

D5.2a Design of smart well-being components - initial

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Summary

The goal of this document is to make initial specifications of software components and devices for creating smart well-being applications. Several aspects are discussed; the main focus is on specific feedback messages for different personalised adaptive feedback strategies to improve a subject's level of self-efficacy with respect to physical activity. The categorisation of these messages per feedback strategy is verified in a validation study. Several experts were asked to participate in a workshop where all items are discussed and linked to the corresponding feedback strategy. A next step is to test these feedback strategies in a small lab study, described in Deliverable 5.1a. The result of this deliverable is a description of several components of the to be developed smart well-being application and a set of messages specific for the personalised adaptive feedback strategies described in Deliverable 5.3a.

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1 Introduction

The goal of Work Package 5 is to construct, demonstrate and evaluate applications capable of increasing a subject's level of well-being. Furthermore, demonstrators will be validated in a pilot study situated in everyday life. Adopted from Deliverable 1.3a; the final service we envision helps to improve an individual's level of well-being by increasing level of physical activity. The reason for this choice is based on research findings showing higher levels of physical activity having significant positive effects on health condition and prevention of several mental and physical chronic diseases. To further specify our goal: developing a service that increases a user's level of physical activity and is not abandoned after three to four weeks but can be used for extended periods of time. With respect to the challenge of developing such a service, Deliverable 1.3a describes several models and theories from behavioural sciences on how to achieve and maintain behavioural change. Incorporating these theories into the service we envision should make for the desired outcome; increasing effect and long term adherence. Elaborating on how to implement these theories and models, Deliverable 5.3a describes some of the major variables and details about the distribution of these variables in a rehabilitation setting and a healthy population. The findings led to the development of eight typical users, for whom six different feedback strategies are developed. Depending on what characteristics a user possesses, he or she is categorised as one of eight typical users and is accordingly assigned one of the six feedback strategies; users will receive a different feedback strategy and thereby different feedback, based on individual user information. This process of adapting feedback to the individual user, based on information from this user, so-called tailoring, is thought to increase the effect of an intervention, but also increase long-term adherence to a service (Deliverable 1.3a & 5.3a).

Summarising, previous deliverables have specified the models, theories and strategies for achieving our goal of achieving and maintaining a higher level of physical activity to increase well-being (Deliverable 1.3a, 5.1a/b & 5.3a). Elaborating on these results, the current deliverable aims to provide a specification of the components that are needed for the design of smart well-being applications. More specifically, the feedback strategies from Deliverable 5.3a will be further developed: individual feedback messages for the feedback strategies will be formed and validated (Chapter 3). To make explicit: with respect to the three levels sensing, reasoning and coaching/feedback, our focus is on the latter. The reason for this is because of the main challenge we face: achieving and maintaining behavioural change.

The document at hand starts with a more extensive summary of relevant deliverables in which several key constructs for achieving effective behavioural changes and their implications for the individual user are described. The different personas and adjacent personalised adaptive feedback strategies are mentioned in Section 1.1.1., but described in detail in Deliverable 5.3a. In the current deliverable, these feedback strategies will be translated into "smart well-being components" for of the to-be developed application that aims to improve a subject's level of physical activity. In more detail, it includes a list of specific feedback messages per feedback strategy, which will be verified through a validation study, of which a description is included in Chapter 3.

Up till now research into the measurement of daily level of physical activity is mostly performed using tri-axial accelerometers. These are small, unobtrusive devices that provide fairly accurate and reliable data throughout the day. Other methods or techniques, like pedometers or doubly labelled

water, are less suited to obtain a valid measure of daily level of physical activity, because of a variety of reasons, like size of the device or costs (Deliverable 1.3a). One key finding with respect to existing technology aided services that support users to increase their level of physical activity is that these typically services lack insights from behavioural sciences. We expect that a service that successfully incorporates such insights will be more effective in achieving a real and lasting change in behaviour.

