Understanding depressive symptoms in nursing home residents: the role of frequency and enjoyability of different expanded everyday activities relevant to the nursing home setting

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Abstract

Depressive symptoms are highly prevalent in nursing home (NH) residents. We assume that enjoyability, besides frequency of activities, is an important facet of expanded everyday activities (EEAs; Baltes et al., in: Baltes and Mayer (eds) *The Berlin aging study*, University of California Press, Berkeley, 2001) and affects residents' depressive symptoms. Furthermore, we assume that associations with depressive symptoms vary for different EEAs, namely contact with co-residents and staff and participation in organized in-home activities. To investigate these associations, longitudinal data from 160 residents ($M_{\text{age}} = 83.1$ years, $SD = 9.8$ years, 73% female) of two German NHs, assessed across four measurement occasions each 3 months apart, were analyzed. Depressive symptoms were assessed by the Geriatric Depression Scale-Residential (GDS-12R); the frequency of EEAs and their enjoyabilities were assessed via proxy ratings and interviews, respectively. As data from the completed Long-Term Care in Motion intervention study were used, 49% of the sample also received a physical activity intervention. Generalized linear mixed models were run to test the hypothesized effects as flexibly as possible, accounting for non-normality of the GDS-12R and controlling for residents' intervention status. The results showed that the interaction effect of the enjoyability of contact with co-residents and contact frequency was relevant for residents' depressive symptoms rather than the effect of contact frequency alone. The frequency of staff contact was only marginally associated with fewer depressive symptoms. Further, enjoying participating in organized in-home activities was associated with fewer depressive symptoms. In conclusion, findings support our conceptually driven expectation of differential effects in terms of different EEAs on depressive symptoms.

Keywords Nursing home · Depressive symptoms · Everyday activity · Social activity · Pleasant events

Introduction

The absolute number of dependent older persons receiving institutionalized care will remain high or even rise in the Western world (European Commission [DG ECFIN] & Economic Policy Committee [AWG], 2012). Among nursing home (NH) residents, clinically relevant depressive symptoms are highly prevalent with estimates of up to 61% (Meeks et al. 2011). Depressive symptoms merit research attention as they are associated with cognitive decline, subjective health problems, impaired activities of daily living (ADL), increased need of care, and mortality (Blazer 2003; Fries et al. 1993).

To conceptualize depressive symptoms, the current study primarily relies on Lewinsohn's well-established behavioral approach to depression (Lewinsohn 1974;

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Lewinsohn et al. 1985) and its key idea of a lack of reinforcement driving depressive symptoms. The model has been adapted to explain depression in NH residents (Meeks and Depp 2003). Lewinsohn (1974) distinguishes between the *frequency* and *enjoyability* of activities. According to Lewinsohn, the interplay of the frequency and enjoyability of activities determines the reinforcing value of a given activity, which then affects an individual's depressive symptoms. Hence, we argue that activity enjoyability needs to be considered next to activity frequency to understand the role of reinforcement as a proximal predictor of residents' depressive symptoms.

Empirically, available studies support the importance of pleasant activities for older community-dwelling adults' and NH residents' low depressive symptoms (Lewinsohn and Graf 1973; Meeks et al. 2007). Successful behavioral treatments for depression in NH residents have built on Lewinsohn's theory, i.e., increased the frequency of pleasant activities (e.g., Konnert et al. 2009; Meeks et al. 2015). However, more research is needed to disentangle the effects of frequency versus enjoyability of different everyday activities on depressive symptoms in the NH ecology.

Besides the overall distinction between frequency and enjoyability, Lewinsohn (1974) distinguished between distinct activity domains (e.g., bodily, cognitive, social) which are expected to be differentially associated with depressive symptoms. Previous empirical findings also support the need to differentiate these activity domains in predicting depressive symptoms in older adults (Hsu and Wright 2014; Lewinsohn and Graf 1973; Meeks et al. 2007; Meeks and Looney 2011). Following this reasoning, the present study examines differential associations of qualitatively different everyday social activities and their respective enjoyabilities with residents' depressive symptoms. To conceptualize everyday activities, we refer to the established everyday competence model proposed by Baltes et al. (2001).

This model distinguishes basic competence (BaCo) from expanded everyday activities (EEAs), the latter being the focus of the present study. According to Baltes et al. (2001), social activity is an important indicator of EEA. EEAs comprise activities that primarily stem from individual preferences and that elicit meaning in life beyond basic self-preservation (Baltes et al. 2001). Moreover, the socioemotional selectivity theory claims that emotionally meaningful social goals become more relevant as an individual's future-time perspective shrinks (Carstensen et al. 2003). Accordingly, potentially reinforcing social activities could be especially important for alleviating depressive symptoms of NH residents who generally represent a vulnerable subpopulation of old-age individuals close to life's end (Freedman and Spillman 2014). Empirical support comes from studies showing that a perceived loss of activity participation or perceived friendliness of staff and co-residents were associated with

residents' depressive symptoms (Mortenson et al. 2012; Park 2009).

