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ORIGINAL INVESTIGATION

Depressive symptoms in later life: differential impact of social support and motivational processes on depression in individuals with and without cognitive impairment

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Abstract This study investigates the role of a motivational process based on a composite of four subcomponents (self-efficacy, decision regulation, activation regulation and motivation regulation), as a mediator of the relationship between social support and depression assessed with the Geriatric Depression Scale in cognitively impaired and unimpaired individuals. Participants were 229 adults with a mean age of 74 years (range: 52–94 years). The sample comprised 64 participants diagnosed with mild cognitive impairment (MCI), 47 participants diagnosed with early-stage Alzheimer's disease (AD), and a group of 118 participants without any cognitive impairment. In this cross-sectional study, bivariate correlations and linear regression models were used to assess the association between the predictor variables and depression. Linear regression models were controlled for age, gender, education, cognitive status, cognitive impairment and activities. In the total sample, social support ($\beta = -0.15$, $p < 0.05$) and motivational processes ($\beta = -0.41$, $p < 0.001$) were significantly associated with depression; the impact of social support was mediated by motivational processes. While motivational processes were associated with depression in all three groups (no impairment: $\beta = -0.61$, $p < 0.001$; MCI: $\beta = -0.28$, $p < 0.05$; early AD: $\beta = -0.30$, $p < 0.06$), social support lost significance (no impairment: $\beta = -0.36$, $p < 0.001$; MCI: $\beta = 0.07$, $p = 0.59$; early AD: $\beta = -0.08$, $p = 0.62$). Based on these findings, it can be argued that the impact of social support on depressive symptoms is attenuated by cerebral deterioration in cognitively impaired individuals, while motivational processes remain relevant.

Keywords Motivation · Self-efficacy · Social support · MCI · Alzheimer's disease

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Introduction

Depressive symptoms are a frequent cause of emotional suffering in old age (Blazer 2003) and increase risk of death among older adults (Blazer et al. 2001). In particular, depressive symptoms are common in older people with dementia in the form of Alzheimer's disease (AD) (Lyketsos and Olin 2002; Rubin et al. 2001). Prevalence rates for depression are estimated at around 25 % for people with dementia (Ballard et al. 1996) and 10–45 % for people with mild cognitive impairment (MCI) (Apostolova and Cummings 2008) compared with approximately 2 % in older adults aged 55 years and over (Beekman et al. 2001) and 65 years and over (Maercker et al. 2008) without cognitive impairment. Depression in patients with AD is an important public health problem with substantial consequences for patients and their caregivers (Lyketsos and

Olin 2002). Depressive symptoms in patients with AD have been linked to diminished quality of life (González-Salvador et al. 2000), greater caregiver depression (Neundorfer et al. 2001), and greater likelihood of physically aggressive behaviour (Lyketsos et al. 1999). Because symptoms typical of depression such as apathy, insomnia, and weight loss may also be owed to dementia-related processes, its diagnosis in dementia is difficult (Brodaty and Luscombe 1996). The aetiology of depression in dementia remains unclear and most research has focused on neurological and physical explanations rather than psychosocial factors (Waite et al. 2004).

Since depression—in addition to its affective (e.g. depressive affect) and cognitive symptoms (e.g. low self-esteem)—is also characterised by social (e.g. social withdrawal) and motivational symptoms (e.g. loss of interest), it is obvious that social support and motivation-related constructs have been found to be associated with depression. The next paragraphs summarise previous research on these associations in old age.

In earlier studies, depressive symptoms in older adults were associated with lack of social support (Henderson et al. 1986; Oxman et al. 1992). Lack of social support was significantly related to risk of depression in Japanese over 70 years of age (Koizumi et al. 2005), and perceived social support has been negatively associated with late-life depressive symptoms (Bruce 2002). Social support significantly correlated with depression in institutionalised older adults (Nelson 1989) and after strokes (Morris et al. 1991). Waite et al. (2004) noted, however, that there has been little research on the effects of social support on depression in individuals suffering from dementia.

With regard to motivation-related constructs, there is less research in samples of older people. Generally speaking, motivation is an umbrella term for various processes involved in goal-directed behaviour. The achievement of personally meaningful goals is related to depression and general well-being, as shown by various studies (Brunstein et al. 1998), also in old age (Brunstein 1999). It has been suggested by early theorists (Lewin et al. 1944) and more differentiated in current models of motivation (Heckhausen and Heckhausen 2008) that two main motivational phases can be distinguished: goal setting and goal implementation. Goal setting and implementation are determined by rather different motivation-related constructs (Gollwitzer and Oettingen 2012). While goal setting is determined by control and expectancy constructs (Skinner 1996) such as self-efficacy (Bandura 1992, 1997) and locus of control (Rotter 1966), goal implementation is rather determined by self-regulatory strategies that are needed to cope with difficulties during the implementation phase such as decision regulation (Kuhl and Fuhrmann 1998), activation regulation (Kruglanski et al. 2000) and motivation regulation (Kuhl and Fuhrmann 1998). Other self-regulatory strategies are also important during goal implementation, e.g. emotion and attention regulation; however, they are not motivation-related and, thus, not in focus of this study. Instead, we focus on a motivational process based on four motivation-related constructs that are well studied in previous research: self-efficacy (i.e. the belief in being able to cope with difficult demands), decision regulation (i.e. the ability to quickly come to self-congruent decisions), activation regulation (i.e. the ability to initiate a planned action), and motivation regulation (i.e. the ability to motivate oneself to persevere in the face of difficulties).

