Cognitive and non-cognitive factors in educational and occupational outcomes – specific to reading disability?

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Abstract

Low education and unemployment are common adult-age outcomes associated with childhood RD (c-RD). However, adult-age cognitive and non-cognitive factors associated with different outcomes remain unknown. We studied whether these outcomes are equally common among individuals with c-RD and controls and whether these outcomes are related to adult-age literacy skills or cognitive and non-cognitive factors or their interaction with c-RD. We examined adult participants with c-RD (n = 48) and their matched controls (n = 37). Low education was more common among c-RD than controls, whereas long-term unemployment was equally common in both groups. Moreover, adult-age literacy skills, cognitive skills, and non-cognitive factors were related to both low education and long-term unemployment. Only a few c-RD-specific associations emerged: c-RD, especially in interaction with low verbal or reading comprehension, was associated with low education, and c-RD in interaction with slow adult-age reading was associated with long-term unemployment. Avoidant coping style, emotional wellbeing, and social functioning were related to education, and life-satisfaction to unemployment irrespective of c-RD. Thus, the non-cognitive factors associated with education and employment are similar in individuals with and without c-RD. Special attention should be paid to training c-RD individuals in basic academic, social, and emotional skills.

Keywords: Reading disability, follow-up, adults, low education, long-term unemployment

There is no longer any doubt that reading disability (RD) is a lifelong condition (e.g., Maughan et al., 2009; Raskind, Goldberg, Higgins, & Herman, 1999; Undheim, 2003). Even in languages with a consistent orthography (such as Finnish or German) RD seems to persist through compulsory education into adulthood and manifest mainly as deficits in fluency (in Finnish: Eklund, Torppa, Aro, Leppänen, & Lyytinen, 2015; in German: Landerl & Wimmer, 2008). In these languages, RD is mainly defined by reading fluency (Landerl & Wimmer, 2008; Torppa, Eklund, van Bergen, & Lyytinen, 2015) as accurate decoding skill is learned quickly during the first grade (Aro & Wimmer, 2003). Therefore, in the present study, RD is defined by deficit in reading fluency detected in childhood.

Perhaps due to its persistence, RD has been found to be associated with poor outcomes in the academic, social, emotional, occupational, and economic domains (for review see Livingston, Siegel, & Ribary, 2018). The effects found for RD on education level, income and employment are particularly striking. A population-based study by McLaughlin, Speirs & Shenassa (2014) indicated that participants with childhood RD were less likely to attain a high level of education and income compared to average-reading participants. In addition, according to Caspi, Wright, Moffitt and Silva (1998), poor reading skills along with low IQ scores, lack of high-school credentials and limited parental resources significantly increased unemployment risk.

However, the specific factors that result in different adult outcomes among individuals with childhood RD (c-RD) remain unknown: why do some achieve a high level of education and succeed in entering the labour market while others struggle to complete their education and experience unemployment? The twenty-year follow-up study of individuals with a learning disability (LD) by Raskind and colleagues (1999) indicated that success in adulthood was related more to non-cognitive than cognitive factors. A multidimensional model of success, including educational attainment, employment, social and familial relationships and life satisfaction, was used. At the 10-year follow-up, intelligence was the only cognitive measure to differ between the

successful and unsuccessful LD groups. Instead, several non-cognitive "success attributes" such as self-awareness, emotional stability, appropriate goal setting, and use of support systems, differentiated successful from unsuccessful participants with LD. Qualitative analysis further validated these findings (Goldberg et al., 2003). However, these studies were conducted without a control group, leaving open the question of whether these findings only apply specifically to students with LD or to all students. Moreover, the participants attended a special school during the 1950's-1970's and were identified as "learning disabled", presumably presenting with a wide spectrum of LDs. Therefore, whether these findings hold only for individuals with RD remains unknown.

The "success attributes" proposed by Goldberg et al. (2003) and the "secondary consequences" of RD proposed by Livingston, Siegel, & Ribary (2018) have also been recognized by other researchers. Several factors, such as poor coping skills (Firth, Greaves, & Frydenberg, 2010; Núñez et al., 2005, Raskind et al., 1999), low self-esteem (Alexander-Passe, 2006; Carawan, Nalavany, & Jenkins, 2016; Gans, Kenny & Ghany, 2003; Nalavany, & Carawan, 2012; Nalavany, Carawan, & Sauber, 2013; Terras, Thompson, & Minnis, 2009) and problems in social functioning (Carroll & Iles, 2006; Lisle & Wade, 2013; McNulty, 2003) have been associated with RD, although a control group was used in only a few studies. Ghisi, Bottesi, Re, Cerea, and Mammarella (2016), in a study on university students, found that students with RD had a lower level of self-esteem, more depressive symptoms and more social problems than controls without RD. In line with this finding, Panicker and Chelliah (2016), in a study in which adolescents with LD were contrasted with a peer group with borderline intellectual functioning, reported that the adolescents with LD had a low level of resilience, indicating inadequate coping skills, and that their depression and anxiety levels increased with age. These results were supported by a later finding that upon reaching school age, individuals with RD showed a decline in wellbeing compared to children without RD (Jordan & Dyer, 2017). It is reasonable to

assume that individuals with RD are more dissatisfied with their lives than non-RD peers (Miller, 2002). However, these findings of emotional malaise have been challenged. Two German follow-up studies of clinical samples found the proportions of psychiatric or emotional symptoms in individuals with RD to be no higher than those in individuals without RD (Schulte-Körne, Deimel, Jungermann, & Remschmidt, 2003; Strehlow, Kluge, Möller, & Haffner, 1992).

Despite the growing number of studies on the cognitive (e.g., reasoning skills, working memory) and non-cognitive attributes (e.g., self-esteem, weak coping strategies, poor overall wellbeing) associated with RD, the extent to which these influence the adult-age educational and occupational outcomes of individuals with RD remains unclear. Furthermore, follow-up studies into adulthood of individuals with RD among are scarce, while the few that exist lack a control group. Thus, the extent to which cognitive and non- cognitive attributes are related specifically to a childhood history of RD remains unknown. The only way to differentiate the unique effects of each of the three factors (c-RD, cognitive attributes, non-cognitive attributes) and their possible interaction effects on education and unemployment, is to include them in one model. Therefore, we examined the associations of cognitive and non-cognitive attributes with educational level (low vs. high) and unemployment (no/short-term vs. long-term), while taking into account the effect of c-RD (c-RD vs. no c-RD). Only by using a control group we can specify, which cognitive and non-cognitive attributes are specific to c-RD.

This study focused on the adult-age education and employment outcomes of individuals with and without c-RD (Figure 1 and 2). First, we examined, whether low educational attainment and long-term unemployment were equally common among individuals with RD diagnosed in childhood and controls. We then sought to better understand the cognitive and non-cognitive factors specifically associated with education and employment by comparing individuals with c-RD to individuals without a known history of c-RD.