We further assume that contact with co-residents, contact with care staff, and participation in offered in-home activities are particularly important EEA domains in the daily ecology of NH residents. In an early observational study, Baltes et al. (1983) found that 35% of residents' social contacts were with co-residents, and 50% with staff, meaning that these are the most prominent social interactions in the NH. Visitor contacts accounted for only 10% of residents' social contacts.

The frequency and enjoyability of *self-initiated contact with co-residents* may be associated with fewer depressive symptoms. As institutional routines might determine contact frequency to a considerable extent, the frequency of *self-initiated* contacts rather than contact frequency as such may be important. Self-initiated co-resident contacts may have the character of being most 'normal' and informal, and may have the strongest overlap with social contacting in earlier life. Additionally, residents may control how often they have contact with whom, which should induce well-being and reduce depressive symptoms (Herzog et al. 1998). Following Lewinsohn (1974), we additionally assume that the more enjoyable co-resident contacting is, the stronger the association with fewer depressive symptoms. That is, if the contact is perceived as enjoyable, residents may gain hedonic rewards, which are assumed to counteract depressive symptoms (Lewinsohn et al. 1985; Meeks and Depp 2003).

However, self-initiated co-resident contact may or may not be enjoyable. It may be enjoyable as co-residents belong to the same in-group, may face comparable emotional strains, and may be able to share pleasures from the same events or activities. Otherwise, it may be unpleasant as co-residents largely suffer from impairments (e.g., sensory, mobility-related, cognitive), which may limit their ability to communicate and to build enjoyable, gratifying relationships (Park et al. 2012). Therefore, enjoyable self-initiated co-resident contacts may only be associated with fewer depressive symptoms if they occur more frequently than unpleasant co-resident contacts; i.e., contact frequency is expected to moderate the effect of contact enjoyability on residents' depressive symptoms. Supporting this notion empirically, unmet needs regarding company (e.g., due to infrequent or unpleasant contacts) were found to be more common in depressed compared to non-depressed NH residents (Ferreira et al. 2016); further, greater perceived co-resident friendliness (i.e., contact enjoyability) was associated with fewer depressive symptoms (Park 2009).

Regarding *self-initiated contact with care staff*, we expect different associations. Here, the frequency of self-initiated staff contact may not be strongly associated with fewer depressive symptoms. The frequency of self-initiated staff contact depends on institutionalized routines, which

minimize residents' chances to control how often they have contact with staff members. Moreover, the frequency of initiating staff contact may represent residents' need of care, which might be associated with more, rather than fewer depressive symptoms. Enjoyable staff contacts, however, may be associated with fewer depressive symptoms. Supporting this notion empirically, perceived staff friendliness was associated with fewer depressive symptoms (Park 2009) but caring for residents typically did not imply close friendship with residents (Park et al. 2012).

Next, for *participating in organized activities within the NH*, frequency alone may not be associated with fewer depressive symptoms as most activities are organized groups with limited opportunity for experiencing social-emotionally gratifying encounters. However, participation enjoyability may be associated with higher reinforcement independent of participation frequency. Therefore, the enjoyability of participation rather than participating more or less frequently may be associated with fewer depressive symptoms. As emerging empirical support, we note that correlations between activities like entertainment and residents' depressive symptoms were observed for the enjoyability rather than the frequency of activities (Hsu and Wright 2014).

This paper uses longitudinal data of a completed physical activity intervention study in the NH (Jansen et al. 2014) to examine the long-term interplay of EEA frequency, EEA enjoyability, and depressive symptoms in NH residents.

Research questions and hypotheses

Based on the reasoning outlined above, we examine two overarching research questions: How do EEA frequencies and their enjoyabilities predict residents' depressive symptoms? How do the associations vary for different activity domains?

For self-initiated co-resident contact, we expect the interaction of contact frequency and enjoyability to be associated with lower depressive symptoms. Precisely, we expect the fewest depressive symptoms for residents having frequent and enjoyable co-resident contacts. For staff contact and participation in organized in-home activities, we expect an effect of enjoyability, but not of frequency on residents' depressive symptoms.

Methods

Setting and study design

Data were drawn from the Long-Term Care in Motion study (LTCMo, Current Controlled Trials ISRCTN96090441; Jansen et al. 2014), an intervention study aiming at enhancing residents' physical activity behavior in the NH.