1.1.1 Self-Efficacy and Stage of Change

In Deliverable 1.3a, two constructs were identified that can be of significant importance with respect to personalisation of feedback and achieving and maintaining behavioural change. These constructs are *Stage of Change* and *Self-Efficacy*. For an extended discussion of these constructs and theories we refer to Deliverable 1.3a and Deliverable 5.3a.

Furthermore, in Deliverable 5.3a, data from Philips Research and Roessingh Research and Development about level of physical activity regarding the target group, being “worried well” and patients experiencing problems with functional performance, are analysed and discussed. This revealed the following interesting findings with respect to the two constructs mentioned above:

- Level of Self-Efficacy is related to the level of activity at baseline as well as to the percentage of change as a result of a twelve week intervention program: the higher a subject’s level of Self-Efficacy, the higher his or her level of physical activity is.
- For subjects who are inactive at the start of the intervention, a higher level of self-efficacy is associated with a higher level of increase in physical activity.
- With respect to patients it was found that they have difficulty distributing their activity evenly throughout the day, regardless of their stage of change.
- Although no differences were found on a behavioural level with respect to Stage of Change, i.e. no differences were found in level of activity between various stages of change, the stages are characterized by different cognitions, which requires different feedback strategies. Users in the maintenance stage are satisfied with their performance and have no intentions to change, unlike users in earlier stages. Users who have no intention to change, should be approached differently than users who do have intentions to become more physically active.

Based on these findings, it is concluded that it is essential to provide personalised adaptive feedback based on the user’s level of self efficacy, baseline activity and stage of change. For example, a user with a high level of activity and high self-efficacy does not need the same guidance as a user with low levels of activity and self-efficacy.

Elaborating on these findings, eight typical users (Table 1) were identified who can be assigned to one of six different feedback strategies (Table 2 & Table 3); one of the strategies focuses on taking action (FBS3), another on helping the user to maintain the situation as it is (FBS4) and a third focuses on making the subject aware of the situation (FBS5/6). It, however, is more interesting to see that the four personas, 1, 2, 5 and 6 need a feedback strategy that includes a focus on increasing self-efficacy, using either feedback strategy 1, 2 or 5.

Table 1. Overview of personas

Intention to change (contemplation, preparation and action)				No intention to change (precontemplation and maintenance)			
Self-efficacy	Level of activity	Level of activity		Self-efficacy	Level of activity	Level of activity	
		Improper	Proper			Improper	Proper
Self-efficacy	Low	Persona1	Persona2	Self-efficacy	Low	Persona5	Persona6
	Average-high	Persona3	Persona4		Average-high	Persona7	Persona8

Table 2. Feedback strategies (FBS) for users with intention to change

		Improper activity pattern	Proper activity pattern
Self-efficacy	LOW	<u>FBS1: Increase self-efficacy</u> By vicarious experience/feedback and letting users experience success.	<u>FBS2: Increase self-efficacy</u> Reassure users that level of activity is high enough.
	AVERAGE / HIGH	<u>FBS3: Take action</u> Support user to achieve better balanced life-style. Provide tools that can help the user to distribute activity better.	<u>FBS4: Maintain situation</u> Let user set goals. Keep challenging and fun.

Table 3. Feedback strategies for users without intention to change

		Improper activity pattern	Proper activity pattern
Self-efficacy	LOW	<u>FBS5: Make aware and increase self-efficacy</u> Confront with actual level of physical activity. Increase self-efficacy by vicarious experience/feedback and letting users experience success.	<u>FBS2: Increase self-efficacy</u> Reassure user that level of activity is high enough.
	AVERAGE / HIGH	<u>FBS6: Make subject aware and take action</u> Confront with actual level of physical activity. Provide tools that can help the user to distribute activity better.	<u>FBS4: Maintain situation</u> Let user set goals. Keep challenging and fun.

Concluding, we assume that physical activity support services can be improved by implementing insights from behavioural science. More specifically, we expect that a service incorporating tailored feedback strategies and/or implementation intentions will support users more effectively in achieving and maintaining a higher level of physical activity.

