Personality and Individual Differences 196 (2022) 111710

Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

Dispositional optimism and pessimism in association with cognitive abilities in early and middle adulthood

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ARTICLE INFO

Keywords:
Dispositional optimism
Dispositional pessimism
Cognitive ability
Intelligence

ABSTRACT

The aim of the current study was to examine the associations of dispositional optimism and pessimism with cognitive abilities in adulthood. We performed two studies with data sets from the prospective Northern Finland Birth Cohort Studies: 26-year-olds (N = 383) and 46-year-olds (N = 5042). In both samples, dispositional optimism and pessimism were measured with Carver and Scheier's Life Orientation Test -Revised. In the data of 26-year-olds, the cognitive abilities assessed were reasoning, vocabulary, verbal fluency, fine-motor skills, selective attention, impulse control, and memory, while in 46-year-olds, memory was assessed. The analyses were carried out using multiple linear regression, and the associations were adjusted for gender, educational level, mother's educational level, and depression. Our results indicated that (I.) higher dispositional optimism and lower pessimism were associated with higher reasoning skills in young adults, and (II.) higher pessimism was related to lower scores on memory test in middle-aged adults. The findings provide a closer look on how dispositional optimism and pessimism are associated with the core cognitive abilities in adults.

1. Introduction

Dispositional optimism and pessimism are defined as personality traits characterized by tendencies to expect positive or negative outcomes in life (Carver, Scheier, & Segerstrom, 2010). Mounting evidence shows that optimism is beneficial for individual's health and wellbeing (Alarcon, Bowling, & Khazon, 2013; Carver et al., 2010; Kelloniemi, Ek, & Laitinen, 2005; Scheier & Carver, 2018; Solberg Nes & Segerstrom, 2006) while pessimism is associated with health-related risks and maladaptive behavior (Carver, Lehman, & Antoni, 2003; Ohannessian, Hesselbrock, Tennen, & Affleck, 1994; Plomin et al., 1992). This evidence has raised a question whether optimism may promote individual's cognitive resources and abilities that could in turn support a healthy and adaptive lifestyle (Carver et al., 2010; Solberg Nes & Segerstrom, 2006).

Intellectual investment theories argue that some personality traits affect the development of cognitive abilities by leading an individual to invest more time and effort in learning and in cognitively challenging situations (Ackerman, 1996; von Stumm & Ackerman, 2013). The role of positive emotionality with cognitive development is noted in the Broaden-and-Build theory (Fredrickson, 2004) stating that the experience of positive emotions broadens individuals' thought-action repertoire, which thus builds personal resources. For example, joy drives an individual to play, create new ideas and push the limits, which supports intellectual and creative abilities. In contrast, negative emotionality narrows individual's thought-action repertoire in order to prepare a person for quick decisions in a threatening situation (Fredrickson, 2004). Several experimental studies have shown that positive emotions support flexible and efficient thinking and openness to a variety of information (Estrada, Isen, & Young, 1997; Fredrickson & Branigan, 2005; Wang, Chen, & Yue, 2017).

Earlier studies have found some differences in optimistic and pessimistic general cognitive processes. Optimists tend to pay attention to positive information over negative information (Isaacowitz, 2005) and the "optimistic bias" is broadly viewed as a vital psychological

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https://doi.org/10.1016/j.paid.2022.111710
Received 8 April 2021; Received in revised form 28 April 2022; Accepted 1 May 2022
Available online 13 May 2022

adaptation to prevent depressive symptoms (Garrett et al., 2014; Korn, Sharot, Walter, Heekeren, & Dolan, 2014). Optimists also have a stronger belief in their capability to influence their lives (i.e., internal locus of control) while pessimists have beliefs that life events are mostly caused by external forces (i.e., external locus of control) and that their own possibilities to influence the outcome are inferior (Hecht, 2013; Rotter, 1966). In addition, optimism is characterized by goal-persistence and effective coping skills which support the actions towards desired outcomes (Shepperd, Waters, Weinstein, & Klein, 2015; Solberg Nes & Segerstrom, 2006). Optimists also have capability to generate vivid positive mental imagery of the future – the power to imagine that positive outcomes come true (Blackwell et al., 2013).