Residents from two NHs (denoted as NH1 and NH2) in Heidelberg, Germany participated. The NHs were located in the same neighborhood, run by the same organization; they offered equally high care standards and similar activity programs. All non-palliative, long-term care residents were approached, irrespective of their cognitive or physical status. Residents (or their legal representatives) provided written informed consent. Ethical approval for the project was obtained from the Ethic Review Board of the Faculty of Behavioral and Cultural Studies at Heidelberg University. The study conformed to the respective policy and mandates of the Declaration of Helsinki.

The current study used a longitudinal design including the quasi-experimental physical activity promotion program of the completed LTCMo trial. Parts of the program aimed at improving residents' BaCo. Residents were assessed before (pretest), immediately after (posttest), and following up the intervention (follow-up) with all assessments occurring at three-month intervals. Additionally, a baseline assessment was conducted 3 months before the pretest in NH2 to investigate residents' development under usual care. Residents moving into the NHs and residents consenting after study start could drop in.

Measures

Depressive symptoms

At all measurement occasions, residents were assessed using the German 12-item Geriatric Depression Scale-Residential (GDS-12R; Sutcliffe et al. 2000), which was developed for use in NH residents. The GDS-12R excludes the items *Do you prefer to stay at home, rather than going out and doing new things?*, *Do you feel you have more problems with memory than most?*, and *Do you think that most people are better off than you are?* that may be ambiguous in the NH context (Sutcliffe et al. 2000). The GDS offers a dichotomous response format and has been validated in old-age samples including persons with mild-to-moderate cognitive impairment (Conradsson et al. 2013). To acknowledge that a self-report measure was used instead of clinical assessments, the term *depressive symptoms* is used throughout the manuscript. To enhance assessment reliability, research assistants were trained in interview techniques with cognitively impaired residents, including dealing with potential answering behavior. Each research assistant also received two field supervisions to get extensive feedback on his/her techniques. If he/she doubted that the resident understood the content of a question, the answer was coded as missing. Negatively worded items were reverse-coded, and scale values were calculated by multiplying the mean item-score (total score of the items divided by number of items as far as had been answered) by the total number of scale items

to control for missing items. If more than three items were missing, the scale score was set as missing (Sutcliffe et al. 2000). Resulting scores ranged from 0 to 12, with higher scores indicating more depressive symptoms. The scale's internal consistency was good (Cronbach's α between .81 and .86 for all measurement occasions).

Expanded everyday activity

Baltes et al. (2001) operationalized EEAs by working, leisure, and social activities. Focusing on activities relevant to the NH context in the present study, EEAs were operationalized by social contacts and in-home leisure activities. We applied a care and behavior assessment for NHs (Köhler et al. 2010) rated by activity-coordinating NH staff. First, staff assessed residents' self-initiated *social contact with co-residents* and *with staff*, rating the frequency of residents' self-initiated contact during the past 2 weeks on a scale ranging from 0 (*does not proactively communicate*) to 2 (*approaches others often and willingly*). As *does not proactively communicate* was rated by only 6 and 3% of residents at their first measurement occasion, this hardly rated category was collapsed with the medium category of each contact item; i.e., these two items were dichotomized for the analyses (*approaches others often and willingly* [formerly 2] or *not often and willingly* [formerly 0, 1]).

Activity-coordinating staff rated the frequency of residents' *activity participation* in several organized activities during the last 2 weeks on a scale ranging from 0 (*never*) to 3 (*very often [nearly daily]*). In keeping with previous analyses, we used the frequency of participation in in-home events (festivals, services, visits from schools, etc.), musical activities (singing, making music, dancing, etc.), and entertainment activities (being read to, watching films, playing games, etc.; Diegelmann et al. 2017b), but excluded participation in in-home physical activities (like seated gymnastics) to avoid confounding with participation in the training (LTCMo). LTCMo participation was included explicitly in the model. To enhance assessment reliability, questions on items were discussed with staff members and examples for activity categories were given. Scale values were calculated by multiplying the mean item-score (total score of the items divided by number of items as far as had been answered) by the total number of scale items to control for missing items. If more than one item was missing, the scale score was set as missing. The score ranged from 0 to 9, with higher scores indicating more frequent participation. It was internally consistent (Cronbach's α between .74 and .81 for all measurement occasions). For the analyses, the score of activity participation frequency was grand-mean-centered (activity participation = 0 for mean activity participation frequency).

