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# Social Participation and Survival at Older Ages:

# Is the Effect Driven by Activity Content or Context?

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**Abstract**

This study tested the hypothesis that time spent on social activities (i.e., in direct interaction with others) and time spent in social contexts (i.e., while others are present) is associated with survival in persons aged 70 and older. An observational study with mortality follow-ups was carried out in the former West Berlin, Germany (Berlin Aging Study). The sample was stratified by age and sex and consisted of 473 persons aged 70 to 103 years. Social activity and social context measures were assessed in 1990-1993 by structured interviews in the participants' homes. Cox regression was used to model survival from time of interview. The main outcome measure was survival on 1 August 2003. Time spent on social activities was revealed as a predictor of survival only in analyses that did not control for confounding factors. In contrast, time spent in context “with friends” was significantly related to increased survival (relative risk = 0.76, 95% confidence interval 0.59 to 0.99) even after several confounding factors were controlled for. This study suggests that time spent with friends affords a survival advantage among older adults, above and beyond the effects of other leisure activities. Future research on social participation and survival may benefit from an examination of the interaction between activity content and social context.

Key words: social activity, social context, role support, mortality, longevity

## Introduction

Through multiple benefits, participation in daily social activities promotes physical and mental health, and ultimately, survival (Glass et al., 1999; Hendricks & Hendricks, 1990; House et al., 1982; Lennartson & Silverstein, 2001; Welin et al., 1992). Participation provides social contacts and thereby fulfills a phylogenetically determined need for affiliation (Cantor & Sanderson, 1999; Reis, Sheldon, Gable, Roscoe, & Ryan, 2000). Activity theory (Lemon, Bengtson & Peterson, 1972; Longino & Kart, 1982) postulates that social activity is associated with life satisfaction because social activity provides opportunities for role support which in turn reaffirms the self-concept. Researchers distinguished between informal social activity (with friends, relatives, and neighbors), formal social activity (e.g., participation in voluntary associations), and solitary activity. Activity theory holds that informal social activity has a stronger association with life satisfaction than formal social or solitary activity, because informal social activity is more intimate and occurs more frequently, and consequently it is more rewarding and provides more specific role support. However, using informal social activity as predictor, researchers were not able to disentangle two different explanations for the beneficial effect: Role support may have been provided through social interactions (activity content) or through the mere presence of other individuals (social contexts).

In this paper we use the term “social participation” to designate both time spent in social interaction as well as time spent in the presence of others. Both direct social interaction and the mere presence of others affirm an individual’s worth (Buunk, 1990) and increase the subjective meaning of whatever activity is performed (Rowe & Kahn, 1998; Thoits, 1983). Moreover, recent research has shown that social participation and specifically social interactions can alter basal risk profiles and attenuate acute stress reactivity (Seeman, Berkman, Blazer & Rowe, 1994; Seeman & McEwen, 1996). The influence on health appears to be exerted by promoting psychobiological recovery processes which play a central role in

the onset of age-related illnesses such as cardiovascular diseases, Type-II diabetes, and dementia (McEwen, 1998; Sapolsky, 1993). Because of the heterogeneity of measures and the neglect of intermediate concepts, progress in the accumulation of knowledge regarding the mediating processes has been slow (Herzog et al., 2002).

In order to be able to advance existing knowledge, it is important to map social activities into a theory-guided activity categorization and disaggregate heterogeneous categories (Herzog et al., 2002). Basing our work on Baltes' two-component model (Baltes, Maas, Wilms, Borchelt, & Little, 1999), we distinguished two broad categories of daily activities (Klumb and Baltes, 1999a; Klumb & Maier, 2002; see Figure 1). On the one hand, there are regenerative activities that have to be carried out by physiological necessity (e.g., personal hygiene, eating, and resting). On the other hand, there are discretionary activities that one can do by choice on the basis of individual abilities and preferences. The third-party criterion (Reid, 1934) served to further sub-divide discretionary activities into productive and consumptive ones. If an activity is performed predominantly due to its outcomes and can, therefore, be delegated to a third party without losing its benefit (e.g., doing laundry, house cleaning, running errands), then it is productive. In contrast, if an activity is performed primarily for its own sake and cannot, therefore, be delegated to a third party without losing benefit (e.g., meeting friends, reading a novel, watching TV), then it is consumptive. We consider "social activity" to be a part of "consumptive activities". Because heterogeneous activity categories do not easily lend themselves to testing causal pathways, we followed Herzog's suggestion (Herzog et al., 2002) and further disaggregated "social activity" into its more basic components "face-to-face talks", "visiting", "phone conversations", and "other social interaction". Moreover, we distinguished four specific social contexts of performing an activity, namely (1) being alone, (2) being with one's spouse, (3) being with family members, and (4) being with friends.

The aim of the present study was twofold. First we investigated if time spent on social activities and time spent in social contexts is associated with survival among older persons. Secondly, in an earlier study we found that time spent on consumptive/leisure activities was related to survival among older adults (Klumb & Maier, 2002). In the present study we investigated the relative importance of social activities and social context for the effect of consumptive/leisure activities on survival. If the beneficial effect of performing leisure activities on mortality were driven through the effects of social activity, then social activities should be more strongly associated with a lower mortality risk than non-social leisure activities. If, however, the driving force behind the effect of leisure activities were the mere presence of other people during the performance of any activity, then--independent of a specific activity content--the social contexts "with spouse", "with family", and "with friends" should be associated with a decreased mortality risk when compared to the social context "alone".

