TAPAS
Training Adapted Personalised Affective Social Skills with Cultural Virtual Agents

ANR AGENCE NATIONALE DE LA RECHERCHE

JST Japan Science and Technology Agency
CREST Symbiotic Interaction

Social skills training with conversational agents

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with Hiroki Tanaka,

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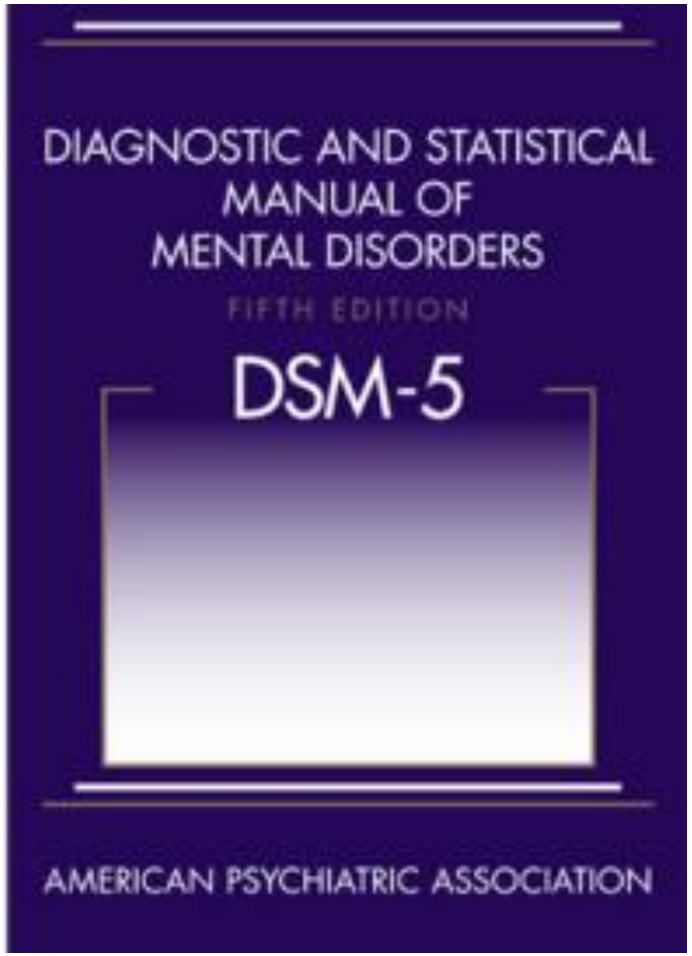
Communication Disabilities

- Communication Disabilities
  - Daily conversation
  - Meetings
  - Interviews
  - Presentation

Various Reasons

- Mental Disorder
  - Anxiety disorder
  - Depression
  - Autism Spectrum Disorder (ASD)
  - Schizophrenia (SZ)
  - Dementia



Social Anxiety Disorder

- Social Anxiety Disorder
  - Social anxiety can have an impact on social skills in a variety of ways.
  - People with a social anxiety disorder (SAD) are less likely to engage in social interactions, giving them less opportunity to build skills and gain confidence.
  - SAD can also have a direct impact on social behavior regardless of skill level.

Social Anxiety Disorder: More than just Shyness

- Blush, sweat, or tremble.
- Have a rapid heart rate.
- Feel their "mind going blank," or feel sick to their stomach.
- Have a rigid body posture, or speak with an overly soft voice.
- Find it difficult to make eye contact, be around people they don't know, or talk to people in social situations, even when they want to.
- Feel self-consciousness or fear that people will judge them negatively.
- Avoid places where there are other people.