Despite the above-mentioned findings, there is still insufficient knowledge on whether dispositional optimism and pessimism are associated with the core cognitive abilities, e.g. reasoning, problem-solving, verbal skills, and memory. To our best knowledge, only three studies have examined this association. Lounsbury, Welsh, Gibson, and Sundstrom (2005) studied optimism and pessimism with cognitive ability (measured with verbal and numerical reasoning tests) in middle and high school students, and found optimism to be related to higher cognitive ability in both samples (Lounsbury et al., 2005). In another study of adolescents (age 11–15 years), higher dispositional optimism was found to be associated with higher scores on analogical reasoning task (Nurmi & Pulliainen, 1991). Lastly, a recent cohort study reported that higher general cognitive ability (IQ) in childhood and in old age was related to lower pessimism in old age (68–87 years) when the age-related cognitive change was in the healthy range (Taylor, Ritchie, & Deary, 2017).

Earlier studies of optimism, pessimism and cognitive abilities have examined adolescence (Lounsbury et al., 2005; Nurmi & Pulliainen, 1991) and old age (Taylor et al., 2017) while evidence from adulthood is missing. However, age differences in cognitive research are important to note. Regarding Cattell's (1943) division of cognitive abilities, “fluid intelligence” (e.g. reasoning, problem-solving and learning) develops early in childhood and peaks in early adulthood, whereas “crystallized intelligence” (e.g. acquired knowledge, vocabulary and professional expertise) depends on fluid abilities and develops more constantly over the life course (Cattell, 1943; Cattell, 1971; Rammstedt, Lechner, & Danner, 2018; Thorsen, Gustafsson, & Cliffordson, 2014). Additionally, fluid abilities are more sensitive to aging processes and changes can be observed already in midlife, while crystallized intelligence remains stable until old age (Jones & Conrad, 1933; McArdle, Ferrer-Caja, Hamagami, & Woodcock, 2002).

We hypothesize that dispositional optimism and pessimism are associated with core cognitive abilities along the same lines as noted in previous positive emotionality research (Fredrickson, 2004; Fredrickson & Branigan, 2005; Wang et al., 2017): higher optimism is associated with higher level of cognitive abilities and higher pessimism with lower level of cognitive abilities. First, we study a young adult sample of 26-year-olds who have presumably achieved a relatively stable level of cognitive abilities. Reasoning, vocabulary, verbal fluency, fine-motor skills, selective attention, impulse control, and memory are assessed along with dispositional optimism and pessimism. Secondly, we examine a sample of 46-year-olds in whom optimism, pessimism and memory are assessed. We adjust our analyses for gender, educational level, mother's educational level and depression.

2. Method

2.1. Participants

The study participants are from the prospective Northern Finland Birth Cohort Studies (NFBC), which aim to study and promote national health and wellbeing. Data gathering for NFBC1986 started in 1985 when 9432 live-born children born in 1985–1986 were invited to the study (Järvelin, Hartikainen-Sorri, & Rantakallio, 1993; University of Oulu, 1986). The older cohort study, NFBC1966, started in 1965–1966, when 12,058 pregnant women and their live-born children were invited to participate (Rantakallio, 1969; University of Oulu, 1966). All the data have been gathered in Northern Finland (Oulu and Lapland) and cover more than 96% of all births in the area in the time frames of the data collections. Both cohort studies are ongoing.

In the current research, we selected samples that were gathered from healthy adults of different ages, and included measurements for optimism, pessimism, and cognitive abilities. Using these criteria, two samples of NFBC data are selected:

1) Data of 26-year-olds (N = 383, 40% men and 60% women) is a subsample of the NFBC1986 (University of Oulu, 1986) that was originally recruited based on exposure to maternal smoking in pregnancy (exposed: 46%, non-exposed: 54%). The exclusion criteria included premature birth, serious medical illnesses, and intellectual disability. The data gathering took place during 2011–2013 when the participants were 25–27 years old (mean age 26 years). In this study, 88 of the 471 participants in the original sample were excluded for not having full data on confounding variables. Details of this sample have been described elsewhere (Björnholm et al., 2020).
2) Data of 46-year-olds (N = 5042, 43% men and 57% women) is a population-based follow-up data set from the NFBC1966 study (University of Oulu, 1966) and was gathered in 2012. The recruitment targeted the whole population in the cohort and 56.7% of them participated in the study. A comprehensive health assessment was carried out with clinical examinations and postal questionnaires. From the original data of 5861 participants, 819 were excluded for not having full data on confounding variables.

The Ethics Committee of the Northern Ostrobothnia Hospital District in Finland approved the study and all participants of the present study gave their written informed consent.

