegian version of the National Adult Reading Test (NART; Sundet & Vaskinn, 2008) and 264 completed the BRIEF–A (Isquith et al., 2005). All RBANS test protocols were re-scored using U.S. normative data (Randolph, 1998).

Neither diagnoses nor medications were registered in test protocols. It was noted if a patient did not have a diagnosis in the schizophrenia spectrum, or whether a patient had substance abuse problems, but not type of substances or severity of abuse. Antipsychotic medication was not registered.

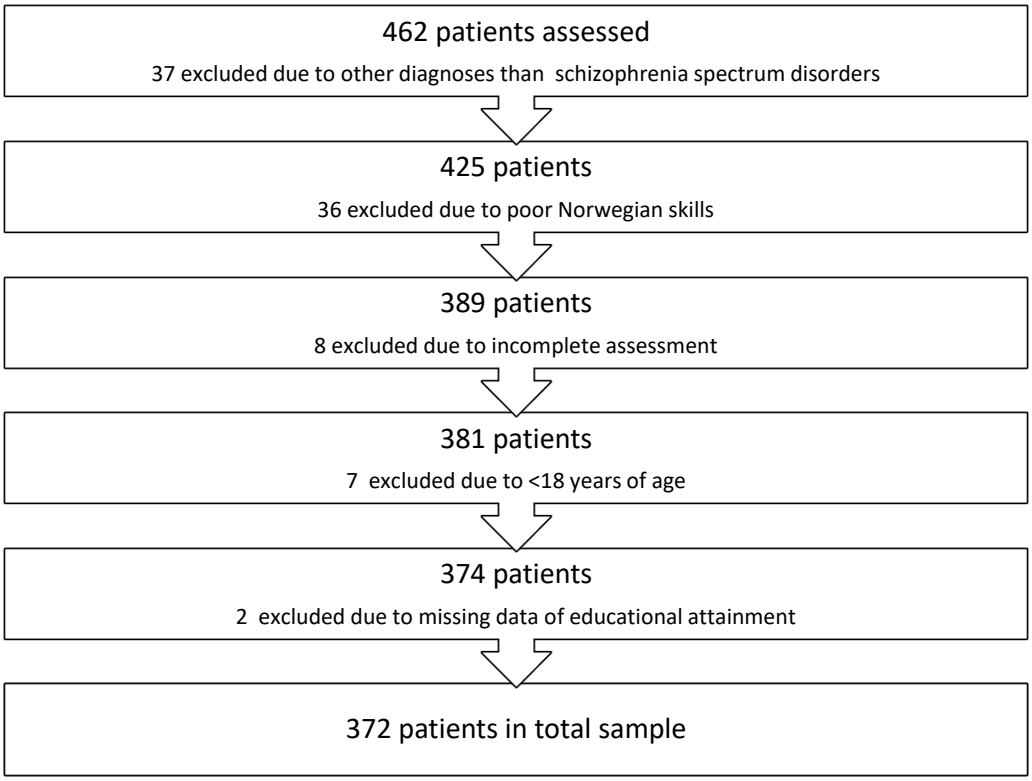
3.1.3 Inclusion and exclusion criteria

Inclusion criteria was referral to the neuropsychology services at the Bergen Psychiatric Hospital due to psychotic symptoms or a verified diagnosis of schizophrenia spectrum disorder. Patients were referred from different wards at the Bergen Psychiatric Hospital or from psychiatric hospitals in the surrounding communities. Younger patients (i.e., 15–30 years old) were prioritized. Patients were seen either as inpatients or outpatients, depending on the phase of illness and recovery. Most of forensically committed patients were inpatients. In total, 90 patients were excluded, primarily for not meeting a diagnosis of schizophrenia spectrum disorders or having poor Norwegian language skills. The flowchart in Figure 1 details the exclusion criteria and corresponding number of patients excluded. Patients of immigrant parents were included, if born and educated in Norway, but ethnicity was not recorded. Patients 18- and 19-year-old were included, despite being younger than the first age bracket in the RBANS normative tables, which start at age 20. In healthy people, test performance increases during puberty and levels off in late adolescence (Smelror et al., 2019) and is increasingly more similar to young adults. Participants with low level of intelligence

(i.e., IQ <70) were not excluded, as this would limit the sensitivity and validity of low scores of normative data (Sansone et al., 2014).

Of the final sample of 372 patients, 315 were included in paper I, 335 in paper II, and 250 in paper III. More patients were included in paper II compared to paper I as the data collection continued in the timespan between these papers. In papers I and II, patients older than 39 years of age were excluded. In paper III, BRIEF–A protocols obtained at patients' first RBANS assessment were included, in effect excluding 14 protocols obtained at later re-assessments. Patients older than 39 years of age were included in this study. Data from re-assessments were not used in any of the studies.

Figure 1. Flowchart of exclusion criteria and corresponding number of excluded patients.



3.1.4 Diagnoses

Patients' diagnoses were according to the ICD–10 (World Health Organization, 2016). Diagnosis evaluations was conducted by a psychiatrist or a certified clinical psychologist. At the end of data collection, an automated extraction of registered diagnoses from journal records of the neuropsychology services at the Bergen Psychiatric Hospital were performed. Due to restrictions in the electronic journal system, no searches before 2015 could be conducted. The search returned 307 registered diagnoses within the schizophrenia spectrum disorders. Because diagnoses were extracted independently, and purposefully without means to combine them with the neuropsychology assessment data set, we ensured protection of patient confidentiality but must then also accept that the diagnostic data is not fully representative of the patient sample.

Of the 307 registered diagnoses retrieved, most patients had diagnoses of schizophrenia disorders (F20.0–F20.9) and schizoaffective disorders (F25.0–F25.9), accounting for 49.0%. Of those, 48.7% had F20.0 paranoid schizophrenia, 27.3% had schizoaffective disorders, and 10.7% had undifferentiated schizophrenia (F20.3). Paranoid psychosis or acute psychosis (F22.0–F23.9) was diagnosed in 23.2%. Psychotic disorder due to substance abuse (F1x.5) was diagnosed in 16.6%. A minority were awaiting diagnostic decision (11.1%), having a diagnosis of hallucinations (R44.0–44.8) or strange and inexplicable behavior (R46.2). Most substance abusing patients were long-time polysubstance abusers diagnosed with schizophrenia spectrum disorders. Substance abuse (yes/no) was recorded for all patients and in the total sample of 372 patients, 153 (41%) were registered with substance abuse problems.

3.1.5 Cognitive measures

Repeatable Battery for the Assessment of Neuropsychological Status

All patients completed the Norwegian version of the RBANS (Randolph, 2013) as part of a routine clinical assessment. This adult screening battery takes 20–40 min to administer and has two forms (A and B) that are interchangeable. Five age-corrected index scores and a total scale with a mean score of 100 and standard deviation of 15 are obtained from 12 subtests. The Total Scale score is derived from the sum of index

scores obtained on the five indices. The RBANS subtests, which cognitive abilities they measure, and their associated indices are presented in table 2. Form A was completed by 57% and Form B by 43% of the patients. All RBANS test protocols were re-scored using U.S. normative data.

Table 2. RBANS Indices, associated subtests and cognitive functions measured

RBANS Indices	RBANS Subtests	Cognitive Function and/or Ability
Immediate Memory	List Learning	A measure of unrelated semantic verbal acquisition and learning. Ten unrelated semantic words are read aloud to the examinee who repeat as many as (s)he can remember. Four consecutive trials are given. The raw score is the total number of corrected repeated words. Number of repetitions and intrusions can also be scored.
	Story Memory	A measure of related semantic verbal acquisition and learning. A story is read to the examinee, who repeats what (s)he can remember. Two trials are given. Scores are correct remembered details, regardless of remembrance of overall theme, coherence, or sequence.
Visuospatial/ Constructional	Figure Copy	A test of visuospatial processing and organization, motor control and attention to visual details. The examinee is shown a multipart geometric drawing and asked to make an exact copy while the drawing remains on display. Time limit is four minutes. Accuracy and placement of 10 figure details are scored.
	Line Orientation	A test of visuospatial skills. The test measures the examinee's ability to match the angle and orientation of lines in space. Examinees are asked to match two angled lines to a set of 13 lines that are arranged in a semicircle and separated 15 degrees from each other. 10 items are given with a time limit of 20 seconds pr item.
Language	Picture Naming	A test of expressive language. The examinee is shown a drawing of 10 objects and is asked to name them. A sematic hint is given if the examinee is unsure what the drawing represents. Time limit is 20 seconds pr item.
	Verbal Fluency	A test of semantic memory and organization. Examinees are given 60 seconds to produce as many

		unique words as possible within a semantic category. The score is the number of unique correct words. Additional measures are number of words pr 15 seconds, and repetitions and intrusions.
Attention	Digit Span	A measure of verbal working memory and attention. Increasingly longer strings of numbers (1–9) is read aloud to the examinee who then repeats them back.
	Coding	A measure of visual scanning, psychomotor speed, and attention. The examinee is presented a sheet of paper filled with symbols and asked to fill in the corresponding number (1–9) to each symbol using the key on top of the page. The score is the total number of numbers correctly completed within 90 seconds.
Delayed Memory	List Recall	A measure of an examinee's ability to recall the words presented in the List Learning subtest. The examinee is asked to produce as many words remembered from the list. Score is number of correct words; repetitions and intrusions can be scored additionally.
	List Recognition	A measure of delayed memory and recognition. 20 words are read to the examinee, of which 10 words were on the original list (targets) and 10 were not (distractors). Correct identification of words either as target or distractor is scored.
	Story Recall	A measure of verbal delayed memory. The examinee is asked to recall as many details as possible from the story learned in the Story Memory subtest. Score is number of correct details remembered.
	Figure Recall	A measure of visual delayed memory. The examinee is asked to draw the figure from the Figure Copy subtest without visual display of the figure. There is no time limit. Accuracy and placement of 10 details are scored.
Total Scale		A summary score derived from the sum of all indices.

Note: adapted from *Manual Supplement*, retrieved from https://www.pearsonclinical.no/mwdownloads/download/link/id/147/

Behavior Rating Inventory of Executive Function–Adult Version

The Behavior Rating Inventory of Executive Function–Adult Version (BRIEF–A; Isquith et al.,2005) were used to assess executive dysfunction. The BRIEF–A is a self-report standardized inventory that measures behaviors associated with executive functions in daily life. The Norwegian version (Nicholas & Solbakk, 2006) of the BRIEF–A was completed by 264 participants as it was not a part of the routine assessment in the beginning but added later. Some participants consented to the RBANS but declined to fill out the BRIEF–A; how many is not known.

The BRIEF–A consists of a questionnaire comprised of 75 written statements that the respondent rates whether the specific behavior is never, sometimes, or often a problem. It takes about 10–15 minutes to administer and requires a reading level corresponding to fifth grade. Examples of statements are "I forget instructions", and "I make careless mistakes" (Gioia et al., 2000). The respondent's rating of each item (i.e., never, sometimes, or often) is given a score of one, two or three, respectively. The 75 items are divided into nine theoretically and empirically derived scales (i.e., Inhibit, Self-Monitor, Plan/Organize, Shift, Initiate, Task Monitor, Emotional Control, Working Memory, and Organization of Materials), two broader indices (i.e., Behavioral Regulation and Metacognition), and an overall summary score (i.e., Global Executive Composite).

For this thesis, the Initiate Scale was used as a measure of patient's difficulties with motivation and interest (i.e., avolition). According to the authors, this scale measures a person's ability to independently beginning a task or activity and generate ideas, responses, or problem-solving strategies. The Initiate Scale does not typically reflect noncompliance but captures problems with getting started on tasks or chores, along with a need for extensive prompts or cues in order to begin a task or activity, despite wanting to succeed at a task (Isquith et al., 2005; Roth et al., 2014). The Norwegian version applies U.S. normative data, which includes 1,136 U.S. men and women from ages 18 to 90 years and from a wide range of ethnic and educational backgrounds, as well as geographic regions matched to U.S. census data (Isquith et al.,2005). Raw scores can be converted to uniform T scores and percentiles. A T score ≥ 65 are

considered clinically significant (<7% of the normative sample had scores above this cutoff; Isquith et al., 2005). The BRIEF–A also includes three validity scales, with cutoffs based on infrequent raw scores in the normative sample and clinical samples (i.e., Negativity ≥ 6; Inconsistency ≥ 8; Infrequency ≥ 3). For example, marking often to "I forget my name" is highly unusual, even for adults with severe cognitive impairment, and suggests haphazard responding (Isquith et al., 2005).

National Adult Reading Test

The Norwegian version of the National Adult Reading Test (NART) was used to estimate levels of intelligence. The NART is a well-established method for estimating premorbid intelligence in both clinical and research settings (Bright et al., 2018; Sundet & Vaskinn, 2008; Vaskinn et al., 2020) and takes about five minutes to administer. NART consists of 50 words of atypical phonemic pronunciations, thus requiring knowledge of how the pronunciation differs from standard Norwegian writing, which is for the most part homologic. The Norwegian NART correlates somewhat less with IQ (r= .50; Sundet & Vaskinn, 2008) compared to the English version (r= .69; Bright et al., 2018). We used the formula published in Sundet and Vaskinn (2008): Estimated IQ = 104.2 + (−0.41 × NART errors) + (0.77 × years of education) + (−0.07 × years of age). The NART was not part of the routine assessment in the beginning, hence 273 patients completed the NART.

Wechsler Adult Intelligence Scale–Fourth Edition

The Wechsler Adult Intelligence Scale–Fourth Edition (WAIS–IV; Wechsler, 2011), a comprehensive measure of intelligence level (i.e., IQ), was completed by 116 patients. The WAIS–IV was not a part of the routine assessment and was administered by request of referrals (e.g., in forensic cases) or when considered appropriate by the neuropsychologist. The results from the WAIS–IV were included in the project on grounds of importance; IQ is associated with performance on many neuropsychological tests, among those the RBANS's subtests, and provided a measure of patients' current IQ levels as opposed to premorbid estimations.

3.2 Statistical analysis

The Statistical Package for the Social Sciences (SPSS) was used to conduct descriptive analyses of clinical and demographic baseline characteristics in each paper and was used for the main analyses in all three papers. Categorical variables were compared between groups using Chi-square or one-way ANOVAs. Group differences in cognitive performance were analyzed using independent samples *t*-tests and differences in normative systems with paired samples *t*-tests. Associations between variables were analyzed using correlation and regression analysis.

3.2.1 Paper I

Descriptive statistics (e.g., mean, median, and standard deviation) for the age adjusted RBANS indices standard scores were computed for the entire clinical sample. Paired samples *t*-test were used to compare differences in RBANS index scores derived from Scandinavian and U.S. normative data. Independent samples *t*-test were used to investigate difference in RBANS test performance between males and females, and between substance abusers and abstainers. Cohen's kappa coefficient was used to measure the intra-rater reliability in identifying cognitive impairment between the Scandinavian and U.S. normative data. Chi-square tests were used to compare differences in classification of impairment across the two normative data sets for substance abusers and non-abusers, men and women, patients older than 28 years of age and those 28 years or younger, patients with less than high school and those with high school or more than high school. Chi-square tests were also used to investigate whether (a) there were any demographic differences of patients classified as not impaired by both normative sets; (b) as impaired by both; (c) those classified as impaired by the Scandinavian norms but not by the U.S. norms; and (d) those classified as impaired by the U.S. norms but not by the Scandinavian norms.

3.2.2 Paper II

Descriptive statistics (e.g., mean, median, standard deviation, interquartile range, skewness, and kurtosis) for the age adjusted RBANS Index standard scores were computed for (a) the entire sample; (b) by comorbid substance abuse (yes/no); (c) by

levels of educational attainment (less than high school, high school, and more than high school); and by (d) gender. Clinical normative data tables and base rates of low RBANS scores tables were computed using frequency analysis tables for the entire sample and then stratified by gender, by levels of educational attainment (less than high school, high school, and more than high school), and by intelligence. Chi-square was used to analyze categorial differences in the sample (gender, substance abuse or no substance abuse, low or high IQ, cognitive impairment versus no impairment). A one-way analysis of variance (ANOVA) was used to explore effects of the three education levels on RBANS test performance. Independent samples *t*-test were used to investigate difference in RBANS test performance between males and females and between substance abusers and abstainers.

3.2.3 Paper III

Frequency analysis tables were used to compute base rates of (a) RBANS embedded performance validity tests (PVTs); (b) the RBANS subtests these indicators are derived from, and (c) the BRIEF–A Initiate Scale. Spearman's rank order correlations were used to investigate associations between the RBANS PVTs and BRIEF–A Initiate Scale, measures of cognition (i.e., RBANS, NART and WAIS–IV) and years of age and education. A standard linear multiple regression was used to explore how much of the variance of BRIEF–A Initiate Scale scores were explained by the RBANS PVT scores (i.e., the EI, ES, and PVI). Preliminary analyses were conducted to ensure no violation of normality, linearity, multicollinearity, and homoscedasticity.

4. RESULTS

4.1 Paper I

Comparing the RBANS Indices and Total score derived from U.S. normative tables to those derived from Scandinavian normative tables identified statistically significant differences of medium effect size between all RBANS Indices and Total Scale, except for Attention Index. The RBANS mean Index scores derived from Scandinavian normative data were more similar to scores reported for patients with schizophrenia spectrum disorders in comparable studies (Dickerson et al., 2004; Iverson, Brooks, & Haley, 2009; Wilk et al., 2004; T. Zhang et al., 2015) than scores derived from U.S. normative data. Defining cognitive impairment as having two or more (out of five) index scores ≤5th percentile (Holdnack et al., 2017; Iverson et al., 2011; Iverson, Brooks, & Young, 2009a, 2009b), 42% of patients met criteria for impairment using U.S. normative data compared to 63% using Scandinavian normative data [χ^2(1, N=315)=99.49, p <.001, φ=.569]. There was moderate agreement in classification between the two normative data sets [κ= .523 (95% CI, .439– .608), p< .001], with an overlap of 94% of those classified as not impaired, and 64% overlap of those classified as impaired. There were no significant differences between patients abusing substances compared with those not abusing substances when applying Scandinavian normative data (p-values ranging from .26– .97). Applying U.S. normative data, patients using substances scored significantly higher on the Language Index (M=85.38, SD=12.91) than patients not using substances (M=81.71, SD=14.78), t(313)= −2.34, p= .020). The U.S. norms classified significantly more women as impaired [χ^2(1, N=315)=9.08, p< .002, φ= .176], whereas the Scandinavian norms did not [χ^2(1, N=315)=1.14, p< .286, φ= .067]. Both the U.S. norms and Scandinavian norms classified more patients with less than high school as impaired compared with those with education at high school level or more [U.S.: χ^2(1, N=315)=10.22, p= .001, φ=− .187; Scandinavian: χ^2(1, N=315)=13.28, p< .001, φ=− .212]. Comparing those older than 28 years of age with those 28 years or younger, the Scandinavian norms classified more of the older patients

as impaired [$\chi^2(1, N= 315)=7.96$, $p= .005$, $\varphi= .167$], whereas the U.S. norms did not [$\chi^2(1,N=315)=0.00$, $p< .936$, $\varphi= .005$]. No other differences were found.

