



**PlusMe: Transitional Wearable Companions
for the therapy with children with
Autism Spectrum Disorders**
a European funded project

Deliverable 2.1
Experimental phase, stage one

Work Package 2 *Test*
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Lead beneficiary: CNR
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1. Overview of the deliverable

This deliverable gives an overview of the first experimental phase of the project, where the *PlusMe* device is used during therapy sessions with children diagnosed with Autism Spectrum Disorders (ASD). This phase is carried out in close collaboration with the researchers from the Department of Human Neuroscience, University of Rome *Sapienza*. The deliverable reports important details and preliminary findings about a pilot study, where the device is tested – for the first time – as a supporting tool with a clear therapeutic purpose: to promote and increase the production of social behaviour such as the eye-contact, imitation, social request.

2. Aim of the pilot experiment

The *PlusMe* device has been previously tested in two studies involving typically developed [1] and ASD participants [2]. Main goal of both studies was to assess the *acceptability* of the toy, in particular to evaluate whether the device was able to arouse the attention of the participants and keep them engaged for a 10 minutes activity. Importantly, in both experiments the children were tested only once, i.e. there was no therapeutic objective in the proposed activities.

In this new pilot study, the *PlusMe* device is used – for the first time – to assess its potential therapeutic use during the treatment; the test relies in fact on several, consecutive sessions and aims to see if repeated activities based on *PlusMe* promote the increment of social behaviour in ASD children.

The study was approved by the CNR Research Ethics and Integrity Committee².

2. Materials and methods

2.1 Participants

The pilot was attended by 3 high-functioning ASD participants, aged 36, 42 and 50 months. The diagnoses were made at the Department of Human Neuroscience, Section of Child and Adolescent Neuropsychiatry, University of Rome *Sapienza*, after a complete neuropsychological and neuro-psychomotor assessment, according to international guidelines based on *DSM-5* criteria [3].

2.2 Procedure

The pilot took place in an observation room at the Department of Human Neuroscience, where the distracting elements were removed. Each child was tested individually in the presence of two persons: the neurodevelopmental therapist who played with the child using the *PlusMe* toy,

² www.cnr.it/en/ethics

and a researcher in charge of recording the session with a camera and of managing the control tablet³. Both persons are not known to the children.



Figure 1. An example of the experimental session. Starting from left: (i) the therapist points the red blinking paw, which the child has to press in the *whack a mole* game; (ii) the child touches the correct paw and obtain a reward (*PlusMe* emits nice sounds and a green coloured pattern); (iii) after the reward the child rejoices and looks at the therapist. The researcher holding the control tablet is in the same room.

The therapist proposed 5 different play activities (described below) with the *PlusMe*, where the child was required to: (i) imitate the actions of the therapist; (ii) to play with the therapist in a turn-taking game; (iii) to make requests to change the reward of *PlusMe*. Importantly, the therapist tried to involve the child in the play activities, stressing both verbal and non verbal communication (see fig. 1).

The 5 play activities can be divided in 3 main categories, according to the behaviour that they are intended to promote: (i) 1 *exploratory activity*, which aims to promote exploratory behaviour on *PlusMe*; (ii) 3 *playful activities*, which aim to promote social game with the therapist; (iii) 1 *freedom activity*, which aims to promote explicit social requests between therapist, researcher and child.

Additionally, the 3 *playful activities* can be played both in *alone* and *together* mode: in the *alone* mode the therapist only shows the child what to do with the toy, then she lets the child play alone⁴; conversely, in the *together* mode the therapist actively participates in the game, encouraging the child to play together in a *turn-taking* mode.

The specific activities are here described in detail:

- **exploratory activity:** it is always the first activity, as it aims to make the child familiarise with the toy. Each paw of *PlusMe* is set to emit different coloured lights (rewarding outputs).
- **playful activities:**
 - **whack a mole:** a random *PlusMe* paw emits a blinking red light; if this paw is touched, a rewarding pattern is emitted (trumpet notes and the colour turns to green). After a couple of seconds the game restarts with another random paw;
 - **caress:** if the child cuddles *PlusMe*, it emits a rewarding pattern;

³ A video showing the *PlusMe* device and its features is available at www.plusme-h2020.eu/video/

⁴ The therapist only observes the child playing, and merely participates with verbal communication like “Good, continue!”.