2.2. Measures

2.2.1. Dispositional optimism and pessimism

Dispositional optimism and pessimism were measured with Scheier and Carver's Life Orientation Test - Revised (LOT-R) (Scheier & Carver, 1985). The test assesses personal differences in future expectancies with six items, three for optimism (e.g. *In uncertain times, I usually expect the best*) and three for pessimism (e.g. *I rarely count on good things happening to me*). Participants gave their responses to each of the six items using a five-point Likert-like scale ranging from 1 = strongly disagree to 5 = strongly agree. Optimism and pessimism can be analyzed as extremes of one personality dimension, but following the suggestions of several studies, optimism and pessimism are here considered as separate variables (Glaesmer, 2012; Hecht, 2013). Internal consistency (Cronbach's alpha) of the optimism items was $\alpha = 0.761$ in 26-year-olds and $\alpha = 0.739$ in 46-year-olds, and for the pessimism items $\alpha = 0.816$ in 26-year-olds and $\alpha = 0.812$ in 46-year-olds.

2.2.2. Cognitive abilities

In the data of 26-year-olds, cognitive abilities were assessed with seven cognitive tests. Reasoning was tested using the Matrix Reasoning section of the Wechsler Adult Intelligence Scale (WAIS-III), and verbal skills using the Vocabulary component of the WAIS-III (Wechsler, 1997). Verbal fluency was measured using the Semantic Fluency Test (Benton, Hamsher, & Sivan, 1976). Fine motor-skills were measured with time taken to complete the Grooved Pegboard test using dominant hand (Trites, 1989). Additionally, selective attention was assessed with time taken to complete the Stroop test (Strauss, Sherman, & Spreen, 2006) and impulse control was tested using the modified Stop Signal Test (MSST) from the CANTAB battery (Lipszyg & Schachar, 2010). Finally, memory was assessed using the Paired Associates Learning (PAL) test from the CANTAB battery (Sahakian et al., 1988).

In the data of 46-year-olds, the participants completed one cognitive test, a memory test (Paired Associates Learning, PAL) from the CANTAB battery (Sahakian et al., 1988).

2.2.3. Confounding variables

The statistical analysis included the following covariates, that have been associated with optimism, pessimism and cognition in earlier studies: gender (Hirnstein, Hugdahl, & Hausmann, 2019), educational level (Guerra-Carrillo, Katovich, & Bunge, 2017; Tetzner & Becker, 2018), mother's educational level (Heinonen et al., 2006), and depression (Carver & Gaines, 1987; Giltay, Zitman, & Kromhout, 2006). Educational level was defined in both data sets as the most advanced level accomplished and was classified into three categories: 1 = comprehensive school or lower, 2 = high school or occupational school, 3 = academic level. Mother's educational level was measured to indicate family's socio-economic status. In the data of 26-year-olds (NFBC1986), mother's educational level was measured when the participants were 15–16 years old, and in the data of 46-year-olds (NFBC1966), mother's educational level was measured in the time of pregnancy. In both samples, the mothers' educational level was classified into three categories, similarly to participants' educational level in adulthood. Finally, depressive symptoms in 26-year-olds (NFBC1986) were measured with Adult Self-Report (ASR) (Kessler et al., 2005) (Cronbach's alpha $\alpha = 0.784$) and in 46-year-olds (NFBC1966) with Beck Depression Inventory (BDI) (Beck, Steer, & Brown, 1996) (Cronbach's alpha $\alpha = 0.851$).

2.3. Statistical analysis

Statistical analyses were carried out using IBM SPSS Statistics version 25. The associations of dispositional optimism and pessimism with cognitive abilities were analyzed with multiple linear regression. We created five models in both of our studies, where confounding variables were included as predictors together with optimism or pessimism. First, associations were examined in a model that was adjusted for gender (Model 1), the second model was additionally adjusted with participant's educational level (Model 2), and the third model was adjusted with participant's gender and mother's educational level (Model 3). The fourth model was adjusted for participant's gender and depression (Model 4), and finally, the fifth model was adjusted with all the confounding variables (Model 5). With these models we could see which confounders influence the association of optimism, pessimism, and cognitive abilities. Within each model, we calculated ΔR^2 values so that a model with covariates was compared with a model with covariates and the main variable (i.e. optimism or pessimism). This was done to calculate the effect size of the main variable, i.e. to find out how large variation of the outcome the main predictor explains when the effect of the control variables is removed. A similar procedure has been reported also in previous research (Hintsanen et al., 2014; Kiema-Junes et al., 2022). We checked for variance inflation factors (VIFs) and found no evidence of multicollinearity between independent variables. In addition, we combined the two data and tested for age group interactions in the associations of dispositional optimism, pessimism, and memory scores, but found no evidence of interaction.

