D3.1.2

Emotion & Performance

Work package	**WP3 Multimodal Analytics & Assessment**
Task	**T3.1 Emotion & Performance**
Editor	**Ernst Koster (GEU)**
Co-authors	**Ivan Grahek (GEU), Ladislas Nalborczyk (GEU)**
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.

30/09/2018

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	LEF		Lefkopoulos KG Jakob-Redtenbacher Gasse 9, A-8010 Graz
04	SVD		Sozialverein Deutschlandsberg Kirchengasse 7, A-8543 Deutschlandsberg
05	GGZ		Geestelijke Gezondheidszorg Eindhoven en de Kempen Postbus 909, 5600 AX Eindhoven, The Netherlands
06	TIU		Stichting Katholieke Universiteit Brabant, Tilburg University PO Box 90153, 5000 LE Tilburg, The Netherlands
07	MCR		McRoberts BV. Raamweg 43, 2596 HN The Hague, The Netherlands
08	MBY		MindBytes F. Roosseveltlaan 348-349, B8, 90600 Ghent, Belgium
09	GEU		Ghent University Sint-Pietersnieuwstraat 25, 9000 Gent, Belgium

Contents

1 Aim

In this deliverable we describe, based on our theoretical analyses provided in Deliverable 3.1.1 and the interactions with the different PLAYTIME partners, the key considerations on implementing cognitive and affective processes within PLAYTIME. Subsequently we consider the design requirements that are needed.

2 Introduction

In examining the possibilities to include affective information in the context of cognitive exercises, it is imperative to consider the bidirectional influences of Cognition on Emotion. There are ample examples of research showing that **emotion influences cognitive processes**:

- *Positive affect is associated with more broad processing in comparison to negative affect (e.g. Whitmer & Gotlib, 2013)*
- *Strong negative affective states (e.g., anxiety) are associated with processing impairments (Eysenk, Derakshan, Santos, & Calvo, 2007)*
- ***Emotions act as feedback system for cognitive processing requirements: Evaluative feedback upon making errors (Inzlicht, Bartholow, & Hirsh, 2015).***

Similarly important, cognitive processes influence affective experiences:

- *Stable impairments in cognitive processing are associated with risk for depression and anxiety (Koster, De Lissnyder, Derakshan, & De Raedt, 2011).*
- *In Persons with Dementia (PwD), cognitive complaints cause negative emotions (frustration, uncertainty, etc.).* ***This phenomenon has adaptive and maladaptive features: It is related to insight in functioning but does increase negative emotions***

These observations have led to the inclusion of affective states and emotional information within the PLAYTIME proposal. Below we specify the theoretical rationale and address the question on how these factors can be included in the PLAYTIME environment, specifically.

3 How emotions can assist in cognitive remediation

3.1 Possibilities and requirements

The Multimodal exercises in PLAYTIME allow to provide a broad idea on the nature of the cognitive impairments (e.g., memory games, antisaccade – cognitive inhibition, etc). More specifically, the repeated cognitive games allow for detailed assessment to determine, among others:

- Specific vs. general impairments
- Stable vs. Dynamic impairments
- Comparison to age group ? (Practical limitations)
- **Relationship with emotional dynamics:**

(a) Do, and if yes which, cognitive impairments elicit negative emotions?

(b) Do negative emotions as feedback signal help to adjust cognitive processes?

For each of these potential aims we discuss below in more detail the **cognitive assessments.** The initial, purely cognitive, possibilities provide an indication whether impairments are observed across a wide range of cognitive operations or merely on specific tasks.

This requires:

- Performance data within each task
- This needs to be based on a sufficient number of observations (trials) in order to be reliable
- These data could be compared to a non-affected comparison group
- Visualisation and appropriate feedback

The temporal stability of cognitive impairments can be assessed through repeated measurement. This is a relevant question in PwD since, especially in early stage Dementia, there is marked differences between different testing. This aspect can also help to assess (rate of) deterioration.