All of these motivation-related constructs have been found to be associated with depression and general well-being. Depressive symptoms have been found to be influenced by self-efficacy (Blazer 2002; Luszczynska et al. 2005; Bandura 1997) and related concepts, for instance external locus of control (Beekman et al. 2001), levels of mastery (Jang et al. 2002), and everyday competence (Chou 2005). Activation regulation (Kruglanski et al. 2000) as well as decision and motivation regulation (Forstmeier and Rüddel 2007; Kuhl and Fuhrmann 1998; Rholes et al. 1989) are also related to depressive symptoms and well-being. Several studies have also highlighted the importance of motivation-related constructs in maintaining emotional health (Forstmeier and Maercker 2008), and adjustment to critical life events (Fankhauser et al. 2010) in cognitively healthy and older individuals. Since the association with depression holds for all mentioned motivation-related constructs, in this study the role of one motivational process is targeted by combining the values of the four subcomponents measuring a common latent variable. Thus, the term "motivational processes" refers to a latent variable mirroring self-efficacy as well as decision, activation and motivation regulation in the rest of this article.

In a variety of studies, self-efficacy has been found to mediate the relationship between social support and depression (Benight and Bandura 2004; Cutrona and Troutman 1986; Saltzman and Holahan 2002). Other studies found personal resources such as self-esteem (Brown et al. 1986), coping strategies (Holahan et al. 1997b), and mastery (Jang et al. 2002) played a role in the association between social support and depression. Whereas social support is one of the most frequently studied psychosocial resources (Thoits 1995), to our knowledge no study has looked at motivational processes which mediate the relationship between social support and depressive symptoms in older individuals with and without cognitive impairment. Because depressive symptoms increase risk of death in older adults (Blazer et al. 2001), lead to increased caregiver depression (Neundorfer et al. 2001), and increase the risk of AD in cognitively impaired individuals (Alexopoulos et al. 1993;

Modrego and Ferrandez 2004), it is important to detect possible factors contributing to depression in old age. Research has shown a differential impact of social support and personal coping resources on depression in individuals with various chronic diseases (Bisschop et al. 2004; Penninx et al. 1998); however, the protective impact of social support and motivational processes on depression in old age might even increase in individuals with the increasing cognitive impairment.

Study objectives and goals

This study investigates motivational processes, a composite of four motivation-related constructs (self-efficacy, decision regulation, activation regulation, and motivation regulation), as a mediator of the relationship between social support and depression assessed with the Geriatric Depression Scale (GDS) in individuals with varying severity of cognitive impairment (none, MCI, early AD). Based on the literature, we expected social support and motivational processes to be negatively associated with depressive symptoms in all groups. With regard to the three cognitively different groups, we expected the impact of social support and motivational processes on depression to be the highest in individuals with early AD, followed by individuals with MCI and cognitively unimpaired individuals, as cognitively impaired individuals are more vulnerable and more dependent on their social and motivational resources than cognitively unimpaired individuals. Furthermore, we expected motivational processes to mediate the association between social support and depressive symptoms in the total sample.

Given the cross-sectional design of this study, an additional mediator analysis was computed to test for a reversed effect (motivational processes mediating the impact of depression on social support). Also, we explored different interaction effects: social support × cognitive impairment (none, MCI, early AD); social support × cognitive status (measured by the MMSE); motivational processes × cognitive impairment (none, MCI, early AD) in a post hoc analysis.

Method

Sample

Of the 229 adults aged 52–94 years who participated in the study, 64 participants were diagnosed with MCI and 47 participants were diagnosed with early-stage AD. The remaining 118 participants had no cognitive impairment. Those with MCI and early AD cases were recruited from the "Motivational Reserve as in Alzheimer's" (MoReA) study (Forstmeier and Maercker, submitted). Given that the MoReA project is an ongoing longitudinal study, results on longitudinal data will follow. The present sample, however, uses only its baseline data. To be included in the MoReA study, participants had to be 55 years old or above and diagnosed with either MCI or early-stage AD. Individuals with a history of malignant disease, severe organ failure, metabolic or haematologic disorders, neurosurgery, or neurological conditions such as Parkinson's disease, epilepsy, or postencephalitic and postconcussional syndrome were excluded.

The sample of 118 older adults without cognitive impairment were also aged 55 or above. All participants were tested for cognitive impairment. The mean MMSE (Mini-Mental State Examination) score was 27.37 ($SD = 3.08$).