3. Results

3.1. Bivariate correlations

Table 1 presents the descriptive statistics of the study variables. Tables 2 and 3 present the bivariate correlations between study variables in the two studies. In the 26-year-olds (NFBC1986 data), higher dispositional optimism correlated with lower dispositional pessimism and lower depression. Higher dispositional optimism correlated also with higher educational level and higher scores on matrix reasoning. Next, higher dispositional pessimism correlated with lower educational level and higher depression moderately. Higher dispositional pessimism also correlated with lower scores on matrix reasoning, vocabulary, and motor skills.

In the 46-year-olds (NFBC1966 data), again, higher dispositional optimism correlated with lower dispositional pessimism and lower depression moderately. Higher dispositional optimism also correlated with higher educational level, higher mother's educational level and higher memory score (in PAL total errors adjusted). In turn, higher dispositional pessimism correlated with lower educational level, lower mother's educational level, and higher depression at medium level. Higher dispositional pessimism also correlated with lower memory scores.

Table 1
Characteristics of the study variables.

Data of 26-year-olds ($N = 383$)		
	N	%
Gender		
Men	154	40.2
Women	229	59.8
Educational level		
Comprehensive school	45	11.7
High school or occupational school	104	27.2
Academic level	234	61.1
Mother's educational level		
Comprehensive school or lower	69	18.0
High school or occupational school	288	75.2
Academic level	26	6.8
	M [range]	*SD*
Optimism	7.6 [1; 12]	2.3
Pessimism	4.1 [0; 12]	2.4
Depression	4.6 [0; 20]	3.6
Matrix Reasoning	21.3 [11; 26]	2.7
Vocabulary	46.2 [15; 64]	9.3
Verbal fluency	55.5 [28; 88]	10.9
Impulse Control	0.4 [0.2; 0.5]	0.0
Selective attention	49.8 [33; 85]	8.2
Motor skills	61.5 [41; 88]	8.3
Memory (First trial memory score)	22.3 [13; 26]	2.3
Memory (Total errors adjusted)	5.4 [0; 53]	6.0

Data of 46-year-olds ($N = 5042$)		
	N	%
Gender		
Men	2169	43.0
Women	2873	57.0
Educational level		
Comprehensive school	1366	27.1
High school or occupational school	1319	26.2
Academic level	2357	46.7
Mother's educational level		
Comprehensive school or lower	3545	70.3
High school or occupational school	1212	24.0
Academic level	285	5.7
	M [range]	*SD*
Optimism	7.8[0; 12]	2.2
Pessimism	3.4 [0; 12]	2.4
Depression	5.3 [0; 55]	6.0
Memory (First trial memory score)	19.3 [6; 26]	3.3
Memory (Total errors adjusted)	12.9 [0; 146]	12.2

Table 2
Bivariate correlations of the study variables in the data of 26-year-olds (N = 383).

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Gender[a]	1													
2. Educational level	0.174**	1												
3. Mother's educational level	0.069	0.059	1											
4. Optimism	0.029	0.108*	0.026	1										
5. Pessimism	−0.102*	−0.203**	−0.029	−0.657**	1									
6. Depression	−0.152**	−0.024	0.007	−0.441**	0.443**	1								
7. Matrix Reasoning	−0.062	0.257**	0.092	0.124*	−0.191**	0.008	1							
8. Vocabulary	0.120*	0.458**	0.135**	0.057	−0.130*	0.066	0.319*	1						
9. Verbal fluency	0.263**	0.242**	0.138**	0.012	−0.086	0.072	0.202**	0.349**	1					
10. Impulse control	0.028	−0.051	0.041	0.045	−0.078	−0.007	−0.100	−0.027	0.000	1				
11. Selective attention	0.069	0.220**	0.025	−0.056	−0.078	−0.013	0.110*	0.224**	0.220**	−0.085	1			
12. Motor skills	0.334**	0.177**	0.127*	0.078	−0.137**	−0.057	0.193**	0.148**	0.253**	−0.080	−0.243**	1		
13. Memory[b]	0.057	0.039	0.064	−0.014	−0.043	0.063	0.171**	0.254**	0.176**	−0.013	−0.167**	−0.068	1	
14. Memory[c]	0.072	0.061	0.052	0.004	0.057	0.054	0.139**	0.194**	0.199**	−0.013	−0.118*	−0.106*	0.796**	1

Notes. Spearman's correlation is used with classified variables: gender, educational level and mother's educational level. Others are Pearson's r correlations.
** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.
[a] Higher values represent females.
[b] Paired associate memory: First trial memory score.
[c] Paired associate memory: Total errors adjusted.

