Eur J Ageing (2015) 12:131–140
DOI 10.1007/s10433-014-0331-y

ORIGINAL INVESTIGATION

The role of cognitive resources for subjective work ability and health in nursing

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Published online: 17 January 2015

Abstract Cognitive resources can be considered to be key variables in the context of work ability and health, particularly in the aging workforce. However, research on this issue is sparse, lacking a comprehensive examination of specific cognitive functions. Therefore, the aim of the present study was to examine the association of cognitive resources with subjective work ability and health in more detail. In 166 geriatric care workers (mean age 42.1 years, SD = 11.5, range 20–62), subjective work ability and health were assessed. Additionally, a comprehensive battery of cognitive tests measuring crystallized intelligence, cognitive speed, short-term memory, working memory, and inhibition was administered in a standardized procedure. Controlling for individual differences in age, education, depressive symptoms, self-regulation strategies (in terms of selective optimization with compensation), and cognitive resources (particularly better performance in short-term memory, working memory, and inhibition) were related to better subjective work ability and health. The present results demonstrate the relation of a variety of specific cognitive functions with subjective work ability and health over and above individual differences in age, education, depressive symptoms, and self-regulation strategies. Implications to explicitly consider a set of cognitive resources in models of work and organizational psychology, particularly with respect to the aging workforce, are discussed.

Keywords Subjective work ability · Subjective health · Cognition · Aging workforce · Nursing

Responsible editor: H.-W. Wahl.

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Introduction

The aging population in the western world entails rising challenges to our society and to the age structure of the workforce. This is particularly important in nursing where, on the one hand, the staff is working until a higher age (because of changes in mandatory retirement age), and on the other hand, nurses have to care for more clients than ever before, which has also led to an increase in job demands (Isfort and Weidner 2007; Schlick et al. 2013). Compared with an average worker in Germany, physical health of nurses was found to be four percent lower and mental health even twelve percent lower (BGW/DAK 2003). Notably, work ability and health are particularly impaired in older nurses (e.g., Camerino et al. 2006; Müller et al. 2013; Pohjonen 2001). Hence, it is of enormous relevance to promote work ability and health in nursing, particularly in the aging workforce.

The potential role of cognitive resources for work ability and health

For successfully managing the daily challenges in nursing, such as talking with relatives under time pressure; serving demanding clients and documenting care activities at the same time; distributing different forms/amounts of medicine to various clients at the appropriate time; and inhibiting unwarranted responses, several cognitive resources are frequently required. Those job demands are linked to specific cognitive functions such as fast processing of incoming information (i.e., cognitive speed), retrieving and applying knowledge (i.e., crystallized intelligence), storing and recalling new information in/from short-term memory as well as processing of information held in memory (i.e., working memory), or executive control as in inhibition of inappropriate responses (e.g., Fadyl et al. 2010; Hacker 2003; Kohn and Schooler 1983; Schooler et al. 1999).

Underlining the important link between cognitive functioning and professional activities has a long tradition in work psychology and work sociology. For example, Kohn and Schooler (1983) specified different levels of cognitive processes involved at work as well as the complexity of work as a context in which these cognitive processes are applied. Modeling cognitive processes in relation to work complexity over time, Kohn and Schooler (1983; see also Schooler et al. 1999) showed that doing substantively complex work increases the level of cognitive functioning, particularly in older workers. At the same time, their findings provide evidence for a possible reverse effect of individuals' level of cognitive functioning on the complexity of their jobs. These early findings underline both the important relation between cognition and work performance and the reciprocal nature of this relationship.

From a work psychology perspective, the Action Regulation Theory (e.g., Hacker 2003; Richter and Hacker 1998) makes related theoretical assumptions describing the components, steps, and levels of cognitive action regulation in a work setting; also stressing the important role of cognitive resources in this context. In particular, the Action Regulation Theory is based on the view that actions are motivated and regulated by higher-order goals (see also e.g., Hacker 1993). Based on this framework, with respect to specific cognitive abilities, crystallized intelligence (in terms of work-specific and general knowledge) as well as cognitive speed (as a general processing resource), short-term memory, and in particular cognitively controlled higher-order functions such as working memory and inhibition (in terms of functions to retrieve, safe, modify, and apply information and knowledge as well as to shield them from information that is currently not pertinent) seem to be key functions underlying cognitive action regulation processes at work (see also e.g., Schooler et al. 1999).