4.2 Paper II

The average (i.e., at the 50th percentile) RBANS scores of patients with schizophrenia spectrum disorders were: Immediate Memory Index=78, Visuospatial/Constructional Index=90, Language Index=78, Attention Index=70, Delayed Memory Index=80, and Total Scale=69. The mean Index scores were similar to those reported by Iverson et al. (2009) and differed on average 3.27 points for all five indices; the largest difference was for the Immediate Memory Index (8.80) and least for the Attention Index (2.03). The average Total Scale score differed by 0.18 points. There were no significant differences when comparing index scores for substance abusers with those not abusing substances (*p*-values ranging from .28– .89). Men had significantly higher scores on the Immediate Memory Index, Visual/Constructional Index, and the Total Scale compared to women (*d* ranged from .29–.37). Years of education were significantly correlated ($p< .001$) with all index scores and Total Scale scores (*rho* ranged from .23–.39). Patients with higher intelligence levels performed significantly better (*p*-values ranging from .009–< .001) on all Indexes and the Total Scale score (*d* ranged from .64–1.13). To enable clinicians to compare a patient's score with other patients with schizophrenia spectrum disorders, clinical normative tables were constructed, using the descriptive classifications (and corresponding percentile range) of extremely low (≤2nd percentile), unusually low (3rd–9th percentiles), low average (10th–24th percentiles), average (25th–75th percentiles), high average (76th–90th percentiles), and superior (≥91st percentile). Tables were stratified by gender and levels of educational attainment. In addition, tables of base rates of low scores were constructed, stratified by gender, level of education, and by intellectual abilities. Low scores were common: 79% had two or more index scores below one *SD*, 63% had two or more at or below the 5th percentile, and 40% had two or more index scores <−2 *SDs*. The base rates of low scores varied by education and by levels of intelligence. In patients with WAIS–IV FSIQ scores below 80, 85% obtained two or more frankly impaired index scores

(i.e., <−2 *SDs*) compared to 40% of patients with WAIS–IV FSIQ scores 80 or higher [$\chi^2(1)=19.47$, $p< .001$, $\phi=-.51$]; and 51% of the patients with less than high school education, 31% of the patients with high school education, and 20% of patients with more than high school education had two or more index scores <−2 *SDs* from the mean [$\chi^2(2)=23.55$, $p< .001$, $V= .265$].

4.3 Paper III

On the BRIEF–A Initiate Scale, which measures self-reported problems with enthusiasm and engagement, passiveness, and ability to independently start tasks or assignments, 51% had a *T* score above the suggested clinical cutoff (i.e., *T* ≥65); 36% had a *T* ≥70 and 19% had a *T* ≥80. The maximum *T* score is 89, which was obtained by 1.2%, whereas *T* scores ≤50 occurred in 17%. Prevalence of scores exceeding cutoffs on the RBANS PVTs varied from 3% (i.e., EI scores >4), 6% (i.e., PVI scores <42), to 28% (i.e., ES scores <12). Of the three PVTs, only the EI had a significant correlation with the BRIEF–A Initiate Scale, albeit very small (*rho*= .158, *p*< .05). When including only patients that had acknowledged clinically significant initiation problems (i.e., those with *T* scores ≥65 on the BRIEF–A Initiate Scale; *n*=128), none of the RBANS PVTs were significantly correlated with the BRIEF–A Initiate Scale (EI: *rho*= .112, *p*= .304; ES: *rho*= .091, *p*= .509; PVI: *rho*= − .018, *p*= .870). All RBANS PVTs had moderate to high correlations with measures of cognitive impairment and small correlations with years of education. The EI and PVI had moderate correlations with intelligence levels and the ES correlated with age (*rho*= .243, *p*< .001). A standard linear multiple regression revealed that the PVTs did not explain a significant amount of variance in BRIEF–A Initiate Scale scores, $F(2, 125)=1.706$, $p= .186$, $R^2= .027$, $R^2_{Adjusted}= .011$, or when including only those patients having BRIEF–A Initiate Scale scores of *T* ≥65, $F(2, 68)= .630$, $p= .535$, $R^2= .018$, $R^2_{Adjusted}= -.011$. The inclusion of the PVI in the model resulted in unacceptable multicollinearity, and this variable was excluded from the regression analysis.

4.4 Summary of findings of Papers I, II, and III

Paper I demonstrated that different normative systems influence the accuracy of detecting cognitive impairment in patients with schizophrenia spectrum disorders. Using U.S. norms on Norwegian patients' RBANS test performance probably underestimate cognitive deficits in this patient group. Overall, there were no significant differences in RBANS test performance between patients abusing substances compared with those not abusing substances. Paper II provides clinical norms for Norwegian patients, and details how educational attainment, levels of intelligence, and gender influences RBANS test performance. The new clinical norms are stratified by education or level of intelligence, facilitating interpretation of test results and identification of cognitive deficits in patients having below average intelligence and/or low education. Paper III provides base rates for three RBANS embedded PVTs and demonstrates that these measures are unrelated to measures of patients experience of motivational problems but are associated with cognitive impairment. About 6% of patients had scores indicating invalid test results, suggesting that completing the RBANS is within the capabilities of most patients with schizophrenia spectrum disorders.

5. DISCUSSION

The main aim of this thesis was to examine the applicability and quality of the RBANS in assessing cognitive impairment in Norwegian young adults with schizophrenia spectrum disorders. The three papers focused on psychometric aspects of the RBANS, and the clinical relevance of these aspects and their relation to schizophrenia spectrum disorders. A central hypothesis was that applying original U.S. normative data would underestimate Norwegian patients' cognitive difficulties. A main objective was to construct clinical normative tables using Scandinavian normative data and compare these tables with clinical normative tables derived from comparable patient samples in North America. Whether RBANS PVTs were associated with patients self-reported motivational difficulties was explored, as was the possible effects of substance use, education, intelligence, and gender on RBANS test performance. Results suggested that applying U.S. norms lead to underestimation of cognitive impairment in Norwegian patients and that the Scandinavian norms yielded test scores that were comparable to findings reported in previous studies of patients with schizophrenia spectrum disorders. Test performance was influenced by levels of intelligence and educational attainment, and to some extent gender, whereas patients with comorbid substance abuse did not differ in test performance compared to patients not using substances. Patients' level of motivational problems was not associated with embedded RBANS PVTs, nor with test performance, but PVTs were highly correlated with cognitive impairment.

5.1 Norwegian patients' cogntive deficits do not differ from patients in North Amercia

As reported in paper I, using the Scandinavian norms resulted in more precise classification of patients' cognitive impairment and using U.S. normative data overestimated cognitive functions in Norwegian patients by 0.4–0.7 *SDs*. This is comparable to re-norming studies in Australia, where healthy Australians' cognition is overestimated when using U.S. norms, averagely by 0.4 *SD* on the RBANS indices (A. Green et al., 2008). In paper II, insubstantial differences in RBANS test performance

between Norwegian patients and patients from Canada and the U.S. was reported. For example, the difference in the average RBANS Total Scale score was 0.18 points when compared with a study from Canada (Iverson et al., 2009) and 1.56 points compared to a U.S. study (Wilk et al., 2004). The better concordance between the results in paper II and results from North America is not surprising, as the Scandinavian norms are more representative of Norwegians than the U.S. norms.

The results in paper I and II contrasts somewhat with previous studies form Norway (e.g., Anda et al., 2016; Helle et al., 2014), where Norwegian patients have RBANS scores that are about 1 *SD* higher than patients in North America (Iverson, Brooks, & Haley, 2009; Wilk et al., 2004). However, the Norwegian studies were conducted before Scandinavian norms were available, and no alternative to the original U.S. norms existed at that time. If the effect of applying U.S. norms on Norwegian patients' RBANS scores reported in paper I are subtracted from the RBANS scores reported by Anda et al. (2016) and Helle et al. (2014), the discrepancy is less, on average about five index points. This remaining difference might be due to differences in sample characteristics. When comparing the North American with previous Norwegian studies (Anda et al., 2016; Helle et al., 2014), we find that the samples are quite comparable considering diagnoses, age, education level and gender, but the Norwegian studies have smaller samples (i.e., 51 participants as opposed to 127 of the Canadian and 575 of the U.S. patient samples). Based on the comparatively smaller samples in the Norwegian studies, they are probably less representative for the patient population compared to the North American studies. Smaller samples are more vulnerable to impact of outliers (Brooks et al., 2009; Kwak & Kim, 2017; Osborne & Overbay, 2019), and a few patients with high RBANS test scores will impact the means of the RBANS Indices much more than studies with larger samples. The patient sample used for the studies in this thesis is about six times larger than previous Norwegians studies, and thus less impacted by outliers. The sample is also probably more representative of Norwegian patients' cognitive functioning, as it closely matches the overall prevalence of diagnosis, gender, and substance abuse in patients with schizophrenia disorders in Norway (Nesvåg et al., 2015).

Since normative data is cross-sectional, they are subjected to cohort effects (Baxendale, 2010). Cohort effects have been demonstrated for several cognitive tests (Overton et al., 2018). This means that normative data can be outdated and yield inaccurate estimates of cognitive functions when applied to people born later than those comprising the normative sample, as the normative sample is no longer representative of the examinee's cohort. The cohort comprising the age band of 20–39 years old in original U.S. RBANS norms published in 1998 (Randolph, 1998) were born between 1959–1978, whereas the Scandinavian cohort was born 15 years later, between 1974–1993. In Norway, cohort effects have been demonstrated on tests of intelligence. The level of intelligence of Norwegian males drafted for military service aged 18–20 years has increased steadily from 1954 until 1994 (i.e., the Flynn-effect), from 100 IQ points in 1954 to 112 in 1994, indicating that Norwegians born in the mid-1970s and onwards have better cognitive abilities than the normative cohort (consisting of people born in the late 1930s), and better than people born in the 1950s and -60s (Storsve et al., 2018). Thus, the overestimation of cognitive functions when using the U.S. normative data might be, in part, due to cohort effects. The reported increase in cognitive abilities over time, such as intelligence, visual learning, memory recall and recognition, are supposedly due to increase in formal education (Baxendale, 2010; Brinch & Galloway, 2012; Ritchie et al., 2015; Rönnlund & Nilsson, 2009).

Test performance on many cognitive tests are affected by ethnicity (Casaletto & Heaton, 2017; Heaton et al., 2004; Shadlen et al., 2001). It is generally believed that effects of ethnicity are due to differences in educational systems or discrepancies in quality of education and not to genetic differences between ethnic groups (Heaton et al., 2004; Manly et al., 2002). It is noteworthy that the U.S. normative data consist of 17% of America Hispanics and American Africans, similar to the percentage of the U.S. census at that time (Randolph, 1998). The precise ethnical composition of the Scandinavian normative data is not known, but is probably more ethnically homogeneous compared to the U.S., as the combined percentage of Hispanics and Africans are approximately 1.8% of the population in the Nordic countries (Statistics Denmark, n.d.; Statistics Norway, n.d.; Statistics Sweden, n.d.). In general, Caucasians

have higher RBANS test scores compared to African Americans and Hispanic Americans (Hobart et al., 1999; Patton et al., 2003; Randolph, 2012). This would also contribute to the U.S. norms' overestimation of cognitive functions in Scandinavian people.

The U.S. RBANS normative sample has 35% participants with less than high school education, which is more than twice of the Scandinavian sample (i.e., 17%). In the age group of 20–39 years, the U.S. normative sample had 55% participants with more than high school, 32% which had completed high school, and 13% with less than high school, whereas these percentages are not reported in the Scandinavian manual. This suggests that there might be unknown educational effects, favoring Norwegians, when U.S. normative data is used. Education effects on performance on the RBANS have been reported in several studies (Andreotti & Hawkins, 2015; Beatty, Mold, et al., 2003; Goette & Schmitt, 2019; Haddad et al., 2020; Hobart et al., 1999; Iverson, Brooks, & Haley, 2009; Muntal et al., 2020; Olaithe et al., 2019; Wilk et al., 2004), accounting for about 7–18% of variance in RBANS test performance (Collinson et al., 2014).

To sum up, there are several noteworthy differences between the RBANS U.S. and Scandinavian normative data. The normative samples differ in composition regarding education levels, ethnical composition, and in the age cohorts' year of birth, which have implications for their educational level; people born in the 1980s were subjected to more education than people born in the 1960s. These differences are probably the underlying reason for the overall better test performance of Scandinavians on the RBANS compared to people from the U.S. Using the RBANS U.S. normative data to convert raw scores to index scores will thus result in overestimation of cognitive functions in people from Norway.

5.2 Substance abuse does not affect cognition in younger Norwegian patients with schizophrenia spectrum disorders

Schizophrenia spectrum patients with comorbid substance abuse did not differ in RBANS test performance compared to patients not abusing substances. This is in accord with meta-analyses and systematical reviews of research literature of patients with schizophrenia spectrum disorders and comorbid substance abuse (Løberg & Hugdahl, 2009; S. Patel et al., 2020; Potvin et al., 2008, 2012). However, years of age and type of substance seem important. Younger patients (i.e., <30 years of age) abusing substances have better cognition than older (i.e., >30 years old) substance abusers (Løberg & Hugdahl, 2009; Potvin et al., 2012). This suggest that the patients included in this thesis might be too young to have used substances sufficiently long for the negative effects of substance abuse to be distinguishable from the general impairment associated with schizophrenia spectrum disorders. Another possibility is that they indeed have better cognition, but that negative effects of substance abuse lower their cognitive functions to the same level of those not abusing substances (McCleery et al., 2006).

Follow-up studies have indicated that in younger adults, negative effects of cannabis use on cognition largely dissipates after about four weeks (Schuster et al., 2018). Other substances (i.e., cocaine, amphetamines, ecstasy, opiates, and alcohol) seem to last substantially longer, for some substances more than 12 months (van Holst & Schilt, 2011). Unfortunately, no data on which substances patients used were recorded and analyses of cognitive functions stratified by type of substance (e.g., cannabis abuse versus poly-substance abuse) cannot be performed. Nor were data on patients' duration of abstinence for those undergoing treatment for substance abuse disorder, length of substance abuse before treatment or number of re-lapses to abuse recorded. Thus, the studies in this thesis do not contribute much in gaining a better understanding of the effects of substance abuse on cognition in schizophrenia disorders, other than supporting previous findings that most younger patients with schizophrenia spectrum disorders and comorbid substance abuse disorder do not differ cognitively from patients not using substances.

5.3 Gender affects RBANS test performance in Norwegians with schizophrenia spectrum disorders

Gender differences in performance on the RBANS were not found for the U.S. or Scandinavian normative samples (Randolph, 1998, 2012, 2013). However, several studies have reported gender differences in test performance on the RBANS in both healthy controls and patient samples across many countries (Andreotti & Hawkins, 2015; Beatty, Mold, et al., 2003; Cardon et al., 2019; Duff, Schoenberg, et al., 2011; Duff & Ramezani, 2015; Iverson, Brooks, & Haley, 2009; Loughland et al., 2007; Tsatali et al., 2018; Wilk et al., 2004; X. Y. Zhang et al., 2012), except in Spain (Muntal et al., 2020) and for Mexican Americans (Hall et al., 2018). In general, women tend to perform better than men on the Immediate and Delayed Memory and the Language Indexes, whereas men perform better on the Visuospatial/Construction Index (Andreotti & Hawkins, 2015; Beatty, Mold, et al., 2003). In paper I and II, men were found to have better cognitive functions than women, which is somewhat unexpected, as women with schizophrenia spectrum disorders tend to have better premorbid functioning and better course of illness (Canuso & Pandina, 2007; Mendrek & Mancini-Marïe, 2016). These finding suggests that men in the current patient sample functions somewhat cognitively better than women.

Gender differences in test performance suggests that RBANS normative data should have been stratified for gender as well as age (Beatty, Mold, et al., 2003; Duff, Schoenberg, et al., 2011; Duff & Ramezani, 2015) but gender effects on the RBANS tend to be small to moderate (Andreotti & Hawkins, 2015; Beatty, Mold, et al., 2003; Cardon et al., 2019; Duff, Schoenberg, et al., 2011; Duff & Ramezani, 2015; Iverson, Brooks, & Haley, 2009; Loughland et al., 2007; Tsatali et al., 2018; Wilk et al., 2004; X. Y. Zhang et al., 2012), and does not in most cases lead to dramatically different results (Duff, Schoenberg, et al., 2011). The clinical norms in paper II were nevertheless stratified by gender, as there were a large number of patients in each category, and because this was also done in the paper that was sought replicated (i.e., Iverson, Brooks, & Haley, 2009).

5.4 RBANS test performance in schizophrenia spectrum disorders is influenced by IQ and level of education

It is well known that educational attainment and level of intelligence is associated with performance on neuropsychological tests (Diaz-Asper et al., 2004; Heaton et al., 2004; Huang & Zhou, 2013; Manly et al., 2002; Parisi et al., 2012; Reitan & Wolfson, 2005). There is a strong correlation between educational attainment and intelligence, which is probably bidirectional (Rindermann, 2008). There is some evidence that education in itself have a direct positive effect on test performance on intelligence tests and tests of memory (Huang & Zhou, 2013; Ritchie & Tucker-Drob, 2018; Rönnlund & Nilsson, 2009; Storsve et al., 2018). For example, capitalizing on educational reforms in Norway in the 1960s and intelligence tests from the compulsory military draft of men at that time, Brinch and Galloway (2012) found that one extra year of schooling resulted in an increase in overall intelligence by 3.7 IQ points.

As noted earlier, education effects on performance on the RBANS have been reported (Andreotti & Hawkins, 2015; Beatty, Mold, et al., 2003; Collinson et al., 2014; Goette & Schmitt, 2019; Haddad et al., 2020; Hobart et al., 1999; Iverson, Brooks, & Haley, 2009; Muntal et al., 2020; Olaithe et al., 2019; Wilk et al., 2004). In line with this, results in paper I and II demonstrated that patients with more education and/or higher levels of intelligence also had higher RBANS index scores, with moderate to large effect sizes. The RBANS have been criticized for lacking education-based norms (Larson et al., 2007) and several supplementary norms stratified by age and education levels, and gender, have been published (Duff et al., 2010; A. Green et al., 2008; Iverson, Brooks, & Haley, 2009; Olaithe et al., 2019). In concordance with this, the clinical norm tables in paper II were stratified by either gender, educational levels, or intelligence levels. For example, for patients with less than high school education, a RBANS Total Scale score of 45 is a score in low average range (10th–24th %-tiles) but is extremely low (≤ 2nd %-tile) for patients with more than high school education. In patients with NART FSIQ scores <100, 51% obtained two or more index scores <−2 *SDs* compared to 28% of patients with NART FSIQ scores ≥100. Thus, the clinician can assess whether a patient's score is unusually low, taking the patient's level of

education or intelligence into consideration. This represents an improvement in methods for identifying cognitive impairment in people with schizophrenia spectrum disorders.

