D2.3.1
Value, User Feedback and Graphics Design

Work package	**WP2 Emotional & Psychosocial Serious Game Framework**
Task	**T2.3 Value, User Feedback and Graphics Design**
Editor	**Geert Vander Stichele (MBY)**
(co-)authors	**Lien Franssens (MBY), Christian Kemp (FAM), Lucas Paletta (JRD)**
Public / confidential	**public**

Project PLAYTIME

The research leading to these results has received funding from the AAL Programme of the European Union and by the Austrian BMVIT/FFG under the Agreement no 857334, ZonMw (the Netherlands) and funding from Brussels (Belgium). It reflects only the author's view and that the Union is not liable for any use that may be made of the information contained therein.

20/02/18

Document information

PLAYTIME partner			organisation
01	JR		JOANNEUM RESEARCH Forschungsgesellschaft mbH DIGITAL – Institut für Informations- und Kommunikationstechnologien, 8010 Graz
02	FAM		FameL GmbH Steinbruchweg 20, A-8054 Seiersberg
03	SVD		Sozialverein Deutschlandsberg Kirchengasse 7, A-8543 Deutschlandsberg
04	GGZ		Geestelijke Gezondheidszorg Eindhoven en de Kempen Postbus 909, 5600 AX Eindhoven, The Netherlands
05	TIU		Stichting Katholieke Universiteit Brabant, Tilburg University PO Box 90153, 5000 LE Tilburg, The Netherlands
06	MCR		McRoberts BV. Raamweg 43, 2596 HN The Hague, The Netherlands
07	MBY		MindBytes F. Roosseveltlaan 348-349, B8, 90600 Ghent, Belgium
08	GEU		Ghent University Sint-Pietersnieuwstraat 25, 9000 Gent, Belgium

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1 Executive Summary

Aligned with the objective of PLAYTIME, which is to motivate people with dementia to perform daily activities and exercises thereby entering a positive feedback cycle, it is critical that PLAYTIME engages users and motivates them in a playful manner. Key aspects related to motivation are derived from the underlying social gathering concept and personalisation techniques applied in the PLAYTIME games. In particular, this deliverable defines the personalisation and user feedback approaches that will be integrated in PLAYTIME to enhance user engagement and motivation to play.

Personalisation of content is described in the literature as a technique to add value for users and enhance game play experience (Bakkes, Tan, & Pisan, 2012). As this technique has been demonstrated to increase player loyalty and enjoyment it has potential to enhance motivation and engagement in the context of the PLAYTIME games. PLAYTIME will focus on data analytics and derive rules for the recommendation of exercises (cognitive training or physical activities). Moreover, the recommender engine will be used control the difficulty level of the cognitive tasks in an adaptive way. In addition, player modelling will be integrated to allow for personalisation of game content (characters adaptation, task adaptation, narrative adaptation, etc.) in the person with dementia and caregiver serious games through the artificial intelligence engine (Bakkes, Tan, & Pisan, 2012).

Engagement is an essential element of the player experience and the concept is described extensively in the literature. Empirical studies have identified a range of components associated with engagement and the desire to continue playing to guide game design (Schoenau-Fog, 2011). MBY SERES platform is consistent with principles from published literature and these elements will be integrated in the serious game for people with dementia and caregivers included in PLAYTIME.

Graphic design concepts have also been evaluated to enhance engagement of end users. Person-centred design is uniquely relevant when designing games for special populations, such as people with dementia. In particular, MBY will incorporate universal design principles from the serious games approach. Moreover, for PLAYTIME training games, FAM will address design principles such as visibility, simplicity, redundancy, etc., which are particularly relevant for older population and people with dementia. Early stage GUI mock-ups are included in this report and these designs will be iteratively refined based on input received during field tests and through interaction with clinical experts such as GGZ.

To ensure alignment between FAM and MBY, a join design implementation plan is discussed. Collaborative work between the parties has facilitated a preliminary agreement on design expectations and needs. FAM will complete integration for the first field study and feedback will allow for iterative refinement and adaptation.

2 Introduction

Personalisation and feedback are key components of achieving learning objectives and further motivating users to engage with a digital system. As motivation is a key objective of PLAYTIME, the aspects of personalisation and feedback are critical to implement in the overall game system. Within the task, these components are described for each player, with a look towards how diverse players will be integrated together in the wider PLAYTIME system. Moreover, the user interface, which needs to be based on end user requirements, is also an integral component of user learning and motivation. Therefore this aspect is also explored from the perspective of maximizing user engagement and motivation.

