



English summary of the report:
Social robots in forensic care
an exploratory study on how they can assist the forensic psychiatric field

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Introduction

Social robotics is a key technology which is expected to have a major impact on society and, potentially, therefore also on the forensic psychiatric field. At the Forensic Psychiatric Center de Oostvaarderskliniek, currently the added value of robot [Maatje](#) in the forensic care practice is evaluated in an exploratory pilot. The research reported in this report is complementary to this pilot. We use a broad and inclusive concept of what a social robot is to avoid excluding potentially promising social interfaces upfront. In the exploratory research reported here, we aim to identify the added value of the use of social robots - now or in the future - in forensic care and whether there is added value specifically for particular patient groups.

Main research question:

What is the added value of social robots – now or in the future – in forensic care, and which patient groups would particularly benefit from their use?

Sub-questions:

- *For which areas of forensic care and which patient groups would social robots have added value?*
- *What are potential applications of social robots in mental health care, and more specifically in forensic mental health care?*
- *Which opportunities do experts from the forensic care practice see, based on prototypes that are presented to them, for social robots in forensic care and what is the added value of using social robots according to these experts?*
- *What are the investments needed, and what are the limitations of social robots - now or in the future – for the deployment of these robots in forensic care?*

Research Methods

In this research, multiple research methods were used, including: literature study, online interviews, development of prototypes, and focus groups. The project was organized according to the so-called funnel model, and in four main steps the opportunities for social robots in forensic care were refined and were made more concrete in each step. In a first step, the relevance of potential tasks that social robots might be able to perform was explored by means of a literature study and consultation of experts. In a second step, by means of online interviews with professionals, experts and practitioners (N=7) from the forensic care practice, we identified in more detail the added value of potential applications and tasks that could be assigned to social robots in forensic care. In a third step, based on the outcomes from the previous step, three prototype social robot use cases were developed to illustrate promising applications of social robots in forensic care. These resulting prototypes illustrate the use of social robots for supporting daily activities, companionship, and early warning signs relapse prevention plan. In a fourth and last step, these prototypes were presented and discussed in focus groups with experts in forensic care (N=12) in order to identify opportunities and limitations of the deployment of social robotics in forensic care.

Overview of and experience with e-health in forensic care

By means of a literature study and exploration of the forensic care field, an overview was made of the field of forensic care, distinguishing segments, care types, and types of forensic care centres. During sessions, in which we validated this overview together with professionals, it became clear that in clinical forensic care (generally dealing with patients with most severe problems and a most serious crime history) resocialization takes place by monitoring and gradually reducing surveillance and guidance in a controlled manner. It is also

the phase in which patients have to (re)build their own social network. Particularly in this phase in which the patient receives ambulant care, assistance of social robotics would be of added value.

The literature study on experience with applications of e-health in mental health care makes clear that social robots should not be used for standalone interventions in (forensic) care (Kip et al., 2019; Mohr et al., 2014), but rather as a form of blended care. In other words, social robots are supposed to be one element in a more extensive intervention that could combine online- and physical contact moments (Krijgsman et al., 2013; Niessen & Cloostermans, 2015). The use of social robotics will have the most added value if it is being deployed complementary to existing care interventions. It is, moreover, important that e-health interventions take into account individual characteristics of forensic patients, including their risk of recidivism, living environment, and the ability to learn. Because social robots enable speech-based interaction, this may also lower the barrier to using robots, in particular for lower-literacy forensic patients.

Social robotics in mental health care

No research publications were found with a specific focus on social robotics in forensic care. Therefore, next to creating an overview of the forensic care itself, a literature study was done focusing more broadly on applications of social robotics in mental health care. In this literature study we first searched for systematic reviews and meta-analyses, which yielded results for the topics autism, dementia, depression and negative emotion of children. For the mental health topics mild intellectual disability, schizophrenia and substance abuse, a literature search yielded only a few papers. There appears to be a research gap for topics such as personality problems and psychoses. The literature study also showed that some studies have been performed on the use of social robots on a small scale for existing mental health treatments, including psycho-education, schema therapy, social skills training and cognitive behavioural therapy. As there is hardly any scientific research that reports on the use of social robotics in forensic psychiatry, it is not possible to identify for which target populations in forensic care social robots would have added value from the literature. There is also more research needed to determine what kinds of robots would be most effective in forensic care.