Table 1 depicts demographic and clinical characteristics of the sample as well as the two variables of interest (motivational processes and social support) according to their degree of cognitive impairment (none, MCI, early AD). Sixty per cent of the participants were female; the mean age was 74 years (age range: 52–94), and the mean education was 13 years. Individuals did not differ in terms of social support and motivational variables but more participants with than without cognitive impairment suffered from depression indicated by a GDS score above five: 28 % (early AD) and 17 % (MCI) of the cognitively impaired group versus only 5 % in the cognitively healthy group. Furthermore, cognitively impaired individuals were older, less educated and less engaged in activities and had a lower cognitive status as indicated by MMSE scores.

Procedure and data collection in the MoReA study

To recruit participants, our lab cooperated with 14 memory clinics and institutions in the German-speaking part of Switzerland. All cooperating clinics had a department which specialised in the diagnosing cognitive impairment and dementia. The study protocol was approved by the regional medical control board.

The study was first mentioned to the patients by their neuropsychologists and/or medical doctors. Those interested in taking part in the study were asked to provide written consent to being contacted by a project psychologist. After that, the project psychologist arranged a first meeting, where the project and further procedure were explained in detail to the participant and written informed consent was obtained from the patient and the informant. All in all, the first meeting lasted about 90 min and included an assessment of general information and the past abilities and interests of the participant. The second meeting included an extensive neuropsychological and clinical assessment of social, cognitive and motivational variables and lasted 2.5 h with breaks. At the same time, the informant was interviewed in a different room. After the second meeting, the participant was given 50 Swiss francs as a reward for participating in the study.

Table 1 Demographic and clinical characteristics, social support and motivational processes comparing individuals with no cognitive impairment ($n = 118$), individuals with MCI ($n = 64$) and individuals with early AD ($n = 47$)

Variable	Total ($n = 229$)	Unimpaired ($n = 118$)	MCI ($n = 64$)	Early AD ($n = 47$)	F/χ^2	Effect size (η^2/w)	Group differences
Age, year (*SD*)	74.4 (7.8)	73.5 (7.4)	73.2 (7.5)	78.0 (8.3)	6.58**	$\eta^2 = 0.06$	U < A; M < A
Gender (% male)	42.4%	38.1 %	56.2 %	34.0 %	7.25*	$w = 0.18$	
Education, year (*SD*)	12.6 (2.6)	13.1 (2.3)	12.3 (2.5)	11.7 (3.0)	6.08**	$\eta^2 = 0.05$	U > A
MMST score, range 0–30 (*SD*)	27.4 (3.1)	29.3 (1.0)	27.1 (2.0)	22.9 (3.0)	192.76***	$\eta^2 = 0.63$	U > M; U > A; M > A
GDS depression mean (*SD*)	2.5 (2.4)	1.7 (1.9)	3.1 (2.7)	3.6 (2.5)	15.79.***	$\eta^2 = 0.12$	U < M; U < A
Depression indicated by GDS >5	13.2 %	5.1 %	17.2 %	28.9 %	17.32***	$w = 0.27$	
Activities (*SD*)	36.2 (13.1)	40.7 (14.6)	34.1 (9.7)	29.7 (10.7)	13.35***	$\eta^2 = 0.12$	U > M; U > A
Motivational processes[a] (*SD*)	0.0 (0.8)	0.04 (0.7)	0.0 (0.8)	−0.1 (0.9)	0.62	$\eta^2 = 0.01$	
Social support (*SD*)	4.2 (0.5)	4.3 (0.5)	4.1 (0.6)	4.2 (0.5)	1.83	$\eta^2 = 0.02$	

Group differences were measured with the Bonferroni post hoc test. *U* unimpaired individuals, *M* individuals with MCI, *A* individuals with early AD. Only significant post hoc tests are mentioned

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. $\eta^2 = 0.01$, 0.06 and 0.14 indicates a small, medium and large effect. $w = 0.10$, 0.30 and 0.50 indicates a small, medium and large effect

[a] Mean of *z*-scores of self-efficacy, decision regulation, activation regulation and motivation regulation

Procedure and data collection for the cognitively unimpaired group

To recruit the sample of cognitively unimpaired participants, two strategies were used: we recruited participants from the "University for Seniors", and contacted participants of former projects undertaken by our research unit. If participants were interested, a meeting was arranged by the project psychologist. First, written informed consent was obtained from the participant. The assessment lasted two hours and included a neuropsychological and clinical assessment of social, cognitive, affective and motivational variables. At the end of the meeting, the participant was rewarded with 30 Swiss francs for participating in the study.

Diagnosis of AD and MCI based on neuropsychological and clinical evaluation

In both the cognitively impaired and the cognitively unimpaired group, general cognitive functioning was assessed with the Mini-Mental State Examination (MMSE; Folstein et al. 1975), a standard screening instrument used to screen for cognitive impairment to assess immediate and delayed memory, orientation, reading and oral comprehension, writing and visual-motor abilities.