The main aim was to ascertain which *literacy* (i.e., reading skills in adulthood), *cognitive* (i.e., adult-age verbal and perceptual IQ, working memory, processing speed, rapid automatized naming), and *non-cognitive* (i.e., adult-age self-esteem, social support, coping skills, emotional wellbeing, social functioning, resilience, life satisfaction) factors are related to a low educational attainment and long-term unemployment in current adult-life when the effect of *childhood RD status* (c-RD vs. control) is taken into account. We also analysed whether c-RD status moderated these associations. Unlike Raskind and colleagues (1999), who used a multidimensional model of success, and to take into consideration concerns about young adults "not in employment, education or training" (NEET) (OECD, 2017), we focused on attributes associated with education level and unemployment. To investigate whether specifically c-RD-related attributes exist for education level and employment, we used follow-up data on individuals with a known history of c-RD and similar adult-age data on matched controls with no known history of c-RD. Furthermore, to make it easier to find associations specifically related to c-RD, our c-RD participants had no other comorbid LDs or socioemotional problems.

The specific research questions were:

1. Are low educational attainment (no further education after high school or vocational school) and long-term unemployment (a continuous period of unemployment lasting one year or more) equally common among individuals with RD diagnosed in childhood and controls? Does c-RD status moderate the association between educational attainment and long-term unemployment?

2. Are adult-age literacy skills (reading fluency, accuracy and reading comprehension), cognitive skills (working memory, processing speed, rapid automatized naming and verbal and perceptual IQ) and non-cognitive factors (self-esteem, coping strategies (avoidance, emotional, task-oriented) related to a) educational attainment and b)

long-term unemployment while c-RD status is taken into account? Does c-RD status have a moderating effect on these associations?

Method

Participants

The participants were adults with RD documented in childhood and their matched controls with no known history of RD. The c-RD sample was drawn from a clinical database of the Clinic for Learning Disabilities (CLD) at the Niilo Mäki Institute in Jyväskylä, Finland. The CLD provides neuropsychological assessments for children with LDs or attention problems (see Aro & al., 2019). For the follow-up study, individuals who had attended the CLD in childhood and reached the age of at least 20 years at follow-up and for whom both reading and math tests scores were available (n = 509) were identified from the archives (see Eloranta, Närhi, Eklund, Ahonen, & Aro, 2019). Thus, to be included in the present study, the participants in the c-RD group had to fulfil three criteria: RD identified in childhood (i.e., a standard score < -1.5 in reading fluency), age 20 years or more at the time of the adult-age follow-up, and no comorbid disabilities, i.e., mathematical disability (a standard score > -1.5 in basic arithmetical skills) or emotional or attention problems (z-score > -1.0 in teacher/parent ratings). The sample did not include participants with extensive socio-emotional problems or global developmental delay, as children with these difficulties as their primary problem are not referred to the CLD (see Närhi, 2002). All participants were Caucasian and spoke Finnish as their native language.

The inclusion criteria were met by 76 participants, of whom contact information was not found for 9 individuals, and one had died. Of the remaining 66 individuals, 49 (74.2 %) completed the follow-up assessments. One was subsequently excluded owing to a low full-scale IQ score (= 60) in childhood. Thus, the final sample size for the c-RD group was 48.

An attrition analysis was performed based on the available data. No significant differences in age ($F(1, 52) = .030$; $p = .864$), childhood RD level ($\chi^2(1, 73) = 2.677$; $p = .102$), rapid automatized naming ($F(1, 53) = .016$; $p = .901$), verbal IQ ($F(1, 53) = .866$; $p = .356$) or perceptual IQ ($F(1, 53) = 1.349$; $p = .251$), emotional ($t(74) = .937$; $p = .352$) or attention problems ($t(74) = .791$; $p = .432$), or in parental level of education ($\chi^2(3, 63) = 3.357$; $p = .340$) were observed between the c-RD participants ($n = 48$) and those declining to participate ($n = 27$). The non-participants included slightly more males (22/27, 81.5 %) than participants (30/48; 62.5 %), but the difference was not statistically significant ($\chi^2(1, 75) = 2.737$; $p = .098$).

The control group ($n = 37$) was based on a large sample provided by the Population Register Center. Each c-RD group individual was matched with five controls based on age, gender, and hometown at the age of seven, (i.e., a beginning of compulsory education). The matched controls were contacted in random order with the aim of obtaining one matched control participant for each c-RD participant. Eleven c-RD participants were left without a matched control, owing to all five control individuals either not being reached or refusing to participate. One potential control with a low IQ was excluded. No childhood data were available for the control group.

Ethical Considerations

The University Ethical Committee approved the study. Each participant signed a written informed consent. Parental consents to use the data for research had been given at the time of the childhood clinical assessment. Licensed psychologists conducted the follow-up assessments, which lasted 4.5 to 5 hours. Upon request, participants received both oral feedback and a written summary of the assessment.

Measures

Identification of c-RD. Childhood reading skill was assessed by oral reading speed in one of two text-reading tests administered at the CLD. Reading speed was used instead of

reading accuracy as in orthographies with consistent letter-sound correspondences such as Finnish, reading accuracy is typically learned during the first grade (Seymour, Aro, & Erskine, 2003; Share, 2008), and therefore reading speed is commonly used as a marker of reading disability after the early grades (Torppa et al., 2015). Misku (Niilo Mäki Institute, 1992) is an age-normed text-reading task for 8- to 12-year-old children, and the ÄRPS (Niilo Mäki Institute, 1994) is a text reading task normed for 2nd to 4th graders. Either the Misku or ÄRPS was used, as the tests administered at the CLD have varied over the years and our participants, who varied in age from 20 to 39, had attended the CLD at different times. In both tests, the child reads aloud a one-page story as quickly and accurately as possible. The time taken to complete the text was measured in the Misku and the number of words read per time unit (one minute for second graders and two minutes for third and fifth graders) was measured in the ÄRPS. Each of the tests was standardised based on its normative data, and a cut-off score of -1.5 SD was used for RD.

Operationalization of adult-age education level and long-term unemployment. Participants reported their highest education level in a phone interview conducted in advance. Participants also reported their longest duration of unemployment in years, using a life history calendar (Caspi et al., 1996). Low education was defined as no education beyond high school or vocational school. Long-term unemployment was defined as a period of continuous unemployment lasting at least one year. Applying these criteria, 64 participants were low educated and 18 participants had experienced long-term unemployment.