3 Personalisation and User Feedback

Personalisation through profiling and implementation of biometric data into PLAYTIME is described in this section. In turn, a description of the implicit and explicit emotional feedback approaches integrated in PLAYTIME follows. The purpose of this feedback is, in part, to enhance user engagement and, accordingly, an exploration of the methods that target user motivation is made. Although the D4.5.1 describes in more detail how the recommender engine will function, it is discussed in function of personalisation and user feedback. Of note, the measurement and evaluation of user motivation is addressed in D3.5.1. Yet, a broad link between the data analytic components and recommender engine is described, hereafter. Accordingly, the recommender engine provides inputs to the motivational feedback, with the target of enhancing user engagement.

3.1 Personalisation

3.1.1 Profiling and Personalisation

Based on permanent measurement of cognitive and physical performance and emotional feedback, we will be able to establish a statistical analysis system providing decision criteria for the recommendation system but also alerts concerning significant performance trends what can also be used as a decision-making aid supporting an expert's diagnosis. Another aspect of personalization includes the client's biography. Certain tools help to collect pictures and sound files and store them as personalized content in the client's database. The clients' data for the statistical analysis is stored in an anonymized way, to assure the clients privacy.

3.1.2 Autobiographical Data and Application

A crucial aspect of the personalised game is the acquisition of autobiographical data from the person with dementia and the application of these data in appropriate training units of the multimodal training component. Autobiographical data from the past of the person with dementia can stimulate and thereby enhance the memory of the user. Furthermore, particularly if confronted with emotionally positively associated memories, the stimulation might become rich and advantageous and even spread to more networked stimulations. In this sense, reminiscence will be worked out and contribute to the other types of multimodal stimulations in the playful training component.

- In the multimodal training component, autobiographical data might be introduced in the following training units:Puzzle (pictures, themes from the past)
- Memory (pictures, themes from the past)
- Songs (important songs from the past)
- Filling letters (describing scenarios from the past)

3.2 User Feedback and Value Chain

3.2.1 Value from Individual Affective Annotation

Values from individual affective annotations should always be transferred as one of 4 possible logical Values 0,1,2,3 chosen by mouse click on one of 4 different colored buttons (interpreted as -2, -1, 1 2 what means “rejection”, “discontent” “satisfaction” and “elation”. Values not being assigned to unique terms can easily lead to statistical misinterpretations. Using 3 or 5 values may cause a trend to indifferent statements. 2 values may be too few – 6 values is too much. Permanent data collection and comparison allows to draw conclusions.

3.2.2 Measurement of Emotion

Engagement is an essential element of the player experience and the concept is described extensively in the literature. Empirical studies have identified a range of components associated with engagement and the desire to continue playing to guide game design (Schoenau-Fog, 2011).

The SERES platform of MBY currently reflects the Objectives, Activity, Accomplishment and Affect framework for player engagement stipulated by Schoenau-Fog and will be adapted to the requirements in PLAYTIME by MBY.

Furthermore, JRD will employ emotion analytics by means of state-of-the-art visual and/or psychophysiological emotion for studies but also for on-line feedback estimation received and measured from the PwD. In particular, JRD will apply simple slide bar based feedback or 9x9 matrix input for value and arousal based feedback. In addition, facial emotion recognition, psychophysiological biosensor data and eye tracking based strategies will be applied to emply a variety of methods in the studies. Emotion data are input to estimation methods to provide a basis for further integrated analytics (WP4).

Measurement of emotion will help the automatic recommender system to choose appropriate content units in a suitable degree of difficulty and sometimes - if necessary - even to abort the entire session.

3.2.3 Overall Value Chain

The idea is to motivate the client by choosing the appropriate units and the right difficulty to motivate him permanently. A user will become depressed, if he always gets a negative result after his session. On the other hand it shouldn’t be too easy as well. Furthermore we will get the units he prefers or he is good in more often to ensure a positive experience throughout playtime.

3.3 Motivational Feedback

3.3.1 Rewarding

The rewarding system will be based on text in dialog boxes, acoustically by text to speech may be supported by simple animations.

3.3.2 Recommendations

Recommender systems have recently obtained great success as an intelligent information system (Adomavicius & Tuzhilin, 2005). Content-based filtering approaches utilize a series of discrete characteristics of an item to recommend items with similar properties. In recent years, contexts, tags and social information have taken recommender systems (Ricci et al., 2011) into account. Personality aspects were recently considered to personalize recommendations and enhance both recommendation quality and user experience (Nunes, 2009; HU & Pu, 2010). An important aspect of recommender systems is the sequential, long-term aspect of interaction and learning of recommendation strategies (Shani et al., 2005). The system learns the optimal strategy autonomously by observing the consequences of its actions on the users and also on the final outcome of the recommendation session (Mahmood & Ricci, 2007).

PLAYTIME will particularly focus on the analysis of correlations in the data streams of the diagnostic toolbox and derive rules for the recommendation of useful exercises, such as, cognitive training or physical activities.

In particular, the recommender engine will be applied to control the difficulty level of the cognitive tasks in an adaptive way.