2 Components for smart well-being applications

Now that we have specified the feedback strategies that need further developing, the current chapter is about the necessary components for the envisioned smart well-being application. For now, our focus will be limited to implementation of the feedback strategies described above. When subjects start using the activity monitoring system, it should first be able to identify the feedback strategy most suited for the individual user. Since these feedback strategies are based on levels of Self-Efficacy, Stage of Change and level of activity, a baseline measurement needs to be obtained of all three measures to categorize users appropriately.

When first using the system, users will receive an accelerometer that assesses the user's level of activity. Also, users are handed a Personal Digital Assistant (PDA). At first start-up, users will be prompted with two questionnaires: the first to assess a user's level of Self-efficacy (Rodgers et al., 2008) (e.g. Figure 1) and a second to assess Stage of Change (Marcus et al., 1992) (Figure 2), and thereby intention to change.

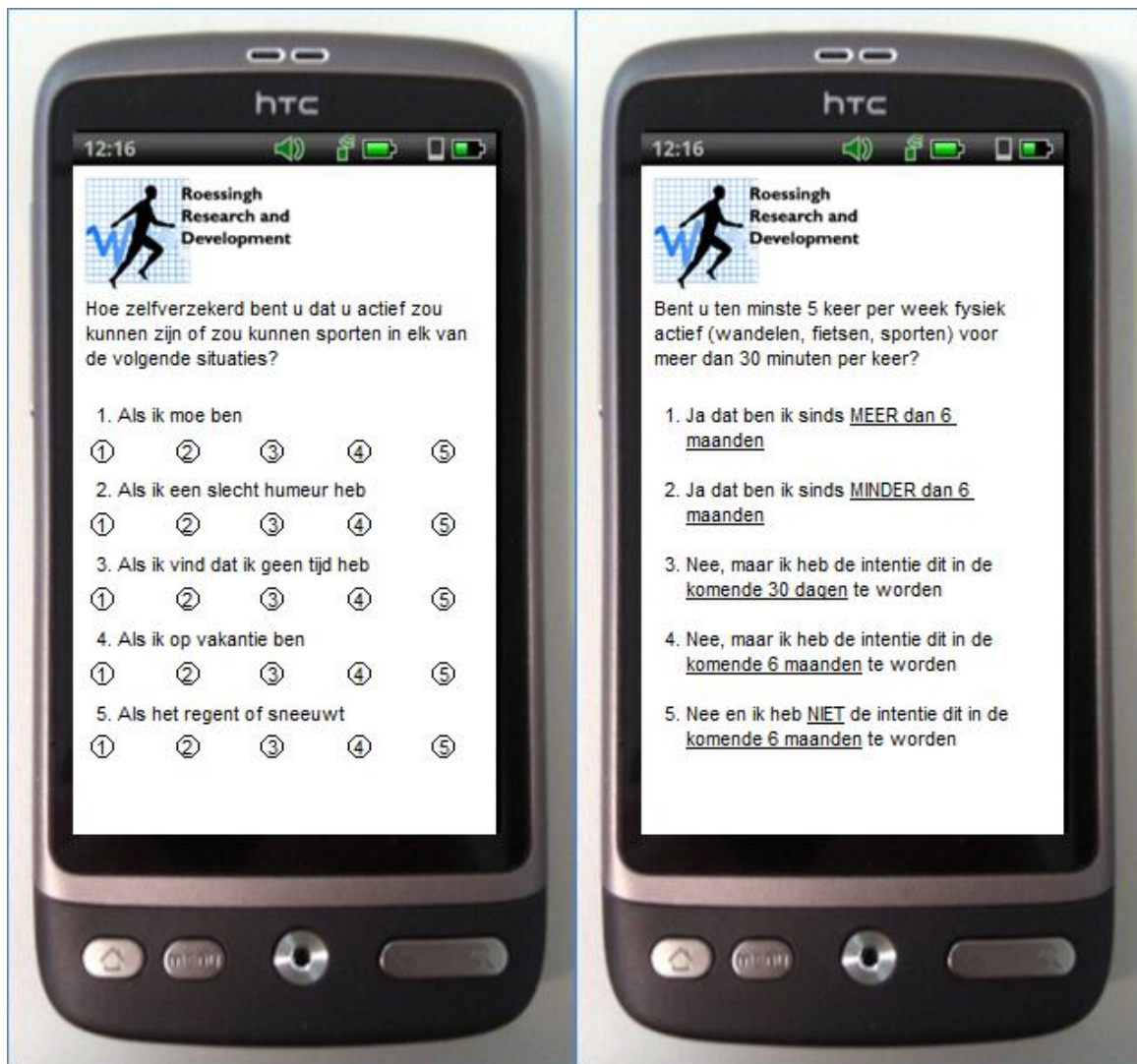


Figure 1. Self-efficacy questionnaire on PDA

Figure 2. Stage of Change questionnaire on PDA

The already gathered activity data will be analysed and categorised as proper or improper and combined with data from the questionnaires. Categorisation criteria are summarised in Table 2.

Table 4. Categorisation criteria for defining feedback strategy

Variable	Score	Category
Activity	High drop in activity over the day* and inactive**	Improper
	Normal drop in activity over the day*, but inactive**	Improper
	High drop in activity over the day*, but active**	Improper
	Normal drop in activity over the day* and active**	Proper
Self-Efficacy	5 through 12	Low
	13 through 25	Average-High
Stage of Change	1 (Precontemplation)	No intention to change
	2 (Contemplation)	Intention to change
	3 (Preperation)	Intention to change
	4 (Action)	Intention to change
	5 (Maintenance)	No intention to change

* High/Normal drop in activity over the day > or < 20% drop in activity respectively.