Tables that considered gender, education and intelligence simultaneously could not be constructed, as this would result in too few participants in each category to be representative of the patient population (Fastenau & Adams, 1996). As noted in paper II, only 26 women in that study had a NART-predicted level of intelligence of ≥ 100; of those 10 had less than high school education, 4 had completed high school, and 12 had more than high school education. Also, too few patients with superior intelligence were included in the sample, and the clinical normative tables could only be stratified by average or below average intelligence.

In paper III, the relationship with measures of test effort derived from neuropsychological tests (i.e., RBANS PVTs) and patients' self-report of problems related to motivation were investigated. When rating behavioral descriptions concerning enthusiasm and engagement, passiveness, and ability to independently start tasks or assignments on the BRIEF–A, 51% of the patients had scores exceeding clinical cutoff (i.e., T-scores ≥65). The objective measures of test effort (i.e., EI, ES, and PVI) indicated that 3%–28% of patients had test scores indicating problems engaging in the tests. The reason for the discrepancy between the RBANS PVTs is the prevalence of the different cutoff scores suggested for these measures. For example, in paper III it was reported that the recommended cutoff for the ES (Novitski et al., 2012) resulted in 28% of patients having possible low test effort, as opposed to 6% when using the recommended cutoffs for the EI (Silverberg et al., 2007) and PVI (Paulson et al., 2015), and 3% when using the suggested cutoff for patients with schizophrenia disorders (Moore et al., 2013). Meta-analyses of the RBANS PVTs have found that the optimal cutoff value of the EI is 3.11 (Goette & Goette, 2019). This corresponds to a prevalence of possible low effort/or invalid test performance of 6% in Norwegian patients with schizophrenia spectrum disorders.

The RBANS PVTs had moderate to high correlations with patients' level of cognitive impairment, which corroborates with previous results (Duff, Spering, et al., 2011; Dunham et al., 2014). This is to be expected, as cognitive impairment results in low test scores, including the subtests comprising the RBANS PVTs (Burton et al., 2015; Goette & Goette, 2019; Hook et al., 2009; Morra et al., 2015; Shura et al., 2018). Of the RBANS PVTs, the ES seems more appropriate for people with severe cognitive impairment, particularly memory impairment, and the EI is probably better suited for people with normal cognition or mild cognitive problems (Riordan & Lahr, 2020).

It has been suggested that cognitive impairment might be more important for understanding symptoms of avolition and motivational problems than currently recognized (Anda, 2020) and that cognitive impairment contributes to or underlies motivational problems in addition to, or instead of, motivational deficits contributing to low cognitive performances (Barch, 2005). However, evaluation of the possible associations of negative symptoms (i.e., avolition and amotivation) and cognitive impairment indicates that they are independent features of schizophrenia spectrum disorders, with different etiologies affecting separate brain regions, but nevertheless correlated (Harvey et al., 2006). It is therefore a little surprising that patients' self-reported motivational problems are not correlated with cognitive measures, as demonstrated in paper III.

The discrepancy between measures of effort derived from neuropsychological tests scores compared to patients' self-reports indicates that these measures are not measuring the same construct. Several studies have found that scores on the BRIEF–A is strongly associated with emotional distress in healthy controls, and in patients with neurological or psychiatric disorders (Bell et al., 2019; Donders et al., 2015; Donders & Strong, 2016; Løvstad et al., 2016; Mohammadnia et al., 2020; Shaked et al., 2020; Shwartz et al., 2020) and is generally unrelated to test performance on neuropsychological tests of executive functions. In patients with schizophrenia disorders, Haugen et al. (2021) found that scores on the BRIEF–A scales Inhibit, Working Memory and Shift did not correlate with performance on neuropsychological tests measuring inhibition, shifting and working memory but were correlated to

measures of self-efficacy. Randers et al. (2020) found that BRIEF–A measures did not correlate with cognitive performance measures in a sample of people of ultra-high risk of developing schizophrenia disorders. In line with this, insubstantial correlations between the Initiate Scale scores and the RBANS PVTs scores were reported in paper III, and the PVTs did not explain any significant amount of variance in patients' BRIEF–A Initiate Scale scores.

The consistent finding that BRIEF–A measures do not correlate much with neuropsychological tests of executive functions suggests that the BRIEF–A cannot be used as a substitute for performance based neuropsychological tests, but can be used as a supplement, which is in line with the authors' intentions (Isquith et al., 2013; Roth et al., 2014). After all, the BRIEF–A contains many different measures of behavioral and emotional control intended to be evaluated in an every-day setting, whereas many neuropsychological tests are deliberately designed to capture few, well-defined, underlying cognitive processes, in a laboratory setting. Because the BRIEF–A measures have been demonstrated to correlate with measures of functions of daily activities , Randers et al. (2020) argues that the relative dissociation of the BRIEF–A and neuropsychological tests is evidence of its usefulness in clinical settings, as it probably captures other important aspects of patients' problems not captured by neuropsychological tests of executive functions, thus underscoring the importance of measuring both objective and subjective cognition in schizophrenia spectrum disorders.

6. METHODOLOGICAL CONSIDERATIONS

6.1 Missed opportunities

The current project included quite limited number of variables and the present thesis is based on these variables. However, if the dataset had included a more extended number of variables, several other hypotheses central in the literature could have been explored and investigated. Since this is not an option one might considered this to be missed opportunities. For example, several other neuropsychological tests were also in use at Bergen Psychiatric Hospital and some patients completed large batteries of neuropsychological tests when undergoing more comprehensive neuropsychological evaluations. Results for these assessments could have been used to evaluate the quality of the RBANS assessment procedure, for example, comparing agreement of level of impairment in comparable cognitive domains (e.g., verbal memory, attention, and processing speed). This would allow for analyses of whether the time spent on large neuropsychological test batteries are worthwhile when assessing cognition in patients with schizophrenia disorders. Such analyses would allow for the RBANS to serve as a benchmark for neuropsychological tests that uses U.S. norms, which is common in Norway (Egeland et al., 2016), to assess whether these tests under- or overestimate cognitive functions in Norwegians.

Other data of interest were also collected routinely at the Bergen Psychiatric Hospital. For example, the Positive and Negative Syndrome Scale (PANSS) were used in diagnostic and treatment evaluations of all patients. PANSS scores would have enabled comparison with patients' symptoms and possible associations with the RBANS test scores, including the PVTs, and the BRIEF–A measures. Other patient data of interest would be whether diagnoses changed over time (e.g., from admission to discharge); medication, dosage, and blood serum levels; and for those using substances: type of substances used, duration use and of abstinence, number of relapses to abuse; furthermore, EEG, MRI, return to education or work, disability status, and more. Capitalizing on these data as well would have enhanced the clinical utility of the project.

6.2 Selection bias and representativeness

Participants included in the sample for this thesis were not drawn form a random sample but is comprised of patients receiving health services at psychiatric hospitals in the Bergen area in Norway. The patient sample consisted of out- and in-patients, of which many were admitted as inpatients due to the severity of their illness, and several were forensically committed. The patient sample is thus probably more representative of patients in the moderate to severe end of the schizophrenia spectrum. All psychiatric treatment facilities were in an urban setting in the western part of Norway and might not be representative of rural areas or other regions. Also, because undergoing neuropsychological assessment was voluntary, an unknown number of patients declined. Inpatients sometimes opted out when receiving more information about the assessment, some patients did not want to participate in any assessment procedures regardless their purpose, and some had other activities they prioritized, such as attending school. Whether those that declined have different characteristics from those included in the study samples is not known but they might not be considered randomly missing. The sample is thus a self-selected convenience sample and cannot be representative of the entire schizophrenia spectrum, such as patients that have milder forms and not needing health care at hospital level, or those patients not capable of participation in the assessment procedure due to the severity of their illness. On the other hand, including a diagnostically diverse group of patients with schizophrenia spectrum disorders, such as those with comorbid substance abuse, patients with FSIQ <70, patients in all stages of illness and recovery, and inpatients and outpatients, strengthens the clinical representativeness of the sample. The sample is comprised of patients that need health care at psychiatric hospital level and is probably representative of that category of patients with schizophrenia spectrum disorders. The sample is also probably representative of most patients with schizophrenia spectrum disorders in Norway, as the sample's demographic and diagnostic characteristics are comparable to national health register data (Nesvåg et al., 2015).

Ethnic identity or background were not registered and the ethnical representation in the sample is unknown. Patients were included regardless their ethnicity if born and

educated in Norway and were considered Norwegians regardless their parent's country of origin. Due to language requirements, patients that had poor Norwegian skills were excluded. These patients were immigrants or refugees that came to Norway as adults or in their late teens. In all, 36 out of 462 patients belonged to this category, which constitutes 8% of the sample. In the Bergen area, immigrants outside Europe and North America constitutes 7% of the total population (Bergen Municipality, n.d.). Omitting this group of patients limits the generalizability of the results to patients with immigrant or refugee status, which in itself is one of several factors increasing the risk of developing schizophrenia disorders (Kahn et al., 2015; McCutcheon et al., 2020).

The patient samples used in the three studies comprising this thesis are quite large, ranging from 250 to 335 participants. This reduces the impact of outliers and results are generally considered more robust compared to results derived from smaller samples. However, when sample size increases, so does the analysis power and this increases the tendency to identify statistically significant differences that are not clinically meaningful (Faber & Fonseca, 2014). The results in paper III illustrates this. Statistically significant correlations between the RBANS EI and the BRIEF–A Initiate Scale were identified, but correlations were small (rho= .158, p< .05) and probably of no clinical significance.

6.3 Validity and reliability

The RBANS were developed to identify and characterize abnormal cognitive decline in older adults and as a neuropsychological screening battery for younger patients (Randolph, 1998, 2012). It has been found to generate cognitive profiles that can be used to accurately discriminate between people with mild dementia and healthy controls, between patients with Alzheimer's disease and Huntington's disease (Randolph et al., 2010), and between Alzheimer's and Parkinson's patients (Beatty, Ryder, et al., 2003). For younger patients, it has been demonstrated to discriminate between people that had sustained a recent concussion from those that had no concussions or one concussion in the past (Moser & Schatz, 2002). The RBANS Total Scale score strongly correlates with measures of cognitive disability at 12 months in

stroke patients, and most RBANS indices have strong correlations with other neuropsychological tests measuring similar constructs (Larson et al., 2007). In patients with moderate to severe traumatic brain injury, the RBANS have been found to have strong convergent validity with other comparable neuropsychological tests and to be a reliable and valid screening tool in assessing cognitive deficits after traumatic brain injury (McKay et al., 2007). In general, these findings indicate that the RBANS is a reliable and valid screening tool to assess cognitive deficits in a large range of diseases and/or conditions affecting cognitive functions.

6.4 Ethical considerations

6.4.1 Patient consent and the right to not participate in research

The recommended and preferred procedure when collecting data for research purposes is to have participants' informed consent. This procedure ensures that the principles guarding and guaranteeing the persons rights and freedoms is observed (Ministry of Justice and Public Security, n.d.). The neuropsychological data used in papers I–III were gathered for clinical purposes, not for research. At the time of the neuropsychological assessment of most of the patients, the research project constituting this thesis did not exist, and patients' informed consent to participate could not be obtained. However, patients' data can be used for research purposes without consent if benefits clearly outweigh disadvantages and if principles guarding and guaranteeing the persons rights and freedoms is observed. In such instances, anonymizing the data is a procedure that will ensure the patients' rights described in the Personal Data Act. Anonymizing patients' data is not considered a violation of privacy (Norwegian Data Protection Authority, 2015), and anonymous data is permitted to use in research projects (Ministry of Justice and Public Security, n.d.; Norwegian Data Protection Authority, 2015). Furthermore, data initially collected for other purposes than research, such as clinical data, can represent an important and valuable data source that can be used to answer research questions which might otherwise be too time consuming, labor intensive, and costly (Vetter, 2017).

To lawfully use the data in the studies in this thesis, benefits that clearly outweighed the possible disadvantages to patients had to be identified. Neuropsychological assessment has potential to prevent failures in treatment and rehabilitation programs, or when returning to work or continuing education, by better aligning the cognitive workload to the patient's cognitive capabilities and capacity. It can be argued that research that can improve the methodology of assessing cognitive deficits in people with schizophrenia spectrum disorders, that demonstrate the method's usefulness, and that encourage the use of such methods to guide treatment and rehabilitation, is beneficial to patients with schizophrenia spectrum disorders. These benefits must then outweigh the disadvantages to the individual person's rights and freedoms outlined in the Personal Data Act. One of these rights is the right to not participate or to withdraw from participation in a research project at any time. This right cannot be observed when research is conducted without patients' informed consent. It is reasonable to assume that some patients would have declined to participate, or withdraw later, if given a choice. However, including all patients that completed the assessment have the added benefit of having a less self-selected sample, as a sample consisting of only those willing to participate in research might be different from those not willing in important ways (Khazaal et al., 2014).

Although patients' right to not participate or to withdraw from the research project could not be observed, data were anonymized without breaching patient confidentiality, used in accordance with current legislation as outlined in the Personal Data Act and with permission from the Data Protection Officer, on behalf of the Norwegian Data Protection Authority (DPA), which is the legislative authority for The Personal Data Act in Norway. Taken together, it can thus be argued that the benefits from the research project outweighs the disadvantage of patients not being able to refrain from participation or withdraw from the research project. This is not to say that patients' consent would not be preferrable. If the project could have started over, informed consent would have been obtained for each patient from the beginning.

6.4.2 Negative consequences of neuropsychological assessment

The Norwegian Neuropsychology Association guidelines mandates that patients are offered feedback after undergoing neuropsychological assessment. The feedback must be adapted to the patients age and cognitive functioning and must incorporate interpretation of results, conclusions, and recommendations (Principles of Neuropsychological Assessement, 2015). There is some evidence that feedback improves quality of life, enhances patients' understanding of their condition, facilitates coping, and that supplementing written information increases retention of information (Gruters et al., 2021). As noted in the introduction, patients' can be acutely aware of their cognitive problems and how these difficulties affect their well-being and functioning. For the most part, patients do not mind discussing their cognitive problems with health providers, and concealing diagnostic and prognostic information from patients are generally not a lawful option (Ministry of Health and Care Services, 2018).

However, sometimes the clinician's feedback is not in line with patients' expectations or hope, such as when patients are hoping for a positive result and/or want support for their plans for future education or work, when test results indicates that the patient's plans are unrealistic. Several guidelines and recommendations of how to best handle these situations exists. Accurate and precise information without technical jargon, delivered in person by the clinician, is recommended despite the possible initial increase in patients' psychological distress (Berkey et al., 2018). On the other hand, understanding that expectations and hopes in life are probably not going to be met is associated with increased suicide risk in patients with schizophrenia spectrum disorders (Sher et al., 2019). Many patients with schizophrenia spectrum disorders have poor insight into their illness, affecting as many as 47–70% depending on sample characteristics (Little, 2021). In instances of poor insight, the neuropsychological test results might be in stark contrast to patients' own appraisal of their cognitive functions. The clinician's recommendations based on neuropsychological test results might be considered hurtful and derogatory, and thus dismissed as not relevant. However, it is a fundamental patient right to have accurate information of their medical condition, conveyed in a considerate and respectful manner (Ministry of Health and Care Services, n.d.). This means that feedback must be tailored to patients' needs. In this

project, the principles and recommendation for feedback as outlined in the Norwegian Neuropsychology Association guidelines were used when providing feedback to patients. Understanding and relating to patients' distress is important when communicating and discussing test results and the possible implications. In situations where patients' expectations could not be met, patients were informed that they did not have to agree or accept the clinician's opinion but were encouraged to reflect on the information provided and discuss the implications of dismissing the results of the assessment with others they entrusted. For most patients, discussing their cognitive difficulties and how these problems affected their overall functioning, were considered important. Some patients conveyed that they now finally had official acknowledgement in writing that they indeed had cognitive difficulties, expressing hitherto poor understanding of how hard it can be to have cognitive problems, and thus little support from their community.

7. CLINICAL IMPLICATIONS AND CONTRIBUTIONS TO THE FIELD

To the individual patient, the results from the neuropsychological assessment were used to gain better understanding of the patients' need for facilitation in therapy sessions, and to align cognitive workload at the workplace or at school with the patients' current cognitive functioning. For some, the results were used to secure patients' rights in the health care system and/or in the social services. It seems reasonable to have used patients test results as a basis for cognitive remediation programs, of which several have been found effective (Bowie et al., 2020). However, cognitive remediation programs were not implemented at the Bergen Psychiatric Hospital at the time of data collection.

The construction of Norwegian clinical norms for people with schizophrenia spectrum disorders in paper II has the potential to enhance the quality of health and social services provided to patients with schizophrenia spectrum disorders. The Norwegian clinical norms are stratified by education and intelligence, which facilitates clinicians' judgement whether patients have cognitive functions that differs from expected levels based on education and/or intelligence. The findings in paper I contributes to bolster clinicians' confidence in the RBANS as quality neuropsychological assessment tool and research tool in this patient group. The brevity of the RBANS means that most patients can exert sufficient effort during the testing procedure without results being compromised by problems with motivation and engagement, as demonstrated in paper III, thus facilitating recommended neuropsychological evaluations for the majority of patients.

8. CONCLUSIONS AND FUTURE DIRECTIONS

This PhD-project aimed to improve the methodology for assessing cognitive impairment in people with schizophrenia spectrum disorders. A central aim was to test and confirm the applicability of the re-normed Norwegian version of the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) in assessing cognitive functions in Norwegian adults diagnosed with schizophrenia spectrum disorders, or under evaluation thereof.

This thesis demonstrated that the Scandinavian re-norming of the RBANS have increased the accuracy of the test battery in identifying cognitive impairment in Norwegian patients with schizophrenia spectrum disorders. The results provide clinicians and researchers with information of how to compare results from international research using the RBANS regarding Norwegian patients. This can bolster clinicians' and researchers' confidence in the method as sound and of good quality. The Norwegian clinical norms can assist clinicians in making more accurate evaluations of patients' cognitive impairment and can be used to better aid patients' understanding of their cognitive difficulties. Better accuracy can aid clinicians in tailoring treatment programs to patients' needs. Clinicians can reasonably expect that most patients with schizophrenia spectrum disorders can complete the RBANS, even those experiencing severe problems with engagement and motivation. Having this information can contribute to securing services for patients that otherwise might have been considered unable to participate in neuropsychological assessment.

8.1 Future directions

When patients are offered neuropsychology assessment as part of the health services they can receive, it seems reasonable to use the information derived from the assessment to the utmost benefit for patients. At the time of data gathering, the neuropsychological test results were used in diagnostic evaluations, in treatment planning, and to secure patient rights in health and social services systems. To further

enhance the benefit of the assessment, the results could be used as a basis for cognitive remediation programs, and in research assessing the effectiveness of such programs.

Qualitative studies of patients' experiences and viewpoints of how cognitive difficulties affects their quality of life and well-being are lacking (Anda, 2020). It would be of interest to know more of whether patients experienced the neuropsychological assessment as helpful or not and their opinion of possible improvements to test procedures and feed-back of test results. It would also be of interest to know more of how the information derived from the neuropsychological assessment was used in the health services and social services, and whether the results were useful for patients continuing educational programs or those returning to work, for example, by adjusting cognitive workload or implementing compensatory strategies to alleviate cognitive difficulties.