3.2. Associations of dispositional optimism and pessimism with cognitive abilities

Tables 4 and 5 show the results of multiple linear regression analysis when predicting cognitive ability by dispositional optimism and pessimism in the two studies. In the 26-year-olds (NFBC1986 data), dispositional optimism and pessimism were associated with matrix reasoning. In optimism, the association disappeared when participant's educational level was controlled for (Model 2). However, higher pessimism was robustly associated with lower matrix reasoning in all models ($B = -0.209$; $p = 0.001$ in Model 5). We also found evidence for association between pessimism and motor skills, but the association disappeared when educational level and depression were adjusted for in Models 2, 4 and 5. In addition, higher pessimism was associated with lower vocabulary, but the association disappeared after adjustment of participant's educational level in Models 2 and 5.

In the 46-year-olds (NFBC1966 data), higher dispositional pessimism was firmly associated with lower memory test scores in all models, although the effect sizes were notably attenuated in Model 5 where all potential confounders were adjusted for ($B = -0.045$; $p = 0.034$ in first trial memory score). In turn, there was no evidence for association between dispositional optimism and memory scores.

4. Discussion

This research is the first to examine the relationship of dispositional optimism and pessimism with a variety of cognitive abilities in population-based adult samples. We hypothesized that higher dispositional optimism and lower dispositional pessimism are associated with higher cognitive abilities. We conducted two studies with samples of 26-year-olds (NFBC1986 data) and 46-year-olds (NFBC1966 data). Our main results provided evidence for the hypothesis in reasoning skills and memory, although the results related to memory may be age-dependent and occur only in middle aged and beyond.

The present study is based on the modern view that personality is systematically related to cognition (Rammstedt et al., 2018; von Stumm & Ackerman, 2013). Research evidence has shown that positive personality traits, for example positive emotionality (Fredrickson & Branigan, 2005; Wang et al., 2017) and openness to experiences (von Stumm & Ackerman, 2013) support cognitive development and effective functioning. These results have challenged the traditional view of seeing personality and cognition as separate constructs of psychological functioning (von Stumm & Ackerman, 2013).

Firstly, our findings in the data of 26-year-olds (NFBC1986 data) showed that higher optimism and lower pessimism are associated with reasoning skills. The results corroborate earlier findings, which have found that higher optimism is linked to higher verbal and numerical reasoning (Lounsbury et al., 2005) and analogical reasoning (Nurmi & Pulliainen, 1991). From the perspective of intellectual investments theory (Ackerman, 1996) and Broaden-and-Build theory of positive emotions (Fredrickson, 2004), it is plausible that optimism acts as an intellectual investment trait in supporting the development of reasoning skills. The short-term effects of optimism include positive thinking and better stress management (Shepperd et al., 2015; Solberg Nes & Segerstrom, 2006), which in turn enhance performance in reasoning tasks. In the long term, optimism increases motivation and drives an individual to spend more time in challenging situations (Carver & Scheier, 1998). Consequently, such persistence might help to strengthen reasoning skills. Conversely, pessimism is linked to depression and giving up more easily (Carver et al., 2003) and might weaken the reasoning performance in the moment, but it could also lead to a lack of experiences that could support the development of these skills over time.

The effects of optimism and pessimism on academic success have been well reported (Lounsbury, Sundstrom, Loveland, & Gibson, 2003; Tetzner & Becker, 2018). Earlier, the association has been explained with the supporting effect of optimism to goal-orientation and

Table 3
Bivariate correlations of the study variables in the data of 46-year-olds ($N = 5042$).

	1.	2.	3.	4.	5.	6.	7.	8.
1. Gender[a]	1							
2. Educational level	0.149**	1						
3. Mother's educational level	−0.024	0.159**	1					
4. Optimism	0.046**	0.048**	0.032*	1				
5. Pessimism	-.015	−0.116**	−0.072**	−0.554**	1			
6. Depression	0.130**	−0.022	−0.021	−0.431**	0.433**	1		
7. Memory[b]	0.069**	0.162**	0.062**	0.020	−0.072**	−0.036*	1	
8. Memory[c]	0.095**	0.168**	0.060**	0.030*	−0.068**	−0.035*	0.700**	1

Notes. Spearman's correlation is used with classified variables: gender, educational level and mother's educational level. Others are Pearson's r correlations.
** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.
[a] Higher values represent females.
[b] Paired associate memory: First trial memory score.
[c] Paired associate memory: Total errors adjusted.

persistence (Shepperd et al., 2015; Solberg Nes & Segerstrom, 2006). Our findings offer an additional explanation to the association with school success by showing that optimism and pessimism are also associated with matrix reasoning, which may support performance in school-related tasks.