** Active/Inactive: average Count per Minute (CPM) over the day > or < 1000 CPM respectively.

Once all necessary data is gathered and combined, users will be assigned the corresponding feedback strategy as described in tables 2 and 3. In the following section we will specify feedback messages corresponding to the separate feedback strategies.

Since Self-Efficacy and Stage of Change are known to vary with time and our intervention is focused on increasing Self-Efficacy, these constructs should be measured repeatedly. A literature search on when and how often Self-Efficacy should be assessed yielded diverse results; most studies measure Self-efficacy at baseline and at the end of an intervention, making the interval between two measurements range from 6 weeks (Everett, Salamonson et al., 2009) to 2 years (McAuley, Morris et al., 2007), including 12 weeks (Smith, Annesi et al., 2010; Costanzo & Walker, 2008), 6 months (Izawa, Watanabe et al. 2005) and 1 year (Robinson, Norman et al., 2008) intervals between two measurements. Although small, a difference in self-efficacy was found in the study by Everett et al. (2009). In view of our goal to develop an application that is to be used for extended periods of time, we recommend measurement of Self-Efficacy every 2 weeks, regardless of whether users have reached a high level of Self-Efficacy. This forms a check for relapse and, possibly more important, provides insight in the course of level of Self-Efficacy over time. The same time interval is recommend regarding the Stage of Change questionnaire. Although an interval of two weeks between two prompts might seem short, literature is not unambiguous about what interval to use. In addition, the questionnaires are relatively short and easy, and therefore do not cost much effort to complete.

Summarising, this section identifies three components of the smart well-being application: [1] a component to assess the psychological constructs Self-Efficacy and Stage of Change, and [2] a decision support tool to determine properness of level of physical activity as well as to determine the patient's profile. Last, [3] a personalized feedback component should be incorporated in the

application, containing the specific feedback messages corresponding to the appropriate feedback strategy.

