

Article

Can a Questionnaire Be Useful for Assessing Reading Skills in Adults? Experiences with the Adult Reading Questionnaire among Incarcerated and Young Adults in Norway

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Abstract: Background: Good screening tools can be of immense value in educational counselling for adults. We report two studies where we explored the factor structure and discriminative power of the Adult Reading Questionnaire (ARQ) in different samples of young adults at risk for reading impairments. Method: The ARQ was designed to screen for literacy skills with low resource requirement. The instrument includes 11 questions regarding reading and writing skills and 6 questions regarding attention deficits and hyperactivity. The first study included 246 undergraduate students. One-third of the sample were under assessment of specific learning impairments/dyslexia. The second study included 1475 incarcerated adults, where 1 in 4 reported specific reading impairments. Results: Principal Component Analyses (PCA) with varimax rotation returned four components for the participants in Study 1: Reading skills, Reading habits, Attention, and Hyperactivity. For the incarcerated sample in Study 2, the analysis returned three components, as the Attention and Hyperactivity items were combined. Conclusion: The ARQ is useful for identifying individuals at risk for dyslexia with acceptable measures of sensitivity and specificity, as well as for identifying those who report difficulties with reading and writing but have not been assessed for their difficulties earlier. The increased prevalence of attention-deficit/hyperactivity disorder (ADHD) seen among incarcerated adults must be considered when screening for reading problems as it may confound the scores on reading questionnaires.



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1. Introduction

Reliable screening procedures and checklists may be of value to determine if further assessment and diagnostic testing of skills and functions are necessary. Earlier surveys, such as the International Adult Literacy Survey (IALS), have shown that adults' literacy in approximately one-third of the population is too weak to provide optimal functioning in a modern society [1,2]. This was, however, not an analysis of learning deficits, but literacy skills at large. Several studies have shown incarcerated adults, in particular, are at risk for reading impairments [3–8]. When Morgan and Kett [9] conducted the IALS among Irish prisoners, they had to include three pre-levels to correctly classify a large group of the responders with literacy skills too weak for the regular classifications of the IALS operationalizations. In adult educational counseling, checklists can be a valuable contribution and straightforward entry to further work. A complete assessment of literacy is resource-demanding and invasive, as a comprehensive functional analysis requires challenging functions that constitute potential areas of difficulty, and which require testing the limits of skills to achieve a valid functional profile. In other words, to achieve the purpose of the assessment, one must expose the test taker to experiences of

not mastering. Good screening instruments can therefore be beneficial when assessing the level of individual literacy and difficulty. Screening instruments can provide good estimates of functions in the event of minimum involvement and time use. However, the screening procedure must also be reliable and valid so that one knows that it measures the characteristics to be measured, and that the results are both stable over time and regardless of who administers the tasks [10]. Furthermore, a screening procedure should be sensitive enough to capture cases where a more comprehensive mapping is required, but also specific enough not to include too many individuals to include too many individuals who do not need further assessment [11].

A fundamental principle of the Norwegian correction system is that prisoners should have the same access to social services as other citizens. The Education Act of Norway [12], which includes all students, guarantees prisoners access to education in the same way as for other citizens and residents (Section 13-2a). This implies 7 years of mandatory primary schooling (age 6–13), 3 years of mandatory lower secondary schooling (age 13–16), and 3 to 5 years of upper secondary schooling (age 16–19). The last of these is not mandatory but is a legal right. Norway applies the so-called “import model” [13], where the local agencies in the community outside the prison also serve the prisoners. As the correctional institutions are mainly smaller regional units with an average of 60 prisoners, the local secondary high school also serves the educational needs of the prisoners. The Norwegian correction system includes a total of 57 institutions for adults, with the capacity ranging from 10 to approximately 250. In addition, two youth facilities, each with room for four prisoners under the age of 18, were established in the later years. Some of the prisons are dedicated to low-security incarceration, but the larger, regional institutions typically contain both low- and high-security units. Combined, the prisons in Norway have a total maximum capacity of 3646 prisoners. In addition, approximately 500 convicted adults are serving their sentence with electronic monitoring. Electronic monitoring (EM) can be used if the sentence is less than 6 months, the crime is nonviolent, and when the convicted is engaged in approved activities during daytime (e.g., work or education) and have appropriate accommodation. It is also possible to apply for EM when the remaining sentence is less than 6 months. The annual number of new incarcerations are decreasing, with 6774 new incarcerations in 2019 compared to 8834 in 2017 [14]. For longer sentences and following more serious crimes, the prisoners usually progress from high-security to low-security incarceration, but the security level does normally not affect the access to education, as the schools have set up their facilities within the prison.

After completion, the graduates can apply for general studies or further vocational studies. Adults also have the right to supplementary basic education and/or special education. All Norwegian prisons currently have established educational programs at the mandatory level and upper secondary level, and they have formally qualified teachers. Prisoners also have access to any education beyond upper secondary school. However, prison teachers do not generally have the requisite qualifications for teaching and supervising at this level, but the prisoners can take part in distance education or can be offered day release to participate in courses. In addition, the correction act [15] includes education among the activities that are required during incarceration.

The prisoner population is heterogeneous, but on the average, completed education among the inmates is low compared to the population at large. About one-third of the inmates have completed upper secondary education (high school graduation) compared to approximately two-thirds of the general population. The incidence of reading and writing difficulties, difficulties with mathematics, and attention difficulties is generally higher than what we expect to see in the general population [16]. In several studies, we have found that approximately one in four report they have dyslexia, and on average, we report reading skills to be approximately level with seventh-grade expectations [17]. Several other studies have shown an increased prevalence of learning challenges with implications for education and academic training [4–6,9,18–21]. Several studies have suggested that

education affects recidivism and reintegration in the community following release [22–26], but several barriers to participation have also been reported [27–29]

The reviewed data show that prison education programs constitute important arenas for adult education and adult education counselling. A relatively high proportion of prisoners in Norway choose to participate in education and training as part of the sentencing [30], and correctional services are important arenas for adult education. Thus, prisons constitute important arenas for testing relationships related to the risk of learning difficulties, learning challenges, and training in adults. Previous surveys of reading skills among inmates using screening tests such as word chains, homophone non-words, and other tests on phonological difficulties among inmates have yielded low scores and low correlations with self-experienced reading skills [17]. This may be a consequence of the increased prevalence of attention difficulties reported among incarcerated adults interact with demands for quick and precise performance in time-limited tasks [31]. The difficulties in literacy skills may also be generalizable to language and communication challenges [32–34].