Substance use and its effects on cognition in schizophrenia spectrum disorders continues to be largely unresolved. Longitudinal studies that follow the trajectory and development of illness have the potential to identify possible sub-groups of illness trajectories. For example, patients that manage to stop using substances might have different characteristics, such as better cognitive functioning, compared to those that continue using substances. Unfortunately, the use of anonymous data in this thesis means that it is impossible to conduct follow-up studies of patients in the current sample. In addition, treatment programs targeting substance use do not presently incorporate information of patients' cognitive functioning systematically, although cognition is considered an important factor of treatment success and a target for intervention (Ramey & Regier, 2019; Verdejo-Garcia et al., 2019). Follow-up studies of patients undergoing treatment programs for substance abuse problems that also incorporate information of patients' cognitive functioning would thus be of particular interest.

The effects of antipsychotic medications on cognition over longer time periods is not well understood. In general, antipsychotics do not resolve patients cognitive problems (Keefe, 2014; McCutcheon et al., 2020). There is some evidence that long-time

antipsychotic treatment contributes to the brain volume reduction associated with the progress of illness over time (Veijola et al., 2014) and that large antipsychotic doses over very long time is detrimental to patients' cognitive functions (Husa et al., 2017). Patient data routinely collected at Bergen Psychiatric Hospital, such as structural brain imaging, blood serum levels of antipsychotic medications, and neuropsychological assessment would have been useful in a longitudinal study to investigate effects of antipsychotic medications on cognition and brain structures.

There is some evidence that early interventions are of importance for outcome and disease trajectory and that treatment should start before onset of psychosis (Fusar-Poli et al., 2020; Johannessen & Joa, 2021). Prevention of psychotic breakdown is important also because having a psychosis can be a painful and distressing experience and sometimes fatal. The symptoms in the early phase are common and indistinguishable from most other mental disorders, consisting primarily of symptoms of anxiety, depression and concentration problems (Johannessen & Joa, 2021). Poor cognitive functioning is one of many factors that increase the risk of developing a psychotic illness (Fusar-Poli et al., 2020). Adding cognitive functioning to the other symptoms of an forthcoming psychosis disorder increases the early detection of those at high risk of developing a psychotic episode and also identifies more people at risk (Schultze-Lutter et al., 2014), suggesting that assessing cognition can improve health services for this group. This patient group is generally between 15–25 years old (Fusar-Poli et al., 2017). Currently, the Norwegian RBANS do not have normative data below 20 years of age and cannot be used to assess adolescents. The updated U.S. RABNS version have norms from the age of 12 years old (Randolph, 2012) and expanding the Scandinavian norms to age groups below 20 years of age, for example 12–15 years and 16–19 years old, would enhance the utility of the RBANS in Scandinavia.

8.2 Conclusions

Taken together, the findings from this thesis suggest that the Norwegian version of the RBANS is robust to effects of motivational problems on test performance and reliably assesses cognitive impairment and/or functions in younger Norwegian patients with schizophrenia spectrum disorders. The clinical normative data and base rates of low RBANS Index scores for Norwegian patients with schizophrenia disorders can facilitate clinicians' judgment of patients' cognitive functions, enhancing the RBANS' clinical utility in assessing cognitive impairment in schizophrenia spectrum disorders.

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10.2 Paper II

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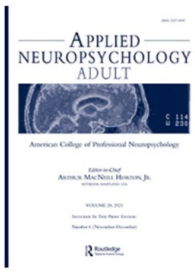

The importance of clinical normative data for conceptualizing neuropsychological deficits in people with schizophrenia spectrum disorders

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ABSTRACT

Objective: To create clinical normative data tables for Norwegian patients with schizophrenia spectrum disorders, to examine whether clinical normative data from Norway differs from similar normative data from Canada and the U.S., and to illustrate the usefulness of such data.
Method: A nationally representative sample of 335 patients from psychiatric hospitals in Bergen, Norway was included. Inclusion criteria were 18–39 years of age, Norwegian as first language, and symptoms of schizophrenia, psychosis, or hallucinations. Comorbid substance abuse was recorded in 134 (40.0%). All completed the Norwegian version of the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS).
Results: The average scores of patients with schizophrenia spectrum disorders were approximately one to two standard deviations below the mean for healthy adults. There were no significant differences in scores between patients with or without comorbid substance abuse. Men had higher scores than women. Clinical normative reference value look-up tables were created.
Conclusions: Clinical normative values were very similar to values from Canada and the U.S. Clinical normative data, as a supplement to standard healthy normative data, can be used to describe patients' cognitive performance in terms of expectation for their peer group which can be useful for multidisciplinary treatment planning.

KEYWORDS
Clinical norms, drug abuse, cross-cultural, RBANS, schizophrenia

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Introduction

People with schizophrenia spectrum disorders usually experience cognitive impairments (Anda et al., 2016; Barder et al., 2013; Dickerson et al., 2004; Gogos, Joshua, & Rossell, 2010; Helle et al., 2014; Hobart, Goldberg, Bartko, & Gold, 1999; Iverson, Brooks, & Haley, 2009; Keefe, 2014; Øie, Sundet, & Ueland, 2011; Sponheim et al., 2010; Wilk et al., 2004; Zhang et al., 2012, 2018). On average, they perform one to two standard deviations below the general population on tests of attention (Holmen, Juuhl-Langseth, Thormodsen, Melle, & Rund, 2010), learning and memory (Barder et al., 2013; Egeland et al., 2003), processing speed (Schaefer, Giangrande, Weinberger, & Dickinson, 2013), and executive functioning (Reichenberg et al., 2010). Cognitive impairment in people with schizophrenia spectrum disorders is associated with worse outcomes, such as decreased quality of life, unemployment, poorer social functioning, and institutionalization (Lysaker, Bryson, Davis, & Bell, 2005; Øie et al., 2011; Rajji, Miranda, & Mulsant, 2014; Rosenheck et al., 2006; Savilla, Kettler, & Galletly, 2008; Vaskinn et al., 2008). The severity of cognitive impairment is somewhat correlated with disease duration (Barder et al., 2013; Keefe, 2014; Rajji et al., 2014; Sponheim et al., 2010; Zhang, Li et al., 2015) and disease severity (Barder et al., 2013; Galaverna, Morra, & Bueno, 2014; Simonsen et al., 2011).

Comorbid substance abuse is common among people with schizophrenia spectrum disorders. In Norway, the overall prevalence rate of substance abuse among patients with schizophrenia spectrum disorders is estimated to be 25–38% (Nesvåg et al., 2015; Ringen et al., 2007). The effect of substance abuse on cognition in schizophrenia spectrum disorders is not well understood. Current findings range from worse cognition, no difference, or better cognition among those patients abusing substances compared to those not abusing (Potvin, Stavro, & Pelletier, 2012).

It is common for people with schizophrenia spectrum disorders to undergo neuropsychological screening evaluations to document the nature and severity of their cognitive deficits. This information can be important for treatment planning (Spaulding et al., 1999). In addition, the nature and severity of cognitive deficits have implications for educational and vocational planning (Hoffmann, Kupper, Zbinden, & Hirsbrunner, 2003). When assessing the nature and severity of cognitive deficits, clinical normative data is particularly useful because it allows clinicians to describe patients' cognitive performance in terms of how they are functioning in comparison to other people with schizophrenia spectrum disorders (Iverson et al., 2009; Periáñez et al., 2007; Wilk et al., 2004). For example, a person with schizophrenia could perform very poorly compared to the standard healthy normative data but perform normally or even above expectations in comparison to other people with schizophrenia (using clinical normative data for comparison). Knowing this information might

facilitate more targeted and personalized psychosocial rehabilitation planning (McGurk, Mueser, DeRosa, & Wolfe, 2009).

The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) is commonly used in research and clinical practice with people with schizophrenia (De la Torre, Perez, Ramallo, Randolph, & González-Villegas, 2016; Dickerson et al., 2004; Gogos et al., 2010; Harris et al., 2004; Helle et al., 2014; Hobart et al., 1999; Iverson et al., 2009; Loughland, Lewin, Carr, Sheedy, & Harris, 2007; Tucker & Bertke, 2019; Wang et al., 2019; Wilk et al., 2004; Zhang, Han et al., 2015; Zhang, Li et al., 2015; Zhang et al., 2012). Two prior studies have provided clinical normative data for the RBANS in people with schizophrenia disorders, one in the United States (Wilk et al., 2004) and one in Canada (Iverson et al., 2009). The purpose of this paper is to illustrate the importance and usefulness of clinical normative data for people with severe and persistent mental illness. Further, we will compare the clinical normative data for the RBANS reported by Iverson et al. (2009) to clinical normative data derived from the current sample, applying identical statistical procedures and presentation of results. We predict that the Norwegian clinical normative values will be fairly similar to those published by Iverson et al. (2009).

Method

Participants

This study uses anonymous data from a clinical sample of 335 patients, referred for neuropsychological assessment from psychiatric inpatient hospitals in Bergen, Norway. The study was evaluated by the Regional Committee for Medical and Health Research Ethics, and by the regional Data Protection Official on behalf of the Norwegian Data Protection Authority (DPA), which is the legislative authority for The Personal Data Act in Norway. Approval from the DPA was granted January 13, 2017. Inclusion criteria were 18–39 years of age, Norwegian as their first language, and symptoms of schizophrenia, psychosis, or hallucinations. Patients with psychotic symptoms due to known affective disorders were excluded ($n = 36$). Patients of immigrant parents were included if born and educated in Norway, but race or ethnicity were not recorded. Patients not born or educated in Norway were excluded ($n = 24$). Comorbid substance abuse was recorded in 134 (40.0%). Type and duration of substances abused were not recorded, but most substance abusing patients were long-time polysubstance abusers. Patients at the time of testing were usually in the process of undergoing differential diagnostic evaluations during their hospitalization. We found 323 registered diagnoses classified according to The International Statistical Classification of Diseases and Related Health Problems–10 (World Health Organization, 2004). The majority of patients had diagnoses of schizophrenia disorders (F20.0–F20.9) and schizoaffective disorders (F25.0–F25.9), accounting for 48.1%. Of those, 49.7% had F20.0 paranoid schizophrenia, 26.5% had schizoaffective disorders, and 23.9% had either undifferentiated schizophrenia (F20.3), simple schizophrenia

(F20.6) or schizophrenia, unspecified (F20.9). Acute psychosis was diagnosed in 16.5% (F22.0–F23.9). Psychotic disorder due to substance abuse (F1x.5) was diagnosed in 16.1%. Unspecified nonorganic psychosis (F29) was diagnosed in 12.1%. A minority were awaiting diagnostic decision (10.9%), having a diagnosis of hallucinations (R44.0–44.8) or strange and inexplicable behavior (R46.2). The subjects ranged between 18–38 years in age, with a mean age of 24.17 years (*SD*=4.92). Years of education ranged from 9–18 years, with a mean of 12.29 years (*SD*=1.83). There were more men than women, 208 (62.1%) and 127 (37.9%), respectively.

In Norway, government-funded mental health clinics offering inpatient and outpatient treatment are available across the country. All treatment facilities are under the same legislation, follow national guidelines for assessment and treatment of mental illnesses, and report to mandatory national health registries. When comparing the current sample with that of a national registry-based prevalence study of substance abuse and mental illness (Nesvåg et al., 2015), we find similar rates of schizophrenia spectrum diagnosis, substance abuse, and sex-ratio to the overall schizophrenia spectrum patient population in Norway. For example, the difference between the present sample and the national registry in sex-ratio is less than 3%, for substance abuse it is less than 8%, and for ICD-10 diagnosis F20 Schizophrenia it is less than 6%.

Measures

All patients completed the Norwegian version of the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS; Randolph, 2013) as part of a routine clinical assessment. This adult screening battery takes 20–40 minutes to administer. Five age-corrected Index scores with a mean score of 100 and a standard deviation of 15 are obtained (Immediate Memory, Visuospatial/Constructional, Language, Attention, and Delayed Memory), as well as a Total Scale. The Norwegian version of RBANS applies Scandinavian norms, matched to the population statistics of 2012 in Denmark, Norway, and Sweden (Randolph, 2013, p. 27). It is based on the U.S. version published in 1998 (Randolph, 1998), and has two alternative forms (A and B), whereas the current U.S. version has four forms (Randolph, 2012). The translations are described in the manual (Randolph, 2013, manual, pp. 8–9), and they were conducted as recommended in the International Test Commission Guidelines for Translating and Adapting Tests (Gudmundsson, 2009). A detailed review of differences in instructions, scoring, and normative data is presented in Raudeberg, Iverson, & Hammar (2019).

Statistical analyses

Each patient was administered the RBANS using the standardized procedure in the Norwegian version of the manual (Randolph, 2013). Form A was administered to 183 (54.6%), Form B to 152 (45.4%). Index scores were calculated using Scandinavian norms for the age group 20–39 years, because applying U.S norms have been shown

to overestimate cognitive functions in Norwegian patients with schizophrenia spectrum disorders (Raudeberg et al., 2019). A subset of the participants (*n*=208) completed the Norwegian research version of the National Adult Reading Test (NART), which provides age and education adjusted measures of estimated premorbid IQ (Sundet & Vaskinn, 2008). They had a mean estimated premorbid Full Scale IQ (FSIQ) of 100.49 (*SD*=4.43, Range=90–117). The majority (79.8%) had estimated FSIQ scores in the range of 95–105 points, 8.7% had an estimated FSIQ < 95. Some participants (*n*=84) completed the Norwegian version of the Wechsler Adult Intelligence Scale Fourth Edition (Wechsler, 2011). They had a mean WAIS-IV Full Scale IQ (FSIQ) of 84.52 (*SD*=12.73, Range=62–118). Descriptive statistics (e.g. mean, median, standard deviation, interquartile range, skewness, and kurtosis) for the age-adjusted RBANS Index standard scores were computed for the entire sample, by comorbid substance abuse (yes/no), by levels of educational attainment (less than high school, high school, and more than high school), and by gender.

The clinical normative data was computed using frequency analysis tables stratified by the above-mentioned groups. RBANS Index scores are presented based on Wechsler-Benton classifications, commonly used in neuropsychology, including: extremely low (≤2nd percentile), unusually low (3rd–9th percentiles), low average (10th–24th percentiles), average (25th–75th percentiles), high average (76th–90th percentiles), and superior (≥91st percentile). The prevalence of low scores was calculated by simultaneously examining all five RBANS index scores (Immediate Memory, Visuospatial/Constructional, Language, Attention, and Delayed Memory), rather than performance on each domain in isolation. The base rates of low domain scores were calculated by using four cutoff scores that might be routinely used in clinical practice, including: (a) more than one standard deviation (*SD*) below the mean (i.e. < 85), (b) below the 10th percentile (i.e. <81), (c) at or below the 5th percentile (i.e. ≤76), and (d) more than two *SDs* below the mean (i.e. <70). The prevalence of low scores is presented for the entire sample, by gender, by comorbid substance abuse (yes/no), by levels of educational attainment (less than high school, high school, and more than high school), by NART estimated FSIQ (i.e. less than 100 or 100 and higher), and by WAIS-IV Full Scale IQ (i.e. less than 80 or 80 and higher) in the subsample that underwent the more comprehensive evaluation.

Results

As seen in Table 1, the mean scores across the sample were one to two standard deviations below the mean for healthy adults. Notice that the average scores (i.e. at the 50th percentile) for patients with schizophrenia spectrum disorders are as follows: Immediate Memory Index=78, Visuospatial/Constructional Index=90, Language Index=78, Attention Index=70, Delayed Memory Index=80, and Total Scale=69.

Table 1. Descriptive statistics for patients with schizophrenia spectrum disorder on the RBANS. (Table view)

Groups	RBANS indices					
	Immediate memory	Visuospatial/ Constructional	Language	Attention	Delayed memory	Total scale
All patients (N = 335)						
Mean (*SD*)	78.50 (20.70)	86.50 (17.34)	77.48 (17.94)	69.67 (19.47)	79.02 (20.97)	68.98 (19.09)
Median (IQR)	78.00 (66–92)	90.00 (77–102)	78.00 (66–89)	70.00 (55–83)	80.00 (70–91)	69.00 (54–82)
Skew/Kurtosis	0.08/−0.36 (Y)	−0.74/−0.24 (N)	−0.19/−0.34 (N)	0.04/−0.50 (N)	−0.23/−0.28 (N)	0.20/−0.68 (N)
Men (n = 208)						
Mean (*SD*)	80.80 (19.83)	88.91 (15.96)	78.87 (17.65)	71.21 (18.80)	80.41 (20.14)	71.06 (18.25)
Median (IQR)	80.00 (68–95)	90.00 (77–102)	80.00 (66–93)	72.00 (62–84)	82.00 (73–93)	71.00 (59–83)
Skew/Kurtosis	0.06/−0.35 (N)	−0.79/−0.14 (N)	−0.19/−0.27 (N)	−0.11/−0.50 (N)	−0.31/−0.10 (N)	0.07/−0.62 (N)
Women (n = 127)						
Mean (*SD*)	74.72 (21.61)	82.55 (18.80)	75.21 (18.25)	67.14 (20.36)	76.73 (22.16)	65.57 (19.99)
Median (IQR)	75.00 (60–92)	84.00 (70–102)	78.00 (60–85)	69.00 (47–81)	80.00 (63–91)	65.00 (49–80)
Skew/Kurtosis	0.20/−0.30 (Y)	−0.58/−0.57 (N)	−0.18/−0.45 (N)	0.29/−0.34 (N)	−0.09/−0.46 (N)	0.47/−0.55 (Y)
No substance abuse (n = 201)						
Mean (*SD*)	78.75 (21.75)	87.33 (17.34)	76.62 (18.24)	70.04 (19.06)	79.15 (22.05)	69.53 (19.56)
Median (IQR)	78.00 (65–92)	90.00 (77–102)	78.00 (65–89)	72.00 (57–83)	80.00 (68–93)	69.00 (55–83)
Skew/Kurtosis	0.09/−0.42 (Y)	−0.81/−0.11 (N)	−0.23/−0.47 (N)	−0.01/−0.31 (N)	−0.13/−0.40 (N)	0.23/−0.64 (N)
Substance abuse (n = 134)						
Mean (*SD*)	78.12 (19.10)	85.25 (17.33)	78.77 (17.47)	69.11 (20.14)	78.82 (19.33)	68.15 (18.41)
Median (IQR)	78.00 (66–92)	90.00 (77–102)	78.00 (66–91)	70.00 (55–83)	80.00 (73–91)	69.00 (54–81)
Skew/Kurtosis	0.05/−0.31 (Y)	−0.66/−0.36 (N)	−0.12/−0.14 (N)	0.10/−0.71 (N)	−0.47/−0.10 (N)	0.14/−0.80 (N)
<High school (n = 196)						
Mean (*SD*)	74.21 (20.21)	83.64 (17.70)	75.57 (16.47)	64.99 (17.56)	75.12 (21.00)	64.11 (17.70)
Median (IQR)	73.00 (60–89)	84.00 (75–102)	78.00 (65–87)	68.00 (49–77)	77.00 (63–88)	64.00 (49–77)
Skew/Kurtosis	0.15/−0.43 (Y)	−0.56/−0.47 (N)	−0.25/−0.32 (N)	−0.06/−0.95 (N)	−0.26/−0.76 (N)	0.29/−0.74 (N)
High school (n = 68)						
Mean (*SD*)	78.79 (19.39)	87.26 (17.82)	75.37 (19.07)	69.91 (21.36)	80.60 (19.67)	69.32 (17.64)
Median (IQR)	78.00 (67–92)	90.00 (77–102)	76.50 (59–89)	71.00 (51–84)	82.00 (73–91)	71.50 (55–82)
Skew/Kurtosis	−0.10/−0.12 (Y)	−0.93/0.09 (N)	−0.23/−0.72	0.26/−0.25 (N)	−0.34/0.27 (N)	−0.04/−0.63 (Y)
>High school (n = 71)						
Mean (*SD*)	90.04 (18.99)	93.65 (13.53)	84.77 (19.06)	82.34 (17.02)	88.27 (19.19)	82.08 (18.08)
Median (IQR)	92.00 (75–102)	96.00 (84–102)	85.00 (75–97)	81.00 (72–94)	88.00 (74–100)	81.00 (68–96)
Skew/Kurtosis	0.15/−0.40 (Y)	−10.01/0.08 (N)	−0.38/−0.04 (Y)	−0.26/0.32 (Y)	0.10/0.17 (Y)	0.00/−0.82 (Y)

RBANS: The repeatable battery for assessment of neuropsychological status; *SD*: standard deviation; IQR: interquartile range. (Y) = yes and (N) = no for approximating a normal distribution based on the Kolmogorov–Smirnov test with Lilliefors Significance Correction.