OPPORTUNITIES NOW	MAYBE (5-10 year)	NOT
Cognitive behavioural therapy	Aggression coping therapy	Occupational therapy
Psycho education	Offence chain procedure	Psychotherapy
Relapse prevention plan	Lieberman modules	System therapy
Early warning signs relapse prevention plan	Trial leave plan	Community Reinforcement Approach (CRA)
Social skills training	Aggression replacement	
Schema therapy	Dialectical behavioural therapy	
	Cognitive Skill Plus (CoVa Plus)	

Task-based opportunities of social robotics for judicial interventions in forensic care

After completing the literature study, the overviews of forensic psychiatry and the use of social robotics in mental health care have been combined. Based on the outcomes of the literature study and sessions of the researchers, in which these outcomes were analysed in more detail, a traffic light model has been created (see table above). In this model, green indicates that there would already be added value at this moment (now) of applying social robotics in forensic treatment, orange indicates that this may be the case within 5-10 years, and red indicates that added value is unlikely anytime soon for the treatments listed in that column.

We already saw that some applications of social robots that provide support for specific forms of therapy are mentioned in the literature. These treatments are listed in the column categorized as green. When treatments are also offered as modules via the Internet, such as via Minddistrict.nl, we also took this as an indication that social robotics can provide support for parts of these treatments. Social robotics offers the opportunity to enrich such treatments, as they enable the use of speech in the interaction with patients.

Treatments in the category 'green' involve specific tasks which can be part of the treatment, such as maintaining a diary, or an educational task. The idea of supporting these tasks with robots was shared with practitioners and experts during online interviews, in order to identify the need for digital support and to identify where social robotics can have added value in forensic care. During these interviews, we also asked participants to mention any limitations or issues with technology acceptance in the forensic field of either the target group (patients) or the care professionals. It appeared that there is a need for digital solutions to provide support for daily activities (e.g., medication intake, maintaining a daily schedule, reminding of agenda items), companionship (e.g., quiz, games, talking about what happened during the day) and a monitoring function of the early warning signs relapse prevention plan (in support of recognizing early signs of potential risks, enabling patients to better monitor their own behaviour, and to make suggestions on how to adjust their behaviour).

In preparation for the focus groups, we have developed prototypes that demonstrate how some of the tasks, that were identified during the interviews as most promising, could be implemented. Moreover, to illustrate the versatility and choices of social interfaces, we used different interfaces (smartphones, tablets and social robots) for these prototypes. By doing so, we also demonstrated that the same scenarios can be realised on multiple interfaces, which can have concrete benefits in practice.

Opportunities and added value of social robotics

The focus groups confirmed the added value of all three prototypes that were developed for the tasks related to daily activities, companionship, and the early warning signs relapse prevention plan. Responses were very positive for the early warning signs relapse prevention plan prototype, which was seen as one of the most promising interventions. It appears to be particularly interesting to further explore the development of this scenario. Besides these scenarios, interest was also shown for further exploring support by robots for tasks such as mindfulness and educational applications aimed at social skills. The potential for effectively using social robotics can be further increased by combining robots with other types of technology such as wearables (e.g., Fitbit), to measure for example stress and arousal. For the target group that receives outpatient care, the use of social robotics will be particularly appealing. More specifically, the use of social robotics is seen as very useful to support the so-called forensic (F)ACT-team that supervises forensic psychiatric patients and offers practical support to enable them to live as independently as possible.

From the point of view of the practitioner, the added value of social robotics is foremost seen in increasing the capacity for care and limiting the number of no-shows. From the perspective of the patient, the added value is the possibility of using speech-based interaction. This modality of interaction will better match the (lack of) skills and needs of the (relatively low-literate) forensic care population. The use of gamification in the interaction with a robot and the opportunity to provide behavioural change support could also increase the motivation of patients in forensic care.

An important advantage of a social robot is its ability to repeat itself without any problems and to act consistently. A robot is able to consistently respond in a neutral way, can provide consistent positive feedback, and can repeat parts of a treatment as often as required, which also makes them more accessible for the target group with mild intellectual disabilities. The use of social robots also enables patients to continue working on their own treatment in addition to the standard face-to-face treatment they receive. This means that more time can be spent on the treatment. This also enables patients to regain more control over their own treatment. This in turn will increase the engagement, responsibility, and feeling of control of patients with their own treatment plan. In summary, a social robot can have added value when a practitioner cannot be there for a patient.

Required investments and limitations of social robotics

The added value of social robotics depends on the specific target group and context in which the robot offers support. For example, patients in a clinical forensic setting do not always have access to a mobile phone or computer because of safety measures that are in place. Such measures may also restrict the use of social robotics. It will also be necessary to take the specific psychiatric problems into account. Moreover, based on findings from the literature study, interviews and focus groups, we conclude that social robotics needs to be used complementary to and in support of the treatment patients receive, taking also the living environment of patients into account. A one-size-fits-all approach will not be effective for the very diverse patient population in forensic care. For this reason, we recommend further exploration of the use of adaptive and personalized solutions. An adaptive social robot can adapt itself to a user on the basis of personal characteristics of this user. To realise as much added value as possible, it is important to ensure that the individual patient, their characteristics, concerns, learning ability, digital skills and needs are taken into account when designing and developing a task to be performed by a social robot.