- **two hands:** if the child touches the two upper paws of the panda at the same time, it emits a rewarding pattern.
- **freedom activity:** it is always the last activity, as it has to be done when the child reasonably realised how the toy works and which rewarding outputs it can produce. The *freedom* activity is thought to promote explicit social requests by the child: the therapist in fact encourages the participant's engagement by asking him/her the preferred gratifying outcomes of *PlusMe* (previously experienced). The toy operating mode is then changed in real time by the researcher holding the tablet, on the basis of the child's request. Importantly, the verbal communication between therapist and researcher is made explicit (e.g. "What color do you want? Did you hear (referred to the researcher) what color Tom desires to see? Let's put it on!" or "did you hear what sound Harry wants to listen?"), so to include the child in a dynamic of joint attention.

Each child was tested for 4 consecutive training sessions, one per week, each session lasting about 10 minutes. During each session all the 5 activities were proposed to the child. In the *playful activities*, the presentation of *alone* and *together* mode was balanced between the sessions.

2.3 Data collection

The experimental sessions were captured with a camera, and later analysed through a video-editing software. The clips were then rated to extract both durations and frequencies of several indexes related to social behaviour, for example: "how many times (and how long) the child looks or smile at the therapist?"; "does he/her play together with the therapist in a *turn-taking* mode?"; "how many explicit requests from child to therapists are detected?". Those indexes have been chosen as they give a general idea about the social interaction between the child, the therapists and the researcher. It is expected that some of these indexes could increase during the 4 sessions, possibly validating the effectiveness of the *PlusMe* based activities.

3. Preliminary results

The data is currently being processed, then the deliverable presents just preliminary findings. The quantitative results seem to indicate that the various activities can be more or less effective in eliciting the child's social responses. Additionally, there is a great behavioral difference between the participants, but it was largely expected: although the children share the same general diagnosis, they are individually characterised by minor, yet very relevant, specific behaviour. This observation is very important as it will help to better identify the target of the experimentation.

In the next subsections some illustrative examples of the preliminary findings are presented.

3.1 Caress activity

In this activity the child is rewarded each time he/she cuddles the panda: the toy emits a rewarding pattern (coloured lights and nice sounds) when a caress or a gentle pat is detected⁵ on the paws or on the panda head. According to the procedure, this activity can be done in *alone* or *together* mode.

This activity seems to promote the eye contact between the child and the therapist: the time spent on looking at the therapist increases in fact for the 3 subjects during the 4 sessions (see fig. 2, left). The imitative behaviour seems to increase too, at least for two subjects (see fig. 2, right). The alternation between *alone* and *together* mode does not seem to have a particular effect on these two behavioural indexes.