Adult-age reading skills and cognitive measures

Reading fluency, accuracy and comprehension. A standardized Finnish test battery for reading and spelling for use with adolescents and adults (Nevala, Kairaluoma, Ahonen, Aro, & Holopainen, 2006) was used to assess reading skills in adulthood. In the subtests Word Reading Task and Pseudo-Word Reading Task, the participants read aloud 30 Finnish words and pseudo-words as rapidly and accurately as possible; the time taken was recorded and the number of

correctly read words counted. In the Text Reading Task, participants read aloud a text for three minutes as rapidly and accurately as possible and the number of correctly read words and errors was counted.

Reading fluency was determined as the mean of the reference data-based z-scores of the time taken (1) in the Word Reading Task and (2) in the Pseudo-Word Reading Task, and the number of words read in three minutes (3) in the Text Reading Task. Cronbach's alpha for three fluency tests was .78. Reading accuracy was determined as the mean of the reference data-based z-scores of the correctly read words and pseudo-words in each of the three abovementioned measures. Cronbach's alpha for accuracy was .74. In the reading comprehension test, participants read a text and then answered 11 multiple choice questions (Nevala et al., 2006). Owing to a ceiling effect, an ability group provided by the test manual was used as a score. Based on the manual, Cronbach's alpha reliability for the task is rather low .57 (Nevala et al., 2006) possibly due to variation in the degree of difficulty of the questions.

Rapid automatized naming. Three subtests (letters, objects and alternating colours, numbers and letters) of the Rapid automatized naming test (RAN; Ahonen, Tuovinen, & Leppäsaari, 2003; Denckla & Rudel, 1974) were used. The subjects named the items as quickly and accurately as possibly. The score was the mean of the time taken in the three subtests. Cronbach's alpha was .80.

Verbal and perceptual comprehension indices, working memory and processing speed indices. Participants completed the abbreviated version of the Wechsler Adult Intelligence Scale – IV (WAIS IV, Wechsler, 2008; Finnish standardization). As in the Wechsler Abbreviated Scale of Intelligence – II (WASI-II, Wechsler, & Hsiao-pin, 2011; e.g., Irby & Floyd, 2013), the Verbal Comprehension Index (VCI), comprised the subtests of Vocabulary and Similarities, and the Perceptual Reasoning Index (PRI) comprised the subtests Block Design and Matrix Reasoning. Both indices were computed using partition according to the WAIS IV test manual

(Wechsler, 2008; Finnish standardization). The Working Memory Index (WMI) and Processing Speed Index (PSI) were used as measures of working memory and processing speed. Test-retest reliability above .90 for VCI and .86 for PRI, has commonly been reported (Irby & Floyd, 2013) in the abbreviated WAIS-IV versions, and.88 for WMI and .90 for PSI is reported (Wechsler, 2008) in the full version.

Adult-age non-cognitive measures.

Self-esteem. Self-esteem was assessed with a shortened, five-item version of the Rosenberg Self-Esteem Scale (RGSE; Rosenberg, 1965) comprising statements relating to self-esteem (e.g., "I feel that I have a number of good qualities"). Ratings were given on a 5-point Likert-scale (from "strongly disagree", to "strongly agree"). A sum of the five items was used in this study, and Cronbach's alpha was .79.

Coping. Coping styles were assessed with Coping Inventory for Stressful Situations (CISS; Endler & Parker, 1990). The CISS measures three main coping strategies: task-oriented focus, emotion-oriented focus and avoidance-oriented coping. The 48 items (e.g., "Take some time off and get away from the situation.") are each measured on a five-point Likert scale. Cronbach's alphas were .85 for task-oriented focus, .76 for emotion-oriented focus and .82 for avoidance.

Emotional wellbeing and social functioning. The Clinical Outcomes of Routine Evaluation – Outcome Measure (CORE-OM; Evans et al., 2002) is a 34-item self-report questionnaire. In the present study two scales were used: a four- item scale to assess emotional wellbeing (e.g., "I have felt like crying.") and a 12-item scale to assess social functioning (social relationships and general functioning; e.g., "Talking to people has felt too much for me."). Participants responded to statements on a 5-point Likert scale (ranging from "not at all", to "most of the time") in the intensity of the emotion or function described. Cronbach's alphas were .48 for Wellbeing and .65 for Functioning in the present data. Cronbach's alphas of .64 for

Wellbeing, and .79 for Functioning have been reported for the general population in a Finnish validation study (Juntunen, Piiparinen, Honkalampi, Inkinen, & Laitila, 2015).

Resilience. Self-evaluated persistence to overcome difficulties was estimated with the Connor-Davidson Resilience Scale -10 (CD-RISC-10; Campbell-Sills & Stein, 2007) which comprises 10 statements measuring the capacity to cope with adversity (e.g., "I am not easily discouraged by failure.") on a 5-point Likert scale (from "not true at all", to "true nearly all the time"). The sum score of all items was used as a measure of resilience. Cronbach's alpha was .89 in comparison with the previously value of .85 (Campbell-Sills & Stein, 2007).

Life satisfaction. A five-item scale designed to measure global cognitive judgments of perceived life satisfaction was used (Diener, Emmons, Larsen, & Griffin, 1985). Participants indicate on a 7-point scale (from "strongly agree", to "strongly disagree") how far they agree or disagree with each of the 5 statements (e.g., "I am satisfied with my life."). The sum score of the five items was used in this study. Cronbach's alpha was .77.

Social support. The multidimensional scale of perceived social support (MSPSS; Canty-Mitchell, & Zimet, 2000) assesses perceptions of the adequacy of the social support received from family, friends and a significant other. The 12-item scale uses a 5-point Likert-scale (from "very strongly disagree", to "very strongly agree"). We chose to use two subscales, family and friends, each of which were assessed with four items (e.g., "My family really tries to help me".). The sum of the four items was calculated, but as the distributions of the scores were skewed, dichotomous variables were formed: a score below 3.5 indicated only little support and a score above 3.5 adequate support. Cronbach's alphas were .79 for family and .84 for friends.

Statistical analysis

Cross-tabulation and Chi-square tests were used to examine whether adult-age educational attainment and long-term unemployment were different depending on the

childhood RD status. We performed two different Multivariate Analyses of Variance (MANOVA) to explore the associations of adult-age reading skills (reading fluency and accuracy) and reading-related cognitive correlates (WMI, PSI, RAN) with educational level and long-term unemployment when c-RD was taken into account. As the WMI index includes the subtest of Arithmetic, we included basic arithmetic skills as a covariate. Three separate analyses of variance (ANOVA) for reading comprehension, verbal comprehension index and perceptual reasoning index were performed as the measures were conceptually separate. Education level, long-term unemployment, and c-RD were used as dichotomous variables. When a statistically significant education level x c-RD or long-term unemployment x c-RD interaction effect was found, further analyses were performed for the c-RD and Control group separately.