Furthermore, JRD will implement a simple model of human motivation and analyse emotional and performance based data towards an estimation of a current or enduring level of motivation of the PwD.

3.3.2.1 Caregiver/Person with Dementia Serious Game AI Engine

The caregiver and person with dementia serious games utilize an artificial intelligence engine to enhance user motivation and engagement. In particular the AI engine generates characters and avatars that are personalized to the user. This ensures that messages and content are more relevant to each user and therefore have a greater likelihood of being learned and internalized.

In addition, the AI engine selects and displays situations that are aligned with each PwD's disease state (e.g. mild cognitive impairment, major functional impairment, etc.) and PwD and Cg psychosocial state (e.g. negative valence, positive relationship status, etc.). In particular, the situations generated by the engine are focused on areas of confirmed user impairment (challenge), thereby ensuring that users play scenarios that are relevant to them – building self-efficacy.

This is also supplemented with cognitive feedback in the form of semi-quantitative results and best practice suggestions from expert avatars (e.g. doctor or nurse), derived from scientific literature. Together, this feedback helps users to recognize the impact of their actions on

relevant psychosocial parameters and develop awareness for alternative strategies. In turn, this facilitates users' learning experience.

4 Graphics Design Concepts

4.1 Playful Training of Persons with Dementia

4.1.1 GUI Design Considerations

The GUI design has to take into account the following requirements ranked by priority:

1. Visibility / Legibility (color-blindness, myopia, farsightedness, other refractive errors) Size of buttons, pictures and texts
2. Simplicity: as few buttons as possible: Choose-, Start-, Next-, Pause-, Abort-
3. Intuitive and redundant control elements for example “drag and drop”, but also click on source and target
4. Multi-layered GUI: user-dependent detail depth. As few control elements for any hierarchical level of user account as necessary.

4.1.2 Early Phase GUI Mockups

In the following, the novel worked out GUIs of the playful training component are presented.

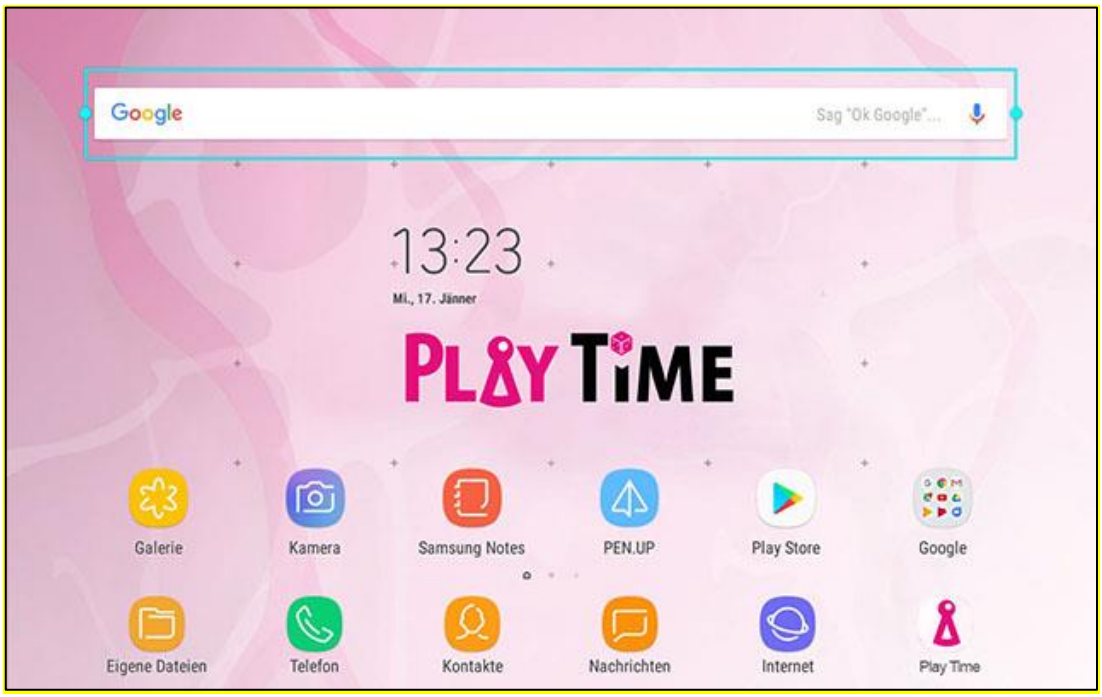

Figure 1. Dashboard of the Tablet PC with PLAYTIME icon.