Enjoyability

Following the Pleasant Events Schedule-Nursing Home Version (Meeks et al. 2009), residents were also interviewed about the enjoyability of *Talking with another resident*, *Talking with care staff or activity coordinators*, and *Participating in a group activity (Morning meeting, current events, singing)*¹ using single items ranging from 0 (*not at all pleasant*) to 2 (*very pleasant*). As *not at all pleasant* was rated by only 9, 5, and 20% of residents at their first measurement occasion, this hardly rated category was collapsed with the medium category of each enjoyability item; i.e., these items were also dichotomized (*very pleasant* [formerly 2] or *not very pleasant* [formerly 0, 1]).

Covariates

Emerging findings support the idea that the physical activity promotion program is indeed able to stabilize depressive symptoms, which is assumed to be achieved via biological, psychological, social, and environmental pathways (Diegelmann et al. 2017a). Therefore, training participation was included in the statistical model. Residents who participated in LTCMo's training were considered as belonging to the intervention group; residents who did not participate in any session were considered as naturally occurring control group. Furthermore, residents' home affiliation, sex, age-at-pretest, and antidepressant medication were obtained from the care documentation. Residents' pharmacological treatment with antidepressants was recorded following the Anatomical Therapeutic Chemical classification codes (ATC code N06A for antidepressants; 0 = does not receive antidepressant treatment, 1 = receives antidepressant treatment). Additionally, residents' cognitive ability was tested using the Mini-Mental State Examination (MMSE; Folstein et al. 1975). To avoid scoring an item as unknown when it was missing due to sensory or motor impairment (e.g., visual impairment or inability to draw) or due to aphasia, MMSE scores were calculated by multiplying the mean item scores (i.e., the number of correct items divided by the number of items answered) with the number of test items to control for missing items (doing so, the MMSE item scored 0–5 was divided by five). If more than four items were missing, the scale score was set as missing. The MMSE ranges from 0 to 30 with higher scores indicating better cognitive performance. For the analyses, the grand-mean-centered person-mean of MMSE was used, so that the difference between the sample's mean MMSE and a person's average score across all measurement occasions was controlled.

¹ That is, a single enjoyability item was used for the in-home activity score.

Data analysis

To examine linkages between the frequency and enjoyability of EEAs and depressive symptoms, generalized linear mixed models (GLMMs; Hedeker 2005) for longitudinal data were used. The role of each EEA domain (co-resident contact, staff contact, participation in organized in-home activities) was investigated in a separate model. GLMMs were chosen because they fit models to non-normal outcome distributions. Also, this method provides missing-at-random data treatment in that it uses all available data points including those for residents who missed some occasions (Schafer and Graham 2002), thereby improving power. First, the main effects of EEA frequency and enjoyability on depressive symptoms were tested ($M1$); then, interactional effects were tested between activity frequency and enjoyability ($M2$). The basic model tested (without interactions) was

$$g(\mu_{it}) = \beta_0 + \beta_1 \text{ACT}_{it} + \beta_2 \text{ENJ}_{it} + \beta_3 T_{it} + \beta_4 \text{PAPOS}_{it} + \beta_5 \text{PAFUP}_{it} + \beta_6 \text{NH}_i + \beta_7 \text{SEX}_i + \beta_8 \text{AGE}_i + \beta_9 \text{AM}_{it} + \beta_{10} \text{MMSE}_i + U_{0i} \quad (1)$$

with $g(\bullet)$ a distribution-dependent link function, μ_{it} the expected depressive symptoms value of resident i at measurement occasion t . The β s denote fixed effects and U_{0i} a random effect. ACT_{it} denotes a dummy variable indicating EEA frequency of resident i at measurement occasion t ,² whereas ENJ_{it} is a dummy variable indicating whether this activity has been perceived as enjoyable or not. T_{it} refers to time-in-study, controlling for a potential (linear) change in depressive symptoms across the observation period.³ PAPOS_{it} denotes a dummy variable indicating post-intervention measurement in the training group (i.e., coded 1 for the post-measurement of training participants but 0 otherwise); hence, β_4 tests the BaCo-related intervention effect at posttest. Additionally, this training-related effect implies that t denotes the expected change in depressive symptoms for all residents before the intervention started and for residents not participating in the training after training start. PAFUP_{it} denotes a dummy variable indicating training follow-up measurement (i.e., 3 months after the end of the study intervention; coded 1 for the follow-up measurement of residents who participated in the intervention, and 0 otherwise);

hence, β_5 tests the intervention's sustainability at follow-up (Diegelmann et al. 2017a). NH_i denotes a dummy variable indicating resident i 's NH to control for potential effects of the home affiliation; SEX_i controls for gender-specific effects, AGE_i for age effects at pretest, AM_{it} for antidepressant medication at the respective measurement occasion, and MMSE_i for residents' cognitive ability.