- → Psychotherapy: Cognitive Behavior Therapy, Social Skills Training, Medication

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- Mental Disorder
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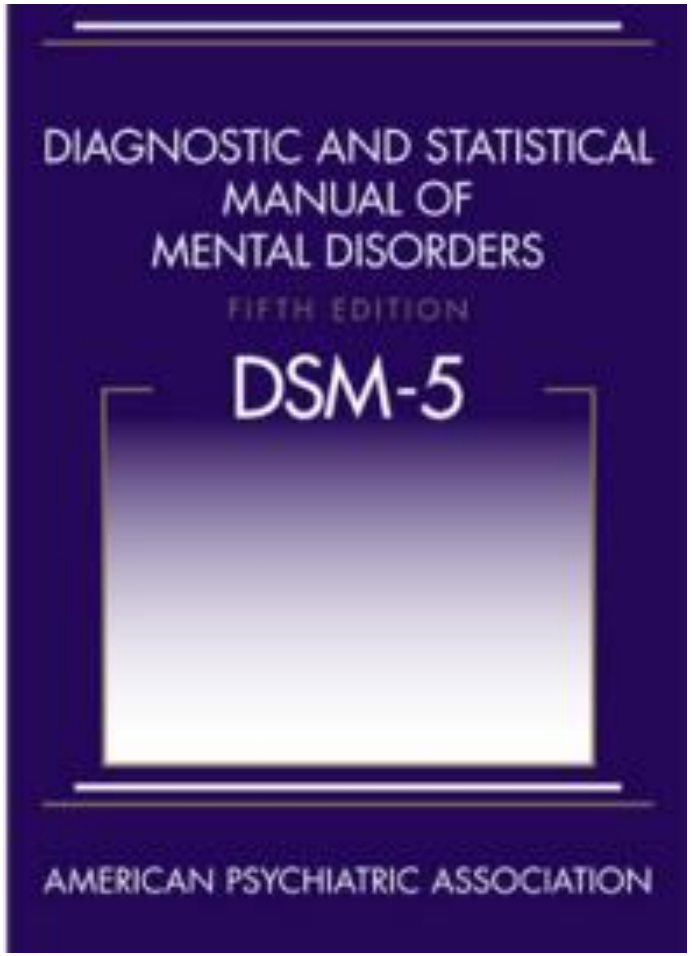
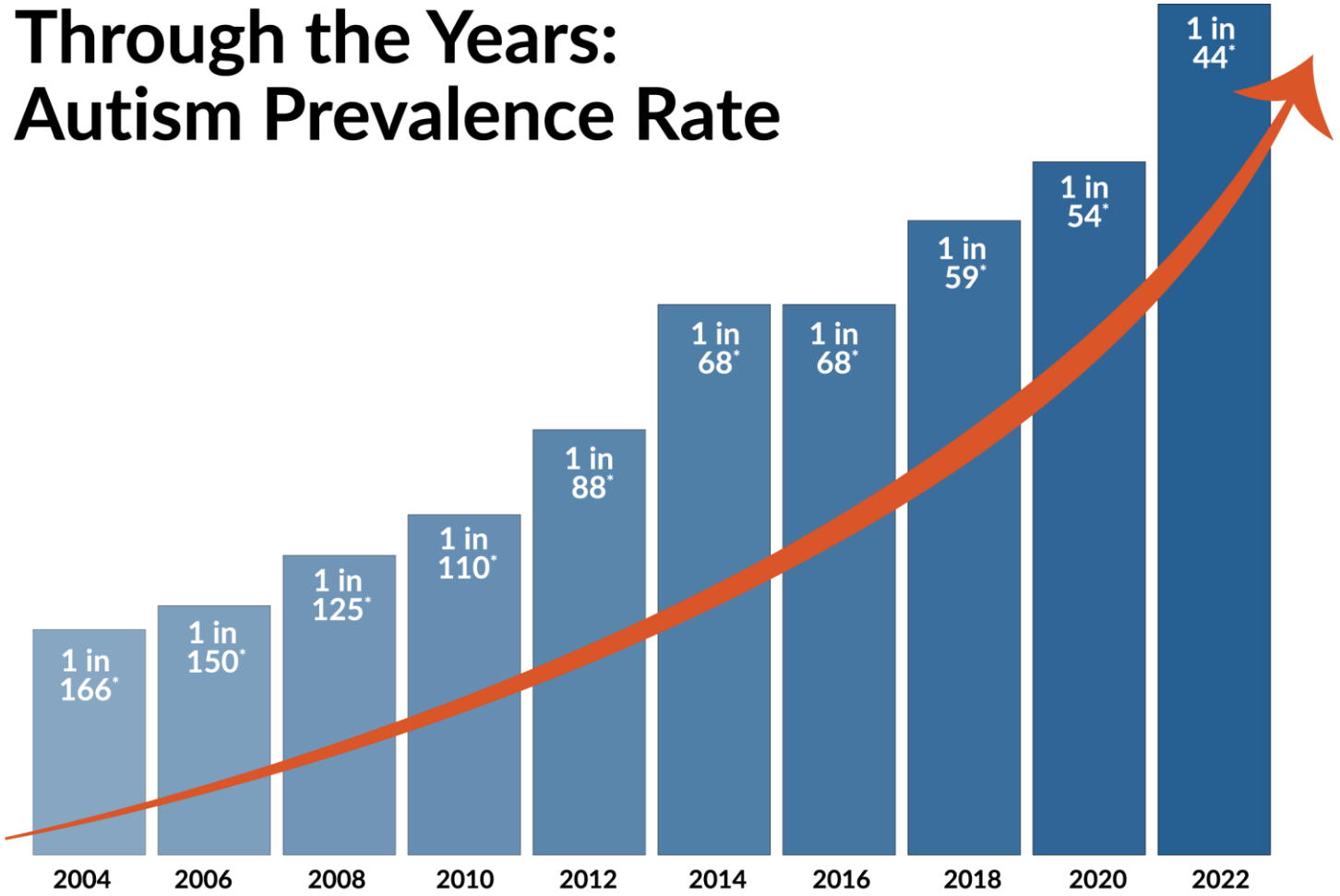


