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ACANTO

A CyberphysicAl social NeTwOrk using robot friends

Deliverable 1.2.3
Longitudinal Tracking – Diary Study

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Dissemination Level		
PU	Public	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Contents

Executive Summary

This deliverable, D1.2.3, explains the method for longitudinally tracking a cohort of older adults across the three years of the ACANTO project. It also presents preliminary findings from the first set of diary studies conducted with this group.

Throughout the course of the ACANTO project, 40 older adults will be tracked for three years to ascertain changes in their physical, psychological and social well-being both due to natural causes and those due to the intervention of the system. At each season, participants will be asked to complete a diary study for two weeks and carry with them a GPS tracker and activity tracker. In this report, we report results from both the quantitative aspects of the diary study and the initial questionnaire. Only a small number of participants are reported due to the early stages of the work.

The questionnaire records data about physical health, psychological health (e.g. depression) and life-space. The diaries record data about daily mood, physical and social involvement, and life-space. After analyzing these, we report several initial findings about the relationships between variables. We note the importance of physical activity in increasing perceptions of mental alertness and attentiveness, the role of social involvement in reducing loneliness, and the role of resilience in increasing well-being.

We argue that these findings, while preliminary, point to the value of this longitudinal tracking study in showing the benefits and mechanisms of improvement in the cohort of older adults tracked throughout the course of the project. By introducing the system to a subset of this cohort, the benefits of the system and the means by which it produces those benefits can be identified.

Introduction

In the ACANTO project we are developing an assisted walker which integrates with a social network for older adults to improve their social and physical wellbeing. To assess the success of the device and its components participants engage in a longitudinal study to track changes in their physical and psychological well-being (measured yearly for three years). Some of these participants will be used as a control while others will use some of the prototypes as they are developed. These participants will provide feedback on their use of the prototypes. All participants complete questionnaires, complete diaries about their physical and social activity during the first year, and use location and activity trackers to monitor their activities. This data will be used to explore the effect of using the ACANTO system on social and physical activities.

In this deliverable, we explore initial findings from the first group of participants who completed the baseline questionnaires and a two-week diary that asked them questions about their physical and social activities for each day.

In the diary study our aim is to explore the daily patterns of physical wellbeing, psychological wellbeing and social wellbeing of older adults by asking them questions about each of these issues. Previous research indicates that mood varies on a daily basis based on activities that fulfil key needs including autonomy, competence and relatedness [1] so we will ask participants about their moods for each day. While mood does not necessarily link to wellbeing (upsetting events can disturb mood without causing long-term effects to wellbeing), more positive moods are generally desirable and consistently negative moods are a sign of concern. Well-being is also affected positively by participation in physical activities, active social involvement, and creative and cultural activities [2] so we ask about each of these. While physical activity and social involvement are the most important issues with regards to the ACANTO project, in the project we also want to encourage creative and cultural activities and generate physical and social wellbeing as a by-product of these. Furthermore, reduced life-space is associated with reduced well-being (depressive symptoms; [3]) so we ask about the life-space [4] of participants. We hypothesise that mood will be positively affected by increased life-space and by regular participation in physical, social and cultural activities. We also anticipate differential effects of types of activities (physical, social and cultural) on wellbeing. Regular participation in social, physical and cultural activities should lead to overall better well-being scores.

Additional data from the diary studies will include the days of the week that certain activities are performed. Mood fluctuates on a weekly cycle [5] and this may affect the activities that users want to engage in. Understanding details like this can feed into the design of the ACANTO recommender system that recommends activities to users.

One interesting additional aspect of our longitudinal tracking is that we will administer the diary study four times per year, once for every season. Seasonal variation is known to affect physical activity [6] and happiness [7] and it will be interesting to explore the effect that the seasons have on the daily lives of participants. This will provide information about how to tailor the system to provide recommendations for users across the seasons.

Questionnaires will be used annually to obtain a wide range of data dealing with participants' health and wellbeing. Such data will be used to assess potential decline of wellbeing by age among control participants as well as providing insight into how use of the system and participation in such a research project can improve wellbeing.