To correctly diagnose MCI or AD in the cognitively impaired group, the MoReA study assessed several aspects of cognitive functioning. The main instrument used for assessment was the Consortium to Establish a Registry for Alzheimer's Disease-Neuropsychological Assessment (CERAD-NP; Morris et al. 1989). This extensive neuropsychological assessment was complemented with further cognitive tests. Language was assessed with the CERAD Animal Naming Task (Isaacs and Kennie 1973), the Modified Boston Naming Test (BNT; Kaplan et al. 1978), and the Controlled Oral Word Association Test (Benton and Hamsher 1989). Memory was assessed with the CERAD Word List Memory (learning, recall, and recognition) (Atkinson and Shiffrin 1971) and the Logical Memory and Visual Reproduction subtests of the Wechsler Memory Scale-Revised (WMS-R; Wechsler 1987). The assessment of praxis was performed with the CERAD Constructional Praxis (Rosen et al. 1984) and the Picture Completion subtest of the Wechsler Adult Intelligence Scale-III (WAIS-III; Wechsler 1997). Several tests were used to assess executive functions: task switching (Trail Making Test—Part B; Reitan 1958), inhibition of prepotent responses (Stroop Color-Word Test; Stroop 1935), updating working memory (Digit Span Backward from the WAIS-III) and attention (Trail Making Test—Part A; Reitan 1958; Digit Symbol Substitution Test from the WAIS-III; Wechsler 1997). To clinically rate the severity of Alzheimer's dementia, the Clinical Dementia Rating (CDR; Morris 1993) scale was used. The CDR is a five-point scale (0 = no cognitive impairment; 0.5 = very mild dementia; 1 = mild; 2 = moderate; 3 = severe cognitive impairment).

In the light of these neuropsychological assessments, an interdisciplinary team in each of the cooperating memory

clinics assigned a diagnosis of MCI or mild AD. For a diagnosis of MCI, several criteria had to be fulfilled according to international consensus criteria (Winblad et al. 2004): absence of dementia as diagnosed by DSM–IV criteria (MMSE $\geq$ 24); cognitive decline, i.e. self- and/or informant-reported, and impairment on objective tasks, and/or evidence of decline over time on objective cognitive tasks; preserved basic activities of daily living and not exceeding minimal impairment in complex instrumental functions (CDR $\leq$ 0.5); at least mild impairment in one of the following cognitive domains: memory, language, praxis, executive function, and attention.

Only mild AD cases with scores between 18 and 24 in the Mini Mental State Examination (MMSE; Folstein et al. 1975) and with a score of one in the Clinical Dementia Rating (CDR) scale (Morris 1993) were included according to the criteria for AD established by the National Institute of Neurological and Communicative Disorders and Stroke/Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA). A history of cognitive decline and evidence of impairment in memory and at least one other cognitive domain was required. These criteria corresponded to the diagnosis of "probable Alzheimer's disease" (McKhann et al. 1984).

Assessment of motivational processes

Self-efficacy

To measure self-efficacy, the General Self-Efficacy scale (GSE; Scholz et al. 2002), a German-language scale for assessing generalised self-efficacy, was applied. The scale includes 10 items (e.g. "I am confident that I can deal efficiently with unexpected events") to which participants responded on a four-point scale. The internal consistency was $\alpha = 0.70$.

Activation regulation

To measure activation regulation, the locomotion scale of the Locomotion and Assessment Questionnaire (LAQ; Kruglanski et al. 2000) was used. Participants had to rate the extent to which they agreed with each of 10 statements (e.g. "When I have decided to do something, I can't wait to get started") on a six-point scale. Items for informant-reported activation regulation were adapted accordingly. The internal consistency was $\alpha = 0.77$.

Motivation regulation and decision regulation

Two scales of the Volitional Components Questionnaire (VCQ; Kuhl and Fuhrmann 1998) were used to assess motivation regulation (e.g. "I can usually motivate myself quite well if my determination to persevere weakens") and decision regulation (e.g. "When I think about doing or not doing something, I usually arrive at a decision quickly"). Participants rated the extent to which they agreed with the items on a four-point scale. The internal consistency was $\alpha = 0.76$.

Assessment of depression, social variables and control variables

Depression Depression was assessed by the short form of the GDS (Yesavage et al. 1983). The GDS consists of 15 items (e.g. "Do you often feel helpless?"). Questions refer to the recent week and responses require a "yes" or a "no". It is a reliable and valid screening device for measuring depression in older adults (Friedman et al. 2005), and is also sensitive to depression among older adults suffering from mild to moderate dementia (Sheikh and Yesavage 1986). The short form of the GDS was found to be an adequate substitute for the long one (Lesher and Berryhill 1994). In addition, the measure, which provides a cut-off score of 5/6 (Herrmann et al. 1996), has been found to have very good concurrent validity with the Beck Depression Inventory (Ferraro and Chelminski 1996). The internal consistency was $\alpha = 0.70$.