Associations of both education level and long-term unemployment with non-cognitive measures using c-RD as a covariate were explored as follows. We performed MANOVAs to examine the differences between the groups in the coping scales (task-, emotion-, avoidance-oriented), as the scales were intercorrelated and conceptually clustered. Separate analyses of variance (ANOVA) were performed for self-esteem, emotional wellbeing, social functioning, resilience and life satisfaction, as the measures were conceptually separate. Differences between the groups in the two social support scales were examined with $\chi 2$-tests, as the variables were initially dichotomous.

Effect sizes (Cohen's *d*) were calculated to describe the magnitude of possible effects and provide data for a future meta-analysis. Effect sizes were calculated using the pooled standard deviation of two groups (Cohen, 1992). In results and discussion, we interpret only statistically significant group differences with an effect size larger than 0.6 to avoid Type I error. According to Cohen (1992), Cohen´s *d* of 0.6 represents at least a moderate effect.

Results

Descriptive statistics of the groups related to gender and age are presented in Table 1. Gender was equally distributed in groups based on the c-RD status ($\chi^2(1, 85) = .001$; $p = .975$). In c-RD group, gender was also equally distributed in groups based on the education level ($\chi^2(1, 48) = .640$; $p = .424$) and long-term unemployment ($\chi^2(1, 48) = .228$; $p = .633$). This also applied in control group for education level ($\chi^2(1, 37) = .426$; $p = .514$) and barely for long-term unemployment ($\chi^2(1, 37) = 3.612$; $p = .057$). At follow-up, no differences in age was found in groups based on c-RD status ($F(1, 83) = 1.517$; $p = .222$). However, in c-RD group, high educated participants were significantly older than the low educated participants ($F(1, 46) = 12.747$; $p = .001$), whereas the difference in age between long-term unemployed and non-long-term unemployed was non-significant ($F(1, 46) = 12.230$; $p = .142$). In the control group, the effect of educational level on age was non-significant ($F(1, 35) = 0.916$; $p = .345$), whereas long-term unemployed participants were significantly older than the non-long-term unemployed ($F(1, 35) = 6.876$; $p = .013$).

C-RD and control group comparisons

Percentages of participants with low / high education and no / long-term unemployment in the c-RD status groups are presented in Table 2. Chi-square tests showed that participants with c-RD had a larger proportion of individuals with low education. Long-term unemployment was equally distributed in the c-RD status groups. Moreover, the Chi-square analysis further showed that c-RD status moderated the association between education and unemployment: low education was associated with long-term unemployment in controls, but not in the c-RD group.

Effects on education level

Adult-age reading and cognitive skills. The MANOVA for reading fluency and accuracy indicated a statistically significant effect only for c-RD status (Table 3). The between-subjects tests showed that the c-RD group scored lower than the control group in both reading measures and that the effect sizes were large. In the ANOVA for reading comprehension,

statistically significant effects for education level and c-RD status were found along with large effect sizes. However, a significant c-RD x education level interaction effect was also found. Further analyses, conducted separately for the c-RD and control groups, indicated that in the c-RD group, those with high education scored significantly higher in reading comprehension than those with low education. No such effect was found in the control group. Moreover, the ANOVA for VCI indicated a statistically significant effect for education level and c-RD x education-level interaction. Further analyses indicated that in the c-RD group, those with high education scored significantly higher in VCI than those with low education. No such effect was found in controls. Thus, high education was associated with better reading comprehension and VCI only in the c-RD group. However, high education was not related to reading fluency or accuracy.

The second MANOVA for reading-related cognitive correlates (WMI, PSI, RAN) did not indicate any statistically significant effects. However, the effect size was large for WMI in the c-RD status groups, indicating that the controls outperformed the c-RD participants. Effect sizes in the other measures varied from small to moderate. The ANOVA for PRI indicated a statistically significant effect only for education level, indicating a higher PRI in the high than low education group irrespective of c-RD history. The effect size was moderate.

Adult-age non-cognitive measures. The MANOVA for task-, emotion- and avoidance-oriented coping indicated a statistically significant effect only for education level. The between-subjects tests showed more avoidance-oriented coping in the low than high education group, but no differences were found in the other coping scales (Table 3). The effect size for avoidance-oriented coping was moderate, while for the other two measures it ranged from negligible to small. Thus, no main effects were detected for c-RD status in coping. Five ANOVAs were conducted to study the association between education level and self-esteem, emotional wellbeing, social functioning, resilience and life satisfaction. C-RD had a statistically significant

main effect on self-esteem. Moreover, as Table 3 shows, the c-RD group scored higher than the control group. However, the effect size was small. In addition, education level had a statistically significant main effect on emotional wellbeing and social functioning, the high education group showing greater emotional wellbeing and a higher level of social functioning than the low education group irrespective of c-RD status (Table 3). The effect sizes were moderate. No statistically significant effects on resilience or life satisfaction were found; both effect sizes were moderate.

The two social support scales (family and friends) were analysed with cross-tabulation and chi-square tests (Table 4). Exploration of the family support scale showed that the amount of perceived support between the two education-level groups and between the c-RD group and controls was equal. Similarly, no difference by education level or c-RD status was found for the friends support-scale. These results indicated that perceived support was not dependent on either education level or c-RD.

Effects on long-term unemployment

Adult-age reading and cognitive skills. The MANOVA for reading fluency and accuracy indicated a statistically significant c-RD x unemployment interaction for reading fluency and a statistically significant main effect for c-RD. Further analysis indicated (Table 5) that in the c-RD group, the long-term unemployed participants scored significantly poorer in reading fluency than those with no such history. In the control group, no such effect was found. This indicates that long-term unemployment was associated with weaker reading fluency only in the c-RD group. The ANOVAs for reading comprehension and VCI showed a statistically significant effect only for c-RD status. Irrespective of unemployment status, the control group performed better in both measures than the c-RD group. The effect sizes for reading comprehension and VCI were both large.

The second MANOVA for reading-related cognitive correlates (WMI, PSI, RAN) also indicated a statistically significant c-RD x unemployment interaction effect. Further analysis showed (Table 5) that in the control group, participants with no history of long-term unemployment scored significantly higher in both the WMI and PSI than those with a history of long-term unemployment. In the c-RD group, no such association was found. The effect sizes varied from large for WMI to moderate for PSI and RAN. Thus, good working memory performance and processing speed were related to employment only in the control group. The ANOVA for PRI indicated no statistically significant effects, the effect sizes varying from negligible to small.