To assure fair assessment, it is also necessary to compare the basic skills of the prisoners with what is typically seen in the community at large, particularly among those who seek education at different levels and in the same age group. Overall, the prisoners in Norway have a mean age of 34 years, but the majority of the inmates are between 18 and 25. Very few are incarcerated under the age of 18 (in 2019, a total of 36 minors were in prison), and they are typically be found in a separate youth facility with their own educational programs [14]. Child welfare agencies in the municipalities normally take care of young people who commit minor crimes.

In the present article, we present data for the Adult Reading Questionnaire (ARQ) as they appear from two different samples, one consisting of undergraduate students who were mainly assessed during their first year in higher education and the other consisting of participants in a national survey among the prisoners in Norway. The ARQ was designed to provide a reliable and valid screening procedure of adult reading difficulties. In its original form, the questionnaire consists of 15 questions about reading and writing and 6 questions covering attention skills and hyperactivity. The ARQ was first reported by Snowling, Dawes, Nash, and Hulme [35]. The questions have been tested in previous surveys, including the reading questions, which were taken from various sources [36], and the questions developed for the World Health Organization's screening test for attention-deficit/hyperactivity disorder (ADHD) among the Adult ADHD Self-Report Scale (ASRS) [37,38]. In our Norwegian version of the form, we built on the questionnaire reported by Snowling et al. (2012), but with a few modifications to the control questions to better match Norwegian respondents' experiences. The questions of the ARQ are designed within several categories. Three questions are regarded as control questions that directly focus on whether the person themselves experiences having reading difficulties. One of these questions provides a brief definition of dyslexia, and based on this definition, the responder is asked to assess whether they have dyslexia or not. Furthermore, the control questions focus on self-assessment of the extent and severity of the difficulties, as well as whether others have questioned the responder's literacy skills. The other main category comprises questions where the content is associated with reading impairments, but without addressing this directly. Two of these questions are aimed at how frequently the participant is reading or writing in his daily work. The other questions consider conditions that are associated with reading and writing difficulties in the research literature, such as word-searching difficulties, difficulty reading aloud, difficulty reading new words, etc., as well as difficulty organizing activities. The questions are, to a lesser extent, based on a particular theoretical model for understanding the etiology of reading difficulties, but are based to a greater extent on empirical findings from research on conditions associated with reading difficulties. This approach can have both positive and negative sides. In previous investigations among inmates, we used the Adult Dyslexia Check List (ADCL) [38,39]. ADCL is, to a larger extent, directly based on a phonological model of dyslexia, and the questions are constructed with clear reference to such a theoretical model. When ADCL

was used in a larger sample of inmates, the results showed good correlation between ADCL scores and self-reporting of dyslexia if participants had previously been assessed using a phonological approach to dyslexia. ADCL scores, on the other hand, showed low correlation with self-reported reading difficulties among participants who were not previously assessed for dyslexia, despite very weak literacy scores [17,18]. Jones et al. [17] also found weak correlation between ADCL scores and actual reading skills as they appeared when using established reading tests for adults. This may show that such a checklist has the greatest validity if respondents have already been assessed and explained their difficulty profiles according to a similar theoretical model. It appeared to be of less value to uncover new cases. A checklist containing broader and more general, albeit valid questions, such as ARQ, could possibly capture more poor readers who need further assessment, but has not previously been examined with diagnostic tests.

Snowling et al. [35] reported good psychometric characteristics with the use of the ARQ in a sample of adults with increased risk of showing dyslexia. In their study, the questionnaire was tested in a sample of adults at increased risk of dyslexic difficulties, defined as parents of children who have been diagnosed with reading difficulties. The participants were surveyed with a wide variety of functional samples in addition to filling out the ARQ. The scale showed good compliance with other measures of literacy, and the researchers reported a particularly high correlation between the reading scale and non-word reading, which is seen as one of the core difficulties of dyslexia. Using confirmatory factor analysis (CFA), Snowling et al. (ibid.) found that the ARQ had an internal structure that coincided with a theoretical four-factor model of literacy, where the factors were described as 'reading', 'word-finding', 'attention', and 'hyperactivity'. High reliability was found for two of these scales. Reading and attention gave Cronbach's alpha of 0.81, while word-finding and hyperactivity, which appeared with only three and two questions, resulted in lower α values of 0.60 and 0.58, respectively. The scores on all four subscales differentiated well between participants who were described as having dyslexia and participants who showed more typical literacy skills. Snowling et al. (ibid.) reported that a summation score of 90 (sic!) points yielded a sensitivity of the scale as 62 percent, which they found acceptable, but it failed to capture those who reported weak reading skills. The specificity was then 93.1 percent, which must be considered high. Another threshold value would have given a different relationship between sensitivity and specificity, but without providing a higher overall accuracy of the scale.

ARQ is a relatively simple measuring instrument, yielding valid and reliable results in the English language version. It will therefore be of high practical usefulness if the instrument can also be used for screening literacy skills in Norway. We used the Norwegian edition of the ARQ in a population survey among Norwegian inmates. In addition, we asked the participants to assess their own reading and writing skills, as well as to report whether they have previously been assessed and may have been diagnosed with dyslexia or specific reading and writing difficulties, either in school or in prison. In addition, we used the ARQ as a part of a survey of reading skills among undergraduate students at the University of Bergen and the NLA University College. Included in this study are also students who have referred themselves to the Adult Education Services in the municipality and had requested an assessment as they suspect they have reading impairments and need attestation for adaptive learning and examination.

The purpose of the study was to investigate whether the ARQ measures the same phenomena in Norwegian language version as it appears in the British study, and whether the psychometric characteristics of the instrument are of such a nature that it is advisable to use ARQ for assessing literacy in Norway.

Second, we investigated whether the ARQ yields different psychometric properties in two different samples of young adults in Norway with approximately the same distribution of specific learning impairments, and if a sample of undergraduate students would show responses to the questionnaire that are different from what was seen for the incarcerated adults given the characteristics discussed earlier.

Furthermore, we investigated whether the ARQ could reliably categorize participants who have known reading and spelling problem as they appear in a specific learning disorder, dyslexia, coherent with the result of former diagnostic assessments.

2. Study 1

2.1. Methods and Measurements

2.1.1. Participants

In the present study, 246 undergraduate students enrolled at either the University of Bergen or the NLA University College, Bergen, participated as voluntary. Approximately one-third of the sample ($n = 93$) was referred to Bergen Adult Education Center because of suspected specific leaning impairments/dyslexia and/or a prior diagnose of dyslexia. They all had Norwegian as their first language. The students recruited by Bergen Adult Education Center were individually tested as part of their assessment. They were tested in 2018–2019. The remaining student sample ($n = 150$) were students recruited on campus, and they were all attending undergraduate programs. They were tested in 2016–2017. The mean age of the participants was 26 years, with a standard deviation of 4.2 years, and the male ($n = 63$) to female ($n = 181$) ratio was 1:3. One participant did not report their gender.