Social support

Social support was assessed with the short version of the German Social Support Questionnaire (Fragebogen zur sozialen Unterstützung, FSozU; Fydrich et al. 1987) which was validated in a previous study (Fydrich et al. 1999). This 14-item questionnaire measures perceived emotional support (e.g. "I have friends or family members who listen to me when I want to talk about a problem"), instrumental support (e.g. "I can borrow anything from friends or neighbours"), and social integration (e.g. "There is a group of people to whom I belong and with whom I meet regularly") on a four-point scale. The internal consistency in the present sample was $\alpha = 0.88$.

Control variables

To assess the participant's level of education, we asked participants to indicate their highest level of schooling and their highest level of professional training. Based on these two answers, total years of formal education were calculated. Cognitive functioning was measured with the Mini-Mental State Examination (MMSE; Folstein et al. 1975). The assessment of activities was similar to that of Scarmeas et al. (2003) and Wang et al. (2002). Participants had to rate how often they participated in 21 common physical, cognitive, creative and social activities on a six-point scale

(1 = every day or about every day; 2 = several times a week; 3 = once a week; 4 = several times a month; 5 = several times a year; 6 = never). The items were inversed, so higher numbers indicate higher frequencies, and the sum of all 21 items was used in the analyses. The internal consistency was $\alpha = 0.54$.

Statistical analysis

All statistical analyses were performed using PASW for Windows, version 18. The composite measure of motivational processes was calculated by converting the four component tests to z scores, using the baseline mean and standard deviation of all study participants, and averaging the z scores. Motivational variables were significantly correlated with each other, providing empirical evidence of the combination of the four subcomponents in one composite measure (self-efficacy and activation regulation: $r = 0.44$, $p < 0.001$; self-efficacy and motivation regulation: $r = 0.62$, $p < 0.001$; self-efficacy and decision regulation: $r = 0.45$, $p < 0.001$; activation regulation and motivation regulation: $r = 0.49$, $p < 0.001$; activation regulation and decision regulation: $r = 0.46$, $p < 0.001$; motivation regulation and decision regulation: $r = 0.30$, $p < 0.001$).

Group differences according to cognitive impairment (none, MCI, early AD) were analyzed for all variables by computing one-way analyses of variance and χ^2 tests; also, the Bonferroni test was computed to assess post hoc differences between the groups. To assess the correlations between social support, motivational processes and depression, bivariate correlations were calculated. To determine whether the impact of the predictor variables (social support and motivational processes) on depression differed between the three groups (no impairment, MCI, early AD), a series of regression analyses were calculated controlling for age, gender, education, cognitive functioning (MMSE) and activities. First, the impact of social support on depression was calculated separately for each group (no impairment, MCI, early AD); then the impact of motivational processes on depression was calculated accordingly.

Based on Baron and Kenny's (1986) definition of a mediator, a series of regression analyses were calculated to test whether motivational processes mediated the effect of social support on depression. To determine the impact of social support and motivational processes on depression, hierarchical linear regression models were used with depression as dependent variable. In all regression analyses, we controlled for age, gender, education, cognitive functioning (MMSE), cognitive impairment (MCI vs. no impairment; AD vs. no impairment) and activities.

To determine the impact of social support on motivational processes, a second regression analysis was computed. In a last step, we tested whether the impact of the predictor variable was reduced to zero when controlling for the mediator variable. We therefore included the predictor and the mediator variable in the same analysis. To determine the degree of mediation, the Sobel test was used (Sobel 1982) as well as the formula by Mackinnon and Dwyer (1993) to calculate the percentage of the total effect that was mediated.

As all analyses were based on a cross-sectional design, we computed an additional mediation analysis in a post hoc analysis with depression as a predictor, motivational processes as a mediator and social support as dependent variable to explore reversed effects. Also, we tested for different interaction effects (social support × cognitive impairment; social support × cognitive status; motivational processes × cognitive impairment) in a post hoc analysis to see if the effects of motivational processes and social support on depression are different according to cognitive status or cognitive impairment.

The level of statistical significance was set at 0.05 for all analyses.

Results

Motivational variables and depression

Motivational processes were negatively associated with depression in the total sample (see Table 2) with higher motivation correlating with lower depression ($r = -0.41$, $p < 0.001$). Not surprisingly, motivational processes were significantly linked to lower depression ($\beta = -0.41$, $p < 0.001$) in the total sample in a regression analysis controlling for age, gender, education, cognitive functioning (MMSE), cognitive impairment (MCI vs. no

Table 2 Bivariate correlations between motivational processes as well as social support and depression (GDS), for all individuals ($n = 229$), cognitively unimpaired individuals ($n = 118$), individuals with MCI ($n = 64$) and individuals with early AD ($n = 47$)

	All individuals ($n = 229$)	Unimpaired ($n = 118$)	MCI ($n = 64$)	Early AD ($n = 47$)
Motivational processes[a]	−0.41***	−0.50***	−0.35**	−0.38*
Social support	−0.19**	−0.34***	0.03	−0.16