While not reported in this deliverable, GPS and pedometer data will be used to collect empirical data on physical activity levels and travel behaviour. This data will be supplemented by qualitative feedback from participants to provide context and information about the journeys and activities undertaken. Using this data, we will categorise participants based on the features of their home-neighbourhood (e.g. number of shops, urban-rural, density of housing, and presence of green spaces) in order to examine the effect this has on travel behaviour. We will also

differentiate between indoor and outdoor activities to examine the effect this has on subjective well-being scores (in line with [8]).

Taken together, this data will provide a well-triangulated picture of how physical and social activity and their specific details affect the well-being of older adults. In this deliverable however, we focus specifically on reporting the findings from the diaries and explore the relationship between the factors measured there.

Method

Design

This is a multi-method study consisting of quantitative and qualitative data. Five types of data will be collected (only the first two are reported in this deliverable):

1. Questionnaires will be administered at the start of the process and then on a yearly basis (for three years). The questionnaire data will be used to assess changes in self-reports of physical activity and psychological well-being.
2. Diaries will be completed and subjected to both quantitative and qualitative analysis.
3. Photographs will be collected from participants. They will use their own cameras. These images will be recorded every day for a two-week period to coincide with the use of the diaries.
4. Location trackers will collect GPS data.
5. Activity trackers will collect numbers of steps per hour.

In later stages of the project, these data can be compared with data gathered by the social network system to see similarities and differences; the effect of using the social network in terms of physical and social activity will be explored.

Ethical approval was granted for this study by the Ethics committee at Northumbria University.

Participants

Overall, 40 participants will be recruited in England from both the NorthEast Age Database held at Northumbria University and from sheltered housing communities in the Newcastle-Gateshead area. In this study, data from 8 of the first participants is presented (mean age = 73.6, Males=3, Females=5). Participants all live independently in the community.

Instruments

In the initial questionnaire, measures were taken from D1.2.1 to assess the physical, psychological and social wellbeing of participants across the three years of the project. These measures were:

- Participant activities [9]
- History of past falls
- Geriatric Depression Scale [10], [11]
- The Brief Resilience Scale [12]
- Falls Efficacy Scale International Short form [13]
- Personal wellbeing index [14]
- de Jong Gierveld Scale [15]
- Theory of Planned Behaviour measures adapted from [16]
- EuroQL 5D 5L (Quality of Life; [17])
- Charlson Comorbidity Index [18]
- UAB life-space assessment [4]

- FRAIL Scale [19]
- Barthel Index [20]
- Lawton Index [21]
- Mini mental state examination (MMSE) [22]

In the diary study, participants were asked questions on the following issues (a full listing of questions is given in Appendix 1):
- Mood (20 items, Likert 5-point scale)
- Social or physically active activities (qualitative)
- People you met with today outside of people in your home (qualitative)
- Perception of physical activity (Likert 5-point scale)
- Perception of social involvement (Likert 5-point scale)
- Perception of cultural involvement (Likert 5-point scale)
- Perception of creative-activity involvement (Likert 5-point scale)
- Life-space zones (5 questions)
- Other reflections on the day (qualitative)

Procedure

Participants were asked to commit to participation for three years (with the right to withdraw for any reason). Initially, participants complete a questionnaire to provide baseline data. Every year, participants will be invited to return and complete the questionnaire again. Each questionnaire takes around 30 minutes to complete.

At the first visit, participants will be provided with a paper diary and asked to record their social and physical activities for a two-week period - see Appendix 1. They will return to Northumbria University to provide their data. This two-week diary will be provided at four points during the course of a year to mark the different seasons.

During the two-week diary study, participants will also be asked to take one photograph per day to summarise their day. This might be of a key event, a person they met or something they made (for example). These can be used to further explore the daily lives of the participants.

During the project (depending on availability of GPS trackers and pedometers), participants will be provided with a GPS tracker and an activity tracker. These devices will be explained to participants. Participants will carry them and will be given instructions to charge the GPS tracker every few days. Reminders will be sent via text message to participants. These devices will be carried for a two-week period (to coincide with the diary task where possible).

When a new prototype is available, participants will be invited to come and use it. Then, every year, participants will be invited to a review meeting where they will hear the results and details of further product development.

Results

Because these were preliminary findings from the research, they are not extensive and are presented to give an overview of some simple relationships between variables measured. Bivariate correlations were explored to see the relationships between variables measured in the questionnaire and the subsequent two-week diary.