Adult-age non-cognitive measures. The MANOVA for task-, emotion- and avoidance-oriented coping revealed a statistically significant effect only for c-RD. The between-participants tests showed that the c-RD group used task-oriented coping less than controls, otherwise no between-group differences were found in the coping scales (Table 5). The effect sizes were negligible (emotional), small (avoidance) and moderate (task-oriented). Five ANOVAs were conducted to study the associations of unemployment with self-esteem, emotional wellbeing, social functioning, resilience, and life satisfaction. As Table 5 shows, unemployment was significantly associated with social functioning and life satisfaction, indicating that, irrespective of c-RD status, participants with long-term unemployment were less socially active and more dissatisfied with their lives than peers with no such history. The effect sizes were moderate. Neither c-RD nor unemployment had a statistically significant effect on self-esteem, emotional wellbeing or resilience. The effect sizes varied from negligible to moderate.

Social support scales (family and friends) were analysed with cross-tabulation and chi-square tests (Table 6). Exploration of the family support-scale showed that the amount of perceived support was equal in the c-RD and control group and across the unemployment groups. Similarly, no differences in the support from friends scale was found between the c-RD

status groups or between the unemployment groups. These results indicated that perceived support was not dependent on either c-RD or unemployment status.

Discussion

This study is a part of a larger follow-up research project tracing the lives of individuals diagnosed with LD in childhood who have since reached adult age (i.e., 20 years of age). The present study sought to identify which literacy, cognitive and non-cognitive factors were related to a low education level (no education beyond high school or vocational school) and to long-term unemployment (continuous unemployment for a period of at least one year) among individuals with c-RD and matched controls with no known history of c-RD. Our results showed that participants with c-RD had lower education, but equal amount of long-term unemployment than control participants in adulthood. Moreover, we found a moderating effect of c-RD: low education was associated with long-term unemployment in the control group, but not in the c-RD group. Educational outcome was not associated with adult-age reading fluency or accuracy. In addition, participants with low education in the c-RD group were poorer in reading comprehension and scored lower in verbal comprehension than those with high education. Irrespective of the history of c-RD, low education was related to avoidance-based coping, poor emotional wellbeing and poor social functioning. Long-term unemployment was related to low life satisfaction irrespective of c-RD. In the c-RD group, those with a history of long-term unemployment also had more problems in reading fluency than those with no such history. In the control group, individuals with no history of long-term unemployment outperformed the long-term unemployment group in working memory and processing speed. Overall, our study suggests that both lower education and long-term unemployment are related to problems in reading and cognitive skills as well as poorer non-cognitive outcomes. However, only a few of these associations were specific to the c-RD group.

Previous studies (e.g., McLaughlin, Speirs, & Shenassa, 2014) have also found a lower education level among individuals with c-RD than those without c-RD. However, in our study, the only cognitive measures associated with education level in the c-RD, but not in the control group, were verbal comprehension and reading comprehension, indicating a somewhat broader verbal deficit in adulthood among those with a history of c-RD and a low education level. This suggests that individuals with c-RD who also have poor reading comprehension and/or verbal comprehension skills are likely be less educated than c-RD peers with better verbal skills. Strong verbal skills may be a protective factor against exclusion from education for individuals with c-RD; if so, verbal skills should receive special attention during the school career.

Low education was associated with problems in emotional wellbeing and social functioning and with avoidance-oriented coping, outcomes which have previously been termed "secondary consequences of RD" (Livingstone et al., 2018). However, these associations were independent of c-RD status. It seems, therefore, that the mechanism behind these associations does not hinge on c-RD status. It can be speculated that weak emotional wellbeing and poor social functioning affect school engagement, or vice versa, that schooling-related problems other than c-RD impair emotional and social wellbeing (Virtanen, Lerkkanen, Poikkeus, & Kuorelahti, 2014). Further research with bigger samples is needed to understand the mechanism and different aspects of emotional wellbeing and social functioning in educational attainment as our measure of emotional wellbeing tapped into different aspects of wellbeing as shown by the low alpha level (.48).

In our sample, individuals with and without c-RD were equally distributed in the long-term unemployment groups. Moreover, those who had experienced long-term unemployment reported less satisfaction with their lives than those with no such history. Likely, the low life satisfaction results in long-term unemployment and thus, is an expected result. However, the

analyses revealed no c-RD-specific non-cognitive factors associated with unemployment. This finding was not counter to our expectations, since problems in emotional and social wellbeing, which might be assumed to be associated with unemployment, have consistently been found in individuals with RD (Livingston et al., 2018).

Participants with c-RD and long-term unemployment were poorer in adult-age reading fluency than those with c-RD but without long-term unemployment. Thus, adult long-term unemployment was more common among individuals with a history of both c-RD and dysfluent reading skills in adult age. This suggests that problems with fluent reading that persist from childhood to adulthood constitute a risk for long-term unemployment but not necessarily for low education. This could mean that some individuals with at least a vocational qualification are not being employed. Similarly, Kelly, McGuinness and O´Connell (2011), in a study on long-term unemployment risks among young people, found that a lack of basic literacy / numeracy skills along with a low level of educational attainment and a previous history of unemployment presented a risk for future long-term unemployment. One can only speculate whether this is because today's working life requires fluent reading skills, or whether poor reading fluency makes working life harder and thus leads to unemployment. An interesting, related, finding was that controls without a history of long-term unemployment had better working memory capacity and higher processing speed than controls with a history of long-term unemployment. This finding suggests that these higher order cognitive skills are related to finding employment and/or to staying employed. It could be tentatively proposed that this result attests to the efficiency demands on employees in today's economic environment.

Our study suggests that the non-cognitive factors previously found to be associated with RD (e.g., Livingston et al., 2018; Miller, 2002) seem to be related either to low educational attainment or to unemployment in general, and not to lack of success specifically among individuals with a history of c-RD, as might mistakenly be concluded in research implemented

without a control group. Poor reading skills along with low IQ scores, lack of high-school credentials and limited parental resources were shown to form risk factors for unemployment in the Dunedin Longitudinal Study (Caspi, Wright, Moffitt, & Silva, 1998), findings that testify to the need for longitudinal designs on the accumulation of diverse types of adversities.

Although the main effects of c-RD on adult-age reading skills were not of direct interest in this study, our results confirm the view that RD is a lifelong condition (e.g., Eklund et al., 2015; Raskind et al., 1999). At follow-up, our participants were 20-39 years old and those with c-RD were outperformed by their same-aged controls in reading fluency and accuracy. As the results indicate, the persistence of reading problems into adult-age is a more important factor making for long-term unemployment than the childhood diagnosis *per se*.