The values represent Pearson correlations

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[a] Mean of *z*-scores of self-efficacy, decision regulation, activation regulation and motivation regulation

impairment; AD vs. no impairment) and activities. When calculating correlations separately for each of the three groups (no cognitive impairment, MCI, early AD), correlations between motivation and depression were higher in the cognitively unimpaired group ($r = -0.50$, $p < 0.001$) than in individuals with MCI ($r = -0.35$, $p < 0.01$) and early AD ($r = -0.38$, $p < 0.05$). Correlations of motivational processes with depression were lower in cognitively impaired individuals (no impairment: $\beta = -0.61$, $p < 0.001$; MCI: $\beta = -0.28$, $p < 0.05$; early AD: $\beta = -0.30$, $p < 0.06$).

Social support and depression

Social support was significantly correlated to depression (see Table 2) in the total sample (social support: $r = -0.15$, $p < 0.05$) and in individuals without cognitive impairment ($r = -0.34$, $p < 0.001$). Contrary to expectations, social support did not correlate to depression in cognitively impaired individuals (MCI: $r = 0.03$, $p = 0.81$; early AD: $r = -0.16$, $p = 0.30$). In a regression analysis with social support as a predictor and depression as the dependent variable (see Table 3), controlling for all covariates including cognitive impairment (MCI vs. no impairment; AD vs. no impairment), we found that social support was negatively associated with depression ($\beta = -0.15$, $p < 0.05$). Among the covariates, both cognitive impairment variables (MCI vs. no impairment: $\beta = 0.29$, $p < 0.001$; AD vs. no impairment: $\beta = 0.35$, $p < 0.01$) had a significant impact on depression. When calculating the impact of social support separately according to the degree of cognitive impairment with regression analyses, social support lost significance in the cognitively impaired groups (no impairment: $\beta = -0.36$, $p < 0.001$; MCI: $\beta = 0.07$, $p = 0.59$; early AD: $\beta = -0.08$, $p = 0.62$).

Table 3 Regression analysis for social support predicting depression (GDS) in the total sample controlled for age, sex, education, cognitive impairment, MMST score and activities

	B	*SE*	*β*
Age	−0.03	0.02	−0.08
Sex (1 = male; 2 = female)	0.35	0.35	0.07
Education	0.08	0.07	0.09
Cognitive impairment 1: MCI vs. no impairment	1.54	0.43	0.29***
Cognitive impairment 2: AD vs. no impairment	2.04	0.71	0.35**
MMST score	0.00	0.09	0.00
Activities	−0.01	0.01	−0.05
Social support	−0.69	0.31	−0.15*

F (201, 8) = 4.83***, $r^2 = 17$

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Motivational processes as mediator

For a mediator effect to be present, the predictor variable—in this case social support—has to be a significant predictor not only of the dependent variable but also of the mediating variable. Social support was indeed significantly linked to the mediating variable in a regression analysis with motivational processes as dependent variable ($\beta = 0.24$, $p < 0.01$) in the total sample. In a last step, the predictor and the mediator variable were entered into the same regression analysis (Table 4; Fig. 1). When social support and motivational processes were included in a regression analysis predicting depression, the beta weight for social support lost significance ($\beta = -0.06$, $p = 0.37$) but motivational processes still predicted depression significantly ($\beta = -0.39$, $p < 0.001$). This mediation effect was supported by the Sobel test ($z = 3.08.$, $p < 0.01$); 63 % of the total effect was mediated (Table 4; Fig. 1a).

Post hoc analyses

To explore potential reversed effects, we computed a second mediator analysis with depression as the predictor variable and social support as dependent variable (Fig. 1b). When depression and motivational processes were included in this regression analysis, depression lost significance ($\beta = -0.07$, $p = 0.37$), and motivational processes were significantly linked to social support ($\beta = 0.19$, $p < 0.01$). This mediation effect was supported by the Sobel test ($z = 2.62$, $p < 0.01$) and 51 % of the total effect was mediated.

Unexpectedly, social support was not linked to depression in the cognitively impaired individuals, so we tested for interaction effects (social support × cognitive impairment; social support × cognitive status) in two additional regression analyses. Neither social support interacting with cognitive impairment variables (MCI vs. no cognitive impairment: $\beta = 0.11$, $p = 0.10$; AD vs. no cognitive impairment: $\beta = -0.01$, $p = 0.88$) nor social support interacting with cognitive status indicated by the MMSE scores ($\beta = -0.03$, $p = 0.70$) were significantly linked to depression. Also, we tested for two additional interaction effects (motivation × cognitive impairment), which were not linked to depression (MCI vs. no cognitive impairment: $\beta = 0.00$, $p = 0.99$; AD vs. no cognitive impairment: $\beta = -0.08$, $p = 0.22$).