There were no significant differences when comparing index scores for substance abusers with those not abusing substances (p-values ranging from 0.28–0.89). Men had significantly higher scores on the Immediate Memory Index, Visual/Constructional Index, and the Total Scale compared to women. Effect sizes were small (Cohen's d=0.30, d=0.37, and d=0.29, respectively). Years of education were

significantly correlated ($p < .001$) with all index scores and Total Scale scores (r_s ranged from 0.23–0.39). A one-way analysis of variance (ANOVA) revealed that there were significant main effects for education for all five Index scores and the Total Scale score. Patients with more than high school education performed significantly better on every Index score and the Total Scale score compared to patients with less than high school. They also performed better than those with high school education on Immediate Memory, Language, and Attention Indexes, and the Total Scale. There were no significant differences between patients that had completed high school and those who had not. Patients with higher NART estimated premorbid FSIQ and higher WAIS-IV FSIQ performed significantly better (p-values ranging from .009–< .001) on all Indexes and the Total Scale score. Comparing patients with IQs lower than 80 with patients with IQs of 80 or higher, we found medium to large effect sizes for all Indexes (Immediate Memory: d=0.64, Visuospatial/Constructional: d=0.73, Language: d=0.86, Attention: d=0.90, Delayed Memory: d=0.88, and Total Scale: d=1.13).

The interpretive classifications for the clinical normative data are presented in Table 2. Using the descriptive classifications (and corresponding percentile range) of extremely low (≤2nd percentile), unusually low (3rd–9th percentiles), low average (10th–24th percentiles), average (25th–75th percentiles), high average (76th–90th percentiles), and superior (≥91st percentile), clinicians can see how a patient's performance on the RBANS Indexes compares to other patients with schizophrenia spectrum disorders. For example: (1) a Delayed Memory Index score of 50 is extremely low for healthy adults, but is low average for patients with schizophrenia spectrum disorders; (2) an Attention Index of 75 is unusually low for healthy adults, but average for younger patients with schizophrenia spectrum disorders; and (3) an Immediate Memory Index of 100 is average for healthy adults but superior for patients with schizophrenia spectrum disorders with less than high school education. Consider also that a score of 50 on the RBANS Total Scale, which later improves to a score of 69 at reassessment after inpatient treatment and a medication change, would continue to be extremely low for healthy individuals, but would move a patient with schizophrenia spectrum disorder from low average to average; an improvement that would not be readily apparent when using standard normative tables.

Table 2. Clinical normative data for patients with schizophrenia spectrum disorder: RBANS index scores corresponding to classification ranges. (Table view)

	Extremely low	Unusually low	Low average	Average	High average	Superior
All patients (N = 335)						
Immediate memory	–	40–47	48–65	66–91	92–105	106+
	40–47	48–59	60–76	77–101	102–107	–
Visuospatial/Constructional						
Language	–	40–51	52–65	66–89	90–99	100+
Attention	–	–	40–54	55–82	83–94	95+
Delayed memory	–	40–42	43–69	70–91	92–105	106+

	Extremely low	Unusually low	Low average	Average	High average	Superior
Total scale	–	–	40–53	54–82	83–95	96+
Men (n = 208)						
Immediate memory	40	41–52	53–67	68–94	95–109	110+
	40–52	53–63	64–76	77–101	102–107	–
Visuospatial/constructional						
Language	–	40–52	53–65	66–92	93–98	99+
Attention	–	–	40–60	61–83	84–95	96+
Delayed memory	–	40–44	45–72	73–92	93–107	108+
Total scale	–	40–43	44–59	60–82	83–96	97+
Women (n = 127)						
Immediate memory	–	40	41–57	58–92	93–99	100+
	–	40–53	54–69	70–102	103–107	–
Visuospatial/constructional						
Language	–	40–44	45–60	61–85	86–100	101+
Attention	–	–	40–45	46–81	82–93	94+
Delayed memory	–	–	40–62	63–91	92–104	105+
Total scale	–	–	40–48	49–79	80–93	94+
<High school (n = 196)						
Immediate memory	–	40–43	44–58	59–88	89–99	100+
	40–44	45–56	57–70	71–101	102–107	–
Visuospatial/constructional						
Language	–	40–52	53–60	61–87	88–95	96+
Attention	–	–	40–47	48–77	78–88	89+
Delayed memory	–	–	40–58	59–88	89–101	102+
Total scale	–	–	40–48	49–77	78–90	91+
High school (n = 68)						
Immediate memory	–	40–46	47–66	67–92	93–109	110+
	–	40–58	59–76	77–102	103–107	–
Visuospatial/constructional						
Language	–	40–42	43–58	59–89	90–101	102+
Attention	–	–	40–49	50–83	84–97	98+
Delayed memory	–	40–46	47–72	73–90	91–104	105+
Total scale	–	40–41	42–53	54–81	82–90	91+
>High school (n = 71)						
Immediate memory	40–53	54–65	66–74	75–101	102–120	121+
	40–59	60–69	70–83	84–102	103–107	–
Visuospatial/constructional						
Language	–	40–57	58–72	73–97	98–109	110+
Attention	–	40–64	65–70	71–93	94–105	106+
Delayed memory	40–44	45–69	70–74	75–99	100–118	119+
Total scale	40–50	51–60	61–67	68–96	97–105	106+

RBANS: The repeatable battery for assessment of neuropsychological status.

The prevalence of low scores is presented in Table 3 for the entire sample, by gender, by levels of educational attainment (less than high school, high school, and more than high school), by NART estimated Full Scale IQ (i.e. less than 100 or 100 and higher), and by WAIS-IV Full Scale IQ (i.e. less than 80 or 80 and higher). In the entire sample, 79.1% had two or more index scores below one *SD*, 63.3% had two or more at or below the 5th percentile, and 40.0% had two or more index scores below two *SDs*. The base rates of low scores varied by education. In this sample, 86.7% of the patients with less than high school education, 79.4% of the patients with high school education, and 57.7% of patients with more than high school education had two or more index scores one or more *SDs* below the mean [χ^2 (2)=26.50, p< .001, V=0.281]. Regarding frankly impaired scores, 50.5% of the patients with less than high school education, 30.9% of the patients with high school education, and 19.7% of patients with more than high school education had two or more index scores two *SDs* below the mean [χ^2 (2)=23.55, p < .001, V=0.265].

Higher base rates of low scores were also more common in those people with lower intellectual abilities. In patients with NART FSIQ scores below 100, 91.4% obtained two or more low scores (i.e., <1 *SD*), whereas patients with NART FSIQ scores 100 or higher, 73.9% obtained two or more scores <1 *SD* [χ^2 (1)=10.53, p= .002, ϕ=−0.25]. In patients with NART FSIQ scores below 100, 51.1% obtained two or more frankly impaired index scores (i.e. <2 *SDs*) compared to 27.8% of patients with NART FSIQ scores 100 or higher [χ^2 (1)=19.39, p < .001, ϕ=−0.31]. In patients with WAIS-IV FSIQ scores below 80, 100% obtained three or more low scores (i.e.,< 1 *SD*), whereas patients with WAIS-IV FSIQ scores 80 or higher, 65.7% obtained three or more scores <1 *SD* [χ^2 (1)=11.45, p=.001, ϕ=−0.40]. In patients with WAIS-IV FSIQ scores below 80, 85.3% obtained two or more frankly impaired index scores (i.e., <2 *SDs*) compared to 40.0% of patients with WAIS-IV FSIQ scores 80 or higher [χ^2 (1)=19.47, p< .001, ϕ=−0.51].

Table 3. Base rates of low RBANS index scores in patients with schizophrenia spectrum disorder. (Table view)

		Gender		Level of education			Intellectual abilities			
Number of index scores below cutoff	All patients (N = 335)	Men (n = 208)	Women (n = 127)	<High school (n = 196)	High school (n = 68)	>High school (n = 71)	NART FSIQ <100 (n = 93)	NART FSIQ ≥100 (n = 115)	WAIS-IV FSIQ <80 (n = 34)	WAIS-IV FSIQ ≥80 (n = 50)
< 1 *SD*										
1 or more	93.7	92.8	95.3	96.4	95.6	84.5	95.7	93.0	–	93.7
2 or more	79.1	76.4	83.5	86.7	79.4	57.7	91.4	73.9	–	79.1
3 or more	65.7	61.5	72.4	73.0	67.6	43.7	80.6	54.8	100.0	65.7
4 or more	45.4	40.4	53.5	53.6	42.6	25.4	60.2	35.7	82.4	45.4
5	21.5	16.8	29.1	29.6	14.7	5.6	32.3	11.3	44.1	44.1
< 10th percentile										
1 or more	88.7	88.5	89.0	92.9	91.2	74.6	94.6	86.1	–	88.7
2 or more	73.7	71.6	77.2	82.1	73.5	50.7	87.1	67.8	–	73.7

		Gender		Level of education			Intellectual abilities			
Number of index scores below cutoff	All patients ($N = 335$)	Men ($n = 208$)	Women ($n = 127$)	<High school ($n = 196$)	High school ($n = 68$)	>High school ($n = 71$)	NART FSIQ <100 ($n = 93$)	NART FSIQ ≥100 ($n = 115$)	WAIS-IV FSIQ <80 ($n = 34$)	WAIS-IV FSIQ ≥80 ($n = 50$)
3 or more	56.1	52.4	62.2	64.3	54.4	35.2	68.8	45.2	100.0	56.1
4 or more	37.0	32.7	44.1	45.9	33.8	15.5	48.4	27.8	76.5	37.0
5	14.6	11.5	19.7	19.9	10.3	4.2	21.5	7.0	32.4	14.6
≤ 5th percentile										
1 or more	81.8	80.3	84.3	87.2	82.4	66.2	87.1	79.1	–	81.8
2 or more	63.3	60.6	67.7	71.4	64.7	39.4	75.3	48.7	100.0	63.3
3 or more	42.4	38.0	49.6	52.6	32.4	23.9	57.0	28.7	85.3	42.4
4 or more	24.2	21.2	29.1	31.1	23.5	5.6	30.1	16.5	50.0	24.2
5	9.0	7.2	11.8	11.7	8.8	1.4	15.1	3.5	23.5	9.0
< 2 *SDs*										
1 or more	66.0	64.4	68.5	74.0	64.7	45.1	80.6	55.7	97.1	66.0
2 or more	40.0	35.6	47.2	50.5	30.9	19.7	58.1	27.8	85.3	40.0
3 or more	23.9	17.8	33.9	31.1	23.5	4.2	31.2	16.5	52.9	23.9
4 or more	13.4	8.2	22.0	16.8	14.7	2.8	18.3	9.6	29.4	13.4
5	3.0	1.0	6.3	3.1	5.9	0.0	5.4	0.0	14.7	3.0

Values represent cumulative percentages of people.
NART: National Adult Reading Test (Norwegian research version); WAIS-IV: Wechsler Adult Intelligence Scale-Fourth Edition; FSIQ: Full Scale Intelligence Quotient.

Discussion

The goal of this study was to present clinical normative data for the RBANS for Norwegian patients with schizophrenia spectrum disorders, and to compare these norms with previously published norms of similar patient groups in North America. Overall, the performance of the current patient sample was similar to the clinical normative data for inpatients and outpatients with schizophrenia disorders presented by Iverson et al. (2009) in Canada and Wilk et al. (2004) in the United States. The average Total Scale scores reported in these studies differed from the average Total Scale score in the current sample by 0.18 (Iverson et al., 2009) and 1.56 (Wilk et al., 2004) points. The mean Index scores reported by (Iverson et al., 2009) differed on average 3.27 points for all five indexes; the largest difference was for the Immediate Memory Index (8.80) and least for the Attention Index (2.03). To our knowledge, it has not been previously reported that Norwegian patients with schizophrenia spectrum disorders have similar RBANS Index scores to comparable patient groups in North America.

Clinical normative data allows a clinician to determine if a patient's cognition is worse, similar, or better than other patients with schizophrenia spectrum disorders (Iverson et al., 2009; Periáñez et al., 2007; Wilk et al., 2004). Stratifying by educational attainment and by IQ-levels provide information on expected performance when considering the influence of these variables on test performance on the RBANS (Gold, Queern, Iannone, & Buchanan, 1999; Iverson et al., 2009; Wilk et al., 2004).

The strong association between level of education, NART-predicted level of intelligence, and RBANS performance is not surprising. People with schizophrenia spectrum disorders who have higher levels of education might, on average, have a later disease onset (Chen, Selvendra, Stewart, & Castle, 2018), lower levels of psychotic symptomatology (Swanson, Gur, Bilker, Petty, & Gur, 1998), and more cognitive reserve (de la Serna et al., 2013; Holthausen et al., 2002).

In the current sample, women had lower scores than men on all RBANS Indexes and the Total Scale, which also has been reported for Australian patients (Gogos et al., 2010), but not in samples in North America or China (Han et al., 2012; Iverson et al., 2009; Loughland et al., 2007; Wilk et al., 2004; Zhang, Han et al., 2015; Zhang et al., 2012). This finding suggests that the normative tables presented here should have considered education and intelligence together with gender, rather than each in isolation. However, the number of subjects would then be too few for some categories to be representative. For example, only 26 women in the current sample have a NART-predicted level of intelligence of ≥ 100; of those 10 had less than high school education, 4 had completed high school, and 12 had more than high school education. Further, the effect of gender on RBANS performance was noticeably smaller than that of education and intelligence, suggesting that educational attainment and IQ-levels might be more important variables to consider than gender when evaluating RBANS performance.

The base rates information presented in Table 3 facilitates the interpretation of all five RBANS index scores simultaneously in patients with schizophrenia spectrum diagnoses. Having several low Index scores is common. For example, 79.1% had two or more Index scores more than one *SD* below the mean, 63.3% had two or more Index scores at or below the 5th percentile, and 40% had two or more Index scores below two *SDs*. These findings are fairly similar to those reported by Iverson et al. (2009). Higher base rates of low RBANS Index scores were more common for patients with lower education and lower intellectual abilities, as reported in previous studies (Iverson et al., 2009; Wilk et al., 2004).

The present RBANS normative data provide information regarding performance on the RBANS for Norwegian patients with schizophrenia spectrum disorders. This information is important for clinicians. Demonstrating that a patient with a schizophrenia spectrum disorder has cognitive deficits is useful, but to further differentiate whether the deficit is severe, moderate, or mild compared to other patients in the same diagnostic group might allow for more precise and better targeted treatment and rehabilitation decisions (Iverson et al., 2009; Periáñez et al., 2007; Wilk et al., 2004).

The RBANS has been used to measure cognitive impairment in schizophrenia spectrum disorders in North America, Europe, and Asia (Anda et al., 2016; Azizian, Yeghiyan, Ishkhanyan, Manukyan, & Khandanyan, 2011; Chianetta, Lefebvre,

LeBlanc, & Grignon, 2008; de Girolamo et al., 2014; De la Torre et al., 2016; Dickerson et al., 2004; Ehrenreich et al., 2007; Gogos et al., 2010; Gold et al., 1999; Halász, Levy-Gigi, Kelemen, Benedek, & Kéri, 2013; Han et al., 2012; Harris et al., 2004; Helle et al., 2014; Hobart et al., 1999; Iverson et al., 2009; Juhász, Kemény, Linka, Sántha, & Bartkó, 2003; Kelemen, Kiss, Benedek, & Kéri, 2013; Loughland et al., 2007; Raudeberg et al., 2019; Sanz, Vargas, & Marín, 2009; Takeuchi et al., 2013; Wang et al., 2019; Wilk et al., 2004; Zhang, Han et al., 2015; Zhang, Li et al., 2015; Zhang et al., 2012, 2018). It might be helpful to replicate the present study (Iverson et al., 2009 and Wilk et al., 2004) in a few more countries to extract common themes of impairment in schizophrenia spectrum disorders across cultures. In particular, educational attainment seems important for assessing the clinical meaningfulness of RBANS scores in Canada, the U.S., and in Norway. This effect might be more or less pronounced in other countries, because educational systems differ substantially between nations. Also, gender differences in performance on the RBANS might be important in schizophrenia spectrum disorders, but as shown in the current study, gender differences in Norway are not similar to findings in North America but seem more similar to findings in Australia (Gogos et al., 2010). The main point is that cognitive impairment might differ somewhat across cultures and might have different impact on functional outcome.

Conclusions

The present study showed that Norwegian patients with schizophrenia spectrum disorders have cognitive deficits similar to patient populations in North America and that these measures of deficits have a similar distribution of severe, moderate, mild, and no impairment. RBANS Index scores varied by gender, education, and IQ within people with schizophrenia spectrum disorders, but not by comorbid substance abuse in the present sample. Stratified clinical normative values, such as those presented in the current study, can be useful when assessing individual patients' neuropsychological profiles. This is important when planning treatment and rehabilitation programs.