2.1.2. Measurements

The Adult Reading Questionnaire (ARQ) is a questionnaire consisting of a total of 15 questions related to reading and writing and 6 questions related to attention and hyperactivity. Three questions are control questions used to validate the reading and writing scale. They include questions about the occurrence of dyslexia and degree of difficulty, and whether others have shown concern about literacy. Seven questions measure literacy, including questions about reading (4 questions, ARQ 4–6 and 11), word-finding difficulties (3 questions, ARQ 7–9). The ARQ also has 1 question (ARQ 10) that goes along with 4 questions from the Adult ADHD Self-Report Scale to cover the attention and concentration skills, ASRS 1–4). Finally, 2 questions are related to hyperactivity (ASRS 5 and 6) These questions are answered using 5-point scales, ranging from never (=0) to always (=4). The total sum score for the scale can therefore be between 0 and 42. Mean scores for the items separate for participants who reported they had dyslexia and those who reported they did not have this condition are presented in Table 1.

Table 1. Mean scores and standard deviation for the Adult Reading Questionnaire (ARQ) items and the Adult ADHD Self-Report Scale (ASRS) items separate for participants with and without a dyslexia diagnosis.

Item	Item Description	Without Dyslexia ($n = 168$)		With Dyslexia ($n = 77$)	
		Mean	Sd.	Mean	Sd.
ARQ1	How would you consider your reading skills?	2.77	0.97	1.70	0.80
ARQ2	How would you consider your writing skills?	1.24	0.90	2.32	0.70
ARQ3	Do you experience any difficulties reading?	0.73	0.93	2.09	0.78
ARQ4	How often do you have to read during your day-to-day activities?	0.81	0.82	0.96	0.99
ARQ5	I find it difficult to read words I haven't seen before	1.63	0.89	2.89	0.95
ARQ6	I find it difficult to read aloud	1.34	1.15	2.71	1.06
ARQ7	I struggle to find the right words when I speak	1.77	0.90	2.21	0.98
ARQ8	I mix up or get the names of objects wrong	1.15	0.79	1.92	0.99
ARQ9	I get right and left mixed up	1.10	1.17	1.94	1.30
ARQ10	I have problems planning my time	1.47	1.01	1.75	1.02
ARQ11	How often do you have to write during your day-to-day activities?	1.28	0.95	1.39	1.12
ASRS1	How often do you have trouble wrapping up the fine details of a project, once the challenging parts have been done?	1.87	0.86	1.97	1.04
ASRS2	How often do you have difficulty getting things in order when you have to do a task that requires organization?	1.48	0.91	1.75	0.96
ASRS3	How often do you have problems remembering appointments or obligations?	1.17	0.86	1.24	0.92

Table 1. Cont.

Item	Item Description	Without Dyslexia (n = 168)		With Dyslexia (n = 77)	
		Mean	Sd.	Mean	Sd.
ASRS4	When you have a task that requires a lot of thought, how often do you avoid or delay getting started?	2.08	0.90	2.03	1.03
ASRS5	How often do you fidget or squirm with your hands or feet when you have to sit down for a long time?	2.61	1.09	2.47	1.14
ASRS6	How often do you feel overly active and compelled to do things, like you were driven by a motor?	1.86	1.01	1.97	1.11

Note: The item descriptions are from Snowling et al. [35]. ARQ1-3 are control items not included in the analyses. The item scores range from 0 to 4, where high scores indicate more problem behavior, except for the ARQ3, where the scale used was 0–3 (0 = “no difficulties”, 3 = “very large difficulties”). Three participants did not answer the question regarding dyslexia.

In this survey, we made some modifications to the control questions of Snowling et al. (2012) to compare the results of the present survey with the results of previous surveys among incarcerated adults in Norway. To identify the occurrence of dyslexic difficulties not already known, Snowling et al. gave a brief definition of dyslexia, and asked the following question: “Based on this, do you think that you have dyslexia?” Participants used a 3-point scale for responding (‘No’, ‘Yes, to some extent’, ‘Yes, completely’). In addition, “Has anyone ever questioned your reading skills?” and “How extensive are your difficulties?” were scored on different scales compared to what we used earlier in similar studies. In our study, respondents were asked if they have ever been assessed for and possibly had received a diagnosis that indicates dyslexia or specific learning difficulties (reading and spelling difficulties), either as a child or an adult. In addition, they were asked to assess their skills in reading and spelling on a 5-point scale (‘very good’, ‘good’, ‘medium’, ‘weak’, ‘very weak’), as well as to assess their experienced difficulties in reading and writing on a 4-point scale. (‘Yes, to a very large extent’, ‘Yes, to some extent’, ‘Yes, but only a little’, ‘No, not at all’). The 11 substance questions were scored on 5-point scales with the options ‘never’, ‘rarely’, ‘sometimes’, ‘often’, and ‘very often’, which was encoded with number values of 0–4 for the statistical processing. For the purpose of letting increasing numbers yield increasing difficulties, the 2 items on how often reading and writing occurred in the daily life were reversed, giving ‘never’ a score equivalent to 4.

The questionnaire was first translated from English into Norwegian by a professional with Norwegian as the first language, and then back translated by an authorized translator with English as a first language. The text of the questions was adjusted in the next round so that the questions reflected the content of the original questions as much as possible. The content aspect of the item was emphasized if there was a content discrepancy in direct translation of questions.

The short version of the ASRS [38,39] consists of 6 questions, 4 of which are descriptions of attention difficulties, and 2 of which are descriptions of hyperactive behavior. Since there is an authoritative translation of ASRS that is in clinical use, this translation was applied in our study. Questions are answered on a 5-point scale from “never” (=0) to “always” (=4). Frequent frequencies of more than 4 symptoms can greatly correctly categorize individuals diagnosed with ADHD [37]. The total score for the ASRS can reach 24. The mean scores for the ARQ and ASRS for the sample participating in Study 1 are depicted in Table 1.

2.1.3. Procedure for Study 1

For the typical students, the survey was introduced in the lecture hall as a continuation of a regular lecture. They were informed about the general purpose of the study and completed a consent form on the front page of the questionnaire, where the information was also printed.