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Figure 1 about here

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## Method

*Participants and Sampling*

We used data from the first measurement occasion of the Berlin Aging Study (Baltes & Mayer, 1999), which took place in the time period 1990-1993. The study was designed to be representative of the West-Berlin population aged 70+, while oversampling men and the very old. Samples originated from a random draw of addresses from the general registry (*Landeseinwohneramt*) of West Berlin. To obtain the final sample of 516 individuals stratified by age and sex, a much larger number of addresses had to be drawn. The study design consists of a hierarchical sequence of four levels of participation, with increasing numbers of variables

but decreasing numbers of participants at each consecutive level: (a) the verified parent sample (N = 1908); (b) the short-contact sample (N = 1264); (c) the Intake-Assessment sample (N = 928); and (d) the Intensive-Protocol sample (N = 516) used in the present study with its 14 sessions of multidisciplinary assessment. Extensive selectivity analyses (Lindenberger et al., 1999) showed the Intensive-Protocol sample to be a somewhat positive selection of the parent sample. The magnitude of the selectivity effects was largest for general intelligence, but it did not exceed half a standard deviation for any of the analyzed domains of functioning. With one exception (dementia prevalence), selectivity effects did not interact with age or gender. Furthermore, comparisons of the sample with the Berlin Census Data showed no significant differences in indices such as marital status, proportion of institutionalized persons, and educational and income levels.

The Intensive-Protocol sample includes individuals ranging in age from 70 to 103. The sample was stratified for age and sex, resulting in 43 women and 43 men in each of six age/cohort groups: 70-74 years (born 1915-1922), 75-79 years (born 1910-1917), 80-84 years (born 1905-1913), 85-89 years (born 1900-1908), 90-94 years (born 1896-1902), and 95-103 years (born 1883-1897). Based on judgements made by one of us (P.K.), we excluded 31 participants from our analyses due to implausible activity data. Most of these persons were diagnosed as suffering from dementia.

Mortality status information and the date of death for the deceased participants were obtained from the State Registry Office. Mortality information on twelve individuals could not be obtained because they had moved out of the Berlin area. These individuals were not considered in our analyses. This means that we utilized a total sample of 473 persons (230 women and 243 men) in our study.

*Measures*

Three types of measures were relevant: activity measures including measures of social activity, social context measures, and a set of covariates. As covariates we rigorously chose common determinants of activity involvement and mortality (Rowe & Kahn, 1998). The set of covariates included age, sex, years of education, measures of health and cognitive status, and an indicator of whether or not participants lived in an institution.

*Activity measures*. The "Yesterday Interview" (YI, Moss & Lawton, 1982) was used to reconstruct the participants' day preceding the interview from waking up to falling asleep. With the YI we recorded the participants' activities as well as the amount of time allocated to each activity. The YIs took place in the participants' homes and lasted an average of about 50 minutes. In a separate study, we compared self-reports assessed with the YI to time samples of activities in daily life and found acceptable agreement (Klumb & Baltes, 1999b).

Interview data were first categorized into 44 activity codes. We quantified the levels of intercoder agreement with the kappa statistic (Cohen, 1960). Kappas for all of the 44 activity codes were above 0.8, suggesting high levels of intercoder agreement. The 44 activity codes were then condensed into 13 activity domains. Activity domains were in turn assigned to three broad activity categories: regenerative, productive, and consumptive activities (Klumb & Baltes, 1999a).

Regenerative activities serve to maintain one's physical existence. This activity category comprised the activity domains "resting" and "self maintenance". The category "productive activities" resulted from collapsing the following five activity domains: "gardening", "helping others" (including volunteer work and provision of care for relatives), "housework" (including maintenance of home and possessions), "paid work", and "running errands". The six remaining domains were aggregated into the category "consumptive activities". Specifically, this category comprised the activity domains "active leisure" (such as attending adult education courses or performing sports), "locomotion" (such as walking,

driving with own vehicle or riding as a passenger), “health-related activities” (including visits to doctors), “reading”, “watching TV/listening to radio/records/tapes” and “social activity”. “Social activity” in turn comprised the more fine-grained subcategories “face-to-face talks”, “visiting”, “phone conversations”, and “other social interaction” such as interaction with professional helpers (see Figure 1). “Face-to-face talks” and “visiting” were coded as different categories because opportunities for the two kinds of activities differ. Specifically, “face-to-face talks” can occur in an individual’s own apartment, in his or her building, or outside the building. However, in order to be coded as “visiting”, a person had to leave his or her apartment and walk or drive to that of somebody else’s.

We were interested in distinguishing the effects of social activity from other consumptive activities. Thus we also examined the category “consumptive activities without social activities” (see “consumptive w/out social” in Tables 1, 2 and 4). This category comprised the activity domains “active leisure”, “locomotion”, “health-related activities”, “reading” and “watching TV/listening to radio/records/tapes”---but not “social activity”. For the purpose of the present analyses, activity measures were coded as either high or low, based on a median split (see Table 1). For all activity measures with a median of zero, this coding is equivalent to the dichotomy “does not do / does the activity”.

*Social context measures*. In the Yesterday Interview, participants also reported the social context in which each activity took place. On the basis of the social partner’s name and his or her relationship to the participant, we coded four social contexts of each activity: alone, with spouse, with family, and with friends. Specifically, we recorded the amount of time spent in each of these four contexts. For the purpose of the present analyses, social context measures were coded as either high or low, based on a median split. For all social context measures with a median of zero, this coding is again equivalent to the dichotomy “does not spend time / does

spend time in this context". Table 1 displays the average time allocated to activity categories and that spent in social contexts.