CDC: Autism Spectrum Disorder (ASD)

- Autism spectrum disorder (ASD) is a developmental disability caused by differences in the brain.
- People with ASD may behave, communicate, interact, and learn in ways that are different from most other people.
- The abilities of people with ASD can vary significantly. Some people with ASD need a lot of help in their daily lives; others can work and live with little to no support.
- As children with ASD become adolescents and young adults, they may have difficulties developing and maintaining friendships, communicating with peers and adults, or understanding what behaviors are expected in school or on the job.
- They may come to the attention of healthcare providers because they also have conditions such as anxiety, depression, or attention-deficit/hyperactivity disorder, which occur more often in people with ASD than in people without ASD.

- → Social Skills Training (SST)

ASD population



*Centers for Disease Control and Prevention prevalence estimates are for four years prior to the report data.

CDC: Schizophrenia

- Schizophrenia is a serious mental illness that affects how a person thinks, feels, and behaves.
- People with schizophrenia may seem like they have lost touch with reality, which can be distressing for them and for their family and friends.
- The symptoms of schizophrenia can make it difficult to participate in usual, everyday activities, but effective treatments are available.
- Many people who receive treatment can engage in school or work, achieve independence, and enjoy personal relationships.

- Psychotherapy: Social Skills Training

Social Skills Training

- Social Skills Training by Alan Bellack*
  - Social skills training (SST) is a type of behavioral therapy for people with mental disorders or developmental disabilities.
  - SST may be used by psychiatrist, teachers, therapists, or other professionals

*Bellack, A. S.: Social skills training for schizophrenia: A step-by-step guide, Guilford Press (2004)
https://www.verywellmind.com/social-skills-4157216

Social Skills Training

- SST Techniques
  - **Behavioral rehearsal**: Role play which involves practicing new skills during therapy in simulated situations
  - **Corrective feedback**: Used to help improve social skills during practice
  - **Instruction**: The educational component of SST that involves the modeling of appropriate social behaviors
  - **Positive reinforcement**: used to reward improvements in social skills
  - **Weekly homework assignments**: Provide the chance to practice new social skills outside of therapy