On the other hand, our findings are in contrast with Ackerman's (1996) argument that personality traits are more often associated with crystallized intelligence that accumulates over time (e.g. vocabulary), but rarely with fluid abilities like reasoning, unless they are related with psychopathology (Ackerman, 1996). Considering the many associations that optimism and pessimism have with health (Scheier & Carver, 2018), the psychopathological factors must be acknowledged. However, in our research we controlled depression in our both samples but found the main effects, nevertheless. Moreover, our data of 26-year-olds (NFBC1986) have gone through an extensive exclusion process in terms of health conditions, including e.g. serious medical illnesses, long-term illnesses, disabilities and mental disorders (Björnholm et al., 2020) because the sample was originally recruited for research about maternal smoking during pregnancy. The generalizability of the results is therefore somewhat limited, but at the same time, the participants are healthier than on average, and the effects of psychopathological factors have been minimized. For that reason, our study provides evidence that dispositional optimism and pessimism have an association with reasoning skills, also independently from psychopathological factors.

Secondly, in the data of 46-year-olds (NFBC1966 data) we observed higher pessimism to be associated with lower test scores in memory. This association has also been observed in some earlier studies, as optimism and pessimism have been linked with working memory in a large adult-age sample (Alloway & Horton, 2016), and higher pessimism has been related with slower processing of positive affect stimuli in the working memory task of emotional faces in university students (Levens & Gotlib, 2012). It is worth noting that, in our study, the association of higher pessimism and lower memory was only observed with 46-year-olds, not with 26-year-olds. This finding may indicate that the association is age-dependent and appears when cognitive aging has started, which might occur already in midlife (Jones & Conrad, 1933; McArdle et al., 2002).

Our findings are supported by earlier evidence from aging studies where it has been shown that pessimistic perceptions of the future are associated with earlier decline in memory (Robertson, King-Kallimanis, & Kenny, 2016) and higher optimism is associated with decreased risk of cognitive impairments (Gawronski, Kim, Langa, & Kubzansky, 2016). According to engagement hypothesis "use it or lose it", the participation in cognitively challenging activities, e.g. social activities, visiting new places or learning new skills, helps to maintain cognitive performance in older age (Bielak, 2010). However, pessimists have smaller social networks than optimists (MacLeod & Conway, 2005) and therefore they may have less regular social interactions that could preserve memory. This might explain the association of higher pessimism and lower memory scores. The PAL test, which we used to assess memory, is generally used to detect symptoms of cognitive decline in dementia and Alzheimer's disease (Junkkila, Oja, Laine, & Karrasch, 2012). However, further work is needed to establish whether dispositional pessimism in adulthood is associated with earlier onset of these memory disorders.

Our results also showed stronger associations between pessimism and cognitive abilities than between optimism and cognitive abilities. This observation supports the view that optimism and pessimism should be analyzed as separate variables rather than as one dimension. Optimism and pessimism have distinct genetic influences (Bates, 2015) and different associations with two cerebral hemispheres (Hecht, 2013) and may therefore have distinct qualities that may go unnoticed if not examined separately.

Our research has the following limitations. While we showed evidence for the association between optimism and pessimism with reasoning skills and memory, this cross-sectional research does not offer evidence for causal interpretations. Future research should focus on clarifying the direction of the association between optimism, pessimism, and cognitive abilities. Additionally, with the 26-year-olds, we were able to cover the core cognitive abilities comprehensively with 7 cognitive tests, whereas with the 46-year-olds, there was only one cognitive measure (PAL test) available.

There are also several strengths in our study. Previously, research evidence from population-based adult age groups was missing, but in this research, we studied two adult age groups of 26-year-olds and of 46-year-olds. While the sample of 26-year-olds was smaller with 383 participants, with the 46-year-olds we were able analyze the associations with a larger sample of 5042 participants. Previously, cognitive ability has only been measured by one or two narrow intelligence tests (Lounsbury et al., 2005; Nurmi & Pulliainen, 1991; Taylor et al., 2017), but we were able to analyze a larger variety of cognitive abilities. Moreover, we managed to control for the potential confounding

Table 4
The estimates of multiple linear regression analyses when predicting cognitive abilities by dispositional optimism and pessimism in the data of 26-year-olds ($N = 383$).