2.1 Personalized feedback messages

The current section elaborates on the module identified in the previous section as the personalized feedback component, [3]. After the first week of measurement, users are categorised and assigned one of the feedback strategies. Deliverable 5.3a contains the complete specification of all feedback strategies, but does not include a specification of the exact messages to present to users. Therefore, the goal of this section is to provide the exact messages that can be presented to users, per feedback strategy. Although six feedback strategies are identified in Deliverable 5.3a, only the feedback strategies that contain a focus on increasing self-efficacy are included in the description below, as not to define the goal too broad and lose focus. This means that, with respect to Tables 2 and 3, feedback messages will be formed for feedback strategy 1, 2 and 5.

The next paragraphs starts with a description of the feedback strategies, adapted from Deliverable 5.3a. Following each description, feedback messages corresponding to that strategy are suggested. Since all of the following feedback strategies include a focus on increasing Self-Efficacy, other aspects or constructs are needed for differentiating between the strategies. What stands out, with respect to feedback strategies 1 and 5, is the difference between absence and presence of an intention to change. When users have a low level of physical activity, but no intention to change, change will be difficult to achieve. One way of achieving this is by confronting users with their improper level of physical activity and focus on what users can gain from being more physically active. Instead, users that do have an intention to change should receive milder feedback and be complemented with the small changes they make. Feedback strategy 2 aims at reassuring users that their level of physical activity is proper, otherwise these users might keep trying to become more active and push themselves too far.

Feedback strategy 1

This strategy is appropriate for users who show a low or imbalanced level of activity, in combination with a low level of self-efficacy. The main goal is to increase self-efficacy by letting users experience that similar users are also able to maintain a balanced level of physical activity. For example, users in the same therapy group could be provided with each others' goal achievement or daily performance on their PDA. In addition, these users should be supported in setting easily achievable short term goals, in order to let them experience successes. Feedback messages should be positive and complimenting.

1. Probeer vandaag eens een korte wandeling te maken, van bijvoorbeeld 10 minuten.
2. Is er nog plaats in je planning om straks een korte wandeling te maken?
3. Het gaat erg goed vanochtend! Pas wel op dat je ook energie overhoudt voor vanavond.
4. Neem gerust een pauze, je bent actief genoeg; goedzo!
5. Je hebt een pauze verdiend! Neem wat rust. Wat vind je leuk om te doen; de krant lezen, even op de computer, enzovoorts?
6. Laat je niet ontmoedigen doordat je bijvoorbeeld je doel niet haalt, je bent op de goede weg.
7. Neem je vandaag weer de trap? Stap anders eens twee verdiepingen lager uit de lift om verder te gaan met de trap.

8. Goed gedaan, je bent vandaag weer actiever geweest dan gisteren.
9. Is het lekker weer buiten? Probeer een tijd te prikken om vandaag een stuk te fietsen.
10. Je gaf aan dat je actiever wilde worden, heel goed! Probeer voor de komende week dagelijks een wandeling in te plannen.
11. Je bent goed op weg om actiever te worden. Een volgende stap is om de wandelingen die je maakt te verlengen.
12. We merken dat je erg actief bent, houd je ook energie over om 's avonds leuke dingen te doen?
13. Elke dag een korte wandeling maken, of bijvoorbeeld met de fiets naar werk, draagt veel bij aan een goede gezondheid.
14. Je bent wat minder actief. Meer fysieke activiteit kan onder andere leiden tot een energieke gevoel.
15. Als je je vermoeid voelt kan het helpen om een stukje te lopen of iets anders actiefs te doen.
16. Wanneer je je van tevoren bedenkt op welke dag en hoe laat je een stuk kunt fietsen is de kans groter dat je het ook daadwerkelijk zult doen. Wanneer kan jij?
17. Wanneer heb je vandaag tijd voor een wandeling?
18. Wanneer heb je vandaag tijd om een stuk te fietsen?
19. Je zult merken dat je op den duur fitter wordt als je zo actief blijft zoals je nu elke dag bent. Probeer dit vol te houden!
20. Doe je kleine boodschappen al op de fiets? Kleine beetjes activiteit worden vaak onderschat.