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Table 1 about here

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*Education*. We used the number of years spent in formal educational settings as an indicator of socio-economic status. In addition to the number of years spent in elementary school and the different types of high school in Germany (graduation after 10 to 13 years of schooling), this variable also includes formal professional (e.g., apprenticeships) and academic (e.g., university) training. On average, participants in this sample had 10.8 years of education (SD = 2.3).

*Number of diagnoses*. We selected the number of diagnosed moderate or severe illnesses as an externally assessed indicator of participants' general health status. Diagnoses were determined in the course of consensus conferences of the research physician and psychiatrist based on a standardized summary of clinical findings from all diagnostic procedures. Diagnosed moderate and severe illnesses were summed up to form the variable "number of diagnoses". On average, participants in this sample had 8 diagnoses of moderate or severe illnesses (SD = 4).

*Balance / Gait*. We selected a measure of sensorimotor functioning as an indicator of participants' functional health. Sensorimotor functioning was represented by a unit-weighted composite of clinical assessments of balance and gait, the Romberg Stance, and the Turn 360 tasks (Tinetti, 1986). In the Romberg Stance task, participants stood upright for about one minute, with legs as close together as possible, arms extended in front of the body, palms turned up, and eyes closed. Performance was scored by a physician on a six-point scale ranging

from “no swaying” to “not able to stand upright at all.” In the Turn 360 task, subjects were asked to perform a full turn around their body axis as fast as they could without risking a fall. The score corresponded to the number of steps needed to finish the circle. For the purpose of the present analyses the Balance/Gait composite was represented as a z-score ($\underline{M} = 0$, $\underline{SD} = 1$), with higher scores indicating higher levels of functional health.

*Digit Letter test*. We employed the Digit-Letter test, a measure of perceptual speed, as an indicator of cognitive functioning. On a large table visible throughout the whole procedure, each of nine different letters was assigned to a digit. Participants were presented with tables containing six digits and their task was to name the corresponding letters. The score consisted of the number of correct answers given within three minutes. Stimulus presentation and data collection were supported by a Macintosh SE30 personal computer equipped with a Micro Touch Systems touch-sensitive screen. For the purpose of the present analyses the Digit Letter test was represented as a z-score ($\underline{M} = 0$, $\underline{SD} = 1$), with higher scores reflecting higher levels of cognitive functioning.

*Living in institution*. We included an indicator reflecting whether a participant was living in the community or in an institution. This information was based on self-reporting by the participants and it was verified by interviewers’ observation. N = 409 persons (86 percent) lived in the community, n = 64 (14 percent) lived in institutions.

*Vital status*. The vital status of participants in the Berlin Aging Study is monitored at regular intervals. By August 2003 (representing a 10 to 13 year period after baseline assessment), 368 individuals, or 78% of this sample, were registered in the state records as deceased, and 95 persons, or 20%, were registered as living. Ten persons, or 2% of this sample, were registered in the state records as alive in February 2000 but were subsequently lost due to follow up. We included the exposure times of these ten individuals and treated them as right-censored in the analyses. As is to be expected for a sample of this advanced age, a

larger proportion of the oldest old had died (older than 85 years: n = 223 decedents vs. n = 7 survivors) than in the younger age group (70-84 years: n = 145 decedents vs. n = 88 survivors). As is also to be expected, a larger proportion of men had died (n = 200 decedents vs. n = 37 survivors) than women (n = 168 decedents vs. n = 58 survivors).

*Statistical Analyses*

Cox proportional hazards regression models (Cox, 1972) were evaluated for the effects of risk factors. We used the PHREG procedure (Allison, 1995) from the SAS software package to estimate Cox regression models. We report relative risks and their 95% confidence intervals.

We proceeded in four stages to test the effects of broad activity types, social activities and social context on mortality risk. We first determined the zero-order relationships, and in a second step we evaluated mortality risks adjusted for the set of covariates (see Tables 2 and 3). A third set of analyses was designed to investigate whether the effects of activity categories diminished or increased with time. We calculated a time-dependent covariate for each of the activity categories as the product of the activity category and time (see Allison 1995). We then calculated a Cox regression model that included the respective activity category, the associated time-dependent covariate, and the set of covariates. A fourth and final set of analyses was aimed at disentangling the effects of consumptive activities, social activity, and social context measures (Table 4).

## Results

*Broad Activity Types and Mortality Risk*

All three broad activity types were significantly associated with risk of death in the unadjusted analyses (Table 2). Higher levels of regenerative activities and lower levels of productive and consumptive activities were associated with an increased mortality risk. The magnitude of the associations was considerably reduced when we controlled for potential

confounds. Only consumptive activities continued to be significantly ($p < .05$) associated with mortality risk after controlling for the activity x time interaction (see last column of Table 2). The risk of death was then reduced by 45% for individuals whose time spent on consumptive activities was above the median. The significant effect for the time-dependent covariate "consumptive * time" indicates that the effect of consumptive activities decreased with time since baseline assessment.

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Table 2 about here

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*Social Activity and Mortality Risk*

The effects of social activity and its subcategories on mortality risk are shown in Table 2. In the unadjusted analyses, those with a higher level of social activity had a 20% lower risk of death. In the adjusted analyses, those with a high level of social activity still were estimated to have a 16% lower risk of death, although the effect did not reach statistical significance. The subcategories "face-to-face talks" and "phone conversations" were significantly associated with a lower risk of death in the unadjusted analyses, but "visiting" and "other social interaction" were not. None of these effects reached statistical significance in the adjusted analyses. Note, however, that the average amount of time allocated to these subcategories was relatively small (Table 1).