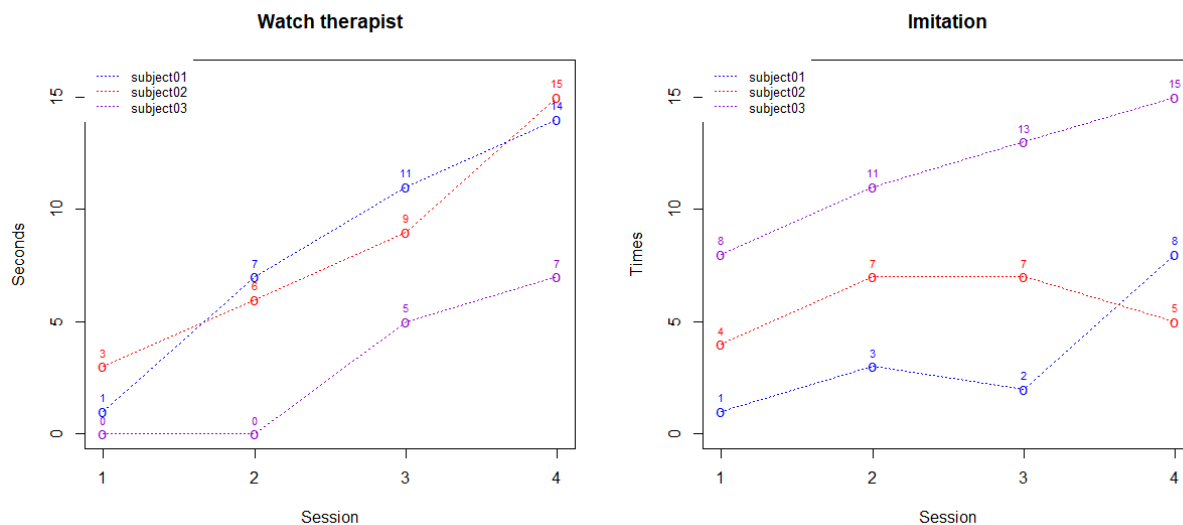


Figure 2. Left: during the 4 sessions (x-axis), the time the children spend to look at the therapist (y-axis) increases for all the participants. Right: the imitation gestures increase especially for subjects 03 and 01.

3.2 Whack a mole activity

In respect to the previous activity, the *whack a mole* game is inherently competitive, as children tend to chase and press the red-blinking light before the therapist: this is partially confirmed by looking at the greater times that the child carries out the activity with respect to the therapist (fig.3, left). The “watch therapist” index seems to increase only for the subject 01, while the trend for the other two children is less clear (see fig. 3, right).

⁵ The researcher holding the tablet triggers the toy response when appropriate.

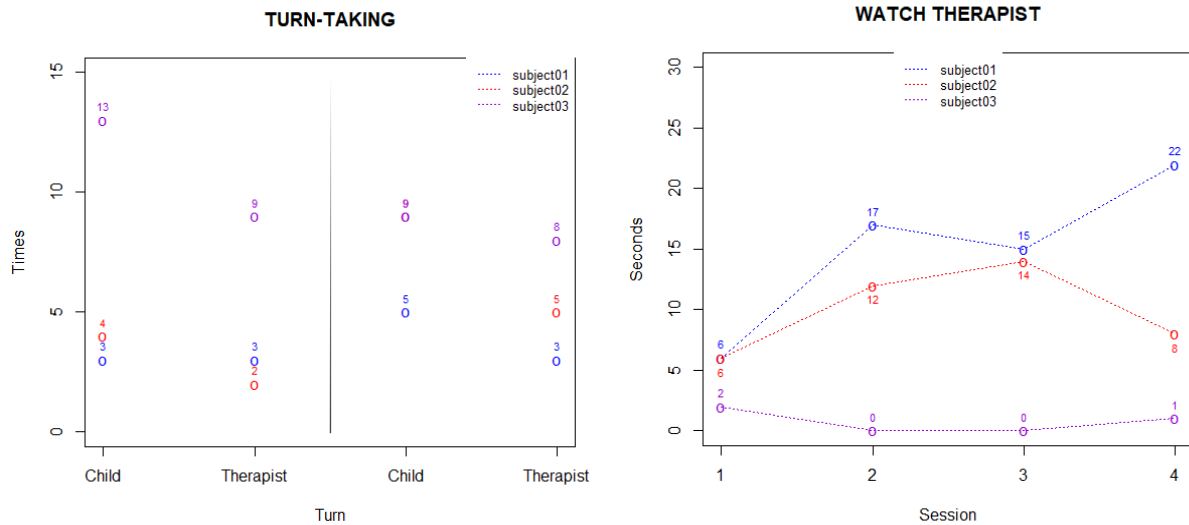


Figure 3. Left: the graph shows how many times the child and the therapist touch the red-blinking paw when playing together⁶; before the central line are reported data of the first time they play together (during the 2nd session); after the central line the data concerns the second time they play together (during the 4th session). Right: during the 4 sessions, only for the subject 01 the time spent to look at the therapist seems to increase.

3.3 Freedom activity

During this activity (which is done as the last game), the therapist tries to involve the child in a wider social interaction which also includes the researcher holding the tablet. The therapist asks the child what is his/her preferred *PlusMe* rewards, extending the request to the researcher too, who actually changes the *PlusMe* sensorial outputs through the control tablet.

About the attentional focus, there seems to be not a clear trend between the different sessions: all children prefer to look at the toy; subject 01 seems to not pay much attention to the researcher; conversely, subject 02 and 03 spend about the same time looking at both the therapist and the researcher (see fig. 4). About the last point, it was qualitatively observed that subjects 02 and 03 shift their attention between therapist and researcher.