These conceptual perspectives on cognitive action regulation at work together with the aforementioned findings on a reciprocal relationship of cognitive functioning with work characteristics, such as work complexity, suggest that cognitive abilities per se may be a key resource to properly act at work and to deal with job demands, therefore predicting individual differences in work ability. Consequently, in their framework of factors contributing to work ability of employees, Fadyl et al. (2010) proposed that, in addition to physical, mental, social, behavioral, and workplace factors as well as factors outside the workplace (see also Liebermann et al. 2013; Schlick et al. 2013), cognitive resources should play a crucial role in the ability to function adequately at work. Yet, surprisingly little empirical research is available to test the proposed relation between cognition and work ability in the field using comprehensive batteries of cognitive sub-processes across core domains such as memory, processing speed, and executive functions.

Besides work ability, similar associations with cognition have been suggested in the domain of work-related well-being and health. Concerning workplace factors, the role of task characteristics (especially demands vs. control) on well-being has been specified in the Job Demand-Control (JDC) model (Karasek 1979). This model predicts a negative effect on health and well-being for high job demands (such as high time pressure, task complexity, and task difficulty), particularly under conditions with low job control (such as low decision authority and skill discretion; see also the Job Demand-Control Support (JDCS) model, (Karasek and Theorell 1990), and the Job Demands-Resources (JD-R) model, Bakker and Demerouti 2007). In order to preserve well-being, the JDC model predicts that increasing job control (e.g., by increasing decision authority and skill discretion) is beneficial. Thus, in view of the JDC model, individual resources such as cognitive abilities seem to interact with key workplace factors and thereby to critically affect well-being and health at work.

Another conceptual route that dovetails with this model in suggesting a critical role of cognitive resources for predicting health in the work context rests on recent models on predictors of health behavior in general. For example, in their health action process approach (HAPA), Schwarzer and Luszczynska (2008; see also Schwarzer et al. 2008a, b) suggest a distinction between (1) a pre-intentional motivation process that leads to a behavioral intention and (2) a post-intentional volition process that facilitates the adoption and maintenance of health behaviors. Importantly, this model considers several self-regulatory mediators such as strategic planning that supports health behavior (particularly in the pre-intentional phase). In general, for a proper planning, cognitive abilities such as short-term memory, working memory, and inhibition are required (e.g., Kliegel et al. 2000; Phillips et al. 2005). Thus, maintaining good health over the course of time is likely also a result of sufficient cognitive functioning (see also e.g., Evers et al. 2012; Inauen et al. 2013; Ownby et al. 2006; Park et al. 1999; Schwarzer et al. 2008a, b, for further evidence).

Taken together, several theoretical models suggest an important role of cognitive functioning for predicting work ability and health. However, so far, empirical research on this issue is sparse, lacking a comprehensive examination of cognitive resources in this context, especially with respect to the aging workforce. Considering that cognitive resources show substantial changes across adulthood (e.g., Salthouse 2009; Schaie 1994), possibly even magnifies the importance of cognitive resources in predicting work ability and health with increasing age; While knowledge and crystallized intelligence tend to be largely preserved (or even better) in older individuals, it is well documented that other facets of cognitive resources such as short-term and working memory performance, cognitive speed, and inhibition rapidly decline in aging (e.g., Borella et al. 2008; Salthouse 2009; Schaie 1994; Schnitzspahn et al. 2013). Thus, it was the major aim of the present study to further elucidate on the relation of cognitive resources with work ability and health in the aging workforce.

Potential confounding variables regarding the relation of cognition with work ability and health

To test for the role of cognitive variables, it is, however, important to consider other variables that have been shown to affect work ability and health in this context. Only when controlling for those effects, the role of cognitive resources over and above those effects can be tested. In the following study, we targeted four core control variables as they have been shown to critically influence work ability and health in older adults: age, education, depressive symptoms, and self-regulation strategies. First, as both cognitive functioning and work ability/health show substantial age relations (e.g., Borella et al. 2008; Camerino et al. 2006; Müller et al. 2013; Salthouse 2009; Schaie 1994; Schnitzspahn et al. 2013), it may be likely that a relation between cognition and work ability/health is simply driven by the possibility that these variables share a substantial amount of variance in terms of age-related differences. Thus, it seems important to control for age differences in the inspected variables to evaluate the strength of the association between cognitive functioning and work ability/health over and above such effects.