*Social Context and Mortality Risk*

We distinguished the amount of time spent in four different contexts: alone, with spouse, with family, and with friends. The mortality risk associated with these contexts is shown in Table 3. From the unadjusted analyses it can be seen that a higher amount of time spent in social contexts (with spouse, with family, with friends) was related to a lower risk of death. From the adjusted analyses it appears that, with regard to survival, time spent with

friends is more important than the other social contexts. Specifically, those who spent time with friends had a mortality risk that was reduced by 28 percent. None of the time-dependent covariates (social context * time) reached statistical significance (data not shown). This suggests that effects of the social context on survival remained fairly stable since baseline assessment.

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Table 3 about here

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*Disentangling Consumptive Activity, Social Activity, and Social Context*

A final set of analyses was designed to disentangle the effects of consumptive activities, social activities, and social context measures. In first step we estimated the mortality risk associated with levels of consumptive activities without social activities ("consumptive w/out social" in Table 4). The mortality risk associated with this category (RR = 0.58, cf. Model 1 in Table 4) was very similar to the mortality risk associated with consumptive activity *including* social activity (RR = 0.55, cf. Model 3 in Table 2), indicating that the beneficial effect of consumptive activities is not mediated through social activity. In a second step we added "social activity" to the regression model (Model 2 in Table 4). This did not alter the association between consumptive activities and survival, again suggesting that social activities contribute little to the beneficial effect of leisure activity on health and survival. In a third step we added "social context: with friends" to the model (Model 3 in Table 4) because this social context measure was found to be associated with survival in the previous analyses (Table 3). Interestingly, "consumptive activities without social activities" as well as "social context: with friends" were both significantly associated with survival. This suggests that time spent with friends affords a survival advantage above and beyond the beneficial effects of consumptive/leisure activities.

Table 4 about here

## Discussion

In this study we investigated the relative importance of activity content and social context for the association between social participation and survival. First, it appears that social participation is related to survival. Individuals with higher levels of social activity and with more time spent in the presence of others had a lower mortality risk in the unadjusted analyses. In these analyses, measures of social participation carried variance associated with common predictors of differential social involvement and mortality risk. After controlling for covariates, several of the effects of social participation did not reach statistical significance, suggesting that the effects were not very strong. Nevertheless, based on an inspection of the relative risks we argue that the association appears to be present even after controlling for confounding risk factors. Above and beyond the confounding influences, only the social context "with friends" was significantly associated with a reduced risk of death. The effect was fairly robust over time as indicated by the absence of a statistically significant interaction with time. Because only little time was spent in each of the social activity categories and our sample was relatively small, we could not draw firm conclusions with regard to the relative importance of the two mediating processes (i.e., social interaction versus mere presence of other people).

Interestingly, time spent on consumptive activities other than social activity, such as active leisure, locomotion and watching TV, was found to be associated with lower mortality. We speculate that at least two different mechanisms are involved. One the one hand it appears that the cognitive stimulation induced by cognitively challenging activities has beneficial effects for intellectual functioning (Schooler & Mulatu, 2001) and reduces the risk of dementia

(Wilson et al., 2002). On the other hand, successful performance of chosen activities leads to the experience of competence and increases personal control. Both factors contribute to psychological well-being and alter the ways in which a person affectively and physiologically reacts to challenge (Mirowsky & Ross, 1998).

*Social Activity, Social Context, and Survival*

Previous studies did report beneficial effects of social activities. For instance, Steinbach (1992) and Menec (2003) found social activities such as visiting or talking to friends or relatives to be related to longevity. Nakanishi and colleagues (2000, 2003) reported an increased mortality risk for individuals who did not participate in any social activities. Walter-Ginzburg, Blumstein, Chetrit, and Modan (2002) reported a lower risk only for measures of social engagement that explicitly involve others. All of these studies had larger sample sizes than ours resulting in smaller confidence intervals for similar point estimates.

The pattern of results from our study is surprising because it lends support to the idea that the beneficial effects of social participation do not depend on social activities in the narrow sense, but can be achieved through the mere presence of other people. Interestingly, not all social contexts were equally conducive to acquiring this benefit. The finding that a positive effect was associated only with the context “with friends” is in line with existing evidence. In contrast to family members, friends can be selected more freely by an individual. Spending time with them is rewarding in itself and affirms the worth of the persons involved (Johnson & Barer, 1997). Contacts within the family, in contrast, tend to be ambivalent in nature. Especially support among family members is liable to have a “dark side”, such as the obligation to reciprocate, devaluation through unwanted support, or loss of autonomy (Kruse & Wahl, 1999; Pinquart & Sörensen, 2000).

Our results pose new questions for future research. First, do some leisure activities have a higher likelihood of being carried out in the context of other people than others?

Secondly, are there specific combinations of activity content and social context that are more beneficial than others, for instance, dancing, playing games vs. watching TV (Menec, 2003)? This question could be investigated by systematically combining activity contents with contexts and an examination of the effects of all the possible combinations. However, our sample was too small to do this. In addition, not all combinations are logically possible because, for instance, face-to-face talk cannot occur in the social context "alone".

*Strengths and Limitations*

A strong point of this study is that we employed a theory-guided activity categorization. Furthermore, we used a well-defined sample which was stratified by age and sex and included a considerable number of very old persons. Assessment of activity involvement and social context based on the Yesterday Interview yielded reliable and valid information. As covariates we rigorously chose common determinants of activity involvement and mortality from the data protocol of the Berlin Aging Study in order to reduce the confounding effects of third variables. The chosen covariates were based not only on participants' self-reporting but also on performance tests and physician-observed diagnoses of illnesses. This selection of covariates minimized confounding through common method variance.