Despite finding no differences between the groups in social support (family or friends) in adulthood, we conducted a post hoc analysis on the significance of perceived family support in childhood. In our sample, the c-RD participants with no history of long-term unemployment reported more perceived family support in childhood. According to previous research, family support serves as a buffer (Carawan et al., 2016) and diminishes the emotional burden (Nalavany, & Carawan, 2012; Nalavany et al., 2013), which may lead to better self-esteem. It is understandable that, given these previous findings on the importance of early diagnosis and support and on the influence of environmental factors on adult-age outcomes, along with the fact that our sample was based on clinical data, we found no main effects of c-RD on either wellbeing or on the self-esteem, resilience or social support scales. This finding is also in line with that of Schulte-Körne and colleagues (2003), who reported that the proportions of psychiatric or emotional symptoms were no higher in a clinical sample of individuals with RD.

Some other, more important, factors could have affected our results. While it is well known that individuals with RD are at risk for additional learning and developmental disabilities (e.g., Landerl & Moll, 2010; Willcutt et al., 2010), only a few studies have considered the effect

of comorbidity, especially on non-cognitive measures. For example, Stack-Cutler, Parrila, & Torppa, (2015) found that adults with RD reporting a greater number of additional difficulties have lower resilience than those reporting fewer difficulties. To address this issue, we sought to clarify the impact of c-RD on, in particular, non-cognitive measures and thus restricted the sample to individuals without comorbid disabilities. We also wanted to take advantage of our follow-up data to ascertain the possible effects of RD status in childhood on the later life-course and thus chose not to form the RD group on the basis of RD status in adulthood. In addition, the definition of the low education group, which also included individuals currently pursuing their studies, may have affected the results. However, these participants were equally distributed in the c-RD (n = 8) and control groups (n = 7).

The study has its limitations. First, our sample was based on clinical data and thus is not representative of the whole RD population. In addition, participants of the control group were selected and matched no earlier than on adult age. Thus, we were unfortunately unable to get comparable information on their prior achievement. Second, while the attrition rate was reasonable (26.0 %) for a longitudinal study and participants did not differ from non-participants in the childhood measures, it remains possible that individuals with more severe psychosocial problems with onset in adulthood may not have participated in the follow-up assessment. Third, our sample size was too small to detect some cumulative effects. Fourth, at follow-up, the high educated group was significantly older than the low educated group and the long-term unemployed group significantly younger than the non-long-term unemployed group. It can be speculated that RD may affect education by lengthening the time taken to graduate (Hakkarainen, Holopainen, & Savolainen, 2016). Future research should focus on replicating the study with larger samples as now the statistical power was decreased due to a small sample size. Also possible gender differences should be examined.

Overall, our study suggests that both low education and long-term unemployment are related not only to problems in reading and cognitive skills but also to non-cognitive factors. However, only a few of these factors are specifically related to c-RD. This finding conflicts with earlier findings of an association between these different success attributes and RD in studies lacking a control group. From the viewpoint of young adult NEETs (OECD, 2017), more attention should be paid to the acquisition of fluent reading, reading comprehension and verbal skills and the training of social skills. Our study also points to the importance of investigating coping strategies in more detail. Our results show that in a high percentage of individuals with RD identified in childhood the disability persists into adulthood. We conclude, therefore, that more attention should be paid to training individuals with RD in basic academic skills along with functional social and emotional skills so that they can lead an active and meaningful life.

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Table 1 *Demographic Data by Childhood RD, Education and Unemployment Statuses*

	c-RD, *n* = 48			Control, *n* = 37		
	Range	M	SD	Range	M	SD
Male, %	62.5			62.2		
Age, follow-up	20-39	26.23	4.75	21-40	27.51	4.79
Age, childhood	8-13	10.68	1.36	-	-	-

	Low education, *n* = 40			High education, *n* = 8			Low education, *n* = 24			High education, *n* = 13		
	Range	M	SD	Range	M	SD	Range	M	SD	Range	M	SD
Male, %	65.0			50.0			58.3			69.2		
Age, follow-up	20-35	25.25	4.09	25-39	31.12	5.06	21-40	26.96	5.25	24-36	28.54	3.78
Age, childhood	8-13	10.61	1.40	9-13	11.02	1.17	-	-	-	-	-	-

	No long-term unemployment, *n* = 39			Long-term unemployment, *n* = 9			No long-term unemployment, *n* = 28			Long-term unemployment, *n* = 9		
	Range	M	SD	Range	M	SD	Range	M	SD	Range	M	SD
Male, %	64.1			55.6			53.6			88.9		
Age, follow-up	20-39	25.74	4.66	21-34	28.33	4.85	21-36	26.43	4.30	25-40	30.89	4.91
Age, childhood	8-13	10.73	1.36	9-13	10.44	1.42	-	-	-	-	-	-

Note.

c-RD = childhood reading disability.

Table 2

Education and Unemployment by Childhood RD Status, and the Moderating Effect of Childhood RD Status on the Association between Education and Unemployment.

	c-RD	Control	(χ^2(1, 85)
Education			
(low / high)	83.3% / 16.7%	58.5% / 41.5 %	3.83*
Long-term unemployment			
(yes / no)	18.8% / 81.3%	24.3% / 75.7%	.389

	c-RD			Control		
	Low education	High education	χ^2(1, 48)	Low education	High education	(χ^2(1, 37)
Long-term unemployment	88.9 %	11.1 %	0.25	100.0 %	0.0 %	6.44*
No long-term unemployment	82.1 %	17.9 %		53.6 %	46.4 %	

Note.

c-RD = childhood reading disability.

* $p < .05$

Table 3

Comparisons of Groups with Low or High Education level, while Controlling for the Effect of Childhood RD Status