Second, in view of the cognitive reserve concept (e.g., Stern 2002; Tucker and Stern 2011), innate cognitive resources together with education in early life build up a buffer against cognitive decline in aging. Evidence for such an initial cognitive reserve effect comes from studies showing that shorter and less complex early education is associated with lower cognitive performance in old age (e.g., Gatz et al. 2001; Ihle et al. submitted). There is some evidence that better education is associated with preserved work ability in nursing (e.g., Golubic et al. 2009; Monteiro et al. 2006), which indicates that considering education (as a correlate of cognitive reserve) may be relevant in the work context.

Third, it is possible that depression (e.g., Jorm 2000) leads to both cognitive decline and to negative evaluations of one's own work ability. The relatively large proportion of workers with depressive symptoms in certain professional groups such as nursing, and the finding that depressive symptoms are related to lower cognitive functioning as well as to lower work ability (e.g., Elinson et al. 2004; Rydrnark et al. 2006; Sun et al. 2013; Van der Linden et al. 2005) suggests that considering depressive symptoms as a potential confounder may be relevant in the work context.

Fourth, self-regulation strategies in terms of selective optimization with compensation (SOC) have been suggested to be instrumental in sustaining good levels of functioning and health in aging (e.g., Baltes and Baltes 1989). Specifically, in their model of successful aging, Baltes and Baltes postulated three strategies, selective optimization with compensation, as effective psychological adaptation to the conditions and developmental challenges of aging. It has been shown that selection, optimization, and compensation are indeed instrumental strategies of life management as they show substantial correlations with indicators of successful aging such as well-being (e.g., Freund and Baltes 1998).

With respect to the work context, by assessing job-specific SOC strategies in 438 nurses (between 21 and 63 years) using the SOC-in-nursing-scale, Müller et al. (2013) recently showed that nurses apply job-specific SOC strategies such as concentrating on the most important job tasks or setting priorities (i.e., selection), making suggestions for improvements, doing exercises, or informing oneself about the current state of professional knowledge (i.e., optimization), and asking for help (i.e., compensation) to cope with demands in their daily care work. Interestingly, the age of participants correlated positively with SOC in nursing, indicating a higher use of job-specific SOC strategies by older than younger nurses. Work ability was lower in older nurses. Importantly, all three SOC strategies (particularly optimization) were related to better work ability, and the positive relationship between SOC in nursing and work ability was stronger for older compared to younger nurses. These findings show that considering SOC strategies may be relevant in the work context. Thus, the present study aimed to additionally investigate whether the pattern of results holds when controlling for age, education (as a correlate of cognitive reserve), depressive symptoms, and SOC strategies as potential confounders as well as which role cognitive resources play *over and above* these variables.

The present study

In summary, the aim of the present study was to investigate the role of cognitive resources for work ability and health in the aging workforce in nursing using geriatric care as an exemplary target field where issues of demographic changes are affecting both the aging workforce itself as well as their clients. Specifically, it was examined whether (1) work ability and health show age differences and (2) whether cognitive resources are related to work ability and health. For this purpose, well-established tasks from the cognitive aging literature measuring crystallized intelligence, cognitive speed, short-term memory, working memory, and inhibition were presented, along with measures assessing subjective work ability and subjective health status.

In terms of predictions, we expected that older individuals show lower work ability and health (e.g., Camerino et al. 2006; Müller et al. 2013; Pohjonen 2001) as well as lower short-term and working memory, cognitive speed, and inhibition but better performance in crystallized intelligence (e.g., Borella et al. 2008; Salthouse 2009; Schaie 1994; Schnitzspahn et al. 2013). Moreover, based on the framework of Fadyl et al. (2010), we predicted that cognitive resources are related to work ability and health. In particular, regarding the role of specific cognitive abilities, based on the Action Regulation Theory (Hacker 2003; see also e.g., Kohn and Schooler 1983), we predicted that better cognitive functioning in crystallized intelligence (in terms of general knowledge) as well as in cognitive speed (as a general processing resource), in short-term memory, and in cognitively controlled higher-order functions such as working memory and inhibition (shielding current goals from distracting information) is substantially related to better work ability and health. Furthermore, we predicted that cognitively controlled higher-order functions such as working memory and inhibition may show the strongest relations with work ability and health due to the hierarchical levels of cognitive (top–down) control proposed by the Action Regulation Theory (Hacker 2003). In terms of additional explanatory power of cognitive resources, we expected that the relations of cognitive functions with work ability and health hold even when additionally controlling for potential confounders such as age, education (as a correlate of cognitive reserve), depressive symptoms, and SOC strategies.