Feedback strategy 2

Users who show a proper level of physical activity, but have a low sense of self-efficacy, should be reassured. The danger to these specific users is that they set unachievable goals. For example, users can feel the need to change, but do not know how, although they already have a proper level of physical activity. Therefore, this feedback strategy focuses on letting the subject experience that he or she is already doing fine. This strategy too contains complimenting messages.

1. Ondanks dat je hebt aangegeven actiever te willen worden blijkt uit metingen dat je vandaag actief genoeg bent geweest!
2. Je zit rond het gemiddelde niveau van gezonde Nederlanders qua activiteit; prima!
3. Je bent erg actief, vergeet niet af en toe rust te nemen; dat kan gerust zonder daardoor meteen als inactief te worden bestempeld.
4. Ondanks dat je aangeeft niet veel vertrouwen te hebben in jezelf als het aankomt op voldoende actief zijn, blijkt uit metingen dat je juist actief genoeg bent!
5. Je bent actief genoeg; je haalt je doelstelling van vandaag ruimschoots als je zo doorgaat.
6. Je hebt aangegeven nog actiever te willen worden, hoewel je vergeleken met gezonde Nederlanders actief genoeg bent.
7. Het wekelijks plannen van activiteiten, zoals wandelen, kan veel bijdragen aan het vertrouwen wat je hebt als het aankomt op fysieke activiteit.
8. Hoe actief ben je al denk je? Metingen wijzen uit dat je op een gezond niveau zit.
9. Je balanceert je activiteit netjes over de dag. Goedzo!
10. Mocht je nog actiever willen worden, probeer dan eens vaker de trap te nemen.
11. Je bent even actief als gezonde Nederlanders, maar je dagelijkse wandeling verlengen is een goede start om actiever te worden.

12. Ondanks je goede activiteitenpatroon zou je je wandelsnelheid kunnen verhogen om nog actiever te worden.
13. Ondanks je goede activiteitenpatroon zou je je fietssnelheid kunnen verhogen om nog actiever te worden.
14. De intensiteit van een activiteit verhogen is een goede manier om actiever te worden.
15. Je activiteitsniveau is goed op peil, pas op dat je niet koste wat kost nog actiever wilt worden.
16. Je activiteitsniveau is goed, ga zo door!
17. Je hoeft geen veranderingen te maken in je niveau van fysieke activiteit, het gaat al goed!
18. Probeer met jezelf af te spreken hoe laat en op welke dagen je een activiteit, zoals wandelen, fietsen of sporten, gaat doen.
19. Spreek met jezelf af wanneer je een activiteit gaat doen. Op die manier vergroot je de kans dat je het op dat moment ook daadwerkelijk zult doen.
20. Je hebt een goed activiteitsniveau. Weet je zeker dat je nog actiever wilt worden?

Feedback strategy 5

This strategy is meant for users who have an improper level of physical activity, low self-efficacy and no intention to change. The main difference between these users and the users who receive feedback strategy 1 is the absence of an intention to change. When the user does not have an intention to change, change will be difficult to achieve. Therefore, this feedback strategy aims at creating the intention to change physical activity. One way of doing so is confronting users with their improper level of physical activity and focus on what users can gain from being more physically active. Next, self-efficacy should be increased by the same strategies proposed in feedback strategy 1; let users experience that similar users are also able to maintain a balanced level of physical activity and provide help with setting easy to achieve, short term goals, in order to let them experience successes. Messages should be framed positively, i.e. telling what can be gained from a more active lifestyle, and be complimenting.