The participants with increased risk of dyslexia were invited by their counselor to participate during the assessment of their reading skills. The municipality adult education

counselling bureau also serves the student population of the local university. The counselor presented an outline of the study and invited them to complete the questionnaire. Otherwise, participation in the study meant no other changes in the standard assessment and counseling procedures. Participants with severe reading difficulties were offered assistance when filling out the form by their counselor.

The participation was voluntary, and no compensation was granted for participation. The form and procedure for data collection were reported to the Privacy Board for research, The Norwegian Social Science Service—NSD (now the Norwegian Centre for Research data).

We conducted all analyses in both studies using Jamovi ver. 1.6.8 [40] and IBM SPSS Statistics 25 [41].

2.2. Results from Study 1

As expected, due to the recruitment procedure, 77 of the participants reported they had received a diagnosis of dyslexia, 168 did not report a diagnosis, and 3 participants did not answer this question ($n = 246$). Of the present sample, 31 percent confirmed that they had specific learning impairments or dyslexia. Among the subsamples, approximately 8 percent of the general student participants reported they had dyslexia compared to 72 percent of those recruited from the educational advisory service. In addition, five of the participants also reported they had received a diagnosis suggesting they had ADHD as a child, but they were not among those who reported to have dyslexia.

2.2.1. Principal Component Analysis

We executed a principal component analysis (PCA) with varimax rotation and Kaiser's normalization to investigate the component structure of data. We used an eigen value above 1.0 as the main criterium for identifying the components. The analysis returned a four-component solution that explained 64.1 percent of the variance. The first component consisted of the five items related to reading (ARQ 5–9). This reading component yielded an eigen value of 3.0, explaining 21.6% of the variance. Herein, this component is referred to as 'Reading skills.' The second component consisted of the five items on attention (ARQ 10, ASRS 1–4), thus covering attention, concentration skills, and organizing skills. Herein, we refer to this component as 'Attention.' This factor showed an eigenvalue of 2.9, explaining 20.9 percent of the variance. The third component consisted of the frequency of reading and writing in everyday activities (ARQ 4, 11), yielding an eigenvalue of 1.7 and explaining 11.9 percent of the variance. This component is herein referred to as 'Reading habits.' The last component, consisting of the two hyperactivity items from the ASRS (ASRS 5–6), yielded an eigen value of 1.4, explaining 9.7 percent of the variance (see Table 2). For the visualization of the components structure, we omitted loadings smaller than 0.40 from the table. Compared to the model proposed by Snowling et al. (2012), items covering word-finding issues were not identified as a unique factor but included in the reading skills component. In addition, items on everyday use of reading and writing were not included in the reading skills component but were identified as a unique factor.

Table 2. Component matrix following principal component analysis after varimax rotation with Kaiser normalization.

		Component Loadings				
Item	Item Description	1	Component			Uniqueness
			2	3	4	
ARQ6	I find it difficult to read aloud	0.821				0.268
ARQ5	I find it difficult to read words I haven't seen before	0.819				0.276
ARQ7	I struggle to find the right words when I speak	0.804				0.290
ARQ8	I mix up or get the names of objects wrong	0.685				0.481
ARQ9	I get right and left mixed up	0.603				0.508
ASRS2	How often do you have difficulty getting things in order when you have to do a task that requires organization?		0.758			0.380

Table 2. Cont.

Component Loadings						
Item	Item Description	Component				Uniqueness
		1	2	3	4	
ASRS1	How often do you have trouble wrapping up the fine details of a project, once the challenging parts have been done?		0.756			0.418
ASRS3	How often do you have problems remembering appointments or obligations?		0.735			0.440
ARQ10	I have problems planning my time		0.720			0.379
ASRS4	When you have a task that requires a lot of thought, how often do you avoid or delay getting started?		0.660			0.509
ARQ4	How often do you have to read during your day-to-day activities?			0.892		0.197
ARQ11	How often do you have to write during your day-to-day activities?			0.872		0.237
ASRS6	How often do you feel overly active and compelled to do things, like you were driven by a motor?				0.857	0.251
ASRS5	How often do you fidget or squirm with your hands or feet when you have to sit down for a long time?				0.654	0.428

2.2.2. Confirmatory Factor Analysis

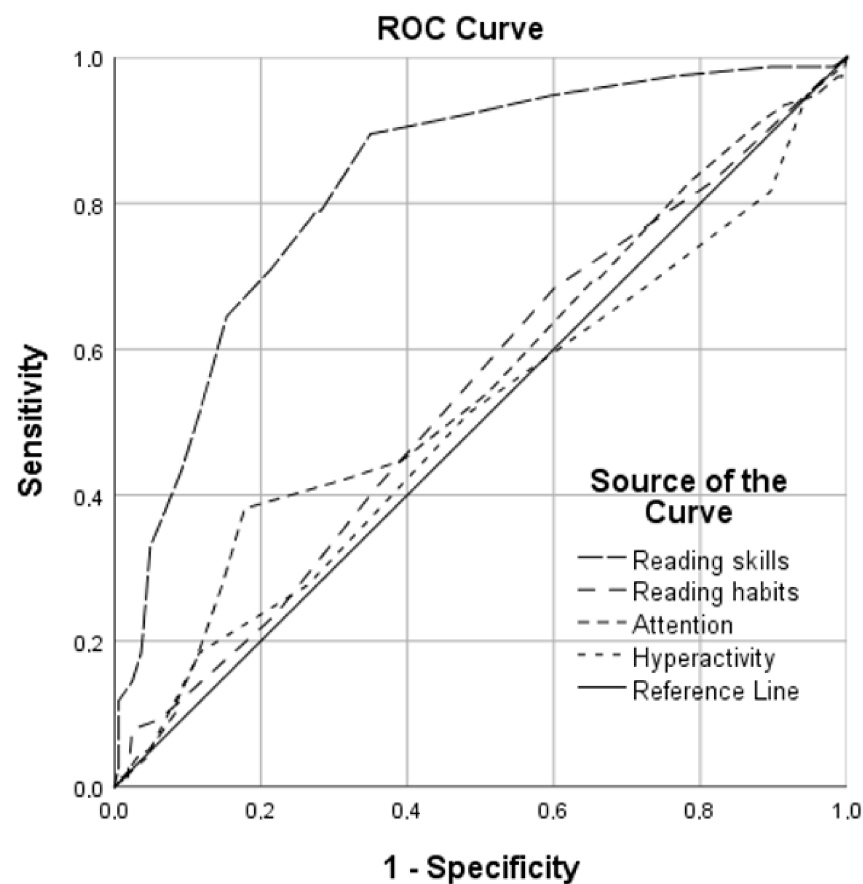
Assessing the fit of the model using confirmatory factor analysis (CFA), the model yielded good compliance with the data basis from this sample of students ($X^2/df = 1.66$, CFI = 0.958 and RMSEA = 0.052). However, a few items in the reading scale asking about word-finding problems yielded substantial covariance that had to be controlled for. The 4 scales based on this factor solution resulted in reliability scores measured by Cronbach's α of 0.87 (Attention), 0.77 (Reading skills) and 0.80 (Reading habits), respectively. These scores are all acceptable considering the low number of items included and that all items explain a slightly different part of the variance. For the Hyperactivity scale, the alpha was considerably lower ($\alpha = 0.50$), reflecting only two items included in this component. In addition, the Hyperactivity items yielded a rather low pairwise correlation ($r = 0.33$).