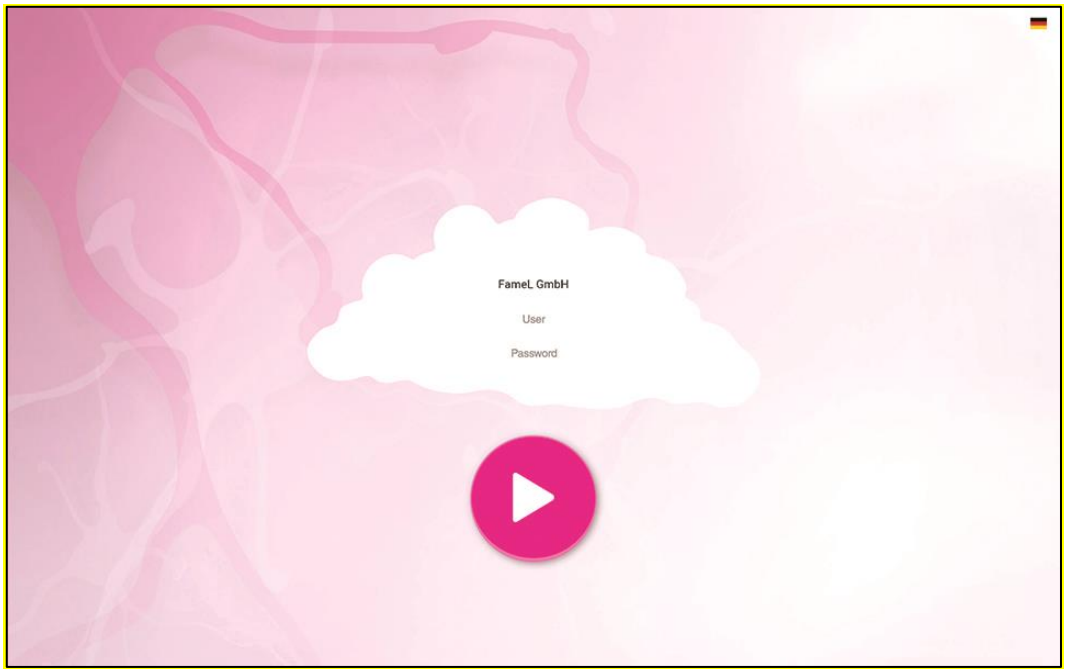

Figure 2. Login Screen.

Figure 3. Overview on various themes of playful training sessions.

Figure 4. Menu for the selection of an active player (multi-player mode).

Figure 5. Menu for the selection of various units. Fox is for cognitively stimulating units, parcel is for surprise unit, and shoe is for physically stimulating unit.

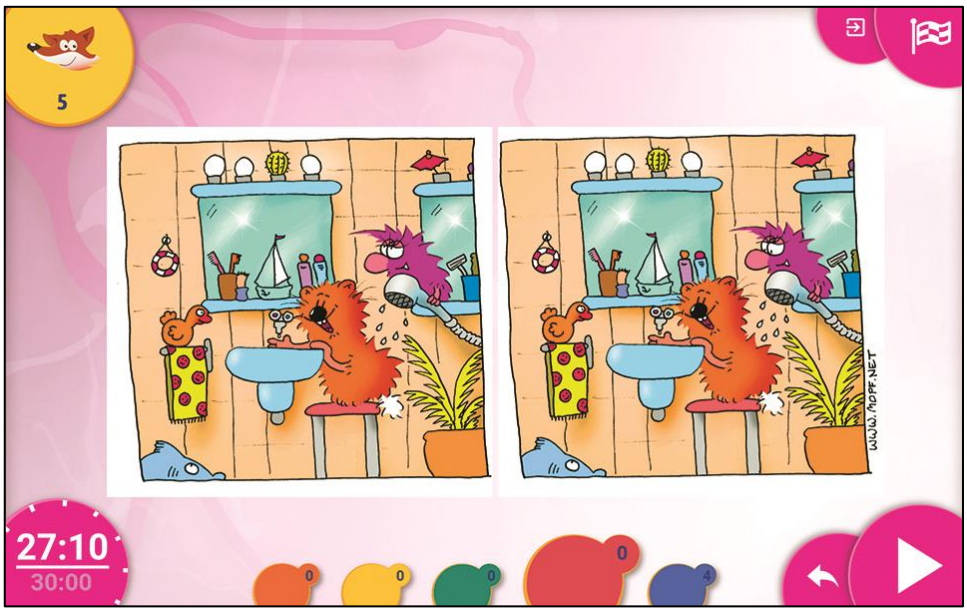

Figure 6. Picture (left) and its counterpart with 5 errors to be found by the user (right)..

Figure 7. Sentence with letters to be filled in..