Discussion

This study investigated the differential impact of social support and a motivational process based on a composite of four subcomponents, namely self-efficacy, decision

Table 4 Regression analysis: motivational processes mediating the relationship between social support (FsozU) and depression (GDS)

	B	*SE*	*β*	ΔR^2	*ΔF*	R^2	*F*
Step 1							
						0.17	4.83***
Social support	−0.69	0.31	−0.15*				
Step 2							
						0.31	9.56***
Social support	−0.26	0.29	−0.06				
Motivational processes[a]	−1.24	0.19	−0.39***	0.14	39.71***		

Age, gender, education, cognitive functioning (MMS), cognitive impairment (none, MCI, AD), depression (GDS) and activities were controlled for

[a] Mean of *z*-scores of self-efficacy, decision regulation, activation regulation and motivation regulation

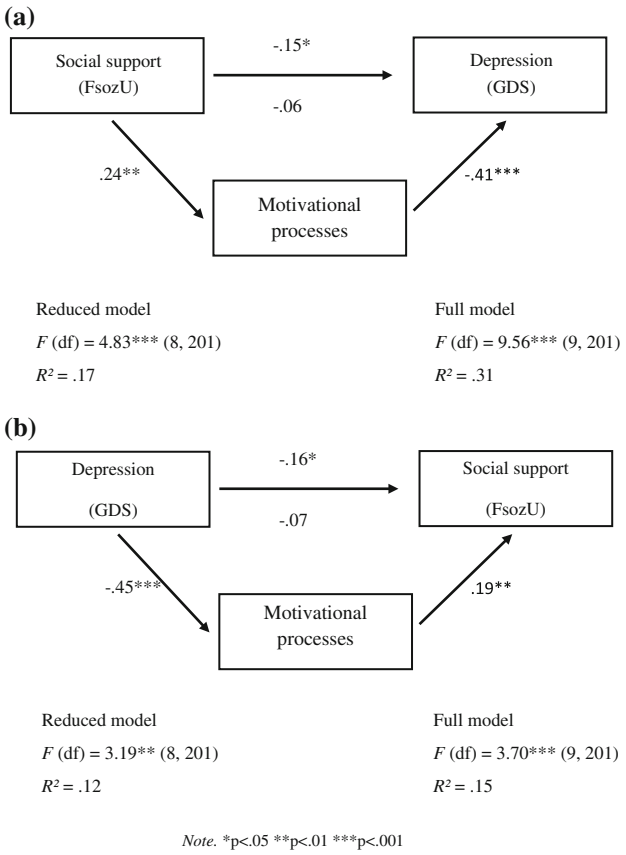

Fig. 1 **a** Mediation regression analysis for depression (GDS), including beta weights, *F* values, and R^2 for the model before (reduced model) and after (full model) inclusion of the mediator (motivational processes). The initial path between the predictor (social support) and depression is indicated by the beta weight above the line connecting these variables; the beta weight after inclusion of the mediator is indicated by the value below this line. **b** Mediation regression analysis for social support (FsozU), including beta weights, *F* values, and R^2 for the model before (reduced model) and after (full model) inclusion of the mediator (motivational processes). The initial path between the predictor (depression) and social support is indicated by the beta weight above the line connecting these variables; the beta weight after inclusion of the mediator is indicated by the value below this line

regulation, activation regulation, and motivation regulation, on depressive symptoms in individuals with and without cognitive impairment. Also, this motivational process was investigated as a mediator in the relationship between social support and depression. In the cognitively impaired group, 28 % (early AD) and 17 % (MCI) were classified as suffering from a depression (GDS cutoff > 5) versus 5 % in the cognitively unimpaired group.

While social support predicted depression significantly in the total sample, it did not correlate significantly in the cognitively impaired sample. Therefore, it can be concluded that the effect was driven mainly by the cognitively unimpaired individuals. The lack of correlation between social support and depression in the cognitively impaired sample may have several reasons. Depressive symptoms in this sample might be the result of dementia-related processes, as symptoms typical of depression also occur in those suffering from dementia (Brodaty and Luscombe 1996). These findings are consistent with results reported by Cervilla and Prince (1997), who found weaker associations between social support deficits and depression for subjects with cognitive impairment than for those without. Cervilla and Prince (1997) suggest two different pathways lead to depression in older adults: social distress and cerebral deterioration clinically expressed as cognitive impairment. Other studies have shown etiologically different subtypes of depression in later life (Dillon et al. 2009; Van den Berg et al. 2001), suggesting that depression in cognitively impaired individuals is determined by other factors than depression in cognitively unimpaired individuals. Based on these findings, it can be argued that the impact of social support on depression is attenuated by cerebral deterioration in cognitively impaired individuals, as depression might be a side effect of brain degeneration (Dillon et al. 2009).