In addition to the small sample size, at least two limitations should be kept in mind. First, we employed only data from a single day, and this day was not necessarily a typical one for all of the participants. It is thus likely that we underestimated the true size of the effects because measurement error in the activity categories may have attenuated these effects. Secondly, it is obvious that the reported effects are not necessarily causal, even though social participation preceded survival outcomes and remained associated with mortality risk after controlling for potential confounds. A risk factor can be called causal only if its manipulation changes the outcome (Kraemer et al., 1997), but we did not manipulate social participation in

this study. However, the effects of altered engagement in social activity can in principle be investigated, because time spent on social activities is amenable to intervention (Seeman, 2000). We suggest that social contexts may contribute considerably to the maintenance of health and to longevity, because they exert their effects on a daily basis and these effects accumulate over the life course (Seeman, Singer, Ryff, Dienberg-Love, & Levy-Storms, 2002).

*Conclusion*

Using time-budget data, we found that time spent in the social context "with friends" and, to a lesser degree, time spent on social activities was related to survival in persons aged 70 and older. This result supports psychological and sociological theorizing on the idea that activity participation and survival are linked through a psychosocial pathway, perhaps involving role support (Lemon, Bengtson & Peterson, 1972; Longino & Kart, 1982). The most adequate conception of the association between social activity and health may be a reciprocal one. On the one hand, social activity appears to be beneficial for health outcomes. On the other hand, it is obvious that good health in turn facilitates participation in social activity. Future research on social participation and survival may benefit from the examination of the interaction between specific types of activity and social contexts.

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## References

Allison, P. D. (1995). *Survival analysis using the SAS system: A practical guide*. Cary, NC: SAS Institute.

Baltes, M. M., Maas, I., Wilms, H.-U., Borchelt, M., & Little, T. (1999). Everyday competence in old and very old age: Theoretical considerations and empirical findings. In P. B. Baltes & K. U. Mayer (Eds.), *The Berlin Aging Study: Aging from 70 to 100* (pp. 384-402). New York: Cambridge University Press.

Baltes, P. B., & Mayer, K. U. (Eds.). (1999). *The Berlin Aging Study: Aging from 70 to 100*. New York: Cambridge University Press.

Buunk, B. P., & Schaufeli, W. B. (2000). Reciprocity in interpersonal relationships: An evolutionary perspective on its importance for health and well-being. In W. Stroebe & M. Hewstone (Eds.), *European review of social psychology*. Vol. 10. Chichester: Wiley.

Cantor, N., & Sanderson, C. A. (1999). Life task participation and well-being: The importance of taking part in daily life. In D. Kahneman & E. Diener (Eds.), *Well-being: The foundations of hedonic psychology* (pp. 230-243). New York: Russell Sage Foundation.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and psychological measurement, 20,* 37-46.

Cox, D. R. (1972). Regression models and life tables. *Journal of the Royal Statistical Society, B34,* 187-220.

Glass, T. A., Mendes de Leon, C., Marottoli, R. A., & Berkman, L. F. (1999). Population based study of social and productive activities as predictors of survival among elderly Americans. *British Medical Journal, 319,* 478-483.

Hendricks, C. D., & Hendricks, J. (1998). *Aging in mass society: Myths and realities*. Reading, MA: Addison Wesley.

Herzog, A.R., Ofstedal, M.B., Wheeler, L.M. (2002). Social engagement and its relationship to health. *Clinics in Geriatric Medicine, 18, 593-609.*

House, J.S., Robbins, C., Metzner, H.L. (1982). The association of social relationships and activities with mortality: prospective evidence from the Tecumseh Community Health Study. *American Journal of Epidemiology, 116*(1),123-40.

Jenkins, K.R., Pienta, A.M., Horgas, A.L. (2002). Activity and health-related quality of life in continuing care retirement communities. *Research on Aging*, *24*(1), 124-149.

Johnson, C. L., & Barer, B. M. (1997). *Life beyond 85 years: The aura of survivorship*. New York: Springer.

Klumb, P. L., & Baltes, M. M. (1999a). Time use of old and very old Berliners: Productive and consumptive activities as functions of resources. *Journal of Gerontology: Social Sciences, 54B*, S271-S278.

Klumb, P. L., & Baltes, M. M. (1999b). Validity of retrospective time-use reports in old age. *Applied Cognitive Psychology, 13*(6), 527-539.

Klumb, P.L., Maier, H. (2002). *Daily activities and survival at older ages*. MPIDR Working Paper WP-2002-041. Max Planck Institute for Demographic Research, Rostock, Germany. Available: http://www.demogr.mpg.de/papers/working/wp-2002-041.pdf

Kraemer, H. C., Kazdin, A. E., Offord, D. R., Kessler, R. C., Jensen, P. S., & Kupfer, D. J. (1997). Coming to terms with the terms of risk. *Archives of General Psychiatry, 54*, 337-343.

Kruse, A., & Wahl, H.-W. (1999). Soziale Beziehungen. *Zeitschrift für Gerontologie und Geriatrie, 32*, 333-347.

Lemon, B. W., Bengtson, V. L., & Peterson, J. A. (1972). An exploration of the activity theory of aging: Activity types and life satisfaction among in-movers to a retirement community. *Journal of Gerontology, 27,* 511-523.

Lennartsson, C., & Silverstein, M. (2001). Does engagement with life enhance survival of elderly people in Sweden? The role of social and leisure activities. *Journals of Gerontology: Social Sciences, 25*, S335--S342.