	Model 1 (adjusted for gender)				Model 2 (adjusted for gender and educational level)				Model 3 (adjusted for gender and mother's educational level)				Model 4 (adjusted for gender and depression)				Model 5 (adjusted for gender, educational level, mother's educational level, and depression)			
	B (R^2_{adj})	*SE*	ΔR^2	*p*	*B* (R^2_{adj})	*SE*	ΔR^2	*p*	*B* (R^2_{adj})	*SE*	ΔR^2	*p*	*B* (R^2_{adj})	*SE*	ΔR^2	*p*	*B* (R^2_{adj})	*SE*	ΔR^2	*p*
I. Optimism																				
Matrix Reasoning	**0.147 (0.015)**	**0.059**	**0.016**	**0.014**	0.110 (0.113)	0.057	0.009	0.054	**0.152 (0.019)**	**0.060**	**0.017**	**0.011**	**0.196 (0.019)**	**0.066**	**0.022**	**0.003**	**0.166 (0.119)**	**0.064**	**0.016**	**0.009**
Vocabulary	0.221 (0.016)	0.207	0.003	0.286	0.013 (0.250)	0.182	0.000	0.945	0.247 (0.029)	0.207	0.004	0.232	0.381 (0.020)	0.231	0.007	0.100	0.220 (0.263)	0.202	0.002	0.277
Verbal fluency	0.031 (0.061)	0.237	0.000	0.897	−0.081 (0.105)	0.232	0.000	0.726	0.017 (0.069)	0.237	0.000	0.943	0.126 (0.060)	0.265	0.001	0.633	0.011 (0.110)	0.261	0.000	0.965
Motor skills	0.256 (0.107)	0.176	0.005	0.147	0.211 (0.118)	0.176	0.003	0.231	0.262 (0.112)	0.177	0.005	0.138	0.096 (0.113)	0.196	0.001	0.624	0.072 (0.126)	0.197	0.000	0.716
Selective attention	−0.203 (0.001)	0.182	0.003	0.265	−0.279 (0.034)	0.180	0.006	0.121	−0.233 (0.003)	0.183	0.004	0.203	−0.297 (0.001)	0.204	0.006	0.146	−0.396 (0.036)	0.202	0.010	0.051
Impulse control	0.001 (−0.001)	0.001	0.002	0.388	0.001 (−0.001)	0.001	0.003	0.310	0.001 (−0.005)	0.001	0.002	0.424	0.001 (−0.004)	0.001	0.002	0.411	0.001 (−0.007)	0.001	0.002	0.382
Memory TEA[a]	0.007 (0.001)	0.133	0.000	0.960	−0.008 (0.005)	0.134	0.000	0.950	−0.011 (0.001)	0.134	0.000	0.935	0.072 (0.000)	0.149	0.001	0.631	0.033 (0.004)	0.151	0.000	0.825
Memory FTMS[b]	−0.019 (−0.002)	0.062	0.000	0.761	−0.029 (0.024)	0.062	0.001	0.636	−0.026 (0.000)	0.062	0.000	0.671	0.014 (−0.002)	0.069	0.000	0.845	−0.009 (0.025)	0.069	0.000	0.897
II. Pessimism																				
Matrix Reasoning	**−0.218 (0.038)**	**0.055**	**0.039**	**<0.001**	**−0.143 (0.120)**	**0.054**	**0.016**	**0.009**	**−0.220 (0.042)**	**0.056**	**0.039**	**<0.001**	**−0.290 (0.051)**	**0.062**	**0.054**	**<0.001**	**−0.209 (0.130)**	**0.061**	**0.026**	**0.001**
Vocabulary	**−0.456 (0.027)**	**0.194**	**0.014**	**0.019**	−0.030 (0.250)	0.175	0.000	0.864	**−0.466 (0.040)**	**0.194**	**0.015**	**0.017**	**−0.684 (0.038)**	**0.218**	**0.025**	**0.002**	−0.231 (0.264)	0.197	0.003	0.241
Verbal fluency	−0.291 (0.065)	0.223	0.004	0.192	−0.070 (0.105)	0.224	0.000	0.755	−0.274 (0.072)	0.223	0.004	0.220	−0.458 (0.068)	0.251	0.008	0.069	−0.204 (0.111)	0.253	0.002	0.420
Motor skills	**−0.377 (0.114)**	**0.166**	**0.012**	**0.023**	−0.315 (0.122)	0.169	0.008	0.064	**−0.375 (0.119)**	**0.166**	**0.012**	**0.024**	−0.258 (0.116)	0.187	0.004	0.168	−0.198 (0.129)	0.191	0.002	0.301
Selective attention	−0.249 (0.003)	0.172	0.005	0.148	−0.117 (0.029)	0.174	0.001	0.503	−0.229 (0.004)	0.172	0.005	0.184	−0.275 (0.000)	0.194	0.005	0.156	−0.114 (0.027)	0.197	0.001	0.565
Impulse control	−0.001 (0.002)	0.001	0.005	0.148	−0.002 (0.005)	0.001	0.008	0.076	−0.001 (−0.001)	0.001	0.005	0.165	−0.002 (0.000)	0.001	0.006	0.138	−0.002 (0.000)	0.001	0.008	0.082
Memory TEA[a]	−0.124 (0.003)	0.126	0.003	0.324	−0.086 (0.006)	0.129	0.001	0.504	−0.111 (0.003)	0.126	0.002	0.381	−0.221 (0.006)	0.142	0.006	0.120	−0.161 (0.007)	0.146	0.003	0.270
Memory FTMS[b]	−0.044 (−0.001)	0.059	0.001	0.457	−0.013 (0.023)	0.059	0.000	0.825	−0.037 (0.001)	0.059	0.001	0.524	−0.092 (0.003)	0.066	0.005	0.162	−0.047 (0.026)	0.067	0.001	0.481