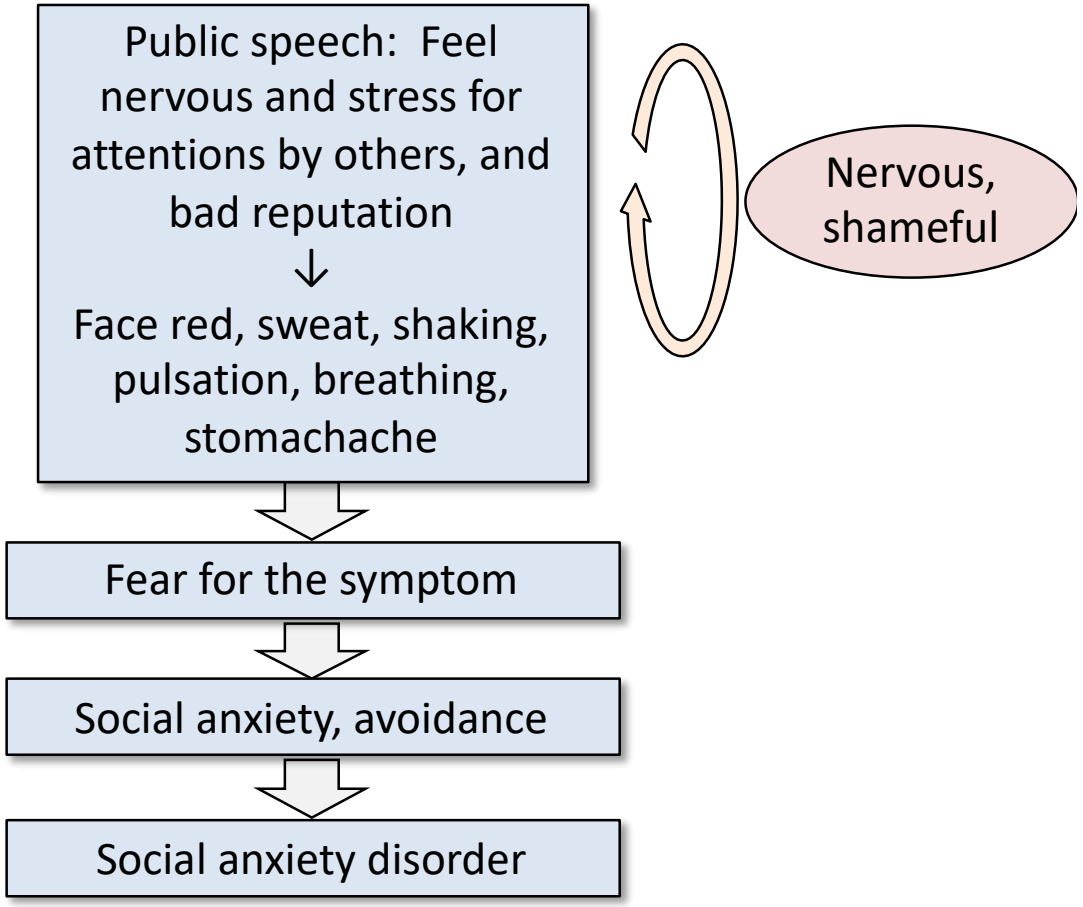
Training Adapted Personalized Affective Social Skills with Cultural Virtual Agents (TAPAS)

Problem: Social anxiety in schools and workplace

Approach: verbal/non-verbal interactive training system **by embodied conversational agent (ECA)**

- Target:
  General populations, Social Anxiety Disorder (SAD)
  Autism Spectrum Disorder (ASD), Schizophrenia (SZ)

- **Behavioral training:**
  Social skills training（SST）
- Cognitive training:
  Cognitive Behavioral Therapy（CBT）



Training **A**dapted **P**ersonalized **A**ffective **S**ocial Skills with Cultural Virtual Agents: ANR-CREST Project

Virtual agents and robots for social skills training (SST)

Robins+1998

Kumazaki+2018

Better communication with Virtual agents!