Lindenberger, U., Gilberg, R., Little, T., Nuthmann, R., Pötter, U., & Baltes, P. B. (1999). Sample selectivity and generalizability of results of the Berlin Aging Study. In P. B. Baltes & K. U. Mayer (Eds.), *The Berlin Aging Study: Aging from 70 to 100* (pp. 56-82). New York: Cambridge University Press.

Longino, C.F. Jr., Kart, C.S. (1982). Explicating activity theory: a formal replication. *Journal of Gerontology, 37*(6), 713-22.

McEwen, B. S. (1998). Protective and damaging effects of stress mediators. *New England Journal of Medicine, 338,* 171-179.

Menec, V.H. (2003). The relation between everyday activities and successful aging: a 6-year longitudinal study. *Journals of Gerontology Series B Psychological Sciences and Social Sciences, 58(2),* 74-82.

Mirowsky, J. & Ross, C. E. (1998). Education, personal control, lifestyle and health - A human capital hypothesis. *Research on Aging, 20,* 415-449.

Moss, M. S., & Lawton, M. P. (1982). Time budgets of older people: A window on four lifestyles. *Journal of Gerontology, 37,* 115-123.

Nakanishi, N., Fukuda, H., Tatara, K. (2003). Changes in psychosocial conditions and eventual mortality in community-residing elderly people. *Journal of Epidemiology, 13,* 72-79.

Nakanishi, N., Tatara, K. (2000). Correlates and prognosis in relation to participation in social activities among older people living in a community in Osaka, Japan. *Journal of Clinical Geropsychology, 6(4),* 299-307.

Pinquart, M., & Sörensen, S. (2000). Influences of socioeconomic status, social network, and competence on subjective well-being in later life: A meta-analysis. *Psychology and Aging, 15,* 187-224.

Reid, M. (1934). *Economics of household production*. New York: Wiley.

Reis, H.T., Sheldon, K.M., Gable, S.L., Roscoe, J., Ryan, R.M. (2000). Daily well-being: The role of autonomy, competence, and relatedness. *Personality & Social Psychology Bulletin, 26*(4), 419-435.

Rowe, J. W., & Kahn, R. L. (1998). *Successful Aging*. New York: Pantheon Books.

Sapolsky, R. M. (1993). Potential behavioral modification of glucocorticoid damage to the hippocampus. *Behavioral Brain Research, 57,* 175-182.

Schooler, C., & Mulatu, M. S. (2001). The reciprocal effects of leisure time activities and intellectual functioning in older people: A longitudinal analysis. *Psychology and Aging, 16*(3), 466-482.

Seeman, T. E. (2000). Health Promoting Effects of Friends and Family on Health Outcomes in Older Adults. *American Journal of Health* Promotion*, 14(6),* 361-370.

Seeman, T. E., Berkman, L. F., Blazer, D., & Rowe, J. (1994). Social ties and support and neuroendocrine function: MacArthur studies of successful aging. *Annals of Behavioral Medicine, 16,* 95-106.

Seeman, T. E., & McEwen, B. S. (1996). Impact of social environment characteristics on neuroendocrine regulation. *Psychosomatic Medicine, 58,* 459-471.

Seeman, T. E., Singer, B. H., Ryff, C. D., Dienberg Love, G., Levy-Storms, L. (2002). Social relationships, gender, and allostatic load across two age cohorts. *Psychosomatic Medicine, 64(3),* 395-406.

Steinbach, U. (1992). Social networks, institutionalization and mortality among elderly people in the United States. *Journal of Gerontology: Social Sciences, 47,* S183-S190.

Thoits, P. A. (1983). Multiple identies and psychological well-being: A reformulation and test of the social isolation hypothesis. *American Sociological Review, 48,* 174-187.

Tinetti, M. E. (1986). A performance-orientated assessment of mobility problems in elderly patients. *Journal of the American Geriatrics Society, 34,* 119-126.

Walter-Ginzburg, A., Blumstein, T., Chetrit, A., Modan, B. (2002). Social factors and mortality in the old-old in Israel: the CALAS study. *Journals of Gerontology Series B Psychological Sciences and Social Sciences, 57(5),* 308-318.

Welin, L., Larsson, B., Svardsudd, K., Tibblin, B., Tibblin, G. (1992). Social network and activities in relation to mortality from cardiovascular diseases, cancer and other causes: a 12 year follow up of the study of men born in 1913 and 1923. *Journal of Epidemiology and Community Health, 46(2)* 127-132.

Wilson, R. S., de Leon, C. F. M., Barnes, L. L., Schneider, J. A., Bienias, J. L., Evans, D. A., & Bennett, D. A. (2002). Participation in cognitively stimulating activities and risk of Alzheimer disease. *Journal of the American Medical Association, 287,* 742-748

Table 1

Average time allocated to activity categories and time spent in social contexts, in minutes.

| Category / context | N=473 | | Participants[1] | |
|---|---|---|---|---|
| | M (SD) | Median | M (SD) | N |
| A - Activity category | | | | |
| Regenerative | 330 (177) | 292 | 330 (177) | 473 |
| Productive | 151 (130) | 120 | 175 (123) | 409 |
| Consumptive | 427 (175) | 430 | 433 (169) | 467 |
| Active leisure | 83 (103) | 50 | 126 (103) | 312 |
| Locomotion | 44 (57) | 25 | 71 (57) | 292 |
| Health-related activities | 9 (21) | 0 | 30 (29) | 136 |
| Reading | 93 (96) | 70 | 126 (91) | 350 |
| TV/radio | 179 (135) | 180 | 207 (124) | 410 |
| Social activity | 63 (81) | 30 | 91 (84) | 329 |
| Face-to-face talks | 37 (65) | 0 | 84 (75) | 210 |
| Visiting | 15 (46) | 0 | 90 (75) | 81 |
| Phone conversations | 7 (22) | 0 | 32 (37) | 109 |
| Other social interaction | 3 (23) | 0 | 37 (71) | 40 |
| Consumptive w/out social | 364 (174) | 375 | 374 (165) | 460 |
| B- Context | | | | |
| Alone | 595 (324) | 665 | 623 (304) | 452 |
| With spouse | 185 (297) | 0 | 546 (251) | 160 |
| With family | 71 (156) | 0 | 269 (199) | 124 |
| With friends | 45 (105) | 0 | 157 (144) | 135 |

[1] Study participants who engaged in the respective activity.