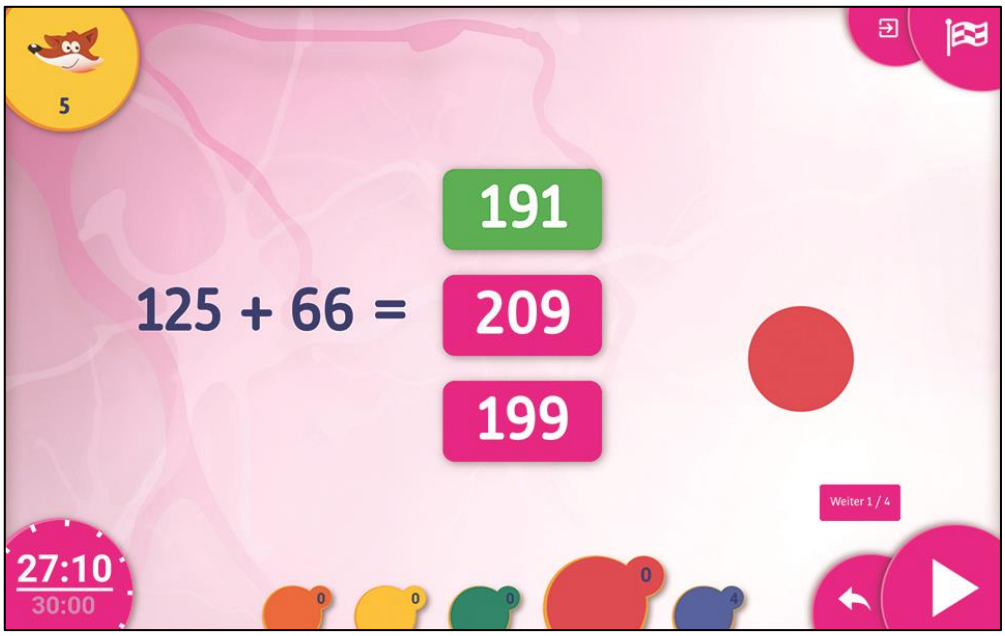

Figure 8. Mathematical task.

Figure 9. Memory game with pairs of pictures.

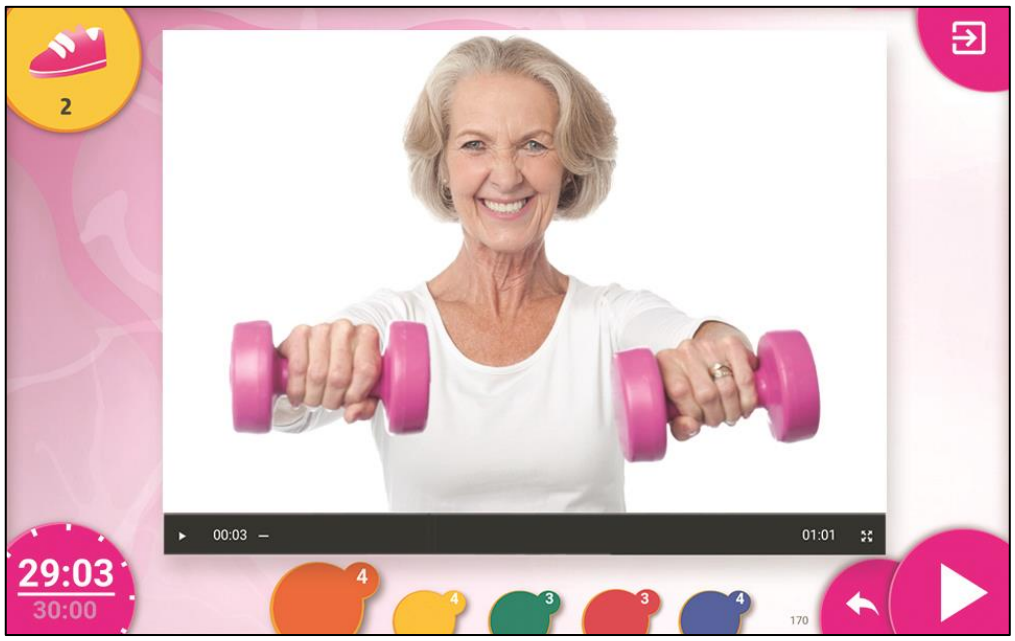

Figure 10. Physical training unit.

Figure 11. Multiple choice quiz.

Figure 12. Puzzle with 9 pieces (adjustable).

Figure 13. Ranking of players (color coded) according to the collected game points.