1. De metingen wijzen uit dat je wel wat actiever zou mogen zijn. Neem je altijd de trap?
2. Voldoende beweging zorgt voor verminderd risico op allerlei ziektes. Plan bijvoorbeeld tijd in voor een korte wandeling van 10 minuten.
3. Eerder heb je aangegeven geen intentie te hebben om te je niveau van activiteit te veranderen. Ben je tevreden met je huidige niveau?
4. Uit metingen blijkt dat je actiever zult moeten worden. Dit hoeft geen grote opgave te zijn; neem bijvoorbeeld eens de trap, of ga eens fietsen.
5. Hoe vind je dat je het gedaan hebt vandaag? Was je actief genoeg?
6. Hoe actief denk je dat je bent, vergeleken met een medepatiënt?
7. Je mag wat actiever worden. Fysieke activiteit, zoals wandelen of fietsen, kan juist als je vermoeid bent leiden tot een energieke gevoel.
8. Je hebt aangegeven geen intentie te hebben actiever te worden, terwijl een voldoende actieve leefstijl leidt tot een energiek gevoel en een gezonder lichaam.
9. Je activiteitsniveau is te laag, terwijl je veel winst kunt halen uit een actieve leefstijl.
10. Als je je activiteiten wat meer over de dag verspreidt, houd je meer energie over om 's avonds leuke dingen te doen.
11. Probeer even rust te nemen zodat je je energie beter verdeelt over de dag.

12. Neem even een pauze. Je bent 's ochtends erg actief, in tegenstelling tot 's avonds. Probeer dit beter te balanceren door activiteiten te spreiden.
13. Zoals je ziet is je niveau van activiteit lager dan het niveau van vergelijkbare anderen. Het is gezond om wat actiever te worden.
14. Een hoger niveau van fysieke activiteit kan al beginnen bij een kleine wandeling tussen de middag.
15. Meer fysieke activiteit kan al beginnen bij de laatste twee verdiepingen traplopen, in plaats van met de lift gaan.
16. Je hebt aangegeven geen intentie te hebben om fysiek actiever te worden. Houd in je achterhoofd dat je ook in kleine stapjes kunt veranderen.
17. Ondanks dat je aangaf geen intentie te hebben om actiever te worden is het een goed idee straks een korte wandeling te maken. Begin met een kort rondje.
18. Ga vanavond eens een stukje wandelen of fietsen. Dit zijn kleine stapjes richting een actievere leefstijl.
19. Maak voor jezelf eens een planning voor de komende week waarin je aangeeft wanneer je een activiteit zal gaan doen, zoals wandelen of fietsen.
20. Denk je dat je voldoende actief bent, vergeleken met anderen in je omgeving?

Advice for users with LOW Self-Efficacy

1. Prik alvast een dag en tijdstip in je agenda om deze week een wandeling te maken.
2. De trap nemen in plaats van de lift kan je gezondheid aanzienlijk verbeteren.
3. Door te beginnen met kleine stapjes, in plaats van verre doelen, is het makkelijker een begin te maken om actiever te worden.
4. Denk er ook eens over na om bijvoorbeeld twee verdiepingen eerder uit de lift te stappen en verder te gaan met de trap.
5. Als je je vermoeid voelt kan het extra moeilijk zijn een activiteit te ondernemen. Bedenk dan dat activiteit juist ook leidt tot een energieke gevoel!
6. Fysieke activiteit leidt tot meer energie. Als je te vermoeid bent, probeer dan toch een kleinere activiteit te ondernemen. Het mag ook met tussenpauzes!
7. Kleine doelen stellen helpt je om succesvol een actieve leefstijl te ontwikkelen, bijvoorbeeld door dagelijks een wandeling te maken en deze geleidelijk te verlengen.
8. Zoals je ziet ben je net zo actief als mensen zoals jezelf, heel goed!
9. Ten opzichte van mensen vergelijkbaar met jezelf ben je normaal actief, dat is goed!
10. Het kan helpen om concrete afspraken met jezelf te maken wanneer je een activiteit gaan ondernemen: welke dag, hoe laat, wat ga je precies doen?

3 Validation study

Now that the feedback strategies have been elaborated to specific feedback messages, their effect should be tested in practice. However, to verify the categorisation of the messages we will first perform a validation study, which is described next.

3.1 Participants

Subjects from varying disciplines will be invited to take place in the study. Psychologists, communicational scientists and individuals with particular experience in research on feedback will be combined to form a diverse expert group.