Hoque+2015

Nijman+2020

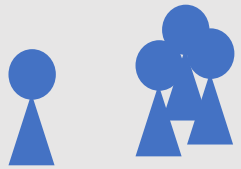
TAPAS project (2019-2024)

Children, Adults with ASD and Social Anxiety

Scenario and Situation

LISN + Nakamura G
Okazaki G + Kudo G

Theories of social interaction



one to one or one to multi-party

(Image: the verge)
VR/AR/Display

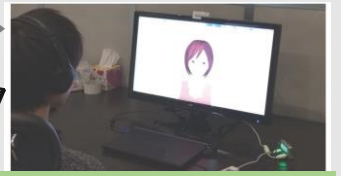
Virtual agent platform

ISIR

Greta platform

LISN

Speech recognition
Language processing
Body movement
Facial expression



Agent system

SST:Behavioral training

Okazaki G
Nara Med. Univ.

CBT: Cognitive therapy

Kudo G
Osaka Univ.

Online Measuring & Feedback

Nakamura G
NAIST

All groups

Evaluation

qualitative Anxiety state inventory
quantitative Physiological responses

Nakamura G NAIST
Satoshi Nakamura, **Hiroki Tanaka**, Seitaro Shinagawa
Hirokazu Kato, Yuichiro Fujimoto

Okazaki G Nara Med. Univ.
Kosuke Okazaki, Yasuhiro Matsuda, Yoshihiro Miyazaki, Hiromi Kanayama, Rio Ishida, Mitsuhiro Uratani, Tsubasa Morimoto, Hajime Sawai, Tsutomu Takeda, Masato Honda, Natsuko Kashiwada