Method

Participants

The sample consisted of 166 geriatric care workers aged from 20 to 62 years (mean age 42.1 years, SD = 11.5). From the 166 participants, 146 (88.0 %) were women and 20 (12.0 %) were men. 113 (68.1 %) were registered nurses, 52 (31.3 %) were assistants, therapists, apprentices, or others, and one (0.6 %) did not respond to the respective item. 128 (77.1 %) were staff, 21 (12.7 %) were ward or team leaders, 16 (9.6 %) were directors of the respective institution or nursing service, and one (0.6 %) did not respond to the respective item. Mean working hours per week were 34.7 (SD = 6.3, range 6–50). Mean period of time for which participants have been working in geriatric care was 12.6 years (SD = 8.4, range 0.1–39.8), for which they were working in the current geriatric care institution was 9.4 years (SD = 6.8, range 0.1–33.8), and for which they were working in their ward/team was 6.0 years (SD = 4.7, range 0.1–18.6). Mean years of education were 13.3 (SD = 1.5, range 9–18). Furthermore, from the 166 participants, 60 (36.1 %) scored below the cut-off score in the WHO-5 questionnaire indicating possible depressive symptoms. All individuals participated in the ODEM study ("*O*rganisationale und personale *De*ter*m*inanten des Erhalt von Arbeitsfähigkeit und Gesundheit älterer Arbeitskräfte" [*O*rganizational and Personal *De*ter*m*inants for maintaining work ability and Health in the Aging Workforce]), a research project investigating different factors for work ability and health in workers of geriatric care institutions in Saxony, Germany (see e.g., Wendsche et al. 2014), in which (besides the examination of other central constructs) a comprehensive battery of cognitive tests was administered. All participants gave informed consent and the present study included adherence to the declaration of Helsinki.

Materials

Subjective work ability and health

Subjective work ability. Subjective work ability was assessed using three items of the Work Ability Index (WAI; Hasselhorn and Freude 2007). First, for a general score, current work ability was rated based on a scale ranging from 0 ("completely unable to work") to 10 ("best work ability ever attained"). Furthermore, current work ability was rated in terms of the physical and psychic job demands, each based on a 5-point Likert scale ranging from 1 ("very bad") to 5 ("very good"). The three items showed an internal consistency of Cronbach's $\alpha = .73$. For analyses, the three item scores (which were standardized before) were averaged (see e.g., Ahlstrom et al. 2010, showing validity of global items to assess work ability).

Subjective health. We assessed subjective health using the respective item of the Short Form Health Survey (short-version, SF-12; Morfeld et al. 2011). Current health status in general was rated based on a 5-point Likert scale ranging from 1 ("bad") to 5 ("excellent"; see e.g., DeSalvo et al. 2009, showing validity of a single item to assess general health status).

Cognitive test battery

A cognitive test battery was administered using the following measures, all of which have been frequently used as standard indicators in the cognitive aging literature.

Crystallized intelligence. We assessed crystallized intelligence using a German vocabulary test ("Mehrfachwahlwortschatztest", MWT; Lehrl 1977) in which participants had to select the existing German word which was intermixed with four distractor words. 37 of those word/non-word items were presented on the testing sheet. The crystallized intelligence score was the total number of correctly completed items.

Cognitive speed. We assessed cognitive speed using the digit-symbol task of the Wechsler Adult Intelligence Scale-Revised edition (WAIS-R; Wechsler 1981) in which participants had to replace digits with symbols according to a previously specified rule within 90 s. The cognitive speed score was the total number of correctly completed items.

Short-term memory. Numerical short-term memory was assessed by adopting the forward digit-span test of the WAIS-R (Wechsler 1981). Participants heard progressively longer sequences of single-digit numbers spoken by a computer voice and presented at a 1-s rate via headphones. Participants had to immediately recall each sequence by typing the respective digits in the same order as being presented. Answers were recorded directly by the computer. We gave two trials for each sequence length (2–8 digits). The short-term memory score was the total number of correctly recalled sequences (min = 0; max = 14).