4.2 Socio-Emotional Game with Caregivers (CG) and Persons with Dementia (PwD)

4.2.1 Universal Design Considerations

MindBytes aims to integrate in the serious games for caregivers and persons with dementia the use of psychosocial and emotional elements. From a design perspective this will mean that the design will incorporate universal design principles from the serious games approach, but also more specific to the type of scenario-based games. Serious games can help patients to learn by trial and error. By using a simulation of real life settings the individuals can test new learned information and different possible decisions immediately without any risk. The design of game elements and their combinations will be carefully considered to optimally transfer the educational content within a playable environment. The design and game mechanics will reflect Mindbytes' objectives to engage the player into the world of the presented scenarios, to provide challenging situations for the player in which they can reflect about their reactions, to provide possible options on how to react to certain challenging situations and to determine the effects of the player's decisions. The design of the game should provide a balance between learning and game mechanics in order to provide a learning experience but one that is still entertaining enough so that the player stays motivated to continue with the game. After a player selects a decision immediate feedback is given to keep the players focused on the game. To keep the flow of the game going key aspects such as sensory stimulation (through engaging visual execution) and imaginative immersion (through relevant storylines) are combined in an easily playable game.

4.2.2 Design Considerations in the Frame of PwD Users

Mindbytes set out to collect the key components that should be addressed by a scenario-based serious game in the context of dementia. The intention of this approach was to translate scientific evidence towards game parameters and the overarching objective was to define the key disease and psychosocial states for the PwD. The socio-emotional game for PwD users will follow narratives tailored to the specific situations that the patients are confronted by or could possibly be confronted by during their daily life. In addition to that, all significant information that needs to be given to the player will be included in the developed game. The scenarios will follow a captivating storyline and are written based on key emotive and motivational components. The interface and visuals of the game are designed in line with Ux principles. The information that is presented both in text and image is going to be aligned with the level of cognition, emotion or social functioning of the targeted end user. Dialogues are kept short and written in easy understandable language. The information presented at once is not too complex so that the players can easily follow the storyline. The visuals are also developed with the specific abilities of the PwD in mind. To do this MindBytes will discuss opportunities and difficulties with patient organizations that have experience in working with patients with dementia. During the first field study more feedback and information will be collected to further tailor the PwD game to the specific needs of the patients. The use of focus groups and field studies provide an opportunity to present an example of how the game will function and look, to see how patients react and to test if the first developments of the PwD game are already a good reflection of the predefined

intentions for the game. In the first ‘mock-up’ 2 modules will be provided in which a similar set-up is considered as is intended to be used in the final product. This set-up will include a welcome screen, 2 different real-life based scenarios, a question with options screen, a feedback screen and a results screen. In this way the test can also reveal if playing the game follows a clear flow and if the PwD understand the goal of the game and the feedback they receive. In function of the need situation (PwD parameter values) the individual components concerning the relevant determinants are “merged” ensuring all the relevant aspects are addressed as a part of the scenario. This also ensures some complexity in decision-making.

4.2.3 PLAYTIME Specific Design Considerations

After the final version of the Cg and the PwD game is developed both games will be integrated, together with the components of the other PLAYTIME partners, into the PLAYTIME suite. In order to do this successfully the overall structure of how the multimodal platform will operate is already kept in mind during the initial design process. An example is being able to adjust the design and components of the visuals according to the feedback received from the PLAYTIME player. The end player will be able to provide feedback at the start of the game, but also input collected during the game (e.g., the answers they give to the questions asked after every scenario) will be used for the modification of the visuals that are presented. This could impact which scenario is selected at a specific time or specific visual design elements (e.g., symbols).

4.2.4 Early Phase GUI Mockups

In the early phase of the PLAYTIME project MindBytes will create GUI mockups to test the underlying scientific foundations, learning objectives and their translation into game mechanics. The results of the literature study in which information about PwD and their caregivers was collected, were used as a base for writing the game content. Issues related to the disease state of PwD or the burden caregivers experience are translated into written scenario’s and visuals. The scenarios are grouped into modules in a way that they are all related to the same particular determinants. Determinants included are society related (e.g., family, social networks) or patient related (e.g., behavioral and psychosocial symptoms, level of autonomy or cognitive functioning). For the Cg game determinants concerning coping strategies were also included. The GUI will allow the players to interact with the game in a straightforward manner. The interface of the game will be presented on a tablet device and will guide the player through the game with visuals of the characters, graphical symbols and text-based dialogues. The visuals and text are kept simple to allow for an easy to understand interaction between player and game. The visual language is kept in line with the learning and communication objectives. The player moves through the game and scenarios with the simple use of a button. Feedback is given in a separate screen. The graphical information presented on the screen will be designed based on the story content. In a later phase this information will also depend on immediate input from the players actions and decisions.