When we checked the theoretical four-factor model proposed by Snowling et al. (2012) against our data, the CFA returned a $X^2/df = 5.90$, CFI = 0.67, and RMSEA = 0.141, yielding a far lower fit between the model and the data.

2.2.3. The Discriminative Properties of the Reading Questionnaire

To investigate whether the ARQ could distinguish between participants with a proven reading difficulty and participants who reported that they did not have such a difficulty, we carried out receiver operating characteristic (ROC) curve analyses. ROC curves are tools for calculating threshold values for optimal sensitivity and specificity (see Figure 1). The analyses showed that only the Reading skills returned an area under the curve that was clearly different from a random distribution, and that the scale scores therefore reliably distinguish between participants with and without dyslexia. Reading skills obtained an area under the curve corresponding to 0.827 with a standard error of 0.028, which is significantly different from 0.50, representing a random distribution. The optimal ratio between sensitivity (98.7 percent) and specificity (94.5 percent) was achieved at a threshold of 0.5 on the reading scale (equivalent to a corrected sum score above 2 for the five items included in this component).

None of the other scales returned an area under the curve that was close to significant (0.56, 0.54, and 0.50, respectively for Attention, Reading habits, and Hyperactivity).



Diagonal segments are produced by ties.

Figure 1. The receiving operator characteristic (ROC) curves for the four components returned by the principal component analysis (PCA) for the undergraduate student sample. The 0.50 diagonal reference line is marked with a solid line in the chart.

2.3. Discussion of Study 1

The main finding in this survey of the Reading Questionnaire for Adults in the undergraduate student sample was that the questionnaire is a brief and easy screening instrument to use with a reasonable accuracy. It can be used to identify and correctly categorize participants who have a known deficit in reading and who have already received a diagnose of dyslexia following standard assessments.

The component structure returned by the PCA analysis consisted of four factors, annotated Reading skills, Attention, Reading habits, and Hyperactivity, which was equivalent to the theoretical model proposed by Snowling et al. (2012) with minor deviances, as word-finding items were not seen as a unique factor in this sample, but included in the reading skills. The solution appears to be robust and supports the theoretical assumptions the scale was built upon.

The scales derived from the component solution also yielded internal consistency measures in the lower end of what is acceptable for a scale, with Cronbach's α -values of around 0.80. However, this may be due to several conditions. In particular, Cronbach's α is sensitive to the number of items in a scale. These scales are quite short, with only five items included in each of the two main scales. In addition, the internal consistency is measured as how much each item is correlated with the total sum of the scale. The items included seem to capture slightly different aspects of the concept of reading skills, and thus yield a

slightly broader interpretation of the concept of the reading scale compared to what would have been possible with a scale with a narrower and more consistent content.

The discriminative power as seen from the ROC curve analysis was as expected, as the Reading skills component could correctly identify participants with a known reading impairment with good sensitivity and specificity (see Figure 1). Contrary to this, but also as expected, the three additional scales of Reading habits, Attention, and Hyperactivity did not discriminate between participants with and without reading impairments. Although attention and organizational skills have been reported to be impaired in samples of reading-impaired children, our samples consisted of young adults who, despite their challenges in reading, have pursued higher education (university or college undergraduates). It is still unknown how these skills would be associated in other samples, such as in similar age groups who dropped out of education at an earlier stage. It is also worth noting that the word-finding items were included in the reading component and did not appear as a unique component as reported by Snowling et al. (2012).

Taken together, the ARQ appears to be a valid and reliable tool for screening for reading impairments in young adults, and the five items of the reading skills scale seem to gather enough variance to act as a good screening measure for this purpose when reading impairments are not confounded with attention deficits.

3. Study 2

3.1. Method and Measurements

3.1.1. Participants

All prisoners with Norwegian citizenship in Norwegian custody in week 43, i.e., from October 22 to 29, 2015, received a request to participate in the survey. A total of 2439 individuals with a Norwegian citizenship were incarcerated this week and received the questionnaire, of which 1475 participants completed most of the questions of the ARQ in addition to the remaining questions related to self-perceived literacy skills and problems. This corresponds to a response rate of 60.5 percent, which is somewhat low in terms of generalization. About 5.7 percent of those who returned the questionnaire were women, which is equivalent to the proportion of women in Norwegian prisons [42]. A total of 347 participants reported they had a diagnosis of the specific learning impairment dyslexia. In addition, 224 reported they had problems equivalent to dyslexia and that they suspected they had such problems but lacked a confirmation from diagnostic assessment. The mean age among participants was 36 years, with a standard deviation of 11.6 years. Of the participants, 39.5 percent reported that they had upper secondary education as their highest completed education, and 12 percent reported that they had completed a studied a single subject or had earned degree at university or college.

3.1.2. Measures

We used the same questionnaire version of the Adult Reading Questionnaire (ARQ) and the WHO's Adult ADHD Self-Report Scale (ASRS) [38] as described in Study 1, with the same modifications of the control questions as earlier explained. All scoring and preprocessing of the data from the surveys were the same as what is described for Study 1, and we applied the same strategies for analyzing the survey data. Mean scores for the participants in Study 2 is shown in Table 3.

Table 3. Mean scores and standard deviations for the individual items of the ARQ and the ASRS for the participants in Study 2.