	Education level					c-RD status					
	Low *n* = 64		High *n* = 21			c-RD *n* = 48		Control *n* = 37			Education x c-RD
	M	*SD*	*M*	*SD*	*F*(1, 69-81); η_p^2 / Cohen`s *d*[a]	*M*	*SD*	*M*	*SD*	*F*(1, 69-81); η_p^2 / Cohen`s *d*[a]	*F*(1, 69-81); η_p^2
Reading					1.91; .05					34.17***; .46	1.26; .03
Fluency	-0.87	1.32	-0.37	1.39	0.02; .00 / 0.37	-1.56	1.05	0.31	0.88	54.13***; .40 / 2.02	1.26; .00
Accuracy	-0.53	0.98	0.08	0.68	3.30; .04 / 0.79	-0.96	.82	0.38	0.44	45.96***; .36 / 2.33	0.03; .00
Comprehension	4.73	1.64	6.05	1.08	8.30**; .10 / 1.05	4.49	1.67	5.88	1.13	5.03*; .06 / 1.07	3.99*; .05
Cognitive correlates					0.56; .02					1.62; .07	0.05; .00
WMI	84.59	12.76	93.29	11.29	1.32; .02 / 0.75	82.76	12.66	92.59	11.00	3.05; .04 / 0.86	0.05; .00
PSI	92.57	14.18	99.41	15.25	0.36; .01 / 0.46	91.13	13.19	98.86	15.71	0.78; .01 / 0.52	0.00; .00
RAN	31.20	5.56	29.97	5.53	0.01; .00 / 0.22	32.34	5.15	28.67	5.47	3.57; .05 / 0.69	0.04; .00
VCI	86.36	15.61	97.33	13.17	6.65*; .08 / 0.79	83.90	16.40	95.78	11.93	3.23; .04 / 0.89	4.38*; .05
PRI	97.34	16.27	105.28	12.33	4.33*; .05 / 0.59	99.10	16.92	99.62	14.22	0.15; .00 / 0.03	0.07; .00
Non-cognitive correlates											
Coping					2.92*; .04					0.81; .03	0.65; .02
Avoidance	13.33	4.98	9.86	5.00	6.71*; .08 / 0.70	13.21	5.01	11.51	5.30	0.13; .00 / 0.33	0.94; .01
Emotional	9.25	3.57	8.84	3.75	2.32; .03 / 0.11	9.25	3.57	8.84	3.75	0.11; .00 / 0.11	1.07; .01
Task oriented	19.38	3.79	21.10	4.04	2.00; .02 / 0.44	18.94	3.94	20.92	3.59	1.88; .02 / 0.54	0.65; .01
Self-esteem	14.06	3.21	14.62	2.87	1.38; .02 / 0.19	14.65	2.59	13.62	3.66	3.98*; .05 / 0.31	1.08; .01
Emotional wellbeing	2.88	1.86	1.81	1.33	4.29*; .05 / 0.72	2.88	1.84	2.27	1.69	1.33; .02 / 0.35	0.17; .00
Social functioning	9.02	4.64	6.14	3.48	5.29*; .06 / 0.75	8.90	4.52	7.54	4.51	0.72; .01 / 0.30	0.03; .00
Resilience	29.50	5.15	30.62	5.56	1.34; .02 / 0.21	30.15	4.78	29.30	5.82	1.93; .02 / 0.16	1.31; .02
Life satisfaction	26.92	4.20	28.29	4.12	1.77; .02 / 0.33	27.48	3.91	26.97	4.57	0.08; .00 / 0.12	0.80; .01

Note.

c-RD = childhood reading disability, WMI = Working Memory Index, PSI = Processing Speed Index, RAN = rapid automatized naming VCI = Verbal Comprehension Index, and PRI = Perceptual Reasoning Index.

[a] Effect sizes, Cohen *d*, were calculated using the pooled standard deviation of two groups.

* $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

Table 4
Social Support by Education and Childhood RD Statuses

	Education level			c-RD Status		
	Low	High		c-RD	Control	
	n = 64	*n* = 21	$\chi^2(1, 85)$	*n* = 48	*n* = 37	($\chi^2(1, 85)$
Family support, percentage of sufficient support	90.6 %	85.7 %	0.40	93.8 %	83.8 %	2.19
Friend's support, percentage of sufficient support	89.1 %	90.5 %	0.03	93.8 %	83.8 %	2.19

Note.

c-RD = childhood reading disability.

Table 5

Comparisons of Groups with Long-term Unemployment (no / yes), while Controlling for the Effect of Childhood RD Status

	Long-term unemployment					c-RD status					
	No *n* = 67		Yes *n* = 18			c-RD *n* = 48		Control *n* = 37			Education x c-RD
	M	*SD*	*M*	*SD*	*F*(1, 69-81); η_p^2 / Cohen`s *d*[a]	*M*	*SD*	*M*	*SD*	*F*(1, 69-81); η_p^2 / Cohen`s *d*[a]	*F*(1, 69-81); η_p^2
Reading					3.50*; .08					50.79***; .56	5.22**; .12
Fluency	-0.64	1.24	-1.15	1.68	7.05**; .08 / 0.33	-1.56	1.05	0.31	0.88	90.17***; .53 / 2.02	8.08**; .09
Accuracy	-0.35	0.96	-0.48	0.94	1.80; .02 / 0.14	-0.96	.82	0.38	0.44	54.81***; .40 / 2.33	0.02; .00
Comprehension	5.00	1.63	5.25	1.61	0.06; .00 / 0.16	4.49	1.67	5.88	1.13	14.76***; .16 / 1.07	0.89; .01
Cognitive correlates					1.85; .08					1.47; .06	3.27*; .13
WMI	86.45	13.01	86.94	12.91	0.15; .00 / 0.04	82.76	12.66	92.59	11.00	0.29; .00 / 0.86	5.81*; .08
PSI	95.95	14.99	87.88	11.56	4.82*; .06 / 0.64	91.13	13.19	98.86	15.71	0.10; .00 / 0.52	3.85*; .05
RAN	30.60	5.69	30.35	5.67	1.19; .02 / 0.04	32.34	5.15	28.67	5.47	4.32*; .06 / 0.69	0.05; .00
VCI	88.75	15.18	90.28	17.97	0.02; .00 / 0.09	83.90	16.40	95.78	11.93	8.58**; .10 / 0.89	0.02; .00
PRI	100.27	14.56	95.83	19.52	1.05; .01 / 0.25	99.10	16.92	99.62	14.22	1.03; .01 / 0.03	2.14; .03
Non-cognitive correlates											
Coping					0.88; .03					3.43*; .12	0.85; .03
Avoidance	12.18	5.23	13.56	4.97	1.21; .02 / 0.28	13.21	5.01	11.51	5.30	1.99; .02 / 0.33	0.04; .00
Emotional	9.10	3.73	8.94	3.33	0.02; .00 / 0.05	9.25	3.57	8.84	3.75	0.30; .00 / 0.11	0.06; .00
Task oriented	20.00	3.72	19.06	4.53	1.12; .01 / 0.22	18.94	3.94	20.92	3.59	8.74**; .10 / 0.54	2.56; .03
Self-esteem	14.52	3.00	13.00	3.38	3.03; .04 / 0.47	14.65	2.59	13.62	3.66	0.54; .01 / 0.31	0.54; .01
Emotional wellbeing	2.45	1.57	3.22	2.42	3.06; .04 / 0.35	2.88	1.84	2.27	1.69	2.46; .03 / 0.35	0.10; .00
Social functioning	7.81	4.36	10.17	4.84	4.43*; .05 / 0.51	8.90	4.52	7.54	4.51	1.23; .02 / 0.30	0.07; .00
Resilience	30.33	5.12	27.72	5.31	3.29; .04 / 0.50	30.15	4.78	29.30	5.82	0.00; .00 / 0.16	0.62; .01
Life satisfaction	27.87	3.79	25.00	4.95	6.69*; .08 / 0.63	27.48	3.91	26.97	4.57	0.00; .00 / 0.12	0.22; .00

Note.

c-RD = childhood reading disability, WMI = Working Memory Index, PSI = Processing Speed Index, RAN = rapid automatized naming VCI = Verbal Comprehension Index, and PRI = Perceptual Reasoning Index.