Table 2
Mortality risk associated with daily activities (N=473).

| Activity category | Relative risk (CI) | | |
|---|---|---|---|
| | Model 1 (unadjusted) | Model 2 (adjusted)[a] | Model 3 (Model 2 + interaction with time)[b] |
| Regenerative | 1.91 (1.56, 2.35)* | 1.18 (0.94, 1.47) | |
| Productive | 0.59 (0.48, 0.73)* | 0.93 (0.74, 1.17) | |
| Consumptive | 0.66 (0.54, 0.81)* | 0.82 (0.66, 1.02) | 0.55 (0.36, 0.84)* |
| Consumptive * time | --- | --- | 1.09 (1.01, 1.18)* |
| Active leisure | 0.73 (0.59, 0.89)* | 0.94 (0.76, 1.17) | |
| Locomotion | 0.53 (0.43, 0.65)* | 0.75 (0.60, 0.93)* | |
| Health-related activities[c] | 1.05 (0.84, 1.32) | 1.05 (0.83, 1.33) | |
| Reading | 0.76 (0.62, 0.93)* | 0.98 (0.79, 1.22) | |
| TV/radio | 0.90 (0.73, 1.10)* | 0.98 (0.80, 1.21) | 0.70 (0.47, 1.04) |
| TV/radio * time | --- | --- | 1.08 (1.00, 1.16)* |
| Social activity | 0.80 (0.65, 0.98)* | 0.84 (0.68, 1.03) | |
| Face-to-face talks[c] | 0.80 (0.65, 0.98)* | 0.85 (0.69, 1.05) | |
| Visiting[c] | 0.85 (0.64, 1.12) | 0.83 (0.63, 1.11) | |
| Phone conversations[c] | 0.65 (0.50, 0.83)* | 0.86 (0.65, 1.12) | |
| Other social interaction[c] | 1.25 (0.88, 1.79) | 1.10 (0.76, 1.59) | |
| Consumptive w/out social | 0.78 (0.63, 0.95)* | 0.94 (0.76, 1.16) | 0.58 (0.38, 0.87)* |
| Consumptive w/out social * time | --- | --- | 1.11 (1.03, 1.20)* |

*Note*. Relative risks are reported. 95% Confidence intervals for relative risks are shown in parentheses.

* $p < .05$.

[a] Adjusted mortality risks were obtained from Cox regression models including the respective activity, age, sex, education, number of diagnoses, balance / gait, digit letter, and living in institution.

[b] Entries in this column indicate that the inclusion of the interaction term significantly ($p < .05$) improved the fit of the model.

[c] The coding of this variable is equivalent to the dichotomy “yes – no” (see Table 1).

Table 3
Mortality risk associated with social context (N=473).

| Context | Relative risk (CI) Model 1 (unadjusted) | Model 2 (adjusted)[a] |
|---|---|---|
| Alone | 1.01 (0.83, 1.24) | 0.92 (0.74, 1.14) |
| With spouse[b] | 0.76 (0.61, 0.95)* | 1.01 (0.77, 1.33) |
| With family[b] | 0.79 (0.62, 1.00)* | 0.90 (0.70, 1.14) |
| With friends[b] | 0.70 (0.55, 0.89)* | 0.72 (0.56, 0.93)* |

*Note*. Relative risks are reported. 95% Confidence intervals for relative risks are shown in parentheses.

* $p < .05$.

[a] Adjusted mortality risks were obtained from Cox regression models including the respective activity, age, sex, education, number of diagnoses, balance / gait, digit letter, and living in institution.

[b] The coding of this variable is equivalent to the dichotomy “yes – no” (see Table 1).

Table 4

Association of consumptive activities, social activity and social context with mortality (N=473).

| Risk factor | Mortality risk | | |
|---|---|---|---|
| | Model 1: "Consumptive w/out social" and covariates | Model 2: Model 1 plus social activities | Model 3: Model 2 plus "social context: with friends" |
| Consumptive w/out social | 0.58 (0.38, 0.87)* | 0.58 (0.39, 0.88)* | 0.59 (0.39, 0.89)* |
| Consumptive w/out social * time | 1.11 (1.03, 1.20)* | 1.11 (1.03, 1.20)* | 1.10 (1.02, 1.19)* |
| Social activity | --- | 0.85 (0.69, 1.05) | 0.91 (0.73, 1.13) |
| Social context: with friends | --- | --- | 0.76 (0.59, 0.99)* |
| Age (years) | 1.08 (1.06, 1.10)* | 1.08 (1.06, 1.10)* | 1.08 (1.06, 1.10)* |
| Sex (0 = F, 1 = M) | 1.69 (1.35, 2.12)* | 1.67 (1.33, 2.09)* | 1.58 (1.25, 1.99)* |
| Education (years) | 1.01 (0.96, 1.06) | 1.01 (0.97, 1.06) | 1.01 (0.97, 1.06) |
| Diagnoses (number) | 1.07 (1.04, 1.10)* | 1.07 (1.04, 1.10)* | 1.07 (1.04, 1.10)* |
| Balance / Gait (z-score)[a] | 0.80 (0.70, 0.92)* | 0.80 (0.69, 0.91)* | 0.79 (0.68, 0.90)* |
| Digit Letter (z-score)[a] | 0.90 (0.79, 1.03) | 0.90 (0.79, 1.02) | 0.91 (0.80, 1.04) |
| In institution (0=N, 1=Y) | 1.47 (1.08, 2.00)* | 1.46 (1.07, 1.99)* | 1.50 (1.10, 2.04)* |