Item	Item Description	without Dyslexia (<i>n</i> = 990)		with Dyslexia (<i>n</i> = 347)	
		Mean	Sd.	Mean	Sd.
ARQ1	How would you consider your reading skills?	0.80	0.86	1.68	1.12
ARQ2	How would you consider your writing skills?	1.00	0.94	1.97	1.14
ARQ3	Do you experience any difficulties reading?	0.46	0.79	1.40	1.06
ARQ4	How often do you have to read during your day-to-day activities?	1.86	1.18	2.03	1.11
ARQ5	I find it difficult to read words I haven't seen before	0.89	0.91	1.77	1.15
ARQ6	I find it difficult to read aloud	1.05	1.15	2.03	1.28
ARQ7	I struggle to find the right words when I speak	1.24	1.01	1.67	1.09
ARQ8	I mix up or get the names of objects wrong	0.88	0.87	1.32	1.04
ARQ9	I get right and left mixed up	0.32	0.69	0.64	0.98
ARQ10	I have problems planning my time	1.22	1.08	1.60	1.12
ARQ11	How often do you have to write during your day-to-day activities?	2.21	1.15	2.33	1.06
ASRS1	How often do you have trouble wrapping up the fine details of a project, once the challenging parts have been done?	1.51	1.07	1.76	1.13
ASRS2	How often do you have difficulty getting things in order when you have to do a task that requires organization?	1.37	0.99	1.64	1.07
ASRS3	How often do you have problems remembering appointments or obligations?	1.35	1.01	1.68	1.13
ASRS4	When you have a task that requires a lot of thought, how often do you avoid or delay getting started?	1.60	1.06	1.84	1.06
ASRS5	How often do you fidget or squirm with your hands or feet when you have to sit down for a long time?	1.97	1.28	2.56	1.20
ASRS6	How often do you feel overly active and compelled to do things, like you were driven by a motor?	1.72	1.27	2.22	1.21

Note: The item scores are as described in Table 1. In addition, 138 participants did not answer the question about dyslexia.

3.1.3. Procedure of Study 2

The survey was conducted in collaboration with the Education Department of the County Governor of Hordaland. The Department for Education has national responsibility for Education of the correctional services in Norway and are administering the funding for this part of the education on behalf of the Ministry of Education and Research.

The ARQ was included as a part of a more comprehensive survey of education in correctional services in Norway. The questionnaire was distributed to all prisons in Norway, through schools that are connected to the education provided for inmates in correctional services, and via departments in the Correctional Services to reach all inmates. The staff in the prison or in the school offered participants with severe reading difficulties assistance when filling out the questionnaire, or they could get help from visitors.

The participation was voluntary, and no compensation was granted for participation. The form and procedure for data collection were reported to the Privacy Board for research, The Norwegian Social Science Service—NSD (now the Norwegian Centre for Research data) and was approved in accordance with national guidelines.

3.2. Results of Study 2

Of the participants in Study 2, 347 reported that they had previously received a diagnosis of dyslexia, either as a child in school or later as an adult. This gives an estimated prevalence of dyslexia of 26 percent of the participants in the population of incarcerated adults. A total of 28 percent of the responders also reported that they had a diagnosis of ADHD, and 12 percent reported they had both dyslexia and ADHD. Table 2 shows the mean scores and standard deviation seen for the individual items of the ARQ and the ASRS.

3.2.1. Principal Component Analysis

We executed a PCA with varimax rotation and Kaiser's normalization to investigate the empirically derived structure in data for the Norwegian sample. The analysis returned a three-component solution that together explained 60 percent of the variance (see Table 4). The first component consisted of the ASRS questions (ASRS 1–6), as well as ARQ10, and therefore covered attention, hyperactivity, and sense of order. Herein, this component is referred to as the 'Attention' component, and it yielded an eigen value of 5.29. The second component (herein referred to as 'Reading skills') yielded an eigen value of 1.87 and included the reading items as well as the word-finding items (ARQ 5–9). The last component yielded an eigen value of 1.43 and consisted of the frequency of reading and writing in everyday activities (ARQ 4 and 11). This component is herein referred to as Reading habits.

Table 4. The component matrix returned by the PCA for the ARQ and ASRS Items for the incarcerated adults following varimax rotation and Kaiser's normalization.

Item	Item Description	Component Loadings			Uniqueness
		1	2	3	
ASRS5	How often do you fidget or squirm with your hands or feet when you have to sit down for a long time?	0.757			0.414
ASRS1	How often do you have trouble wrapping up the fine details of a project, once the challenging parts have been done?	0.750			0.393
ASRS4	When you have a task that requires a lot of thought, how often do you avoid or delay getting started?	0.742			0.374
ASRS2	How often do you have difficulty getting things in order when you have to do a task that requires organization?	0.710			0.393
ASRS3	How often do you have problems remembering appointments or obligations?	0.707			0.439
ASRS6	How often do you feel overly active and compelled to do things, like you were driven by a motor?	0.702			0.499
ARQ10	I have problems planning my time	0.671			0.425
ARQ5	I find it difficult to read words I haven't seen before		0.785		0.362
ARQ8	I mix up or get the names of objects wrong		0.744		0.383
ARQ6	I find it difficult to read aloud		0.742		0.386
ARQ7	I struggle to find the right words when I speak		0.737		0.416
ARQ9	I get right and left mixed up		0.453		0.746
ARQ11	How often do you have to write during your day-to-day activities?			0.906	0.177
ARQ4	How often do you have to read during your day-to-day activities?			0.895	0.191

3.2.2. Confirmatory Factor Analysis

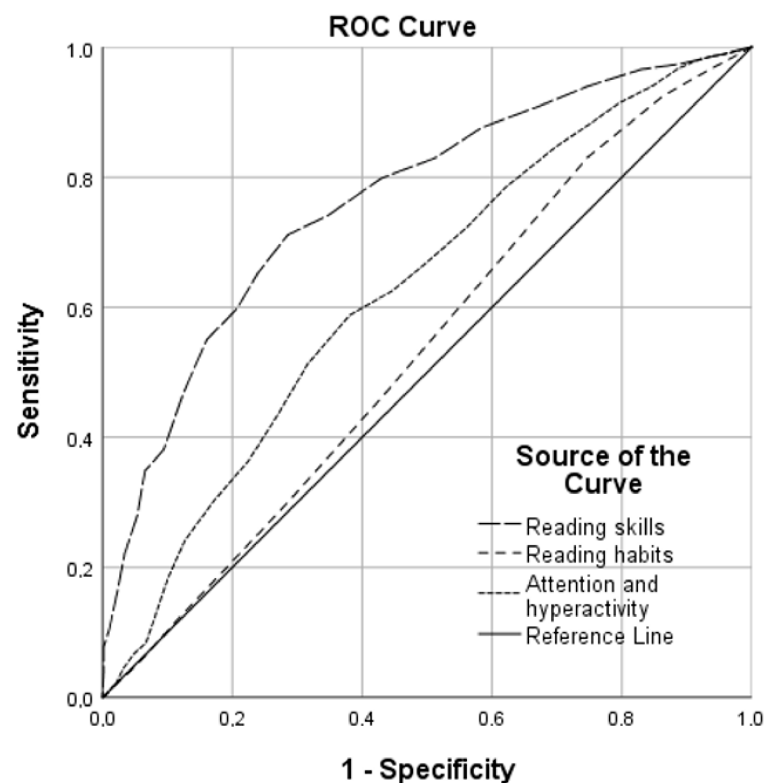
We assessed the component model returned by the PCA with a CFA. The analysis did not yield an overwhelmingly good fit between the model and the data from this sample of inmates ($X^2/df = 10.6$, CFI = 0.907, and RMSEA = 0.083). However, we also noticed significant correlations between some of the variables included in the model, as self-assessment of reading and writing skills (ARQ4 and 7), the word-finding items (ARQ 6 and 7), and the questions of hyperactivity (ASRS5 and 6) yielded correlations that needed to be controlled. We then achieved good fit ("goodness of fit") between the model and the data this sample of inmates ($X^2/df = 3.63$ and RMSEA = 0.046). The three scales based on this factor solution resulted in reliability scores measured by Cronbach's α of 0.87 (Attention), 0.77 (Reading skills), and 0.80 (Reading habits), respectively, which is acceptable. The alpha values slightly below 1.0 may be due to that the different variables included in the scales measure slightly different aspects of the same phenomenon, in addition to the relatively low number of items included in the scales.