Working memory. Working memory was assessed in two different tests. First, we adopted the backward digit-span test of the WAIS-R (Wechsler 1981). Participants heard progressively longer sequences of single-digit numbers spoken by a computer voice and presented at a 1-s rate via headphones. They had to immediately reproduce each sequence by typing the respective digits in reverse order as being presented. Answers were recorded directly by the computer. We gave two trials for each sequence length (2–7 digits). The working memory score was the total number of correctly reproduced sequences (min = 0; max = 12).

Second, we adopted a digit ordering task reported by Hoppe et al. (2000). Participants heard progressively longer sequences of single-digit numbers spoken by a computer voice and presented at a 1-s rate via headphones. Participants had to immediately report each sequence by typing the respective digits in ascending order (from the smallest to the largest digit). Answers were recorded directly by the computer. We gave two trials for each sequence length (2–8 digits). The working memory score was the total number of correctly ordered sequences (min = 0; max = 14). For analyses, the scores of the two working memory measures (which were standardized before) were averaged to derive a composite measure. Both working memory measures were significantly correlated with each other ($r = .55$, $p < .001$).

Inhibition. We used the Go/No–Go task (e.g., Newman et al. 1985). In this task, stimuli consisted of a series of capital letters ranged from A to Z that were serially presented in the center of a computer screen with a duration varying between 750 and 1,250 ms. Each trial began with a fixation cross appearing for 250–750 ms. The maximum trial length was 1,500 ms. Participants were required to respond as fast as possible to any letter using the down-arrow key (Go trial), but not to respond when the letter "X" (No–Go trial) appeared on the screen. The No–Go rate was 20 %. The test block was presented for 3 min resulting in a varying trial number depending on individual's response time with a mean number of trials of 167.8 (SD = 9.8, range 148–207). The task started with a practice block of 30 s. As a global measure for inhibition, we analyzed the proportion of overall correct responses (that was calculated from the sum of correct Go– and No–Go-trials divided by the total number of trials). The resulting score was then divided by the individual's mean response time (on correct trials; in seconds) to control for the possibility that a good inhibition performance was achieved by a deliberately slowed down processing to avoid mistakes. Thus, this score represents the rate of correct Go/No–Go responses per second.

Control variables

Education. Participants were asked to indicate the number of years spent in total to obtain their highest educational level (i.e., school/apprenticeship/university).

Depression screening. We used the 5-item quality of life questionnaire of the World Health Organization (WHO-5; Bech 2004) as a control measure to screen for possible depressive symptoms indicated by low values in well-being. Five items in terms of having good mood, feeling relaxed, feeling active, feeling reposed after waking up, and having interest in activities, each referred to the last 2 weeks, were rated based on a 6-point scale ranging from 1 ("at no time") to 6 ("at all times"). The five items showed an internal consistency of Cronbach's $\alpha = .89$. For analyses, we adapted the suggested cut-off level of 13 (WHO 1998) to the applied scoring which resulted in a value below 3.6 as an indicator for possible depressive symptoms.

SOC. To assess supportive self-regulation strategies in aging, we used a validated 12 item short-version of the *S*election *O*ptimization and *C*ompensation-questionnaire reported by Baltes et al. (1999). Each of the four subscales, i.e., elective selection, loss-based selection, optimization, and compensation consisted of three items. One point was given for those items where the participant agreed with the target, a prototypical statement reflecting selection, optimization, or compensation. Zero points were given for choosing the distractor reflecting alternative options (theoretically "unspecified", i.e., not necessarily opposites to S, O, and C). Item scores were then averaged for the three respective items of each subscale (Cronbach's *alpha* for the four subscales were between .52 and .66; overall .74 for all 12 items; see Baltes et al. (1999), for Cronbach's *alpha* values of similar size for the 48-item version of the SOC-questionnaire).

Procedure

Participants took part in a laboratory session. First, informed consent was obtained, then a socio-demographic questionnaire was administered, followed by a battery of cognitive tests which were partly computerized and partly paper–pencil based. The same pseudo-randomized order of tests was used for all participants. Participants were tested in groups of two to five; all participants were separated by partitions, which prevented them from seeing each other. The experimenter always assured that all in the group fully understood and followed the instructions. The session lasted approximately 2 h and included two short breaks. Before the laboratory session, participants received a questionnaire containing the items of subjective work ability, subjective health, the depression screening, and SOC. They were asked to fill it out at home without the help of anybody else and return it to the testing session.