We expected to see a relationship between perceptions of physical activity ("To what extent do you feel you were physically active today?") and the mood of participants during the diary study. However, only two relationships were significant; there was a positive correlation between feeling active and feeling alert ($r=.79$, $p=.019$, $n=8$) and a positive correlation between attentiveness and

feeling active (r=.86, p=.007, n=8). This points to the cognitive and emotional benefits of physical activity.

We expected that social involvement would have an effect on mood but no significant relationships were found. However, feeling socially involved correlated with cultural activity perceptions (r=.968, p<0.005, n=8). This may be because many social activities are also cultural activities (e.g. visiting the cinema, theatre, museums, and art galleries).

Feeling socially involved correlated negatively with going outside one's town (r=-.775, p=.024, n=8) but had no significant correlation with life-space overall. This may be because social involvement occurs frequently inside the towns of the participants.

Several items negatively correlated with being outside one's house: feeling scared (r=-.91, p=.004, n=7), feeling nervous (r=-.832, p=.02, n=7), and feeling afraid (r=-.90, p=.015, n=6). Because correlations do not show causation, it is unclear whether leaving one's house reduces these fearful feelings or whether they (i.e., not feeling scared) are a precursor to leaving one's house. Fear of falling measures may be useful in this regard but did not show significant relationships (the relationships were moderately positive nonetheless).

Using the data from the questionnaires and the diaries together, further relationships can be identified. Feeling socially involved negatively correlated with emotional loneliness on the De Jong Giervald Scale (r=-.895, p=.003, n=8) and with social loneliness (r=-.865, p=.006, n=8). The same pattern is observed for participation in cultural activities: Emotional loneliness (r = 0.85, p = 0.01, n = 8) and social loneliness are negatively correlated with perception of cultural activity (r = 0.79, p = 0.02, n = 8). This shows the role of both social and cultural involvement in reducing feelings of loneliness. Further regression analysis will be conducted in future stages of the research to determine the contribution of these to loneliness scores since cultural activities may be explained largely by the social involvement inherent in them.

Scores on the Geriatric Depression Scale correlated positively with life-space (r = 0.96, p = 0.01, n = 5) but this can be explained by the fact that all but one person scored 5 in the GDS scores (he/she scored 6) and they had a higher life-space score than the others thus giving a positive skew to the data.

Resilience was measured as a way of understanding how well participants cope with difficult life-events. It was found to correlate positively with wellbeing (using the Personal Wellbeing Index; r = 0.87, p = 0.01, n = 8) and Quality of Life scores (r = -0.84, p = 0.01, n = 8) while it correlated negatively with both emotional and social loneliness (r = -0.84, p = 0.01, n = 8; r = -0.85, p = 0.01, n = 8 respectively). These findings are entirely to be expected and indicate that resilience plays an important role in buffering the individual from negative life events and fostering greater well-being.

Quality of Life scores were related to a number of other variables. QoL was negatively correlated with both emotional and social loneliness (r = -0.85, p = 0.01, n = 8; r = 0.84, p = 0.01, n = 8 respectively). QoL also positively correlates with number of times fallen over the past year (r = 0.8, p = 0.02, n = 8) and two years (r = 0.82, p = 0.01, n = 8). Furthermore, it is positively correlated with cultural activities (r = 0.72, p = 0.046, n = 8). The latter finding is suggestive of the advantage of distinctly cultural activities in maintaining and producing well-being but awaits further exploration with a stronger dataset.

Finally, several measures were taken to assess beliefs about physical activity drawn from the Theory of Planned Behaviour [23]. Beliefs about control ("How much control do you have over whether or not you engage in regular physical activity?") were correlated with falls over the past year (r = -0.94, p = 0, n = 8) and two years (r = -0.94, p = 0, n = 8). This probably suggests that falls have a negative impact on one's control beliefs – their sense of how much control they have over their physical activity. To some extent this doubtless reflects physical constraints but it also may reflect psychological constraints whereby the individual feels unable to engage in physical

activity but could be assisted with appropriate encouragement. Nevertheless, this is only a suggestion.