The theory-based four-factor model proposed by Snowling et al. (2012) consisting of a reading factor including ARQ4–6 and 11, a word-finding factor consisting of ARQ7–9, an attention factor that included ARQ10 and ASRS1–4, and finally a hyperactivity factor consisting of ASRS5–6, yielded a more moderate adaptation to the data ($\chi^2/df = 21.61$, $p < 0.001$; CFI = 0.81; RMSEA = 0.122). This chi-square value is clearly significant, which means that there is a difference between the model and data against which it is tested, i.e., poor compliance. The difference between the χ^2 values is also significant, implying that the model based on the PCA yield better goodness of fit compared to the theoretically derived model.

Overall, the confirmative factor analysis showed that this questionnaire used in a Norwegian sample of incarcerated adults yields comparative results as what was reported using ARQ in a UK sample. However, the Norwegian model had weaker adaptation between the four-factor model and data, probably due to a confounding effect of attention deficits on the measurement of reading.

3.2.3. The Discriminative Properties of the Reading Questionnaire

To investigate whether the ARQ could distinguish between participants with identified reading difficulties and participants who reported that they did not have such a difficulty, we carried out ROC curve analyses for this sample (see Figure 2). The analyses show that all three scales provided an area under the curve that is clearly different from a random distribution, and that the scale scores therefore reliably distinguish between participants with and without dyslexia. Reading skills obtained an area under the curve corresponding to 0.72, which is significantly different from 0.50, representing a random distribution. The optimal ratio between sensitivity (89.8 percent) and specificity (67.3 percent) was achieved at a threshold of 0.45 on the reading scale (equivalent to a corrected sum score of eight and above).



Diagonal segments are produced by ties.

Figure 2. The ROC curves for the three scales derived from the components returned by the PCA for the participants in Study 2. Note: The solid line in the graph shows the 0.50 diagonal reference line.

The attention scale provided an area under the curve equivalent to 0.63, which is also significantly different from 0.5. A similar optimal dividing point was found for an average score of 2.5, yielding 97.8 percent sensitivity and 90.9 percent specificity. This corresponded to a corrected sum score of 11 or above. In other words, the attention scale was not as effective as the reading scale in correctly classifying participants who had diagnosed extensive reading and writing difficulties. The scale increases the risk of both false-positives and false-negative categorizations. This also appears in Figure 2, as the curve for attention is closer to the diagonal that represents random distribution.

The reading habit scale, with two questions concerning how frequently participants use reading and writing in everyday pursuits, could barely distinguish between participants with or without a diagnosis of specific learning difficulties, with 54 percent probability of correct classification ($p = 0.036$).

3.3. Discussion of Study 2

The main finding from this study is that the Reading Questionnaire for Adults can aid in the correct identification and categorization of participants who have an identified specific learning impairment or dyslexia. However, we also found that a significant proportion of the participants who had not previously received a similar diagnosis achieved high scores, and therefore were categorized together with participants who had previously been given such a diagnosis. There are several possible explanations for this. The questions used in this questionnaire could be too general and not specific enough to distinguish between participants who have generally weak literacy skills without necessarily having a specific learning difficulty. As mentioned initially, the scale is constructed without a specific anchoring model for dyslexia but is largely based on empirical findings of characteristics and traits associated with extensive reading difficulties. It is also a part of the explanation that a larger proportion of participants have extensive difficulty reading and writing without having been formally assessed with diagnostic tests.

One-third of the participants in study 2 reported that they had already been diagnosed with dyslexia. A similar pattern was seen for ADHD, as 28 percent reported that they had been diagnosed with ADHD, with 12 percent of the participants reporting that they had been diagnosed with both conditions. The items developed to measure attention deficit and hyperactivity yielded quite elevated scores in the present sample, and the ASRS-items yielded stronger difference between participants with and without dyslexia compared to what was found for the reading items. It has been reported that the prevalence of ADHD in incarcerated populations varies between 35 percent and 60 percent [5,43–47]. It is therefore expected that the items measuring attention deficits and hyperactivity covaried with the other variables in the model, thus leaving less unique variance to be explained by reading problems alone. Similarly, the comorbidity of reading impairments and ADHD has also been reported to be substantial [48–52].

However, the ARQ yielded good psychometric properties in this sample of incarcerated adults, although the high frequency of attention deficit and hyperactivity symptoms may pose a challenge to correct identification of the unique existence of reading impairments.

4. General Discussion

Overall, we found that the ARQ, at the present time and as a result of these two surveys, shows good psychometric characteristics in two quite different samples of participants. This makes the ARQ a useful supplement if a screening test for literacy is needed in adults. We observed that these scales differentiated well between groups of participants who reported that they had a diagnosis such as dyslexia or specific learning impairments and participants who did not have such a diagnosis. However, there were also several participants who scored above the threshold that should indicate that there is a risk of extensive reading and writing difficulties or dyslexia, but without such difficulties being documented previously.