Statistical analyses

The following analyses were run: First, using regressions with age as predictor, it was examined which variables showed an age relation. Second, using regressions with the respective cognitive resource as predictor, it was explored which cognitive resources were related to subjective work ability and health and whether this held when additionally controlling for age, education, depressive symptoms, and SOC (simultaneously entered as control variables in the regression).[1] For all analyses, the R environment was used (version 3.0.3; R Core Team 2014).

Results

Descriptive statistics

Mean scores of subjective work ability, subjective health, and the cognitive measures are summarized in Table 1.

[1] We investigated relations for ordered categorical variables once subjective health was the outcome.

Table 1 Descriptive statistics for subjective work ability, subjective health, and cognitive measures

Variables	*M*	*SD*
Subjective work ability (general)	7.61	1.33
Subjective work ability (physical)	3.73	0.65
Subjective work ability (psychic)	3.66	0.71
Subjective health	3.05	0.60
Crystallized intelligence	29.56	3.62
Cognitive speed	52.97	10.68
Short-term memory	8.12	2.41
Working memory (digit backwards)	6.20	2.11
Working memory (digit ordering)	8.88	2.63
Inhibition	2.04	0.24

Table 2 Age relations of subjective work ability, subjective health, and cognitive resources

Variables	β	R^2
Subjective work ability	−.16*	.03
Subjective health	−.21*	.04
Crystallized intelligence	.29***	.08
Cognitive speed	−.48***	.23
Short-term memory	−.22**	.05
Working memory	−.34***	.11
Inhibition	−.48***	.23

Age was entered as a continuous variable and as a single predictor in the regressions. β coefficients are standardized

*** $p < .001$; ** $p < .01$; * $p < .05$

Intercorrelations r of the cognitive measures ranged from .04 ($p = .614$) to .55 ($p < .001$).

Age relations of subjective work ability, subjective health, and cognitive resources

Subjective work ability and health as well as crystallized intelligence, cognitive speed, short-term memory, working memory, and inhibition showed significant age differences with lower scores in older individuals (except for crystallized intelligence with higher scores in older individuals; see Table 2 for an overview).

Relations of cognitive resources with subjective work ability and health

There were significant positive relations of subjective work ability with cognitive speed, short-term memory, working memory, and inhibition. Subjective health was also significantly positively associated with short-term memory, working memory, and inhibition (see left panel of Table 3 for an overview).

Table 3 Relations of cognitive resources with subjective work ability and health

Predictor	B	R^2	β	ΔR^2
Subjective work ability				
Crystallized intelligence	.07 ns	<.01	.07 ns	<.01
Cognitive speed	.14′	.02	.03 ns	<.01
Short-term memory	.21**	.04	.17*	.03
Working memory	.23**	.05	.20**	.04
Inhibition	.15′	.02	.07 ns	<.01
Subjective health				
Crystallized intelligence	−.09 ns	<.01	.02 ns	<.01
Cognitive speed	.09 ns	<.01	.06 ns	<.01
Short-term memory	.20*	.04	.18*	.03
Working memory	.14′	.02	.13′	.02
Inhibition	.17*	.03	.14′	.02

Left panel Relations of cognitive resources with subjective work ability and health. The respective cognitive resource was entered as a single predictor in the regressions. *Right panel* relations of cognitive resources with subjective work ability and health, simultaneously controlled for age, years of education, presence/absence of possible depressive symptoms, and SOC strategies. ΔR^2 represents the amount of individual differences in subjective work ability/health that is associated with the respective cognitive resource over and above the control variables. β coefficients are standardized

** $p < .01$; * $p < .05$; ′ $p < .10$, significance at one-tailed level; *ns* non-significant, $p > .10$

In order to investigate the relation of subjective work ability and health with cognitive resources over and above potential confounders, we examined associations controlling for age, years of education, presence/absence of possible depressive symptoms (i.e., WHO-5 values below/above the cut-off level, respectively), and self-regulation strategies (i.e., SOC-elective selection, loss-based selection, optimization, and compensation). Entering these seven control variables simultaneously in a first step in the regression revealed a significant overall association with subjective work ability (total $R^2 = .27$, $p < .001$; with age, $\beta = -.20$, $p = .005$, and depressive symptoms, $\beta = -.46$, $p < .001$, being the only significant variables within this set, all other $ps > .247$) and subjective health (total $R^2 = .22$, $p < .001$; with age, $\beta = -.27$, $p < .001$, and depressive symptoms, $\beta = -.39$, $p < .001$, being the only significant variables within this set, all other $ps > .113$). Controlling for the associations with the seven control variables, in a second step, the positive relations of subjective work ability with short-term and working memory and of subjective health with short-term memory, working memory, and inhibition were still significant (see right panel of Table 3 for an overview), underlining the incremental value of cognitive resources in this context.[2]

[2] We additionally investigated whether the relationship between cognitive resources and subjective work ability/health is mediated by SOC strategies. There were no such mediation effects (all $ps > .252$).