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10.3 Paper III

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Examining the repeatable battery for the assessment of neuropsychological status validity indices in people with schizophrenia spectrum disorders

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ABSTRACT

Objective: We examined the frequency of possible invalid test scores on the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) in patients with schizophrenia spectrum disorders, and whether there was an association between scores on the embedded RBANS performance validity tests (PVTs) and self-reported symptoms of apathy as measured by the Initiate Scale of the Behavior Rating Inventory of Executive Function-Adult Version (BRIEF-A).
Methods: Participants included 250 patients ($M = 24.4$ years-old, $SD = 5.7$) with schizophrenia spectrum disorders. Base rates of RBANS Effort Index (EI), Effort Scale (ES), and Performance Validity Index (PVI) test scores were computed. Spearman correlations were used to examine the associations between the RBANS PVTs, the RBANS Index scores, and the BRIEF-A Initiate Scale. Regression analyses were used to investigate how well the RBANS PVTs predicted scores on the BRIEF-A Initiate Scale.
Results: The frequency of invalid scores on the EI (>3) and the PVI (<42) in participants with schizophrenia spectrum disorders was 6%. The frequency of invalid ES scores (<12) was 28% in the patients compared to 15% in the U.S. standardization sample. There was a small significant correlation between the EI and the BRIEF-A Initiate Scale (*rho*=.158, $p<.05$).
Conclusions: The rates of invalid scores were similar to previously published studies. Invalid scores on the BRIEF-A were uncommon. Apathy measured with the BRIEF-A Initiate Scale was not associated with performance on the RBANS validity measures or with measures of cognition.

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Introduction

Cognitive impairment is commonly experienced by patients with schizophrenia spectrum disorders (Barder et al., 2013; Keefe, 2014; Øie et al., 2011) along with apathy and avolition (Barch et al., 2014; Blanchard et al., 2011; Dollfus & Lyne, 2017; Dorofeikova et al., 2018; Galaverna et al., 2014; Morra et al., 2015; Strauss et al., 2013). Apathy and avolition have a negative impact on functional outcome (Rabinowitz et al., 2012; Strauss et al., 2013) and afflict about 40% of patients (Patel et al., 2015; Rabinowitz et al., 2013; Schennach et al., 2015). Researchers have reported that about 20% of clinical samples with schizophrenia spectrum disorders perform at levels suggesting possible invalid performance on neuropsychological tests (Morra et al., 2015). Depending on sample characteristics and type of performance validity tests (PVTs; Heilbronner et al., 2009), the frequency of invalid scores reported by previous researchers has ranged from about 5% (Duncan, 2005; Egeland et al., 2003) to 72% (Gorissen et al., 2005; Hunt et al., 2014). About 15–35% of the variance in performance on cognitive tests can be accounted for by invalid scores and/or negative symptoms in patients with schizophrenia spectrum disorders (Foussias et al., 2015; Gorissen et al., 2005; Whearty et al., 2015).

Symptoms of apathy and avolition in schizophrenia spectrum disorders are commonly assessed using rating scales, such as the Scale for the Assessment of Negative Symptoms (SANS), the Positive and Negative Syndrome Scale (PANSS), or the Negative Symptom Assessment (NSA; Blanchard et al., 2011; Van Erp et al., 2014). Instruments like these have been criticized as problematic and outdated by some authors (Blanchard et al., 2011; Kumari et al., 2017; Strauss et al., 2012). Concerns have been raised that these measures do not adequately address cognitive factors (Kumari et al., 2017) and omit patients' self-report of relevant symptoms and internal states (Blanchard et al., 2011). There is some evidence that self-report questionnaires, such as the Behavior Rating Inventory of Executive Function–Adult Version (BRIEF–A; Isquith et al., 2005) can provide clinically important information on executive functions, including symptoms of motivation and initiation problems, in everyday life in patients with neurological or psychiatric problems (Løvstad et al., 2016; Power et al., 2012). Patients with schizophrenia report greater dysfunction on the BRIEF–A Working Memory and Shift scales compared to healthy controls, indicating more difficulty holding information in mind and adjusting to changes in routine (Kumbhani et al., 2010). In patients diagnosed with schizophrenia, greater self-reported dysfunction on the BRIEF–A Working Memory scale was associated with smaller bilateral frontal lobe volumes and with worse performances on neuropsychological tests of working memory (Garlinghouse et al., 2010). Further, patients with schizophrenia have reported greater dysfunction on the BRIEF–A Initiate Scale compared to the other BRIEF–A scales (Bulzacka et al., 2013), indicating that patients rated their problems with beginning a task or activity and independently generating ideas, responses, or problem solving strategies as comparatively worse than

problems with inhibition, flexibility, emotional control, social awareness, working memory, and with planning.

There is no consensus regarding what symptoms or behaviors best constitute the term "negative symptoms" in schizophrenia spectrum disorders, but a central concept is reduction or absence of behaviors related to motivation and interest (Correll & Schooler, 2020). The BRIEF–A Initiate Scale has items related to motivation and interest, such as behavioral descriptions concerning enthusiasm and engagement, passiveness, and ability to independently start tasks or assignments. This suggests that the BRIEF–A Initiate Scale, in particular, might capture important aspects of negative symptoms associated with schizophrenia spectrum disorders (e.g., affective blunting, avolition, apathy, and anhedonia).

Poor performance on cognitive tasks might, in part, be due to lack of engagement or motivation to do well rather than difficulties with the cognitive processes measured by the tasks (Barch, 2005; Iverson & Binder, 2000). Empirically derived PVTs can assist clinicians in evaluating whether patients' test results are attributable to invalid test performance as opposed to a cognitive weakness or impairment (Chafetz et al., 2015; Sherman et al., 2020; Slick et al., 1999). Evaluation of invalid test performance is particularly important when assessing cognitive functions in patients with schizophrenia spectrum disorders, due to the high prevalence of motivation and initiation problems. Researchers have even proposed that empirically derived PVTs can be used to identify patients in need of intervention for motivational difficulties (Morra et al., 2015). Interventions for increasing intrinsic motivation in patients with schizophrenia disorders when learning cognitively demanding tasks have been promising (Choi & Medalia, 2010), underscoring the importance of assessing and targeting both motivational problems and cognitive deficits when choosing and adapting treatment and rehabilitation protocols for this patient population.

The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS; Randolph, 1998) has been used to assess cognitive functioning in a large range of clinical populations of neurological and psychiatric diseases (Randolph, 1998, 2012), including patients with schizophrenia spectrum disorders (Dickerson et al., 2004; Hobart et al., 1999; Iverson et al., 2009; Loughland et al., 2007; Wilk et al., 2004). Several empirically derived embedded PVTs have been constructed for the RBANS (Novitski et al., 2012; Paulson et al., 2015; Silverberg et al., 2007). Results from meta-analyses have indicated that some of these PVTs are sufficiently specific to use as indicators for invalid test performance in neuropsychological assessments (Goette & Goette, 2019; Shura et al., 2018). However, in schizophrenia spectrum disorders, patients with greater negative symptoms are more likely to score below cutoffs on the RBANS PVTs (Galaverna et al., 2014; Morra et al., 2015; Whearty et al., 2015), suggesting that performances on these measures may indicate the effects of apathy and avolition on test performance in this patient population (Morra et al., 2015). That is,

based on previous literature, clinicians can conclude that many patients with schizophrenia spectrum disorders may have problems engaging in cognitive testing, but might want to know if a patient had these difficulties during the cognitive assessment, and if so, to what extent. This approach differs somewhat from forensic and litigation cases, where the detection of feigned cognitive symptoms and deficits is more important (Williams et al., 2020).

The RBANS allows for the concurrent assessment of cognitive deficits and motivational problems in patients with schizophrenia spectrum disorders. The frequencies at which patients with schizophrenia exceed cutoffs on RBANS PVTs have been examined for some, but not all, possible PVTs deriving from the battery, and have ranged from 9–24% (Bailie et al., 2012; Bayan et al., 2018; Moore et al., 2013; Morra et al., 2015; Toofanian Ross et al., 2015; Williams et al., 2020). No previous study has reported the frequencies of BRIEF–A scores indicating problems with motivation and interest in patients with schizophrenia disorders. The aim of this study was to investigate the rates of possible invalid performance on three PVTs derived from the RBANS in a large sample of patients with schizophrenia spectrum disorders. We further aimed to investigate whether the RBANS PVTs scores were associated with a self-report BRIEF–A measure of motivational problems (i.e., the Initiate Scale), which is a novel approach to investigating negative symptoms in schizophrenia spectrum disorders. A better understanding of the relationship between PVTs and measures of negative symptoms in this patient population may inform clinicians that invalid test performance corresponds to amotivation as a symptom of the disorder, rather than purposeful underperformance.

Based on previous reports of the RBANS PVTs (Bailie et al., 2012; Bayan et al., 2018; Moore et al., 2013; Morra et al., 2015; Toofanian Ross et al., 2015; Williams et al., 2020), we expect that about 20% of the participants will have scores exceeding the PVTs cutoffs. We assume that BRIEF–A scores suggesting problems with motivation and interest will be comparable (i.e., about 40%) to findings from other studies describing the prevalence of problems with motivation in schizophrenia spectrum disorders (Patel et al., 2015; Rabinowitz et al., 2013; Schennach et al., 2015). Even though the RBANS PVTs and the BRIEF–A Initiate Scale differ conceptually and methodologically, they purportedly measure some aspects of patients' motivation and ability to engage in cognitive testing, so we presume that they should correlate.

Method

Participants

The current study used anonymized archival data from a neuropsychological testing database of 462 patients referred for neuropsychological assessment from psychiatric hospitals in Bergen, Norway. The study is part of a research project that has been evaluated by the Regional Committee for Medical and Health Research Ethics, and by

the regional Data Protection Official on behalf of the Norwegian Data Protection Authority (DPA), which is the legislative authority for The Personal Data Act in Norway. Approval from the DPA was granted January 13, 2017. These patients were evaluated for clinical purposes. All patients were informed that the neuropsychological assessment was to be used in diagnostic evaluations and for treatment and rehabilitation planning. They were also informed that participation was voluntary and that they could withdraw from the assessment procedure at any time. All were offered a feedback session and a written neuropsychological report of the assessment findings. Patients were informed that valid test results were contingent on cooperation and motivation to perform to the best of their abilities, but they were not screened for potential external gain or motivation to perform poorly. Inclusion criteria were minimum 18 years of age, Norwegian as their first language, and a confirmed diagnosis of a schizophrenia spectrum disorder or undergoing a diagnostic evaluation due to manifest symptoms of schizophrenia, psychosis, or hallucinations. Diagnoses were according to the International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD–10; WHO, 2016) and were decided by consensus of a team of psychiatrists and certified clinical psychologists. Patients with psychotic symptoms due to known affective disorders were excluded ($n = 36$). Given the purpose of the current study, inclusion criteria included completion of the RBANS and the BRIEF–A Initiate Scale, resulting in a final sample of 250 participants.

Comorbid problems with substance use were recorded in 94 participants (37.6%). Most patients had long-term problems with polysubstance use, but neither type nor duration of substances used were recorded. Patients with substance use problems were older ($M = 5.9$ years, $SD = 5.9$) and had less education ($M = 12.1$, $SD = 1.9$) compared to patients without substance use problems (age: $M = 23.5$ years, $SD = 5.3$, $t(248) = -3.39$, $p < .001$; education: $M = 12.8$, $SD = 1.7$, $t(248) = 3.04$, $p = .003$). Demographic data for the entire sample are presented in Table 1.

Table 1. Age, education, neuropsychological test results and self-reported executive deficits.

	N	Mean	*SD*	Minimum	Maximum
Age in years	250	24.37	5.67	18	51
Education in years	250	12.48	1.84	9	18
NART predicted FSIQ	176	100.73	4.28	92	117
WAIS-IV FSIQ	49	85.37	11.66	69	112
RBANS Indices					
Immediate Memory Index	250	80.52	20.36	40	133
Visuospatial Index	250	88.39	16.10	40	110
Language Index	250	79.54	17.12	40	121
Attention Index	250	71.14	18.81	40	118
Delayed Memory Index	250	81.00	21.14	40	131
Total Scale	250	71.20	18.81	40	117
BRIEF-A Initiate Scale	250	65.23	13.45	37	89

Note. NART = National Adult Reading Test; WAIS-IV FSIQ = Wechsler Adult Intelligence Scale, Fourth Edition Full Scale Intelligence Quotient; RBANS = Repeatable Battery for the Assessment of Neuropsychological Status; BRIEF-A = Behavior Rating Inventory of Executive Function-Adult Version.

Measures

All patients completed the authorized Norwegian version (Nicholas & Solbakk, 2006) of the BRIEF–A (Isquith et al., 2005) and the Norwegian version of the RBANS (Randolph, 2013). The BRIEF–A is a self-report standardized inventory that measures behaviors associated with executive functions in daily life. It consists of 75 items which yields nine theoretically and empirically derived scales (Inhibit, Self-Monitor, Plan/Organize, Shift, Initiate, Task Monitor, Emotional Control, Working Memory, and Organization of Materials), two broader indices (Behavioral Regulation and Metacognition), and an overall summary score (Global Executive Composite). *T* scores ≥ 65 are considered clinically significant. The BRIEF–A also includes three validity scales, with cutoffs based on infrequent raw scores in the normative sample and clinical samples (i.e., Negativity ≥ 6; Inconsistency ≥ 8; Infrequency ≥ 3). The Norwegian version applies U.S. normative data, which includes U.S. men and women from ages 18 to 90 years and from a wide range of ethnic and educational backgrounds, as well as geographic regions matched to U.S. census data (Isquith et al., 2005). The BRIEF–A takes about 10–15 minutes to administer.

The RBANS yields five age-corrected Index scores with a mean score of 100 and standard deviation of 15 (Immediate Memory, Visuospatial/Constructional, Language, Attention, and Delayed Memory), as well as a Total Scale score. The Norwegian version of the RBANS applies Scandinavian norms (Randolph, 2013), and takes about 20–30 minutes to administer. Each patient was administered the RBANS (Form A: *n*=159 and Form B: *n*=91), and the BRIEF–A using the standardized instructions in the manuals. A subset of the participants (*n*=176) completed the Norwegian research version of the National Adult Reading Test (NART), which provides age adjusted measures of estimated full scale intelligence quotient (FSIQ; Sundet & Vaskinn, 2008; Vaskinn et al., 2020). FSIQ level was measured by the Norwegian version of the Wechsler Adult Intelligence Scale, Fourth Edition (Wechsler, 2011) in a minority of participants ($n = 49$), for most to assure that low intelligence would not be a formal hindrance to stand trial, to make decisions of treatment options or to self-discharge etc.

The RBANS Effort Index (EI; Silverberg et al., 2007), RBANS Effort Scale (ES; Novitski et al., 2012), and RBANS Performance Validity Index (PVI; Paulson et al., 2015) were computed as described by the authors. These measures are primarily derived from raw scores on the RBANS subtests List Recognition, a forced-choice recognition task, and Digit Span, a task in which participants immediately repeat a string of numbers read by the examiner. List Recognition and Digit Span tests are somewhat insensitive to a wide range of cognitive disorders and poor performances on these tests have been considered to be a type of embedded validity indicator (Iverson et al., 1994; Iverson & Tulsky 2003; Miele et al., 2012; Shura et al., 2020; Silverberg et al., 2007).

The EI is calculated by assigning raw scores on the Digit Span and List Recognition subtests a weighted score ranging from 0–6. The weighted scores are based on the frequency of raw scores in clinical populations (i.e., the raw scores associated with the following percentile ranges: 0, 0.1–1.9, 2–4.9, 5–8.9, 9–15.9, 16–24.9, and ≥25). Less frequent scores have higher weighted scores. The sum of the two weighted scores is the EI score. An EI score of >0 was found to be optimal compared to scores indicating invalid performance on the Test of Memory Malingering (TOMM; Tombaugh, 1997) in a sample of people with mild traumatic brain injury (mTBI) versus three malingering groups (i.e., a clinical sample consisting of probable or definite neurocognitive malingering and two samples of healthy participants instructed to malinger; Silverberg et al., 2007). Based on these findings, and the frequencies of EI scores in a heterogenous sample of clinical patients with cognitive impairment and no evidence of invalid test performance, Silverberg et al. (2007) suggest that EI scores >3 should be considered indicative of invalid performance in clinical populations referred for neuropsychological testing.

The ES is calculated by subtracting the sum of raw scores of the RBANS free recall subtests (i.e., List Recall, Story Recall, and Figure Recall) from the sum of raw scores obtained on List Recognition and Digit Span. Novitski et al. (2012) noted that ES scores <12 occurred in 15.1% in the RBANS standardization sample, and found this cutoff to have excellent discriminability between a sample of patients with mTBI scoring below the standard cutoff scores on a free-standing PVT and an amnestic sample consisting of probable Alzheimer's disease and amnestic mild cognitive impairment (aMCI). Novitski et al. (2012) caution that the ES will produce high false positive rates in people with adequate free recall performance and should be limited to cases where there is evidence of cognitive impairment or possible invalid test performance. They suggest that calculating ES scores should be limited to participants having Digit Span raw scores of <9, List Recognition raw scores of <19, or sums of Digit Span and List Recognition raw scores of <28.

In constructing the PVI, Paulson et al. (2015) performed a series of independent-samples *t*-tests to identify which RBANS subtests participants with valid responding performed better on, compared to participants with invalid responding based on the TOMM and behavioral criteria. Valid responders had better performance on the RBANS subtests Digit Span, List Recall, Story Recall, Figure Recall, and List Recognition. The PVI score equals the sum of raw scores of these subtests. Paulson et al. (2015) found that invalid test performance responding was optimally identified by PVI scores <42.

Statistical analyses

Frequency analysis tables were used to compute base rates of raw scores on the RBANS subtests Digit Span and List Recognition; the sum of Digit Span and List Recognition

raw scores; scores on the EI, ES, and PVI; and the BRIEF–A Initiate Scale. Spearman's rank order correlations were computed between the EI, ES, PVI, BRIEF–A Initiate Scale, RBANS Indices and Total Scale score, NART FSIQ and WAIS-IV FSIQ, and years of age and education. In the correlation analysis, we included an aggregate measure of global performance that excluded the Digit Span and List Recognition subtests, by summing the RBANS Index scores to which neither of these subtests contributes (i.e. the Immediate Memory, Visuospatial/Construction, and Language indices), as described in Silverberg et al. (2007). We then repeated the Spearman's rank order correlation computations for participants having a *T* score ≥65 (*n*=128) on the BRIEF–A Initiate Scale, in effect including only those participants acknowledging clinically significant initiation problems.

Results

Descriptive statistics for age, years of education, NART estimated FSIQ, WAIS-IV FSIQ, the RBANS Indices and Total Scale score, and BRIEF–A Initiate Scale are presented in Table 1. We note that mean NART estimated intelligence was in the average range and that WAIS-IV FSIQs were in the low average range (i.e., a standard deviation below the normative mean). The means for the RBANS Indices and Total Scale score indicate that patients had, on average, mild to moderate cognitive deficits. There were no differences on any of these measures between patients with and without comorbid substance use problems ($p > .05$).