GLMMs with Laplace approximation (to obtain maximum likelihood-based fit statistics) and the empirical estimator were run using PROC GLIMMIX (SAS Institute Inc 2011). Model fit was assessed using the portion of intra-individual variance explained by the model estimates following Xu's (2003) operationalization of R^2 as the reduction of residual variance of the model tested (σ^2) compared with the residual variance of the random intercept-only null model (σ_0^2), i.e., $R^2 = 1 - \sigma^2 / \sigma_0^2$. If hypothesized effects were marginally significant, they are reported.

As the GDS-12R items *Have you dropped many of your activities and interests?* and *Do you often get bored?* may overlap with the item *participation in in-home physical activity groups* and may thus introduce some bias, the activity participation analyses were re-run excluding those items.

Results

Descriptive data on the sample

Descriptive information on study variables is displayed in Table 1. The analyzed sample consisted of 160 residents.⁴ At participants' first measurement occasions, 28% showed clinically relevant depressive symptoms according to the GDS-12R cut-off criterion (Sutcliffe et al. 2000). Residents were aged 83.1 (SD = 9.8 years), 73% were female, and 52% were widowed; they had an average of 12.2 years of education. Of the participants, 61% resided in NH2, 16% lived on a dementia-care unit. No dementia diagnosis was available, but following Paquay et al. (2007), 44% were cognitively impaired ($\text{MMSE} \leq 19$). 11% had $\text{MMSE} < 10$, 16% between 10 and 14, 40% between 15 and 24, and 33% had $\text{MMSE} > 24$. Half of the residents (49%) participated in the BaCo-related intervention. During the longitudinal observation, only three participants were newly medicated with antidepressants. Considering a resident's first participation, bootstrap step-down-corrected p values from t tests and Fisher's exact tests did not show any differences between trained and untrained residents on model-relevant variables (all $p > .05$).

² Except for activity participation, for which an interval-scaled and grand-mean-centered activity score was used.

³ Note that $T_{it} = 0$ indicates NH-specific first measurements, hence it may refer to pretest (NH1) or to the baseline measurement before pretest (NH2). Moreover, as the respective random-slope variance was close to zero in previous analyses (Diegelmann et al. 2017a) and caused convergence problems in the present analyses, it was discarded from the models.

⁴ Sample size reductions in the presented GLMM-models are due to missing data on covariates.

Table 1 Sample description by study variables

Variable	NH1: pretest/NH2: baseline		Posttest/pretest		Follow-up/posttest		NH2: follow-up	
	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)
Geriatric Depression Scale-Residential (GDS-12R; 0–12)	124	3.0 (3.1)	128	3.0 (3.0)	111	3.4 (3.3)	71	3.9 (3.7)
Self-initiated contact with co-residents (0, 1)	116	0.6 (0.5)	113	0.6 (0.5)	106	0.6 (0.5)	63	0.6 (0.5)
Enjoys talking with co-residents (0, 1)	117	0.4 (0.5)	119	0.4 (0.5)	107	0.5 (0.5)	66	0.3 (0.5)
Self-initiated contact with staff (0, 1)	113	0.7 (0.5)	112	0.6 (0.5)	106	0.7 (0.5)	66	0.7 (0.5)
Enjoys talking with staff (0, 1)	114	0.5 (0.5)	117	0.6 (0.5)	107	0.6 (0.5)	64	0.6 (0.5)
Activity participation (0–9)	117	3.8 (2.4)	114	3.1 (2.2)	109	3.4 (2.2)	63	3.0 (2.3)
Enjoys participating (0, 1)	118	0.5 (0.5)	120	0.5 (0.5)	102	0.5 (0.5)	63	0.5 (0.5)

T referring to time-in-study; *T*₃ was only available in NH2 as NH1 did not have a baseline measurement

Table 2 Correlations of study variables

	GDS-12R	CR	ER	CS	ES	AC	EA	PO	FU
Geriatric Depression Scale-Residential (GDS-12R)									
Self-initiated contact with co-residents (CR)	– .15								
Enjoys talking with co-residents (ER)	– .24**	.22*							
Self-initiated contact with staff (CS)	– .03	.70***	.21*						
Enjoys talking with staff (ES)	– .14	.01	.42***	.17					
Activity participation (AC)	– .17	.41***	.08	.32***	.04				
Enjoys participating (EA)	.01	.29**	.28**	.23*	.27**	.36***			
Training group post-intervention ^a (PO)	– .20*	.13	– .06	.02	.02	.06	– .02		
Training group following-up intervention ^b (FU)	– .10	.10	.01	– .01	– .01	.08	– .07		
Home 1	.11	– .20*	– .09	– .18	– .03	– .30***	– .21*	– .06	– .08
Male	– .06	– .21*	– .15	– .21*	– .13	– .28**	– .15	.06	.07
Age-at-pretest	– .11	.13	.13	.07	– .17	.10	.10	.10	.09
Antidepressant medication	.07	– .09	.03	.02	.10	– .05	– .05	– .02	– .12
Mini-mental state examination	.18*	.07	– .21*	.05	.10	– .18	.05	– .12	– .16