We observed slightly different component models in the two studies that may have been due to the characteristics of the two samples that were included. The two samples are quite different regarding prevalence of comorbid impairments of attention deficits and hyperactivity, and also in general adaptation, as seen in level of completed education. Compared to the theoretical model proposed by Snowling et al. (2012), we found a four-component model to fit the data for the student sample of Study 1 and a four-component solution to fit the prisoner sample in Study 2. Word-finding difficulties as hypothesized by Snowling et al. (ibid.) were not seen as a unique component in our samples, and to a varying degree, we found that hyperactivity was seen as a unique component only in Study 1. The hyperactivity items of the ASRS that appeared as a unique factor in the original study by Snowling et al. (2012) was only found for the student sample of Study 1, but not for the incarcerated sample of Study 2, where attention problems and hyperactivity seemed to be more closely associated and thus did not appear to cover two different conceptual issues. The high prevalence of attention deficits and hyperactivity among incarcerated respondents could have implications for diagnostics of other specific learning issues, as attention deficits, with or without agitated behavior or hyperactivity, may interfere with and confound the results of diagnostic assessment of learning. Our participants consisted of adults with Norwegian as their native language. The Norwegian language has a relatively transparent orthography. Therefore, such skills probably share variance with other literacy skills, and they were not separated as a separate factor. Our sample is large enough that we should expect such a solution if this is present in the data material. Snowling et al. reported good compliance for the model in their data, but they also reported the nuisance of covariation between items that needed to be controlled to get a good fit. The empirically derived models reported here yielded better fit to the data and makes good theoretical sense compared to the theory driven model earlier proposed. It is also necessary to investigate further whether the checklist can be used to distinguish between weak literacy related to a specific learning disorder [53], or whether weak literacy emerges as a result of inadequate training, lack of reading experience, or other experience based conditions [54].

Although the ARQ yielded similar psychometric properties in the two studies reported, there are also some differences that need to be considered. The component structure was found to be slightly different. There are several topics that may account for these differences. First, earlier surveys have reported an increased prevalence of attention deficits and hyperactivity among incarcerated adults in addition to increased prevalence of learning impairments. The association between attention deficit and reading scores may be different in samples with largely increased attention deficit scores and make it more difficult to separate these two conditions conceptually. It is intriguing that the data showed that attention scores yielded better discrimination between participants with dyslexia or not compared to the reading scores. This was not expected, and was also not in line with what was reported in a different sample of Norwegian prisoners earlier [55], where ADHD items of the ASRS could not correctly classify participants with dyslexia.

Adults in custody, as in the sample of Study 2, have, on the average, low formal education compared to the general population in Norway. In addition, they appear to have high rates of interrupted education or drop out from regular education programs. Therefore, the probability is high that diagnostic examination of learning difficulties has not been carried out earlier. The theoretical models aiding assessment and decisions during diagnostic work on reading difficulties have also changed over time. Also, the test items included in such assessments may also provide different answers to the etiology of the difficulties. This, in turn, affects which diagnostic labels that have been used to categorize the difficulties of the individual. To further complicate the picture, there was a period of professional resistance to using diagnostic concepts on various forms of learning difficulties in the schools. This also increases the possibility that some who have been assessed in schools may not be aware that they have such difficulties. As the present sample of incarcerated adults is complex age-wise, it is likely that several such explanations

may result in an overaccumulation of false-negative cases (participants who had actual reading difficulties but who were not diagnosed). In such a screening test, we would prefer correct inclusion, as well as the rejection of cases and the inclusion of more cases, thus achieving high sensitivity as well as high specificity. However, the inclusion of false-positives who are subject to further assessment is preferred to an inflation of false-negative cases. Therefore, we are less concerned about high sensitivity than increased specificity for educational guidance.

One of the most surprising findings from our analysis of ARQ was that left-right confusion did not fit the model in the way described in Snowling et al. (2012) and also as described elsewhere in the literature. There is evidence that right-left confusion is associated with the reading skills [56], but maybe not clearly as a part of a word-finding problem. However, it was also argued early on that such difficulties are not related to dyslexia [57], but can appear regardless of dyslexic difficulties. Thus, our findings may be due to the fact that such difficulties are so common in a sample with a high incidence of educational, socioemotional, and psychiatric coexisting conditions. As such, it does not provide additional information about reading and attention per se. Alternatively, it may be possible that our findings are genuine, and that in such a sample, there is no association between directional/visuospatial difficulties and literacy skills. Another alternative explanation is that space and directional skills (visuospatial skills) are genuinely associated with reading difficulties, but spatial skills, as measured with the left-right confusion, represent different cognitive processes compared to the word-finding difficulties. Word-finding difficulties are mainly related to lexical processes that are mainly associated with the parieto-temporal area of the left cerebral hemisphere, often located around what is popularly referred to as the Wernicke's area [58]. Right-left confusion is associated with similar areas [59], and it has also been found that transcranial stimulation over gyrus angularis on the left side has implications for the ability to discriminate right and left [60]. Nevertheless, we found that this item did not share variance with other items that measure word-finding difficulties and access to lexical information in this survey. Apparently, left-right confusion represents a difficulty with spatial relationships more than recognizing the correct naming of the right and left side, although naming skills are also associated with such difficulties [61].

There are several important practical implications of the present findings. First, as the checklist yields good compliance with difficulties confirmed through reported clinical assessment of reading and spelling difficulties in adults, it appears to be a valuable tool in educational counselling. It can provide information on reading problems with appropriate sensitivity and specificity to be of practical value. Second, the results from incarcerated adults differ slightly from the results obtained from a non-incarcerated sample. These differences can be seen as a consequence of the increased prevalence of attention impairments and hyperactivity reported among incarcerated adults. Whereas this may influence the total score of the ARQ, it does not seem to influence the usefulness of the reading items in identifying accurately individuals with reading problems. The factor structures obtained from both samples show good internal consistency and, for most part, overlapping component structures. However, the comorbidity of attention deficits must be considered in some subsamples of the population. Finally, as is also emphasized by the lack of a perfect match between ARQ scores and apparent reading problems, a screening tool such as the ARQ can never substitute a formal assessment, but it may be a good and practical tool for the beginning step of the counseling process.

5. Conclusions

The brief and noninvasive Adult Reading Questionnaire appears to be a useful instrument that can identify reading problems in adults. The questionnaire yields appropriate internal consistency and can identify known cases of dyslexia with appropriate sensitivity and specificity. The obtained factor structures from two different samples of adults are overlapping, but as the scale also includes items on attention difficulties and hyperactivity,

the scores may appear confounded with comorbid traits of attention deficits and hyperactivity. However, the checklist can give important information regarding whether a more comprehensive clinical assessment should be required or not. Future investigations will show if the Norwegian modified version of ARQ also produces results that correspond to current literacy skills as seen on standardized and norm-based tests of literacy, and not only with self-reported difficulties and skills as in this survey.

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