Most patients were able to answer all BRIEF–A items. Having two or more unanswered items was uncommon and occurred in just 1.6% of participants. On the BRIEF–A validity measures, 3.6% had scores exceeding the cutoff for inconsistent responding, 2.8% had scores exceeding the cutoff for a negative response pattern, and 0.4% had scores exceeding the cutoff for an unusual response pattern. On the BRIEF–A Initiate Scale, 51% had a *T* score above the suggested clinical cutoff (i.e., $T \geq 65$); 36% had a $T \geq 70$ and 19% had a $T \geq 80$. The maximum *T* score is 89, which was obtained by 1.2%, whereas *T* scores ≤50 occurred in 17.2%.The frequencies of low raw scores on the Digit Span and List Recognition, the frequency of scores <28 for the sum of Digit Span and List Recognition raw scores, EI, ES, and PVI scores exceeding the cutoffs in the current sample are presented in Table 2. We also report (a) the corresponding frequencies of low raw scores on the Digit Span and List Recognition, and frequencies of EI scores in the EI derivation sample (Silverberg et al., 2007); (b) the frequencies of low raw scores on the Digit Span and List Recognition, the frequency of scores <28 for the sum of Digit Span and List Recognition raw scores, and ES scores <12 from the RBANS standardization sample (Novitski et al., 2012); and (c) frequencies of EI scores >0, ES scores <12, and PVI scores <42 in the PVI derivation sample (Paulson et al., 2015) in Table 2 for comparison. In the current sample, 128 participants (51%) had either a raw score of <19 on List Recognition, a Digit Span raw score of <9, or a combined List Recognition + Digit Span raw score of <28. Using the

criterion of List Recognition + Digit Span raw scores of <28 as an indicator for calculating an ES score as suggested by Novitski et al. (2012), 73 (29%) participants qualified for calculating an ES score, of which 70 had an ES score <12, constituting a frequency of invalid ES scores of 28% in the entire sample. The EI has several suggested cutoffs. Silverberg et al. (2007) suggested a cutoff score >0 in post-acute mild TBI cases and a cutoff score of >3 for populations referred for neuropsychological assessment. A cutoff of >4 has been suggested for older and more cognitively impaired patients with schizophrenia disorders (Moore et al., 2013). Using the cutoffs of >0, >3, and >4, 28%, 6%, or 3% of participants, respectively, had EI scores exceeding these cutoffs.

Table 2. Frequency distributions of measures of the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) Performance Validity Tests in Clinical populations and Standardization Sample.

Cutoff Scores	Schizophrenia Spectrum Disorders (current study; N = 250)	Effort Index Derivation Sample (N = 103)	RBANS U.S. Standardization Sample (N = 540)	Performance Validity Index Derivation Sample (N = 234)
Digit Span raw scores				
<9	40%	32%	23%	–
<8	21%	11%	7%	–
<7	11%	8%	–	–
List Recognition raw scores				
<19	22%	39%	14%	–
<18	13%	24%	7%	–
<17	8%	16%	–	–
<16	5%	10%	–	–
<15	2%	8%	–	–
Digit Span + List Recognition				
<28	29%	–	17%	–
Effort Index				
>0	28%	34%	–	48%
>1	24%	25%	–	–
>2	14%	16%	–	–
>3	6%	6%	–	–
>4	3%	–	–	–
Effort Scale				
<12	28%	–	15%	32%
<1	16%	–	–	–
<−5	6%	–	–	–
Performance Validity Index				
<53	29%	–	–	–
<50	16%	–	–	–
<42	6%	–	–	35%

Note. RBANS = Repeatable Battery for the Assessment of Neuropsychological Status. The Schizophrenia Spectrum Disorders column designates frequencies observed in the current study, the Effort Index Derivation Sample was reported in Silverberg et al. (2007), the RBANS U.S. Standardization Sample was reported in Novitski et al. (2012), and the Performance Validity Index Derivation Sample was reported in Paulson et al. (2015).

Non-parametric correlations (i.e., Spearman's *rho*) for the entire sample are presented in Table 3. Only the EI had a significant correlation with the BRIEF–A Initiate Scale, albeit very small (*rho* = .158, $p < .05$). When including only participants that had acknowledged clinically significant initiation problems (i.e., those with *T* scores ≥65 on the BRIEF–A Initiate Scale; *n*=128), none of the RBANS PVTs were significantly correlated with the BRIEF–A Initiate Scale (EI: *rho*=.112, $p = .304$;

ES: *rho*= .091, *p*= .509; PVI: *rho*=–.018, *p*= .870). The new RBANS aggregate global score, which excludes the Digit Span and List Recognition subtests, had lower correlation coefficients with all three PVTs (EI: *rho*=–.400, *p*< .001; ES: *rho*= –.633, *p*<.001; PVI: *rho*= .671, *p*< .001) compared to the RBANS Total Scale score (EI: *rho*=–.484, *p*< .001; ES: *rho*=–.762, *p*< .001; PVI: *rho*= .826, *p*< .001). The ES (*rho*=–.906, *p*< .001) and PVI (*rho*= .951, *p*< .001) had high correlations with the RBANS Delayed Memory Index compared to the EI (*rho*=–.456, *p*<.001). All PVTs correlated with years of education (EI: *rho*=–.186, *p*<.001; ES: *rho*=–.239, *p*< .001; PVI: *rho*=.212, *p*< .001) and the ES with age (*rho*= .243, *p*< .001). The EI and PVI correlated with NART predicted FSIQ (EI: *rho*=–.285, *p*< .001; PVI: *rho*= .331, *p*< .001) and WAIS-IV FSIQ (EI: *rho*=–.556, *p*<.001; PVI: *rho*= .511, *p*< .001).

A standard linear multiple regression was used to explore how much of the variance of BRIEF–A Initiate Scale scores were explained by the RBANS PVT scores (i.e., the EI, ES, and PVI). Preliminary analyses were conducted to ensure no violation of normality, linearity, multicollinearity, and homoscedasticity. The inclusion of the PVI in the model resulted in unacceptable multicollinearity, and this variable was excluded from the regression analysis. The regression analyses revealed that the PVTs did not explain a significant amount of variance in BRIEF–A Initiate Scale scores, $F(2, 125)=1.706$, $p= .186$, $R^2= .027$, $R^2_{Adjusted}= .011$, or when including only those participants having BRIEF–A Initiate Scale scores of $T \geq 65$, $F(2, 68)= .630$, $p= .535$, $R^2= .018$, $R^2_{Adjusted}= –.011$.

Table 3. Spearman's Rank Order Correlations Matrix.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Effort Index	–													
2. Effort Scale	.192*													
3. Performance Validity Index	−.574**	−.864**												
4. BRIEF-A Initiate Scale	.158*	.052	−.073											
5. Immediate Memory	−.407**	−.647**	.710**	−.074										
6. Visuospatial/ Constructional	−.260**	−.328**	.356**	−.077	.222**									
7. Language	−.214**	−.312**	.353**	−.071	.429**	.189**								
8. Attention	−.397**	−.420**	.563**	−.113	.456**	.325**	.390**							
9. Delayed Memory	−.456**	−.906**	.951**	−.059	.713**	.357**	.347**	.514**						
10. Total Scale	−.484**	−.762**	.826**	−.103	.790**	.540**	.621**	.734**	.822**					
11. Aggregate Global Performance	−.400**	−.633**	.671**	−.105	.793**	.601**	.730**	.536**	.677**	.920**				
12. Age in Years	−.075	.243**	−.081	−.177**	.018	.065	.068	.010	−.120	.001	0.067			
13. Years of Education	−.186**	−.239**	.212**	−.128*	.341**	.178**	.199**	.350**	.224**	.345**	.342**	.215**		
14. NART predicted FSIQ	−.285**	−.163	.331**	−.088	.398**	.237**	.315**	.333**	.276**	.482**	.481**	.148	.554**	
15. WAIS-IV FSIQ	−.556**	−.247	.511**	.053	.374**	.261	.468**	.639**	.469**	.621**	.549**	−.065	.279	.516**

Note. N = 250 for all variables except for the ES (n = 128). BRIEF-A = Behavior Rating Inventory of Executive Function-Adult Version; Aggregate Global Performance = the sum of Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) Immediate Memory, Visuospatial/Construction, and Language indices. NART = National Adult Reading Test; WAIS-IV FSIQ = Wechsler Adult Intelligence Scale, Fourth Edition Full Scale Intelligence Quotient;.

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

Discussion

The aim of this study was to investigate the frequency of several measures suggested as indicators of problems with motivation, interest, and performance validity in schizophrenia spectrum disorders derived from neuropsychological test scores (i.e., RBANS) in a large sample of younger patients with schizophrenia spectrum disorders, and to compare these scores with measures of apathy derived from a self-report symptom questionnaire on executive functions in everyday life (i.e., BRIEF–A Initiate Scale). About 28% of the current sample had scores indicating possible invalid test performance on some of the RBANS PVTs, which was close to the hypothesized frequency (i.e., ∼20%) and is about twice as frequent than the prevalence of the same scores in the U.S. standardization sample (Novitski et al., 2012). Depending on which PVT and cutoff we chose, the prevalence of scores exceeding cutoffs varied from 3% (i.e., EI scores >4), 6% (i.e., PVI scores <42), to 28% (i.e., ES scores <12), which is not substantially different from previous studies of the RBANS PVTs in schizophrenia spectrum disorders (Bayan et al., 2018; Moore et al., 2013; Morra et al., 2015). In the current sample, an ES cutoff of <12 does not yield substantially different rates of scores exceeding the cutoff in comparison to a combined raw score on List Recognition and Digit Span score of <28 or an EI score >0. In the present study, an EI score >3 (occurring in 6% of our sample) seems appropriate, and this is also the most used cutoff in samples of people with schizophrenia (Morra et al., 2015).

The prevalence of scores above the suggested clinical cutoff on the BRIEF–A Initiate Scale was 51%, which was somewhat higher than we hypothesized. The correlations of self-reported initiation problems and empirically derived PVTs were either non-significant, or too small to be of any probable clinical significance, even when including only those participants that had BRIEF–A Initiate Scale scores in the clinical range (*T* score ≥65). Further, the results of the regression analyses suggest that the BRIEF–A Initiate Scale and the RBANS PVTs are measuring different constructs. There is some evidence that elevated BRIEF–A scores are more related to emotional distress and psychiatric problems than performance on neuropsychological tests (Donders et al., 2015; Donders & Strong, 2016; Hanssen et al., 2014; Løvstad et al., 2012, 2016; Shwartz et al., 2020).

All RBANS PVTs had moderate to high correlations with measures of cognitive impairment as measured with the RBANS Total score and the new RBANS aggregate global score, a score that does not include the subtests (i.e., Digit Span and List Recognition) used to calculate the PVTs scores. The ES and the PVI rely more on raw scores that are used to compute the RBANS Delayed Memory Index compared to the EI, which accounts for their high correlations with that index. The association with cognitive impairment is to be expected. Low motivation, insufficient exertion, or other behaviors that might underlie low scores on embedded PVTs will also result in lower scores on other RBANS subtests. On the other hand, cognitive impairment, by

definition, results in low test scores, including those subtests comprising the RBANS PVTs (Burton et al., 2015; Goette & Goette, 2019; Hook et al., 2009; Morra et al., 2015; Shura et al., 2018). It has been suggested that cognitive deficits in schizophrenia spectrum disorders could contribute to motivational deficits, in addition to, or instead of, motivational deficits contributing to low cognitive performances (Barch, 2005). We cannot assume that the RBANS PVTs are a direct and precise measure of "effort," or "motivation;" they are cognitive tests. The associations of all three RBANS PVTs with years of education, measures of intelligence, and cognitive impairment indicates that patients with genuine cognitive impairment, or patients with lower intelligence and/or lower educational attainment, will have a greater likelihood of obtaining scores that exceed cutoffs on the RBANS PVTs (Burton et al., 2015; Duff et al., 2011; Goette & Goette, 2019; Hook et al., 2009; Morra et al., 2015; O'Mahar et al., 2012; Shura et al., 2018). Given these associations, we cannot rule out that the RBANS PVTs are simply measuring levels of cognitive functioning in the current sample, rather than decreased motivation and interest, particularly considering that the patients' self-report of initiation problems do not correlate with the RBANS PVTs.

Although the RBANS PVTs can alert the clinician that insufficient engagement and reduced motivation might have influenced test performance, these measures are perhaps more helpful for inferring valid test performance (Bayan et al., 2018; Lippa et al., 2017). That is, a patient that obtained a RBANS PVT score in the acceptable range has probably had reasonable and sufficient engagement in the cognitive tests during assessment, regardless of the level of cognitive impairment. The RBANS PVTs can thus aid the clinician in ruling out that patients' problems with decreased motivation, engagement, and interest had substantial effect on test scores.

Limitations

The present study has several limitations. Adding a standalone PVT would have enabled much more detailed analyses, including analyses of classification accuracy for the embedded PVTs and the associated confidence intervals for different cutoffs of the RBANS PVTs. Embedded PVTs are generally considered less sensitive than standalone PVTs in some studies (Armistead-Jehle & Hansen, 2011; Miele et al., 2012; Riordan & Lahr, 2020). That said, the RBANS embedded PVTs have been criticized for yielding too many false positives in people with a schizophrenia diagnosis, particularly forensically committed inpatients (Williams et al., 2020). The addition of other measures of apathy and avolition, such as the SANS, PANSS, or NSA, would allow for better comparisons with previous studies investigating the RBANS PVTs and negative symptoms in schizophrenia spectrum disorders. Further, we have no information regarding patients' use of psychotropic medications, and thus we cannot examine possible associations between medication use, embedded PVT scores, and cognitive functioning (Ballesteros et al., 2018; MacKenzie et al., 2018). The use of U.S. normative data for the BRIEF–A in a Norwegian patient sample, might also be

problematic, because studies conducted in Norway have found that healthy respondents can have mean scores 0.5 to 0.75 *SDs* below the U.S. normative means (Grane et al., 2014; Løvstad et al., 2016; Sølsnes et al., 2014). A matched control group could have remediated most of these limitations.

Conclusions

In principle, the RBANS allows for the concurrent assessment of cognitive deficits and motivational problems in patients with schizophrenia spectrum disorders. By combining the RBANS and BRIEF–A in a neuropsychological assessment, the clinician can evaluate the degree of cognitive impairment, potential invalid test performance, self-reported initiation problems, and other behaviors associated with executive functions in daily life, in less than 60 minutes. The majority of participants could complete the RBANS (i.e., 72–94%) and the BRIEF–A (i.e., 96%) without obtaining low scores on the validity indicators, suggesting that these assessment tools are well within the capabilities of most patients seen with schizophrenia spectrum disorders.

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Doctoral Theses at The Faculty of Psychology,

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	Bjørkelo, Brita	Whistleblowing at work: Antecedents and consequences
	Reme, Silje Endresen	Common Complaints – Common Cure? Psychiatric comorbidity and predictors of treatment outcome in low back pain and irritable bowel syndrome
	Helland, Wenche Andersen	Communication difficulties in children identified with psychiatric problems
	Beneventi, Harald	Neuronal correlates of working memory in dyslexia
	Thygesen, Elin	Subjective health and coping in care-dependent old persons living at home
	Aanes, Mette Marthinussen	Poor social relationships as a threat to belongingness needs. Interpersonal stress and subjective health complaints: Mediating and moderating factors.
	Anker, Morten Gustav	Client directed outcome informed couple therapy
	Bull, Torill	Combining employment and child care: The subjective well-being of single women in Scandinavia and in Southern Europe
	Viig, Nina Grieg	Tilrettelegging for læreres deltakelse i helsefremmende arbeid. En kvalitativ og kvantitativ analyse av sammenhengen mellom organisatoriske forhold og læreres deltakelse i utvikling og implementering av Europeisk Nettverk av Helsefremmende Skoler i Norge
	Wolff, Katharina	To know or not to know? Attitudes towards receiving genetic information among patients and the general public.
	Ogden, Terje, dr.philos.	Familiebasert behandling av alvorlige atferdsproblemer blant barn og ungdom. Evaluering og implementering av evidensbaserte behandlingsprogrammer i Norge.
	Solberg, Mona Elin	Self-reported bullying and victimisation at school: Prevalence, overlap and psychosocial adjustment.
2011 V	Bye, Hege Høivik	Self-presentation in job interviews. Individual and cultural differences in applicant self-presentation during job interviews and hiring managers' evaluation

	Notelaers, Guy	Workplace bullying. A risk control perspective.
	Moltu, Christian	Being a therapist in difficult therapeutic impasses. A hermeneutic phenomenological analysis of skilled psychotherapists' experiences, needs, and strategies in difficult therapies ending well.
	Myrseth, Helga	Pathological Gambling - Treatment and Personality Factors
	Schanche, Elisabeth	From self-criticism to self-compassion. An empirical investigation of hypothesized change prosesses in the Affect Phobia Treatment Model of short-term dynamic psychotherapy for patients with Cluster C personality disorders.
	Våpenstad, Eystein Victor, dr.philos.	Det tempererte nærvær. En teoretisk undersøkelse av psykoterapautens subjektivitet i psykoanalyse og psykoanalytisk psykoterapi.
	Haukebø, Kristin	Cognitive, behavioral and neural correlates of dental and intra-oral injection phobia. Results from one treatment and one fMRI study of randomized, controlled design.
	Harris, Anette	Adaptation and health in extreme and isolated environments. From 78°N to 75°S.
	Bjørknes, Ragnhild	Parent Management Training-Oregon Model: intervention effects on maternal practice and child behavior in ethnic minority families
	Mamen, Asgeir	Aspects of using physical training in patients with substance dependence and additional mental distress
	Espevik, Roar	Expert teams: Do shared mental models of team members make a difference
	Haara, Frode Olav	Unveiling teachers' reasons for choosing practical activities in mathematics teaching
2011 H	Hauge, Hans Abraham	How can employee empowerment be made conducive to both employee health and organisation performance? An empirical investigation of a tailor-made approach to organisation learning in a municipal public service organisation.
	Melkevik, Ole Rogstad	Screen-based sedentary behaviours: pastimes for the poor, inactive and overweight? A cross-national survey of children and adolescents in 39 countries.
	Vøllestad, Jon	Mindfulness-based treatment for anxiety disorders. A quantitative review of the evidence, results from a randomized controlled trial, and a qualitative exploration of patient experiences.
	Tolo, Astrid	Hvordan blir lærerkompetanse konstruert? En kvalitativ studie av PPU-studenters kunnskapsutvikling.

	Saus, Evelyn-Rose	Training effectiveness: Situation awareness training in simulators
	Nordgreen, Tine	Internet-based self-help for social anxiety disorder and panic disorder. Factors associated with effect and use of self-help.
	Munkvold, Linda Helen	Oppositional Defiant Disorder: Informant discrepancies, gender differences, co-occuring mental health problems and neurocognitive function.
	Christiansen, Øivin	Når barn plasseres utenfor hjemmet: beslutninger, forløp og relasjoner. Under barnevernets (ved)tak.
	Brunborg, Geir Scott	Conditionability and Reinforcement Sensitivity in Gambling Behaviour
	Hystad, Sigurd William	Measuring Psychological Resiliency: Validation of an Adapted Norwegian Hardiness Scale
2012 V	Roness, Dag	Hvorfor bli lærer? Motivasjon for utdanning og utøving.
	Fjermestad, Krister Westlye	The therapeutic alliance in cognitive behavioural therapy for youth anxiety disorders
	Jenssen, Eirik Sørnes	Tilpasset opplæring i norsk skole: politikeres, skoleledereres og læreres handlingsvalg
	Saksvik-Lehouillier, Ingvild	Shift work tolerance and adaptation to shift work among offshore workers and nurses
	Johansen, Venke Frederike	Når det intime blir offentlig. Om kvinners åpenhet om brystkreft og om markedsføring av brystkreftsaken.
	Herheim, Rune	Pupils collaborating in pairs at a computer in mathematics learning: investigating verbal communication patterns and qualities
	Vie, Tina Løkke	Cognitive appraisal, emotions and subjective health complaints among victims of workplace bullying: A stress-theoretical approach
	Jones, Lise Øen	Effects of reading skills, spelling skills and accompanying efficacy beliefs on participation in education. A study in Norwegian prisons.
2012 H	Danielsen, Yngvild Sørebø	Childhood obesity – characteristics and treatment. Psychological perspectives.
	Horverak, Jøri Gytre	Sense or sensibility in hiring processes. Interviewee and interviewer characteristics as antecedents of immigrant applicants' employment probabilities. An experimental approach.