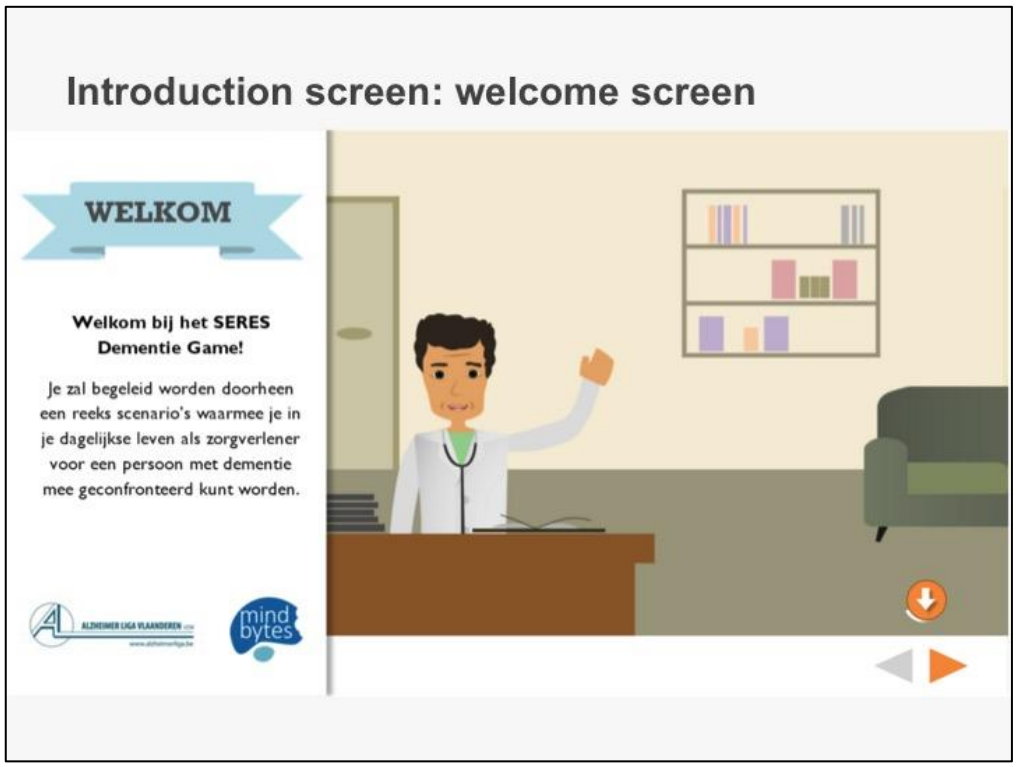

Figure 14. GUI Mockup, introduction screen.

Figure 15. GUI Mockup, scenario explanation.

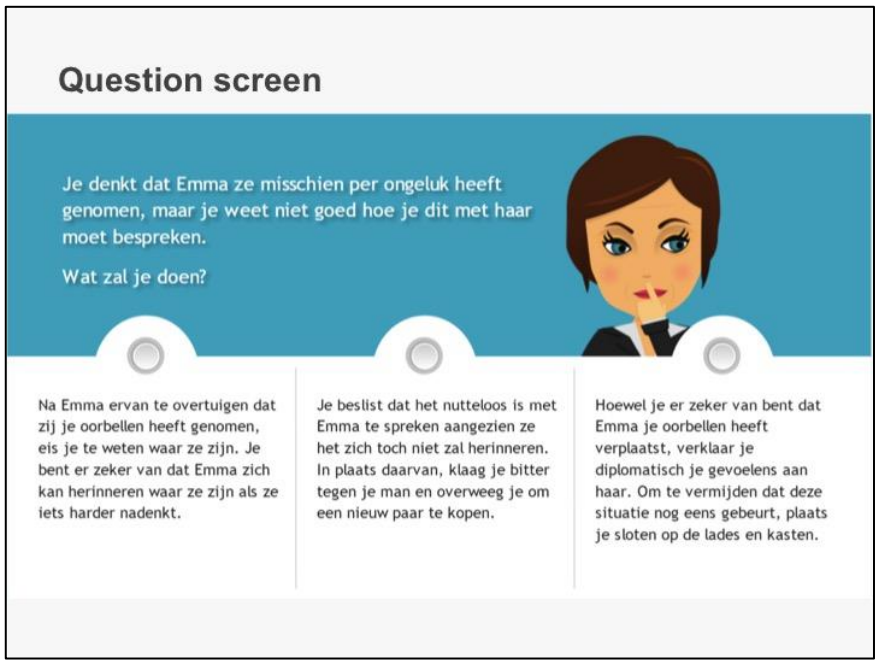

Figure 16. GUI Mockup, question screen.