Kudo G Osaka Univ.
Takashi Kudo, Hiroyoshi Adachi
Yukako Sakagami

Pelachaud G（France CNRS-ISIR)
Catherine Pelachaud, Donatella Simonetti

MARTIN G (France CNRS-LISN）
Jean-Claude MARTIN, Laurence BOLOT, Céline CLAVEL

Theoretical framework

Collaboration with Nara Medical University

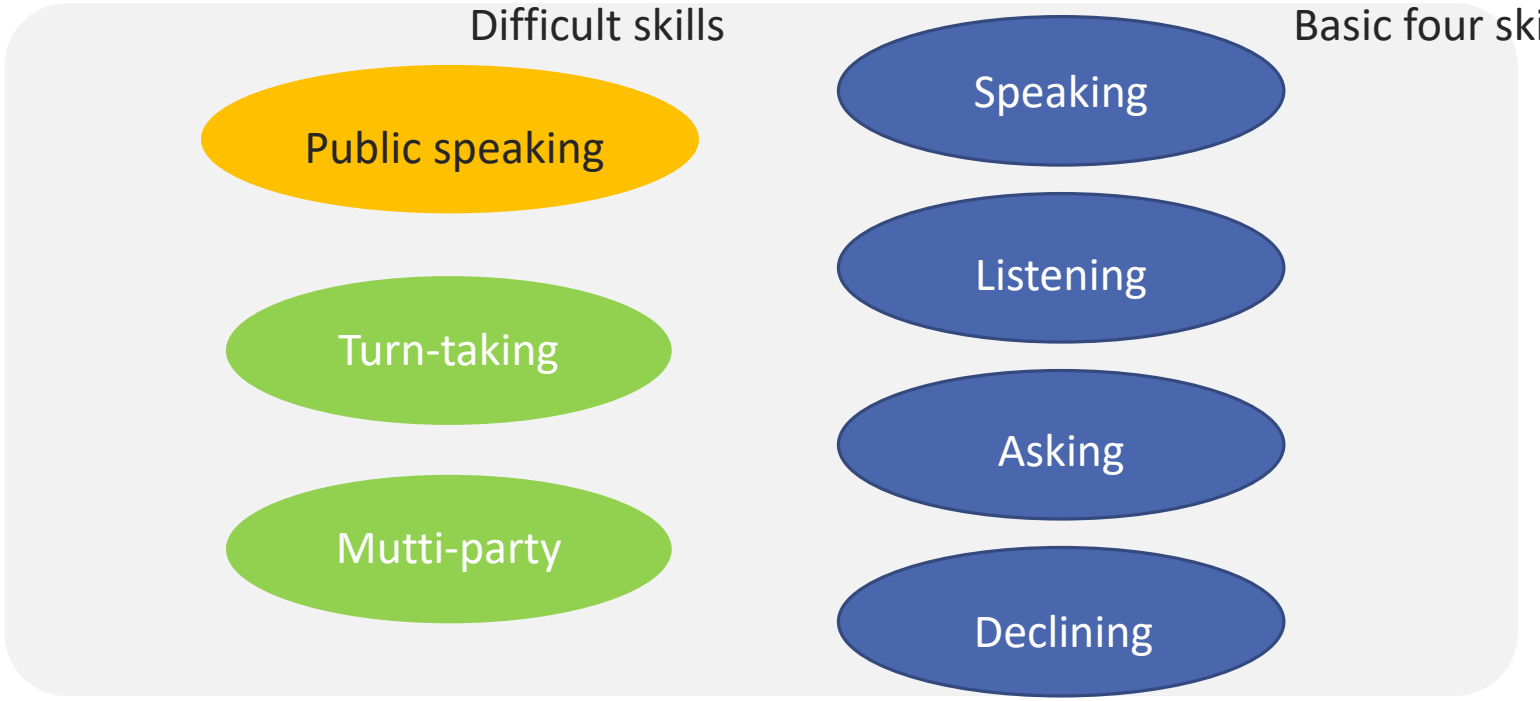
SST scenario

- Bellack model: social learning theory and psychosocial treatment
- Self-introduction, motivation, modeling, role-playing, feedback, homework

Based on the above scenarios

Virtual agent adaptively change behaviors as humans do

Social skills and target populations



SST on Greta platform

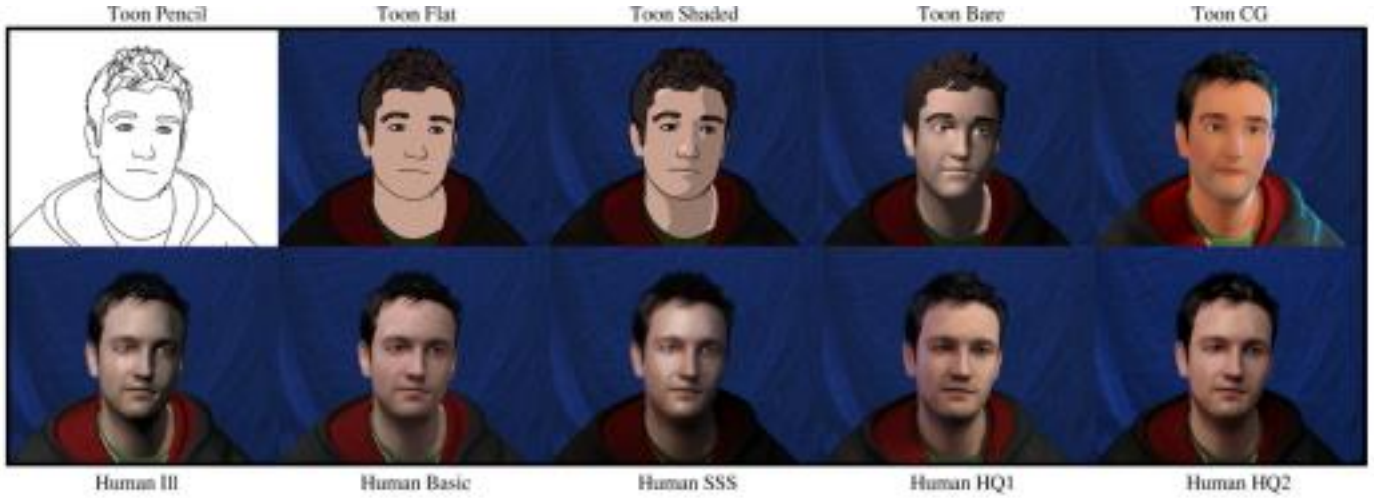
Hello. I'm tapas. What is your name?
Hello, hundred's. How have you been recently?
Was that so, today we will learn speaking skills together. Why do you think speaking skills are important?
...
Let's do role-playing.
Tell me your recent fun story.
Then please.
Yes, this is all right. Thank you very much.
We will calculate the result, so please wait.
Now for feedback.
...