The experts that were consulted had different opinions on the type of interface they think is most suitable for forensic care. Based on practical concerns (convenience, accessibility, costs) a tablet is seen as more useful. The benefits of a humanoid social robot, however, were also explicitly mentioned: It will be clearer for patients that they are interacting with a robot when it has an explicit shape and are more natural to talk to it. The humanoid characteristics (appearance, emotion, voice) are also seen as more engaging than those of a tablet. More research is needed to identify which type of interface will be most effective for which type of task and which part of the forensic population. It is clear, however, that the interaction with a social robot should be fluent and smooth. In other words, the easier to use, the more effective a social robot will be.

Even though experts are positive about the possibilities and added value of social robots in forensic care, they also see some practical, financial, technical, and ethical barriers. They foresee a lack of enthusiasm of practitioners, of time due to high work pressure of practitioners, of digital expertise and skills of both practitioners and patients, and a lack of awareness of the effectiveness of social robots. Communication and training about the possibilities and added value of social robotics, how they work and how they can be

integrated into the care practice, will therefore be crucial for a successful deployment of these robots. It will also be essential to develop new treatment protocols in which social robot use is integrated, so professionals will know how to use social robots and other types of e-health effectively. More research is needed to assess the feasibility, identify how to design and develop, and how to evaluate the effectiveness and added value of social robotics in forensic care.

Recommendations

This report shows that social robotics can have added value in forensic care. To be able to ensure successful application of social robots in forensic care, several recommendations were formulated. These recommendations concern prerequisites for success, next steps towards the realisation of social robots in the forensic care practice, and the need for additional research to explore specific topics in more detail.

Prerequisites for success

There are a number of prerequisites for the successful deployment of social robotics in forensic care. The following recommendations are preconditions for the effective deployment of social robots in the current circumstances.

- *Ensure the use of advanced software for implementing one specific social robot application*
It is very difficult to evaluate the added value of the use of social robotics based only on a (simple) prototype. We therefore recommend investing in developing a more mature application for one specific, well-chosen task within forensic care to be able to more clearly see the added value of a social robot in practice. The advice is to develop an application that implements one of the tasks discussed in the current report in chapter 4 (e.g., support for daily activities, companionship, or early warning signs relapse prevention plan). It will be most important to identify exactly which functions are most relevant for users and which of these functions still need more development to ensure they meet user expectations.
- *Get the required expertise to resolve any existing technical barriers.*
Invest in resolving the technical barriers mentioned in the report (e.g., issues with speech recognition during the interaction with a robot) by acquiring the required expertise and/or the help of experts that are experienced with these issues.

Concrete next steps

Invest in the following concrete next steps, which are based on the findings of this report:

- *Create a project plan for robotics that continues the work already done in the pilot with robot Maatje in the Oostvaarderskliniek.*
To be able to demonstrate the added value of social robotics in forensic care, it is recommended to create a project plan and put together a team with a broad expertise (robotics, software, user interaction, design) to execute this plan. This team should have the skills to implement a mature social robot solution and know how to evaluate it. It is advised to take the prerequisites mentioned above into account, and to consider the use of techniques such as speech-based interaction, gamification, and/or personalisation. It is recommended to include three (or more) separate development cycles in the project plan, each of which consists of a design, implementation, and evaluation step. Patients should be

involved in the design step (co-creation), while yet other patients than those involved in the design step should be asked to participate in the evaluation step.

- *Explore the potential of social interfaces other than social robots for specific target groups.*

Social robots are not expected to be effective for each target (sub)population. It is therefore useful to also explore the use of alternative interfaces that still enable the use of social interaction and/or interaction based on natural language to make digital solutions more accessible. The use of more simple interfaces, such as tablets, which are enabled to also support social interaction, may have significant added value for some specific target groups, such as low-literate forensic patients. It is therefore recommended to start a pilot to further explore the choice of interface using a concrete use case and evaluate the added value within different patient (sub)populations.

Follow-up research

There is more potential for the use of social robotics, but in order to more clearly identify these opportunities, follow-up research is needed:

- *Explore more in depth where and how speech-based interaction, gamification, and personalisation can be used to increase effectiveness in existing digital solutions in forensic care.*

The use of techniques such as speech-based interaction, gamification, and personalisation can also have added value in the development of digital solutions for forensic care that do not use social robotics. Given the diversity of the forensic population, we expect that in a follow-up study more opportunities will be identified where these techniques can create even more added value.

- *Explore the added value of social robotics in the mid-to-long term.*

In this study, the focus has been on applications of social robotics which are seen as feasible in the short term (green in the traffic light model). As a consequence, the potential use of social robotics for most forms of treatments has not been analysed in any detail. A follow-up study that involves practitioners more and is done in close cooperation with these practitioners will provide more insights into the feasibility and added value of the use of social robots for specific treatments which have been identified as feasible on the mid-to-long term (orange in the traffic light model).