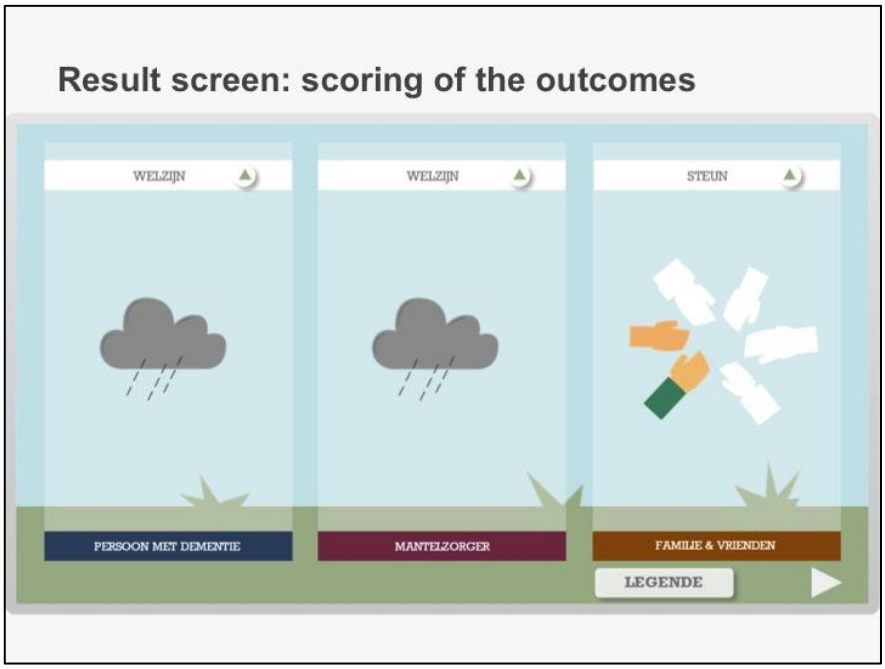

Figure 17. GUI Mockup, results screen.

4.3 Joint Design Implementation Plan

4.3.1 Development of a Conceptual Framework (Meta-Concept)

When PLAYTIME gets started it shows a learning page to the players. The trainers and users can then provide input data (e.g., gender, age, familial status, disease state, etc.) to personalize the game parameters. Behind the scenes the data gets stored and then processed by the algorithms to select the appropriate content for it to create the output data. Generating this output data includes having the engine decide the module, the sub-module, the level, exercise category, design elements, etc. When the right content is selected those elements get populated and visualized on the front end of the PLAYTIME platform. These elements also keep adapting based on the user input (decisions, eye movements, etc.) collected during the session. The end goal is that PLAYTIME provides an unique solution to the player. For this solution general decisions are taken into account (e.g., disease state; to focus more on cognition, movement and/or psychosocial factors, etc.), but also specifics are considered such as current level within all the different PLAYTIME modules.

4.3.2 Development of a Blueprint Prototype

During the initial phase of the PLAYTIME project a prototype will be developed that tests the functioning and integration of the different modules. Because the output data will be based on customization there will be separate components that have to come together into an integrated whole. These will be developed separately and stored in the back end (database). For the first blueprint prototype a test will be done based on a couple of examples in order to visualise how a concrete final scenario could look like. The scenarios developed in the prototype will cover a subset of the final product and will be based on the scientific foundations done before the start of development. In these foundations a selection of parameters, situational settings and answer options were defined. After the first functional testing, there will also be a fine-tuning of the specific content.

4.3.3 Integration of Feedback into Final Prototype

A first field study will be done in cooperation with GGZ and SVD in which a first prototype of both the Cg game as the PwD game will be presented. The test group will be able to play 2 modules. Each module has 3 separate scenarios that are followed by a question for which the player is asked to provide an answer. After selecting an answer option they get feedback on their choice. During the study sessions player feedback will be collected mainly via observation and qualitative research (e.g., interviewing the caregivers and patients about their experience with the prototype). The comments and feedback that they provide will then be used to make adjustments to the relevant aspects that were mentioned. Integration of feedback could then result in adjusting or fine-tuning the written content (dialogues, subjects addressed, etc.), playability (interaction, timing, play experience, etc.), functionality (such as technical issues) or visuals (representation, communication, etc.). The end objective is to make the games more catered to the needs of the target group.

5 Conclusions and Outlook

As described in the introduction, the concepts addressed by this report are integral to maximize user engagement and motivation. Therefore, they must be implemented in the overall PLAYTIME system. Several partners have already received feedback from prospective end users on the individual games and, accordingly, current prototype versions integrate this feedback. This will be further complemented by end user feedback from the first and second field studies.

Key aspects of personalisation, which will be applied through the recommender engine will be evaluated in the first field study. As this aspect is believed to be an integral driver of user engagement and motivation, it will be iteratively refined as PLAYTIME progresses.

The components of personalisation and motivational recommendations will be described more in depth in D3.4.1 and D4.5.1, whereas, the emotional measurements and related motivational aspects will be explored in D3.4.1. In addition, data from the first field study will provide direct feedback on the graphic design and user interface in the individual players. This will serve as key input, which will be used to implement changes, modifications, and revisions with the goal of enhancing user engagement and motivation.

6 Abbreviations

Table 1. *Abbreviations.*

Abbreviation	Description
AI	Artificial Intelligence
Cg	Caregiver
GUI	Graphic user interface
PwD	Person with dementia
Ux	User experience