Discussion

The present study aimed at thoroughly investigating the relation of a broad set of specific cognitive functions with subjective work ability and health in the aging workforce. As expected, and in line with the literature (e.g., Borella et al. 2008; Camerino et al. 2006; Müller et al. 2013; Salthouse 2009; Schaie 1994; Schnitzspahn et al. 2013), we found substantial age differences in subjective work ability and subjective health as well as in cognitive resources (i.e., crystallized intelligence, cognitive speed, short-term memory, working memory, and inhibition). Consistent with the predictions derived from the framework of Fadyl et al. (2010), we also found substantial (positive) associations of a variety of specific cognitive functions with subjective work ability and health (particularly for short-term memory, working memory, and inhibition). Importantly, these relations remained significant when controlling for age, education, depressive symptoms, and common self-regulation strategies, which does not argue in favor of those confounders being the major driving force in the relations observed.

In terms of mental health, the relatively large proportion of possibly depressed workers in our sample (more than one-third of our sample with a value below the cut-off level in the WHO-5 questionnaire indicating possible depressive symptoms) confirms that working in nursing is highly demanding and that health is a real concern in this workforce. Moreover, these findings underline the need to further specify the correlates and precursors of such precarious situations in the workforce. In this context, the present study set out to examine some of those potentially relevant correlates of (subjective) work ability and health. Following the present findings, the most important cognitive resources that could be of high relevance in this context are short-term memory, working memory, and inhibition. Conceptually, the present findings are in line with the Action Regulation Theory (Hacker 2003), and suggest that better cognitive functioning in short-term memory and in cognitively controlled higher-order functions such as working memory and inhibition (in terms of functions to retrieve, store, modify, and apply information and knowledge as well as to shield them from information that is currently not pertinent) may be key cognitive functions underlying cognitive regulation processes of (adaptive) actions in order to preserve work ability and health at work. The finding that cognitively controlled higher-order functions such as working memory show relatively strong relations with subjective work ability and health is in line with the assumption of hierarchical levels of cognitive top-down control postulated by the Action Regulation Theory (Hacker 2003). Regarding the role of knowledge (i.e., crystallized intelligence as a measure of general knowledge), no significant relations with subjective work ability and health were observed. Thus, this suggests that not (general) knowledge per se but possibly rather controlled higher-order cognitive functions to apply knowledge (such as working memory) may be crucial (particularly in highly complex work environments; see e.g., Kohn and Schooler 1983; Schooler et al. 1999). Interestingly, the finding of no significant association with cognitive speed (i.e., in terms of a general processing resource) suggests that not the speed to process and apply knowledge may be decisive but rather the elaborateness (achieved by highly complex executively controlled modulation processes in working memory).

Importantly, the present findings have implications for models of work and organizational psychology (such as the JDC model, Karasek 1979, and its extensions such as the JD-R model, Bakker and Demerouti 2007). Present data clearly suggest that it may not be sufficient to only consider job resources (at the workplace such as autonomy, as proposed in the JD-R model, e.g., Bakker and Demerouti 2007; Bakker et al. 2010). Instead, it may be necessary to explicitly integrate the role of (specific) cognitive functions (e.g., short-term memory, working memory, and inhibition) in those models. In particular, it seems reasonable that individual resources such as cognitive abilities interact with the two workplace factors, job demand and job control, in two ways: first, in helping to cope with high job demands and second, in supporting performance also in conditions with high job control that require a relatively high individual qualification level.