Social support usually refers to the functions performed for the individual by significant others (Thoits 1995). Although the underlying mechanisms are not clear, we

suggest social support is closely related to coping with difficult situations. Lazarus (1991) differentiates problem-focused from emotion-focused coping. Instrumental support and problem-focused coping are both directed at managing a stressful situation, whereas emotional support and emotion-focused coping are directed at relieving negative emotions during a stressful situation (Thoits 1986). In particular, proactive coping—the active endeavour to improve one's life—was found to be negatively associated with depression (Greenglass et al. 2006). Thus, accepting Thoits' (1986) definition of social support as coping assistance, the providers of social support help the receiver cope successfully with stressful situations, which in turn decreases the risk of a depressive reaction. This is in line with the findings of Greenglass (1993), who found an association between social support and proactive coping.

Proactive coping includes motivational concepts and combines goal-setting with self-regulatory cognitions and behaviours (Schwarzer and Taubert 2002), so it is not surprising that social support lost significance in the mediation analyses when motivational processes were included. That is, motivational processes were shown to be the crucial factor influencing depressive symptoms even with social support as a predictor. In the overall sample, motivational processes based on the four subcomponents self-efficacy, activation regulation, motivation regulation and decision regulation mediated the impact of social support on depression. Thus, social support influences depressive symptoms only to the extent that it has an impact on motivational processes. The present findings are consistent with previous research (Benight and Bandura 2004; Bisconti and Bergeman 1999; Cutrona and Troutman 1986; Saltzman and Holahan 2002; Smith et al. 2000) and with the assumption that social support operates through adaptive mechanisms such as self-efficacy (Berkman et al. 2000) and coping (Holahan et al. 1997a).

Motivational processes were significantly linked to lower depression, even when we controlled for cognitive functioning and cognitive impairment. The higher the motivational processes of an individual are, the lower are his or her depressive symptoms. The use of efficient-coping strategies may account for this result. If depressive symptoms are interpreted as a reaction to ineffective attempts to solve problems, the importance of motivational variables is evident. When trying to solve a problem, individuals define goals to improve the situation. To achieve these goals, motivational skills are required—activation regulation to initiate an action, decision regulation to reach a fast decision, motivation regulation to persevere with a task when facing difficulties, and self-efficacy to believe in the ability to cope with difficult tasks (Kuhl and Fuhrmann 1998; Kruglanski et al. 2000; Bandura 1997). Problem-solving was shown to moderate stress-related depressive symptoms in previous studies (Nezu and Ronan 1988), suggesting that depressed patients rely on inadequate strategies to address their problems. According to Bandura (1982), low self-efficacy is associated with suboptimal performance of skills. Watkins and Baracaia (2002) suggested that impaired social problem-solving in depression is a consequence of state-oriented rumination, which is characterised by preoccupation with the evaluation of past successes and failures and with simulating alternative plans (Kuhl 1981). People with a disposition toward state orientation were shown to be more vulnerable to depressive symptoms (Rholes et al. 1989). In contrast, action orientation is characterised by action planning and effective self-monitoring, and utilises strategies such as activation, motivation and decision regulation. These motivational variables may, therefore, be important resources protecting individuals from depressive symptoms because they help them to solve problems and reach goals actively and successfully rather than focusing on the evaluation of past failures and simulating different plans. Contrary to expectations, correlations of motivational processes with depression were lower in cognitively impaired individuals, indicating that similar as described above regarding the impact of social support on depression in cognitively impaired individuals other mechanisms such as cerebral deterioration play a role in these groups.

Strengths, limitations and outlook

Because the presented data are cross-sectional, no assumptions can be made about the causal directions of the effects. Although previous research supports our interpretation, other explanations can account for the results. It can be argued that depressive symptoms lead to less proactive coping, and that depressed people elicit less social support. This possibility was tested in an additional post hoc analysis with motivation mediating the impact of depression on social support. Results indicate that effects in both directions (social support leading to less depression and depression leading to less support) are possible. This is consistent with earlier results on longitudinal studies on the relationship between depression and social support (Stice et al. 2004; Wade and Kendler 2000). Also, cognitive impairment might have a detrimental effect on motivational processes rather than the other way round. To test for causal effects, further studies on the subject should use a longitudinal design. Given that the present findings are based on a baseline assessment of an ongoing longitudinal study, subsequent results will make the analysis of causal effects possible. Furthermore, the educational level was very high, with an average number of 13 years of education, which might not represent the average educational level in the general population.

The present study has highlighted a number of issues linking motivational processes, social support and depression in individuals with and without cognitive impairment. Despite several limitations, this study expands past findings on the subject by analyzing various motivation-related constructs mediating the relationship between social support and depressive symptoms. Based on our findings, it can be argued that the impact of social support on depressive symptoms is attenuated by cerebral deterioration in cognitively impaired individuals, while motivational processes remain relevant. Programmes aimed at treating depression in old age should also target motivational processes such as self-efficacy and self-motivation, which have already proved to be malleable (Bandura 1997; Forstmeier and Rüddel 2007), and take differences between cognitively healthy versus cognitively impaired individuals into account. As different processes seem to be responsible for depressive symptoms in cognitively impaired individuals, different approaches to treating depression in later life might be appropriate.

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