⁶ The *Whack a mole* activity is played in *together* mode by child and therapist during the sessions 2 and 4.

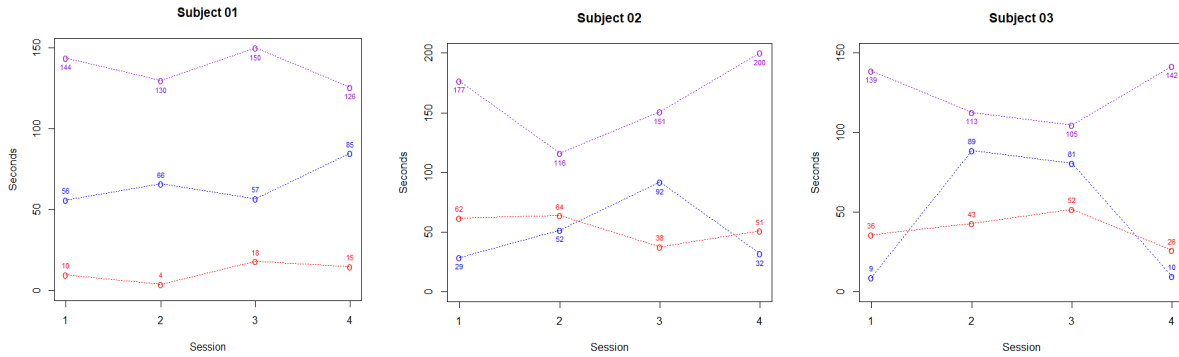


Figure 4. For each subject, it is shown the amount of time that the child spends to look at the *PlusMe* (violet line), the therapist (blue line) and the researcher (red line). As shown, there is not a clear trend between the sessions. Subject 01 pays little attention to the researcher, while subject 02 and 03 seem to understand the researcher’s role in the activity.

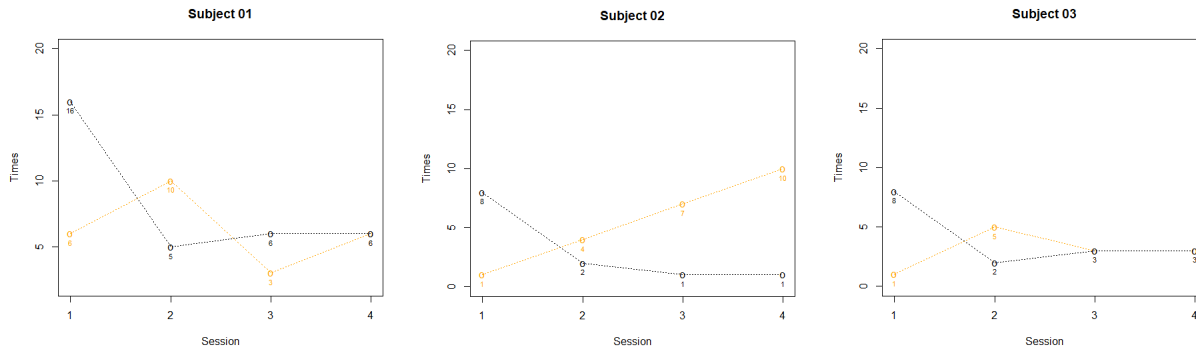


Figure 5. For each subject, it is shown how many social requests by the child (yellow line), and the therapist (black line), are directed to the researcher holding the tablet, to obtain the *PlusMe* desired output. About subject 02, his requests increase over the sessions, while the situation is less clear for subjects 01 and 03.

4. Conclusions

The aforementioned preliminary results are currently under analysis, but they seem to be promising⁷: according to the child types and to the activity type, the *Plusme* interactive toy appears to be an helpful supporting tool, which promotes some social behaviour. A short paper about the pilot experiment, with deeper analysis, is in preparation. In September the same experimental protocol will be tested again with new participants, in order to expand the sample, increase the amount of data, strengthen the statistics and clear some social dynamics.

Updates on the experimental activities will be provided in the next public deliverable *D2.2 Experimental phase stage two*, due at month 18 (28th February 2022), at the end of the project.

⁷ Selected clips of the experimental sessions will be available on the project website at the link www.plusme-h2020.eu/video/

Bibliography

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