Values in the lower triangular part denote between-subject (inter-individual) correlations at residents' first measurement occasion

^aCorrelations for this variable at the post-intervention measurement

^bCorrelations for this variable at the measurement following up the intervention

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

Correlations between study variables are depicted in Table 2. Pearson correlations are displayed which are equal to point biserial correlations between interval-scaled and dichotomous variables (correlations with depressive symptoms and activity participation; Kornbrot 2014) and also to the ϕ -coefficient of the association between dichotomous variables (Chedzoy 2014). A strong correlation was found for self-initiated co-resident contact with staff contact ($\phi = .70$, $p < .001$). Frequency and enjoyability were only weakly correlated for co-resident contact ($\phi = .22$, $p < .05$); they were not significantly correlated for staff contact ($\phi = .17$, $p > .05$), but higher correlated for activity participation ($r = .36$, $p < .001$). Of the enjoyability variables,

only enjoying co-resident contact significantly correlated with depressive symptoms ($r = -.24$, $p < .01$).

Preparatory analyses

The depressive symptoms score showed substantial non-normality across residents and measurement occasions (median = 2, range = 0–12, skewness = 0.9, kurtosis = – 0.2). That is, the score was highly right-skewed. The Anderson–Darling fit statistic—a squared difference statistic—indicated that the gamma distribution ($A^2 = 10.0$) was more appropriate for modeling the outcome than the normal distribution ($A^2 = 18.5$), though neither fit perfectly (both A^2

Table 3 Generalized linear mixed models of depressive symptoms regressed on EEA-related activity, the respective enjoyability, and covariates

Parameter	Co-resident contact $n = 154$ with 371 observations		Staff contact $n = 151$ with 363 observations		Activity participation $n = 154$ with 369 observations	
	<i>M1</i>	<i>M2</i>	<i>M1</i>	<i>M2</i>	<i>M1</i>	<i>M2</i>
	Est (SE)	Est (SE)	Est (SE)	Est (SE)	Est (SE)	Est (SE)
<i>Fixed effects</i>						
Intercept	1.32 (0.11)***	1.28 (0.11)***	1.31 (0.11)***	1.31 (0.12)***	1.28 (0.10)***	1.28 (0.10)***
ACT	− 0.13 (0.08) ⁺	− 0.04 (0.09)	− 0.12 (0.07) ⁺	− 0.12 (0.09)	− 0.00 (0.02)	0.02 (0.02)
ENJ	− 0.14 (0.07) ⁺	0.03 (0.09)	− 0.12 (0.07)	− 0.12 (0.11)	− 0.10 (0.06) ⁺	− 0.09 (0.06)
ACT × ENJ		− 0.26 (0.13)*		0.01 (0.12)		− 0.03 (0.03)
<i>T</i> (Months)	0.04 (0.01)**	0.04 (0.01)**	0.03 (0.01)**	0.03 (0.01)**	0.03 (0.01)*	0.03 (0.01)*
PAPOS	− 0.20 (0.08)*	− 0.19 (0.08)*	− 0.18 (0.08)*	− 0.18 (0.08)*	− 0.22 (0.09)*	− 0.23 (0.09)*
PAFUP	− 0.23 (0.11)*	− 0.21 (0.11) ⁺	− 0.20 (0.11) ⁺	− 0.20 (0.11) ⁺	− 0.15 (0.12)	− 0.16 (0.12)
NH1	− 0.11 (0.11)	− 0.12 (0.11)	− 0.10 (0.11)	− 0.10 (0.11)	− 0.15 (0.11)	− 0.15 (0.11)
Male	− 0.21 (0.12) ⁺	− 0.20 (0.12) ⁺	− 0.22 (0.13) ⁺	− 0.22 (0.13) ⁺	− 0.21 (0.13) ⁺	− 0.21 (0.12) ⁺
Age-at-Pretest ^a	− 0.00 (0.01)	− 0.00 (0.01)	− 0.01 (0.01)	− 0.01 (0.01)	− 0.00 (0.01)	− 0.00 (0.01)
AM	0.17 (0.11)	0.18 (0.11)	0.24 (0.11)*	0.23 (0.11)*	0.25 (0.11)*	0.25 (0.11)*
MMSE ^b	0.02 (0.01)**	0.02 (0.01)***	0.02 (0.01)**	0.02 (0.01)**	0.02 (0.01)**	0.02 (0.01)**
<i>Random variances</i>						
Intercept	0.33 (0.05)***	0.32 (0.05)***	0.33 (0.05)***	0.33 (0.05)***	0.34 (0.04)***	0.34 (0.04)***
Residual	0.21 (0.02)***	0.20 (0.02)***	0.20 (0.02)***	0.20 (0.02)***	0.20 (0.02)***	0.20 (0.02)***
R^2	.09	.10	.11	.11	.11	.11