3.2 Procedure

The workshop will start with a presentation about how the various feedback strategies have been established; an overview of Deliverables 1.3a, 5.1a and 5.3a, giving participants a clear image of the SWELL project. After the presentation, participants receive a list of the feedback messages and are asked to link them to one of the three feedback strategies mentioned in Chapter 2. If participants think a message can be linked to more than one strategy, they will be asked to make a top 3 of best matching strategies.

After the first meeting the lists are collected and analyses are performed to clarify where participants agree, but more important, where they disagree. These items will be discussed with the group in a subsequent meeting to find the best matching strategy or strategies. The result will be a validated list of messages appropriate for strategies aiming at increasing self-efficacy or making users aware of their unbalanced or inactive lifestyle.

3.3 Results and conclusion

The list of feedback messages mentioned under Section 2.1 can already be regarded as a more detailed description of the personalized feedback component of the, to be developed, smart well-being application. The purpose of additionally bringing together several experts from behavioural sciences was to question and discuss the categorisation already made by the author of the deliverable at hand. Through this, the result of this study can be considered a validated list of feedback messages. During the workshop, the participants indicated some messages to be applicable to more than one feedback strategy. This is not considered a problem; the main goal is to construct feedback messages based on theories from behavioural sciences. Future actions relate to testing whether these new feedback strategies are more effective than the messages currently programmed on the ambulant activity based feedback module from Roessingh Research and Development. Hereafter, differences between the effects of the separate feedback strategies might be investigated.

4 Conclusion

In this document several components of a smart well-being application are described, based on the personalized strategies as suggested in Deliverable 5.3a. To enable personalized feedback, three different components are defined: [1] a component to assess the psychological constructs Self-Efficacy and Stage of Change, [2] a decision support tool to determine properness of level of physical activity as well as to determine the patient's profile and [3] a personalized feedback component.

This document also provides a more detailed description of [3]; a list of feedback messages per feedback strategy. The categorisation of the various feedback messages per feedback strategy has been verified in a validation study; several experts were invited to participate in a workshop where they were first asked to categorise the different messages, after which the categorisation was discussed in the group. This resulted in a validated list of feedback messages per feedback strategy that focuses on increasing Self-Efficacy. Ultimately, the envisioned application will dynamically adapt to changes in users' profiles during the intervention program. For now, however, the user will be prompted with two questionnaires (see Chapter 2) every two weeks to keep the feedback strategies appropriate for the user.

4.1 Future directions

The document at hand describes components that need to be developed for achieving our goal of creating a service for increasing a user's level of well-being, by achieving and maintaining a balanced level of physical activity. Next steps include testing and evaluation of the feedback messages and feedback strategies in a real life setting, although a small scale lab study is also planned for testing the effect of the feedback messages. A description of this experiment is included in Deliverable 5.1b.

An additional component that might be incorporated in future versions of the application is a module that supports users to form *implementation intentions*. Implementation intentions specify exactly when, where and how the behavior will be performed, as well as what will be done to overcome potential barriers: "When situation x arises, then I will perform behavior y ". Deliverable 5.1b describes in detail how implementation intentions can be implemented in a system based on the Philips DirectLife activity program. A study is planned to investigate whether implementation intentions can be incorporated in the DirectLife program and whether this leads to a more prominent increase in physical activity than the regular DirectLife program. If the beneficial effects of implementation intentions can be proven in the DirectLife environment, they are likely to be effective in the future SWELL system as well. In addition, implementation intentions may be used as a strategy to increase self-efficacy (Murray, Rodgers & Fraser, 2009).

A scenario that should be considered is that the suggested feedback strategies do not have the hypothesized effect. One explanation might be that the messages or strategies lack appeal; maybe a gaming aspect could be incorporated. Another possible explanation is that the current messages and/or strategies focus too less on making users aware of their improper activity pattern. This would imply a suggestion for the use of a more educational approach.

Regarding links to other work packages we see a strong link between this deliverable and Work Package 2, which is mainly focused on development of the reasoning behind smart feedback

systems. Future work should be focused on close collaboration and implementing the suggested components.

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