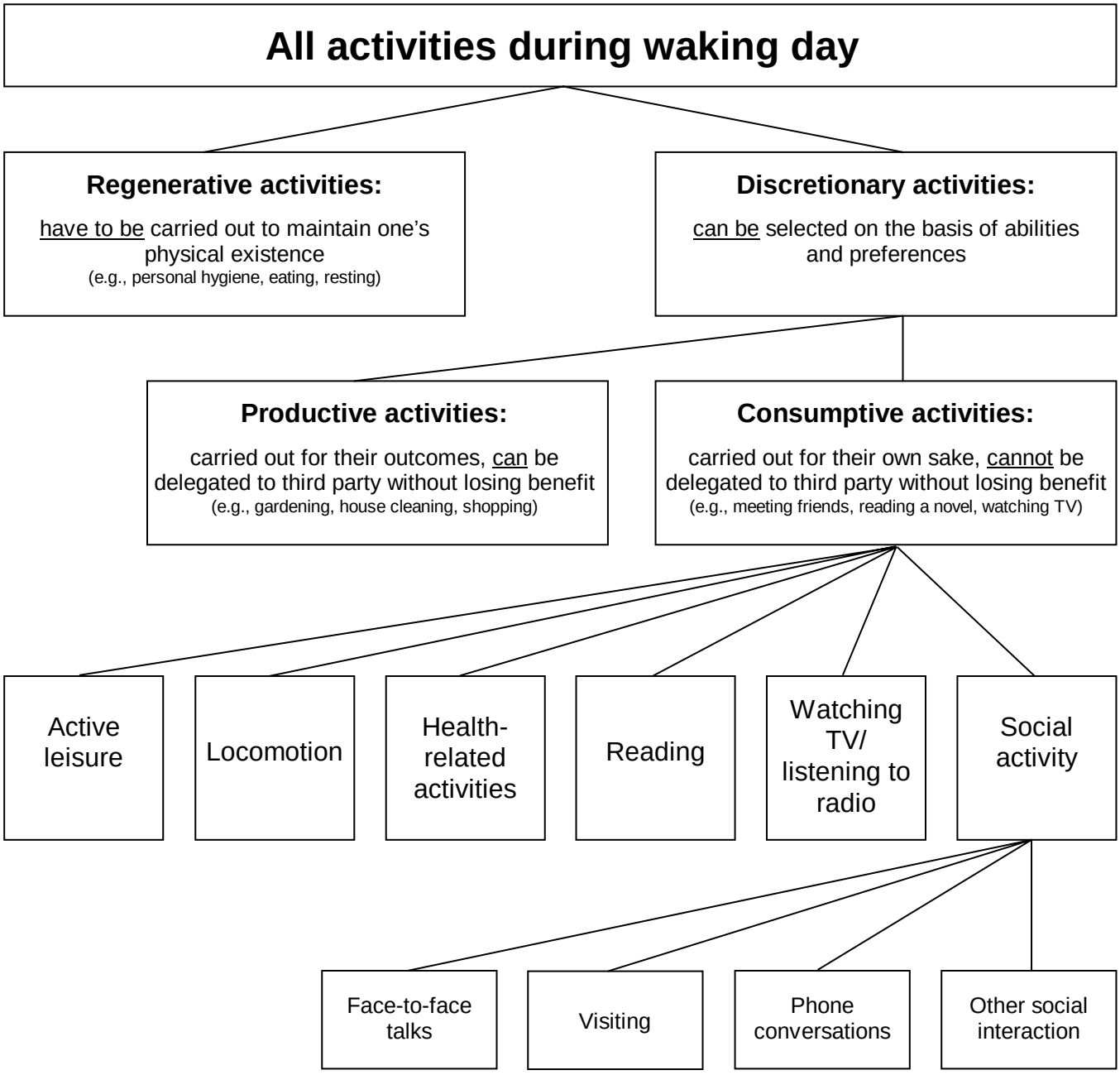
*Note*. Relative risks are reported. 95% Confidence intervals for relative risks are shown in parentheses.

* $p < .05$.

[a] Higher scores indicate higher levels of functioning.

# Figure Caption

Figure 1. A theory-based categorization of all activities during waking day


All activities during waking day
Regenerative activities:
have to be carried out to maintain one's physical existence
(e.g., personal hygiene, eating, resting)
Discretionary activities:
can be selected on the basis of abilities and preferences
Productive activities:
carried out for their outcomes, can be delegated to third party without losing benefit
(e.g., gardening, house cleaning, shopping)
Consumptive activities:
carried out for their own sake, cannot be delegated to third party without losing benefit
(e.g., meeting friends, reading a novel, watching TV)
Active leisure
Locomotion
Health-related activities
Reading
Watching TV/ listening to radio
Social activity
Face-to-face talks
Visiting
Phone conversations
Other social interaction