Models estimated using the gamma link function in SAS PROC GLIMMIX (SAS Institute Inc. 2011)

ACT activity dummy for the respective EEA-related domain (co-resident contact, staff contact, or participation in organized in-home activities), ENJ enjoyability dummy, *T* Time-in-Study, PAPOS dummy indicating posttest in physical activity training group, PAFUP dummy indicating follow-up measurement in physical activity training group; NH nursing home; AM antidepressant medication, MMSE mini-mental state examination

⁺ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

^aGrand-mean centered

^bGrand-mean-centered person-mean of the mini-mental state examination score

R^2 following (Xu 2003) with residuals on the data scale of *M* and the random intercept-only model, respectively

with $p < .01$).⁵ To fit the gamma distribution, the outcome was rescaled to exclude zero (i.e., GDS-12R + 1).

Expanded everyday activity and the role of enjoyability for depressive symptoms

Table 3 displays the GLMM results. Across all EEA domains, residents' depressive symptoms significantly increased over 9 months between baseline and follow-up measurement if residents did not participate in the BaCo-related training (all $p < .05$ for *T*). The training effects were shown most consistently across activity domains and despite

controlling for covariates (all $p < .05$ for posttest; all $p < .1$ for follow-up, except for activity participation). That is, while depressive symptoms increased for non-participating residents, they stabilized in the training group. Furthermore, males suffered from fewer depressive symptoms than females (except for the co-resident contact model; all other $p < .1$) and residents taking antidepressants showed significantly more depressive symptoms than residents not taking antidepressants (all $p < .05$ except for the co-resident contact model). Residents with better cognitive performance on the MMSE suffered from significantly more depressive symptoms than residents with weaker cognitive performance although the increase may not be clinically relevant (all $p < .01$).

⁵ Other continuous, right-skewed distributions checked (beta, log-normal, exponential) showed worse fit than the gamma distribution (larger A^2), but better fit than the normal distribution. We conclude that the gamma distribution was the best distribution model for the mixed model analyses.

Self-initiated social contact with co-residents

Both frequent self-initiated contact with co-residents and contact enjoyability was marginally associated with fewer depressive symptoms (both $p < .1$; see *M1* in Table 3). Additionally, an interactional effect between self-initiated co-resident contact and its enjoyability emerged ($p < .05$; see *M2* in Table 3). That is, residents, who initiated co-resident contact *often and willingly* and who enjoyed it, showed fewer depressive symptoms than all other residents (see Table 3) at all measurement occasions after controlling for covariate effects. Considering R^2 , 9–10% of the intra-individual variance of depressive symptoms was explained by self-initiated social contact with co-residents, its enjoyability, time-in-study, and covariates.

Self-initiated social contact with care staff

Frequent self-initiated staff contact was marginally associated with fewer depressive symptoms ($p < .1$; see *M1* in Table 3). Although the effect of contact enjoyability did not reach significance, it was of equal size. No interactional effect of frequency and enjoyability was obtained (see *M2* in Table 3). Considering R^2 , 11% of the intra-individual variance of depressive symptoms was explained by self-initiated social contact with care staff, its enjoyability, time-in-study, and covariates.

Activity participation

Enjoyable rather than frequent participation in organized in-home activities was marginally associated with fewer depressive symptoms ($p < .1$; see *M1* in Table 3). When the interaction was added in *M2*, it did not have a significant effect on residents' depressive symptoms ($p > .05$; see *M2* in Table 3), but the effect of participation enjoyability remained stable. Considering R^2 , 11% of the intra-individual variance of depressive symptoms was explained by participation frequency, its enjoyability, time-in-study, and covariates. When the analyses were repeated using the GDS-12R scale excluding potentially overlapping activity items, participation enjoyability was significantly associated with fewer depressive symptoms ($\beta_2 = -0.16$, $p < .01$).