	Jøsendal, Ola	Development and evaluation of BE smokeFREE, a school-based smoking prevention program
	Osnes, Berge	Temporal and Posterior Frontal Involvement in Auditory Speech Perception
	Drageset, Sigrunn	Psychological distress, coping and social support in the diagnostic and preoperative phase of breast cancer
	Aasland, Merethe Schanke	Destructive leadership: Conceptualization, measurement, prevalence and outcomes
	Bakibinga, Pauline	The experience of job engagement and self-care among Ugandan nurses and midwives
	Skogen, Jens Christoffer	Foetal and early origins of old age health. Linkage between birth records and the old age cohort of the Hordaland Health Study (HUSK)
	Leversen, Ingrid	Adolescents' leisure activity participation and their life satisfaction: The role of demographic characteristics and psychological processes
	Hanss, Daniel	Explaining sustainable consumption: Findings from cross-sectional and intervention approaches
	Rød, Per Arne	Barn i klem mellom foreldrekonflikter og samfunnsmessig beskyttelse
2013 V	Mentzoni, Rune Aune	Structural Characteristics in Gambling
	Knudsen, Ann Kristin	Long-term sickness absence and disability pension award as consequences of common mental disorders. Epidemiological studies using a population-based health survey and official ill health benefit registries.
	Strand, Mari	Emotional information processing in recurrent MDD
	Veseth, Marius	Recovery in bipolar disorder. A reflexive-collaborative exploration of the lived experiences of healing and growth when battling a severe mental illness
	Mæland, Silje	Sick leave for patients with severe subjective health complaints. Challenges in general practice.
	Mjaaland, Thera	At the frontiers of change? Women and girls' pursuit of education in north-western Tigray, Ethiopia
	Odéen, Magnus	Coping at work. The role of knowledge and coping expectancies in health and sick leave.
	Hynninen, Kia Minna Johanna	Anxiety, depression and sleep disturbance in chronic obstructive pulmonary disease (COPD). Associations, prevalence and effect of psychological treatment.
	Flo, Elisabeth	Sleep and health in shift working nurses

	Aasen, Elin Margrethe	From paternalism to patient participation? The older patients undergoing hemodialysis, their next of kin and the nurses: a discursive perspective on perception of patient participation in dialysis units
	Ekornås, Belinda	Emotional and Behavioural Problems in Children: Self-perception, peer relationships, and motor abilities
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	Årdal, Guro	Major Depressive Disorder – a Ten Year Follow-up Study. Inhibition, Information Processing and Health Related Quality of Life
	Johansen, Rino Bandlitz	The impact of military identity on performance in the Norwegian armed forces
	Bøe, Tormod	Socioeconomic Status and Mental Health in Children and Adolescents
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	Urheim, Ragnar	Forståelse av pasientaggresjon og forklaringer på nedgang i voldsrate ved Regional sikkerhetsavdeling, Sandviken sykehus
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	Rød, Anne Marie Kinn	Consequences of social defeat stress for behaviour and sleep. Short-term and long-term assessments in rats.
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	Tjora, Tore	Smoking from adolescence through adulthood: the role of family, friends, depression and socioeconomic status. Predictors of smoking from age 13 to 30 in the “The Norwegian Longitudinal Health Behaviour Study” (NLHB)
	Vangsnes, Vigdis	The Dramaturgy and Didactics of Computer Gaming. A Study of a Medium in the Educational Context of Kindergartens.
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	Halvorsen, Kirsti Vindal	Partnerskap i lærerutdanning, sett fra et økologisk perspektiv
	Solbue, Vibeke	Dialogen som visker ut kategorier. En studie av hvilke erfaringer innvandrerungdommer og norskfødte med innvandrerforeldre har med videregående skole. Hva forteller ungdommenes erfaringer om videregående skoles håndtering av etniske ulikheter?
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	Haug, Thomas	Predictors and moderators of treatment outcome from high- and low-intensity cognitive behavioral therapy for anxiety disorders. Association between patient and process factors, and the outcome from guided self-help, stepped care, and face-to-face cognitive behavioral therapy.
	Sjølie, Hege	Experiences of Members of a Crisis Resolution Home Treatment Team. Personal history, professional role and emotional support in a CRHT team.
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	Schmid, Marit Therese	Executive Functioning in recurrent- and first episode Major Depressive Disorder. Longitudinal studies
	Sand, Liv	Body Image Distortion and Eating Disturbances in Children and Adolescents
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	Amugsi, Dickson Abanimi	Child care practices, resources for care, and nutritional outcomes in Ghana: Findings from Demographic and Health Surveys
	Jakobsen, Hilde	The good beating: Social norms supporting men's partner violence in Tanzania
	Sagoe, Dominic	Nonmedical anabolic-androgenic steroid use: Prevalence, attitudes, and social perception
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	Røykenes, Kari	Testangst hos sykepleierstudenter: «Alternativ behandling»

	Bless, Josef Johann	The smartphone as a research tool in psychology. Assessment of language lateralization and training of auditory attention.
	Løvvik, Camilla Margrethe Sigvaldsen	Common mental disorders and work participation – the role of return-to-work expectations
	Lehmann, Stine	Mental Disorders in Foster Children: A Study of Prevalence, Comorbidity, and Risk Factors
	Knapstad, Marit	Psychological factors in long-term sickness absence: the role of shame and social support. Epidemiological studies based on the Health Assets Project.
2016 V	Kvestad, Ingrid	Biological risks and neurodevelopment in young North Indian children
	Sælør, Knut Tore	Hinderløyper, halmstrå og hengende snører. En kvalitativ studie av håp innenfor psykisk helse- og rusfeltet.
	Mellingen, Sonja	Alkoholbruk, partilfredshet og samlivsstatus. Før, inn i, og etter svangerskapet – korrelater eller konsekvenser?
	Thun, Eirunn	Shift work: negative consequences and protective factors
	Hilt, Line Torbjørnsen	The borderlands of educational inclusion. Analyses of inclusion and exclusion processes for minority language students
	Havnen, Audun	Treatment of obsessive-compulsive disorder and the importance of assessing clinical effectiveness
	Slåtten, Hilde	Gay-related name-calling among young adolescents. Exploring the importance of the context.
	Ree, Eline	Staying at work. The role of expectancies and beliefs in health and workplace interventions.
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2016 H	Løvoll, Helga Synnevåg	Inside the outdoor experience. On the distinction between pleasant and interesting feelings and their implication in the motivational process.
	Hjeltnes, Aslak	Facing social fears: An investigation of mindfulness-based stress reduction for young adults with social anxiety disorder
	Øyeflaten, Irene Larsen	Long-term sick leave and work rehabilitation. Prognostic factors for return to work.
	Henriksen, Roger Ekeberg	Social relationships, stress and infection risk in mother and child
	Johnsen, Iren	«Only a friend» - The bereavement process of young adults who have lost a friend to a traumatic death. A mixed methods study.

	Helle, Siri	Cannabis use in non-affective psychoses: Relationship to age at onset, cognitive functioning and social cognition
	Glambek, Mats	Workplace bullying and expulsion in working life. A representative study addressing prospective associations and explanatory conditions.
	Oanes, Camilla Jensen	Tilbakemelding i terapi. På hvilke måter opplever terapeuter at tilbakemeldingsprosedyrer kan virke inn på terapeutiske praksiser?
	Reknes, Iselin	Exposure to workplace bullying among nurses: Health outcomes and individual coping
	Chimhutu, Victor	Results-Based Financing (RBF) in the health sector of a low-income country. From agenda setting to implementation: The case of Tanzania
	Ness, Ingunn Johanne	The Room of Opportunity. Understanding how knowledge and ideas are constructed in multidisciplinary groups working with developing innovative ideas.
	Hollekim, Ragnhild	Contemporary discourses on children and parenting in Norway. An empirical study based on two cases.
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2017 V	Katisi, Masego	The power of context in health partnerships: Exploring synergy and antagony between external and internal ideologies in implementing Safe Male Circumcision (SMC) for HIV prevention in Botswana
	Jamaludin, Nor Lelawati Binti	The “why” and “how” of International Students’ Ambassadorship Roles in International Education
	Berthelsen, Mona	Effects of shift work and psychological and social work factors on mental distress. Studies of onshore/offshore workers and nurses in Norway.
	Krane, Vibeke	Lærer-elev-relasjoner, elevers psykiske helse og frafall i videregående skole – en eksplorerende studie om samarbeid og den store betydningen av de små ting
	Søvik, Margaret Ljosnes	Evaluating the implementation of the Empowering Coaching™ program in Norway
	Tonheim, Milfrid	A troublesome transition: Social reintegration of girl soldiers returning ‘home’
	Senneseth, Mette	Improving social network support for partners facing spousal cancer while caring for minors. A randomized controlled trial.
	Urke, Helga Bjørnøy	Child health and child care of very young children in Bolivia, Colombia and Peru.

	Bakhturidze, George	Public Participation in Tobacco Control Policy-making in Georgia
	Fismen, Anne-Siri	Adolescent eating habits. Trends and socio-economic status.
2017 H	Hagatun, Susanne	Internet-based cognitive-behavioural therapy for insomnia. A randomised controlled trial in Norway.
	Eichele, Heike	Electrophysiological Correlates of Performance Monitoring in Children with Tourette Syndrome. A developmental perspective.
	Risan, Ulf Patrick	Accommodating trauma in police interviews. An exploration of rapport in investigative interviews of traumatized victims.
	Sandhåland, Hilde	Safety on board offshore vessels: A study of shipboard factors and situation awareness
	Blågestad, Tone Fidje	Less pain – better sleep and mood? Interrelatedness of pain, sleep and mood in total hip arthroplasty patients
	Kronstad, Morten	Frå skulebenk til deadlines. Korleis nettjournalistar og journaliststudentar lærer, og korleis dei utviklar journalistfagleg kunnskap
	Vedaa, Øystein	Shift work: The importance of sufficient time for rest between shifts.
	Steine, Iris Mulders	Predictors of symptoms outcomes among adult survivors of sexual abuse: The role of abuse characteristics, cumulative childhood maltreatment, genetic variants, and perceived social support.
	Høgheim, Sigve	Making math interesting: An experimental study of interventions to encourage interest in mathematics
2018 V	Brevik, Erlend Joramo	Adult Attention Deficit Hyperactivity Disorder. Beyond the Core Symptoms of the Diagnostic and Statistical Manual of Mental Disorders.
	Erevik, Eilin Kristine	User-generated alcohol-related content on social media: Determinants and relation to offline alcohol use
	Hagen, Egon	Cognitive and psychological functioning in patients with substance use disorder; from initial assessment to one-year recovery
	Adólfsdóttir, Steinunn	Subcomponents of executive functions: Effects of age and brain maturations
	Brattabø, Ingfrid Vaksdal	Detection of child maltreatment, the role of dental health personnel – A national cross-sectional study among public dental health personnel in Norway
	Fylkesnes, Marte Knag	Frykt, forhandlinger og deltakelse. Ungdommer og foreldre med etnisk minoritetsbakgrunn i møte med den norske barnevernstjenesten.

	Stiegler, Jan Reidar	Processing emotions in emotion-focused therapy. Exploring the impact of the two-chair dialogue intervention.
	Egelandsdal, Kjetil	Clickers and Formative Feedback at University Lectures. Exploring students and teachers' reception and use of feedback from clicker interventions.
	Torjussen, Lars Petter Storm	Foreningen av visdom og veltalenhet – utkast til en universitetsdidaktikk gjennom en kritikk og videreføring av Skjervheims pedagogiske filosofi på bakgrunn av Arendt og Foucault. Eller hvorfor menneskelivet er mer som å spille fløyte enn å bygge et hus.
	Selvik, Sabreen	A childhood at refuges. Children with multiple relocations at refuges for abused women.
2018 H	Leino, Tony Mathias	Structural game characteristics, game features, financial outcomes and gambling behaviour
	Raknes, Solfrid	Anxious Adolescents: Prevalence, Correlates, and Preventive Cogntive Behavioural Interventions
	Morken, Katharina Teresa Enehaug	Mentalization-based treatment of female patients with severe personality disorder and substance use disorder
	Braatveit, Kirsten Johanne	Intellectual disability among in-patients with substance use disorders
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	Darkwah, Ernest	Caring for "parentless" children. An exploration of work-related experiences of caregivers in children's homes in Ghana.
	Valdersnes, Kjersti Bergheim	Safety Climate perceptions in High Reliability Organizations – the role of Psychological Capital
2019 V	Kongsgården, Petter	Vurderingspraksiser i teknologirike læringsmiljøer. En undersøkelse av læreres vurderingspraksiser i teknologirike læringsmiljøer og implikasjoner på elevenes medvirkning i egen læringsprosess.
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	Heradstveit, Ove	Alcohol- and drug use among adolescents. School-related problems, childhood mental health problems, and psychiatric diagnoses.
	Riise, Eili Nygard	Concentrated exposure and response prevention for obsessive-compulsive disorder in adolescents: the Bergen 4-day treatment

	Vik, Alexandra	Imaging the Aging Brain: From Morphometry to Functional Connectivity
	Krossbakken, Elfrid	Personal and Contextual Factors Influencing Gaming Behaviour. Risk Factors and Prevention of Video Game Addiction.
	Solholm, Roar	Foreldrenes status og rolle i familie- og nærmiljøbaserte intervensjoner for barn med atferdsvansker
	Baldomir, Andrea Margarita	Children at Risk and Mothering Networks in Buenos Aires, Argentina: Analyses of Socialization and Law-Abiding Practices in Public Early Childhood Intervention.
	Samuelsson, Martin Per	Education for Deliberative Democracy. Theoretical assumptions and classroom practices.
	Visted, Endre	Emotion regulation difficulties. The role in onset, maintenance and recurrence of major depressive disorder.
2019 H	Nordmo, Morten	Sleep and naval performance. The impact of personality and leadership.
	Sveinsdottir, Vigdis	Supported Employment and preventing Early Disability (SEED)
	Dwyer, Gerard Eric	New approaches to the use of magnetic resonance spectroscopy for investigating the pathophysiology of auditory-verbal hallucinations
	Synnevåg, Ellen Strøm	Planning for Public Health. Balancing top-down and bottom-up approaches in Norwegian municipalities.
	Kvinge, Øystein Røsseland	Presentation in teacher education. A study of student teachers' transformation and representation of subject content using semiotic technology.
	Thorsen, Anders Lillevik	The emotional brain in obsessive-compulsive disorder
	Eldal, Kari	Sikkerheitsnettet som tek imot om eg fell – men som også kan fange meg. Korleis erfarer menneske med psykiske lidingar ei innlegging i psykisk helsevern? Eit samarbeidsbasert forskingsprosjekt mellom forskarar og brukarar.
	Svendsen, Julie Lillebostad	Self-compassion - Relationship with mindfulness, emotional stress symptoms and psychophysiological flexibility
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	Ludvigsen, Kristine	Creating Spaces for Formative Feedback in Lectures. Understanding how use of educational technology can support formative assessment in lectures in higher education.

	Hansen, Hege	Tidlig intervensjon og recoveryprosesser ved førsteepisode psykose. En kvalitativ utforsking av ulike perspektiver.
	Nilsen, Sondre Aasen	After the Divorce: Academic Achievement, Mental Health, and Health Complaints in Adolescence. Heterogeneous associations by parental education, family structure, and siblings.
	Hovland, Runar Tengel	Kliniske tilbakemeldingssystemer i psykisk helsevern – implementering og praktisering
	Sæverot, Ane Malene	Bilde og pedagogikk. En empirisk undersøkelse av ungdoms fortellinger om bilder.
	Carlsen, Siv-Elin Leirvåg	Opioid maintenance treatment and social aspects of quality of life for first-time enrolled patients. A quantitative study.
	Haugen, Lill Susann Ynnesdal	Meeting places in Norwegian community mental health care: A participatory and community psychological inquiry
2020 H	Markova, Valeria	How do immigrants in Norway interpret, view, and prefer to cope with symptoms of depression? A mixed method study
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	Sunde, Erlend	Effects of light interventions for adaptation to night work: Simulated night work experiments

	Kusztrits, Isabella	About psychotic-like experiences and auditory verbal hallucinations. Transdiagnostic investigations of neurobiological, cognitive, and emotional aspects of a continuous phenomenon.
	Halvorsen, Øyvind Wiik	Aktørskap hjå norsklærarar i vidaregåande skule – Ein sosiokulturell intervjustudie
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	Marti, Andrea Rørvik	Shift work, circadian rhythms, and the brain. Identifying biological mechanisms underlying the metabolic and cognitive consequences of work timing, using a rat model.
	Thomassen, Ådne Gabriel	Hardiness and mental health in military organizations. Exploring mechanism and boundary conditions.
	Husabø, Elisabeth Bakke	Implementation of indicated anxiety prevention in schools
	Hagatun, Kari	The Educational Situation for Roma Pupils in Norway. Silenced Narratives on Schooling and Future.
	Herrero-Arias, Raquel	Negotiating parenting culture, identity, and belonging. The experiences of Southern European parents raising their children in Norway.
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	Eilertsen, Silje Elisabeth Hasmo	Who profits from concentrated exposure treatment for obsessive-compulsive disorder (OCD)? A quality assurance project from the OCD-team in Bergen.
	Chegeni, Razieh	Anabolic-Androgenic Steroids and Aggression in Humans: Experimental Studies, Subgroups, and Longitudinal Risk
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Errata for
Improving the Methodology for Assessing Cognitive Impairment in People with Schizophrenia Spectrum Disorders

Rune Raudeberg

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22.04.2022 R. Raudeberg
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22.04.22 Helen Green
(date and sign. of faculty)

Errata

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Substituted “that” with “which”

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Substituted “that” with “than”

Page 45

Corrected misspelling “ethnc” to “ethnic”

Corrected misspelling “notewothy” to “noteworthy”

Corrected misspelling “presices etnhincal compositipon” to “precise ethnical composition”

Corrected misspelling “probaly more etcnically homogeneus comapred” to “probably more ethnically homogeneous compared”

Page 63

Corrected misspelling “RABNS” to “RBANS”

Page 64

Corrected misspelling “Conclutions” to “Conclusions”

Page 157

Corrected misspelling “impariment” to “impairment”

Corrected misspelling “initiaton” to “initiation”

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