Discussion

Naturally, the presentation of the results has been somewhat guarded due to the small sample size and preliminary nature of the findings. However, several of the results are suggestive and overall, the results show the potential of the research to explore the factors involved in the physical, social and psychological well-being of older adults. For example, the mood benefits of physical activity suggest that alertness is one benefit of being more physically active. Also, social and cultural involvement correlate with decreased loneliness, which indicates the benefit of this involvement for older adults. Furthermore, the buffering effect of resilience shows the importance of this factor in helping older adults through difficult life transitions. Moreover, research has shown that group memberships (and thus social involvement) help to produce resilience [24] so future research can explore the role of social involvement in predicting resilience. There is potential for developing solid evidence to show the many benefits of social involvement for older adults both physically and psychologically.

When this data is linked with GPS data and activity data, we will be able to explore in more detail where older adults perform most of their physical activity and the effect of different types of physical activity (e.g. gym activity vs. walking in a park or museum) on psychological and social wellbeing. The GPS data will pinpoint where the activity occurs and by matching timestamps in the data with timestamps in the activity data, the locations of physical activity can be identified. Furthermore, qualitative data from the interviews will help to uncover the meanings associated with particular locations (e.g. a favourite coffee shop or a friend's house) to further identify the types of physical activity most conducive to greater well-being.

Limitations

Because these findings are from the first few participants in the study, the sample size is very low. This means that significant results are harder to achieve and thus, the relative lack of findings in this initial report are not to be expected further on in the research. Furthermore, some findings were clearly false positives (e.g. the relationship between GDS scores and Life-space) because of the small sample size.

While simply analyses are not to be avoided merely because they are simple, nevertheless, more complex more complex analyses were avoided in this report because of the small sample size. Consequently, we cannot make claims about the relative strength of different variables in predicting other variables (via regression analysis) or about group differences in variable scores (via ANOVA).

Another limitation of showing relationships is that correlations cannot show causation. While they show how variables are related to one another, they cannot show whether one variable causes another. Future studies will seek to rectify this by employing a wider range of analytic tools.

Relevance to the overall project

This part of the project has an important role in relation to the other parts insofar as it will help to show clear evidence of the social, physical and psychological benefits of using the cyber-physical social network and the associated FriWalk. Not only will it show the benefits, but we anticipate that it will show the pathways to those benefits. For example, we have noted the beneficial role of resilience in psychological well-being. By showing that increases in social activity as a result of using the CPSN are linked to increases in resilience, we could show a pathway by which psychological well-being is increased. Likewise, by showing that cultural involvement plays a role in producing well-being, we could demonstrate that the system's role in facilitating museum and gallery visits is important in that it recognizes the important factors in producing well-being.

While this report is preliminary, it nevertheless shows the potential for this ongoing study to identify the benefits of using the ACANTO system and the mechanisms by which they occur.

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Appendix 1: Diary

Week 1

Sunday 27th September

The following questions are about how you were feeling today. Beside each word, please tick the extent to which you felt the feeling described. 1 indicates that you only felt it very slightly or not at all and 5 indicates that you felt it very much. For example, if you felt moderately irritable today, you would tick the third box (3) beside the word "irritable".

	1	2	3	4	5		1	2	3	4	5
interested						irritable					
distressed						alert					
excited						ashamed					
upset						inspired					
strong						nervous					
guilty						determined					
scared						attentive					
hostile						jittery					
enthusiastic						active					
proud						afraid					

What social or physically active activities did you do today?

_____

_____

What people did you meet with today (outside of people in your home)?

_____

_____

To what extent do you feel you were physically active today?

Very active	Somewhat active	Neither active nor inactive	Somewhat inactive	Very inactive

To what extent do you feel you were socially involved today?

Very involved	Somewhat involved	Neither involved nor uninvolved	Somewhat uninvolved	Very uninvolved

To what extent do you feel you were involved in cultural activities today? (e.g. cinema, theatre, concert/live music, museums, art exhibitions or sermons)

Very involved	Somewhat involved	Neither involved nor uninvolved	Somewhat uninvolved	Very uninvolved

To what extent do you feel you were involved in creative activities today?

Very involved	Somewhat involved	Neither involved nor uninvolved	Somewhat uninvolved	Very uninvolved

Were you in the following areas today? Place a tick if you were.

In other rooms of your home besides the room where you sleep?	
An area outside your home such as your porch, garden, garage or driveway?	
Places in your neighbourhood other than your yard or apartment building?	
Places outside your neighbourhood but within your town?	
Places outside your town?	

Other comments or reflections on your day... (One A5 page)

_____

_____