Discussion

Descriptively, one quarter of the present sample showed clinically relevant depressive symptoms, which is consistent with previous findings on major depressive disorder in long-term care (Meeks et al. 2011). Therefore, it can be assumed that our sample was not very biased in terms of mental health. We found support for the assumption that

EEA enjoyability has great reinforcing value because it predicted lower depressive symptoms across two out of three domains considered. For activity frequency, an effect was observed only in interaction with co-resident contact enjoyability, which may show the relevance of considering activity enjoyability in future depressive symptoms-related research and interventions. We found, also as hypothesized, differential patterns between EEA frequency, their enjoyabilities, and residents' depressive symptoms for the different EEA domains.

For contact with co-residents, self-initiated contact moderated the enjoyability effect conforming to our hypothesis. That is, frequently initiating pleasant co-resident contact may have shifted the balance toward more enjoyable than unpleasant encounters. The relevance of both co-resident contact frequency and its enjoyability is in line with the socioemotional selectivity theory which claims an increasing importance in emotionally meaningful relationships as the future-time perspective shrinks (Carstensen et al. 2003). This finding also supports the relevance of meaningful contact with residents which has been emphasized in earlier work (Baltes et al. 1991) and has recently been promoted by the *resident engagement and peer support* model (Theurer et al. 2015).

Unexpectedly, neither the frequency nor the enjoyability of staff contact was significantly related to fewer depressive symptoms. As the frequency effect was, however, at the border of significance, future research may investigate this effect using a larger sample and include potential covariates like staffing ratio or perceived staff friendliness to better understand the associations with depressive symptoms.

For regularly offered in-home activities, higher enjoyability was, as expected, marginally associated with fewer depressive symptoms and irrespective of participation frequency. The absent participation frequency effect is consistent with previous research which found that organized activities are unlikely to improve positive affect in residents not suffering from high depression ($\text{GDS-30} \geq 11$; Meeks et al. 2007).

The present study focused on contact with co-residents, staff, and participation in in-home activities. Following the socioemotional selectivity theory (Carstensen et al. 2003), however, contacts with family and friends might be especially meaningful for some residents and could be considered as predictors of depressive symptoms in future research.

Limitations

Some issues should be kept in mind when interpreting these results. First, the combination with an intervention study may be problematic; however, an analytical approach most suitable to the data was chosen, as it allows statistically accounting for the effect of intervention participation.

Second, we did not focus on the relationship between a change in EEA frequency and/or enjoyability and a subsequent change in depressive symptoms as proposed by theoretical considerations (Meeks and Depp 2003), nor did we examine activity enjoyability as a mediator between frequency and depressive symptoms (Lewinsohn et al. 1985). That is, the present study does not allow conclusions on the causal direction between EEA frequency, enjoyability, and depressive symptoms. Third, the present study focused on EEA frequency and enjoyability, which may both be considered as manifestations of depressive symptoms (i.e., of loss of interest and loss of energy, of loss of pleasure, respectively). Still, we argue that frequency operationalizes the theoretically postulated number of potentially reinforcing events and that enjoyability operationalizes the postulated potential intensity of gratification a person might draw from that specific contact or activity (Lewinsohn 1974). Therefore, we consider the operationalization as appropriate to answer our research questions. Fourth, the operationalization of EEAs only approximates the one originally used (Baltes et al. 2001). Baltes and colleagues measured EEA using the *yesterday interview* (Moss and Lawton 1982) that gives detailed times per activity. Given that this method was not feasible in our NH sample, the staff-rated activity participation and social contact information may approximate residents' EEAs. This operationalization was theoretically driven to operationalize the original constructs and the measures are assumed to be more objective than the originally used interview-derived measures. Besides, the measures used allowed us to examine the association between EEA domains and depressive symptoms differentially. Fifth, challenges from working with institutions have complicated our commitment to strict research standards of data generation. That is, the proxy-rated measures could not be obtained at the same date as the interview data but, rather, with a delay of several days to weeks (no exact dates provided). Furthermore, a change in a law caused a change in activity-coordinating staff in NH2 after baseline. Therefore, the rater for a single resident could change across time, especially in NH2.

Conclusion

This study investigated how the associations between EEA frequencies, their enjoyabilities, and residents' depressive symptoms longitudinally differ by EEA domains. The frequently found argument that *activity* in the NH setting is good for depressive residents finds important differentiations in this work and the basic associations underlying pleasant events-based interventions in NHs are addressed. Future research may follow up these findings and investigate the effect of systematic combinations of BaCo-related trainings with pleasant activities like enjoyable co-resident contact.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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