Notes. ΔR^2 values indicate how large proportion of the outcome the main predictor (optimism or pessimism) explains after the effect of the confounding variables has been removed. P-values below 0.05 are shown in bold.
[a] Total errors adjusted.
[b] First trial memory score.

Table 5
The estimates of multiple linear regression analyses, when predicting cognitive abilities by dispositional optimism and pessimism in the data of 46-year-olds (N = 5042).

	Model 1 (adjusted for gender)				Model 2 (adjusted for gender and educational level)				Model 3 (adjusted for gender and mother's educational level)				Model 4 (adjusted for gender and depression)				Model 5 (adjusted for gender, educational level, mother's educational level, and depression)			
	B (R^2_{adj})	*SE*	ΔR^2	*p*	*B* (R^2_{adj})	*SE*	ΔR^2	*p*	*B* (R^2_{adj})	*SE*	ΔR^2	*p*	*B* (R^2_{adj})	*SE*	ΔR^2	*p*	*B* (R^2_{adj})	*SE*	ΔR^2	*p*
I. Optimism																				
Memory TEA[a]	0.148 (0.009)	0.079	0.001	0.059	0.081 (0.043)	0.077	0.000	0.297	0.139 (0.012)	0.078	0.001	0.077	0.042 (0.010)	0.087	0.000	0.629	−0.016 (0.044)	0.086	0.000	0.849
Memory FTMS[b]	0.026 (0.004)	0.021	0.000	0.213	0.007 (0.044)	0.021	0.000	0.741	0.023 (0.009)	0.021	0.000	0.275	−0.003 (0.006)	0.024	0.000	0.891	−0.020 (0.045)	0.023	0.000	0.380
II. Pessimism																				
Memory TEA[a]	**−0.348 (0.013)**	**0.072**	**0.005**	**<0.001**	**−0.207 (0.044)**	**0.072**	**0.002**	**0.004**	**−0.330 (0.015)**	**0.072**	**0.004**	**<0.001**	**−0.300 (0.013)**	**0.080**	**0.003**	**<0.001**	−0.147 (0.045)	0.080	0.001	0.065
Memory FTMS[b]	**−0.100 (0.009)**	**0.019**	**0.005**	**<0.001**	**−0.059 (0.045)**	**0.019**	**0.002**	**0.002**	**−0.094 (0.013)**	**0.019**	**0.005**	**<0.001**	**−0.090 (0.009)**	**0.022**	**0.003**	**<0.001**	**−0.045 (0.046)**	**0.021**	**0.001**	**0.034**

Notes. ΔR^2 values indicate how large proportion of the outcome the main predictor (optimism or pessimism) explains after the effect of the confounding variables has been removed. P-values below 0.05 are shown in bold.
[a] Total errors adjusted.
[b] First trial memory score.

variables of gender, participants' educational level, mother's educational level, and depression in both studies, and the main findings survived the inclusion of these covariates with significant results.

Our results offer novel information about optimistic and pessimistic cognition. Our findings suggest that, along the lines of the Broaden-and-Build theory (Fredrickson, 2004), optimism and pessimism are associated with reasoning skills in young adults, and higher pessimism associates with lower memory in older adults. However, longitudinal evidence is needed to clarify the temporal associations and developmental aspects of optimism, pessimism, and cognitive abilities.

Funding

This work was supported by the Finnish Cultural Foundation, North Ostrobothnia Regional Fund. The funding source had no role in study design, data collection, data analysis, data interpretation, writing of the report, or in the decision to submit the article for publication.

CRediT authorship contribution statement

Jutta Karhu: Conceptualization, Formal analysis, Writing – original draft. **Mirka Hintsanen:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Ellen Ek:** Writing – review & editing. **Jari Koskela:** Methodology, Formal analysis. **Juha Veijola:** Conceptualization, Resources, Methodology, Writing – review & editing, Supervision.

Declaration of competing interest

None.

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