[a] Effect sizes, Cohen *d*, were calculated using the pooled standard deviation of two groups.

* $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

Table 6
Social Support by Long-term Unemployment and Childhood RD Statuses

	Long-term unemployment			c-RD status		
	No	Yes		c-RD	Control	
	n = 67	*n* = 18	$\chi^2(1, 85)$	*n* = 48	*n* = 37	($\chi^2(1, 85)$
Family support, percentage of sufficient support	89.6 %	88.9 %	0.01	93.8 %	83.8 %	2.19
Friend's support, percentage of sufficient support	91.0 %	83,3.5 %	0.89	93.8 %	83.8 %	2.19

Note.

c-RD = childhood reading disability.

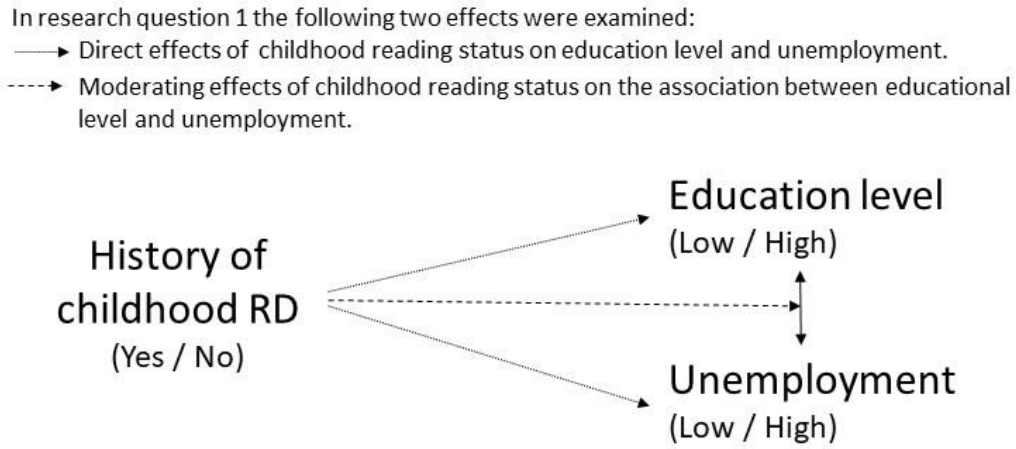

Figure 1. Illustration of research question one: examination of differences between cRD group (yes/no) in educational level (low/high) and unemployment (low/high) and cRD's moderating effect on the association between educational level and unemployment.

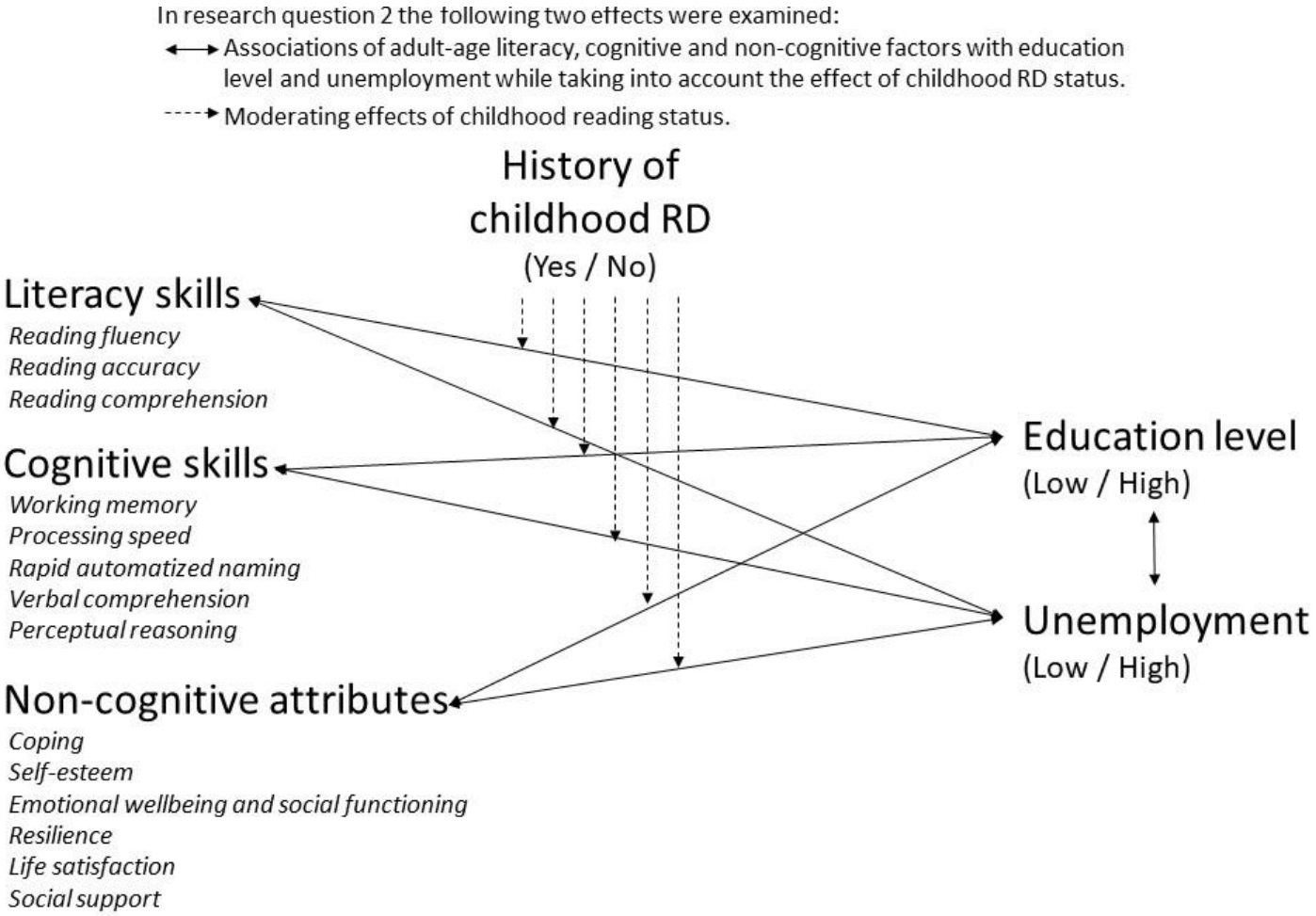

Figure 2. Illustration of research question two: examination of educational level (low/high) and unemployment (low/high) group mean differences in literacy skills, cognitive skills, and non-cognitive attributes and the