In this context, future research might consider whether the *fit* of individual cognitive resources with the objective specific job demands additionally moderates the association of cognitive resources with work ability and health, particularly with a lifespan developmental perspective (cf. Liebermann et al. 2013). As a further notion in this context, Thomas (1993) underlined that care is both work (caring work) and an interpersonal relation which implies some forms of emotions (caring about or for someone). The affective dimension is also regarded as an important component of care by other authors such as Hochschild (2003). In this context, one might speculate that managing the double exigency of professionalism and emotional engagement in nursing is some kind of cognitive control task and may be partly underlying the effects observed in the present study. Thus, future work will have to combine the research lines of work and organizational psychology with cognitive and emotional aging research in order to investigate how specific cognitive processes and resources interact with task-related and affective job demands in detail and how this influences work ability and health, particularly in the aging workforce.

We acknowledge that the present study is limited by its cross-sectional design that does not allow for causal inferences. Analyses of the present study give only information about age differences but do not allow drawing conclusions regarding intra-individual changes over time, which should be investigated by future research using longitudinal data. Moreover, the power of our study may have been too low to detect smaller effects and hence effects of further cognitive functions could become evident in larger samples. Furthermore, subjective work ability was only represented by three items. Subjective health was measured using only a single general item for which it is thus impossible to calculate the reliability. Although true values may be more accurate when the construct is derived from various items, there is evidence that such global measures are valid and can be used for further analysis (e.g., Ahlstrom et al. 2010; DeSalvo et al. 2009). Besides that, we acknowledge the general limitation that present results are based on subjective measures. Hence, findings await replication with objective measures for work ability and health. Moreover, in the present study, (general) knowledge (in terms of crystallized intelligence) did not show a substantial relation with subjective work ability and health. We acknowledge the limitation that only one facet of knowledge has been assessed and that thus work-specific knowledge should be investigated in future research. Furthermore, we did not find significant relations of the three SOC strategies with subjective work ability (as reported by e.g., Müller et al. 2013). It has to be noted that the sample in Müller et al. was much larger ($N = 438$) than in the present study and correlation sizes with (also subjective) work ability in Müller et al. were rather of small size (*r*s between .13 and .19). In addition, Müller et al. assessed job-specific SOC strategies. Thus, future research should additionally consider job-specific SOC strategies such as the SOC-in-nursing-scale when investigating the relationship of SOC strategies with (subjective) work ability.

However, beyond these issues, the present findings have important conceptual implications as they may serve as demonstration of the relation of a variety of specific cognitive functions with subjective work ability and health over and above traditionally studied variables such as education, depressive symptoms, and common self-regulation strategies. Importantly for the aging workforce context, the present findings raise the question whether age differences in (subjective) work ability and health may be (at least partly) linked to age-related decline in cognitive resources. This question could be integrated in future studies with (large) longitudinal intervals to examine whether (an age decline in) cognitive resources contributes to a substantial effect on (age differences in) work ability and health over time, thereby allowing for evaluating causality. One further issue in this avenue could be to investigate whether enriching the cognitive stimulation of the existing work environment to maintain overall cognitive function over time (see e.g., Schooler et al.

1999) could be a strategy to also maintain and promote work ability and health in the long term at the workplace, particularly in older employees. Finally, remaining questions that have to be answered are for example whether the present findings hold for other outcome variables, such as burnout and intention to leave nursing, and for the (aging) workforce in general beyond nursing.

Conclusion The present results demonstrate the relation of a variety of specific cognitive functions with subjective work ability and health and argue for explicitly considering a set of cognitive resources in models of work and organizational psychology, particularly with respect to the aging workforce.

Acknowledgments We would like to thank the other members of the ODEM study group, which consists of Paulina Bilinska, Katharina Goerdeler, Katharina Roitzsch, Nadine Schrod, Anne Tomaschek, and Johannes Wendsche. Furthermore, we wish to thank our student assistants Martha Baumgärtel, Florian Dietsch, Tino Franzke, Franziska Giller, Adam Karcz, Nadine Richter, Annett Weber, and Monique Zenker for helping with the data collection, as well as Lena Küttler and Franziska Spannbauer for helping to prepare the cognitive test battery. Winfried Hacker, Matthias Kliegel, and Jürgen Wegge acknowledge support from the German Research Foundation (DFG; grants HA 2249/17-1, KL 2303/7-1, and WE 1504/12-1)). Michel Oris benefited from the support of the NCCR LIVES. Overcoming Vulnerability. Life Course Perspectives. The NCCR are a tool of the Swiss National Science Foundation. The publication was further supported by a PhD scholarship awarded by the German Social Accident Insurance (Deutsche Gesetzliche Unfallversicherung, DGUV) to Marlen Rahnfeld.

Conflict of interest We declare no conflict of interest.

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