This requires:

- Performance data within each task
- Within-person comparison of task performance

  - Such comparison requires that the tasks have about the same length and are administered in rather similar contexts
- Visualisation and appropriate feedback

Comparison to a non-affected comparison group could be of interest to assess the magnitude of the impairments. However, this would require an extensive comparison group and it is uncertain whether there would be additional benefit over existing cognitive measures (e.g., MINI, clockdrawing test etc.).

Cognition & Emotion. Within the aim to examine the relationship between cognition and emotional dynamics, several options exists, which we will describe below:

(a) Do, and if yes which, cognitive impairments elicit negative emotions?

(b) Do negative emotions as feedback signal help to adjust cognitive processes?

Required for a):

- Having an “emotion slider” at the start and end of specific cognitive tasks. Here we can make a selection of tasks that are most informative (to avoid too many ratings)
- Comparison of onset vs. end state affect after specific tasks
- Within session & between session info: integration
- Visualisation and feedback
- This would also allow game adjustments upon eliciting strong negative emotions.

Key consideration here are that the emotion ratings need to be simple and should not be administered too frequently. This feature could allow to see which types of cognitive tasks (attention, memory, etc.) are most taxing for participants and which types of cognitive operations are still enjoyable. Here it is important to have patients practice both on enjoyable as well as less enjoyable tasks to ensure that they try to improve affected cognitive domains.

Required for b):

A number of approaches are possible to examine sustained influences of negative affect on performance during the rest of the training. This would help to, in line with theories of emotion and cognitive control, help to see whether for individual patients, negative emotions help to improve performance or hinder task performance. If negative affect in PwD helps with performance than this could have implications for training as these individuals can be encouraged to play more demanding and frustrating games. In the individuals where negative emotions are elicited but who are unable to adjust performance or where performance is negatively affected, the gameplay could be adjusted accordingly to limit too intensive exercises.

For this purpose the flowing things are required:

- If negative emotions are elicited (onset vs. end state affect) => Examination of Influence on accuracy on the next task
    - This requires some within-person comparison to past performance
- If improvements in accuracy are shown this suggests awareness of errors and cognitive adaptation (confounders: time, practice effects, etc.)
- Perhaps too difficult. Alternative could be meta-awareness: Comparison between actual performance and perceived performance.

4 General recommendations and next steps

The multimodal nature of training allows many interesting ways to assess cognitive performance and to provide some relevant diagnostic information about the nature of the cognitive impairments. In this document various options have been specified including system requirements.

The most feasible integration of affective information into the cognitive architecture is represented by examining whether certain cognitive operations have a negative impact on emotions and whether such negative emotions have further downstream consequences.

This would require careful mapping of the different cognitive games into various areas (attention, memory, etc.). Moreover, the output of the game should include performance metrics such as error percentage and task-specific scores (e.g., antisaccade score) to allow calculating, relating and visualising the influence of affect on performance.

5 Bibliography

Eysenck, M. W., Derakshan, N., Santos, R., and Calvo, M. G. (2007). Anxiety and cognitive performance: attentional control theory. Emotion 7, 336–353. doi: 10.1037/1528-3542.7.2.336

Inzlicht, M., Bartholow, B. D., & Hirsh, J. B. (2015). Emotional foundations of cognitive control. *Trends in Cognitive Sciences*, *19*(3), 126–132. http://doi.org/10.1016/j.tics.2015.01.004

Koster, E. H., De Lissnyder, E., Derakshan, N., and De Raedt, R. (2011). Understanding depressive rumination from a cognitive science perspective: the impaired disengagement hypothesis. Clin. Psychol. Rev. 31, 138–145. doi: 10.1016/j.cpr.2010.08.005

Whitmer, A. J., & Gotlib, I. H. (2013). An attentional scope model of rumination. *Psychological Bulletin, 139*, 1036–1061.