Agents acceptability (prior studies)

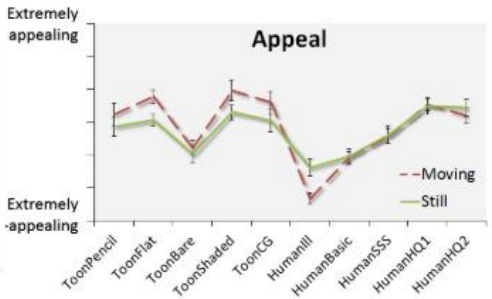
Appearance, behavior, realism, task seriousness

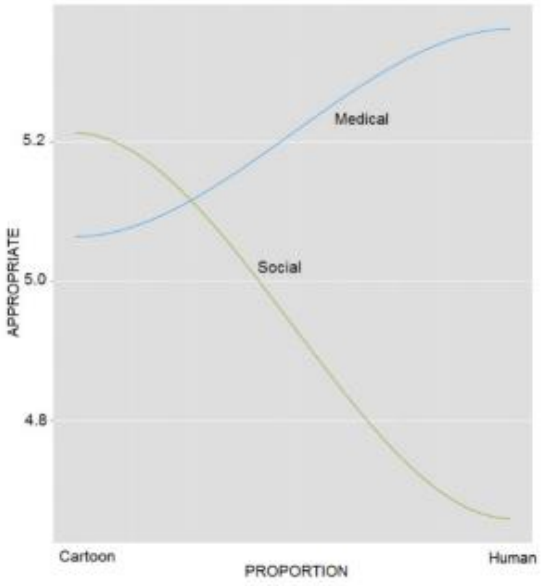
(a) Michael (renamed Michele) (b) Eddie (renamed Edoardo). (c) Julie3 (renamed Giulia) (d) Victoria2 (renamed Clara)

Esposito+ 2019ab



McDonnell+ 2012





Ring et al+ 2014

Question items

What is the appropriate appearance of virtual agents as SST trainers? (N=1218) [Tanaka+2022]

Acceptability as a trainer

Acceptability as a listener

Realism

Familiarity

Trustworthiness

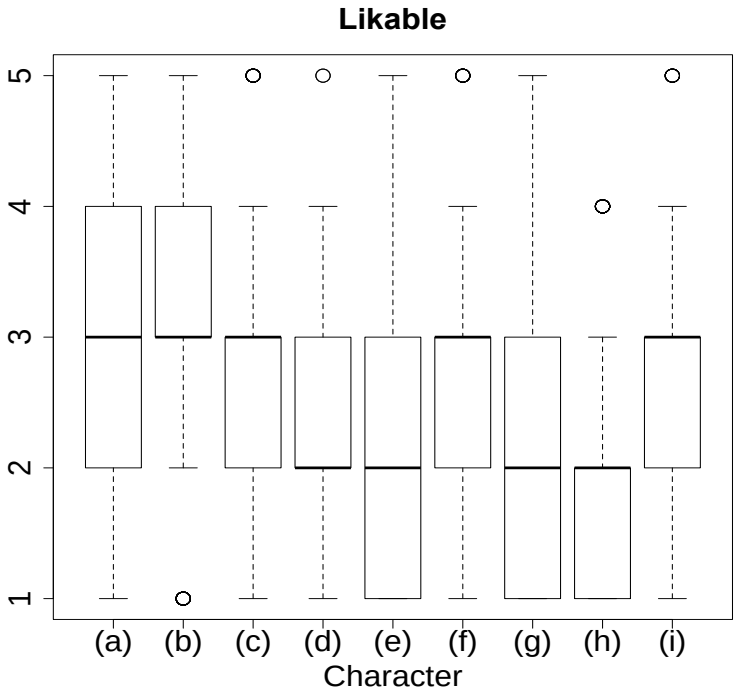
Eeriness

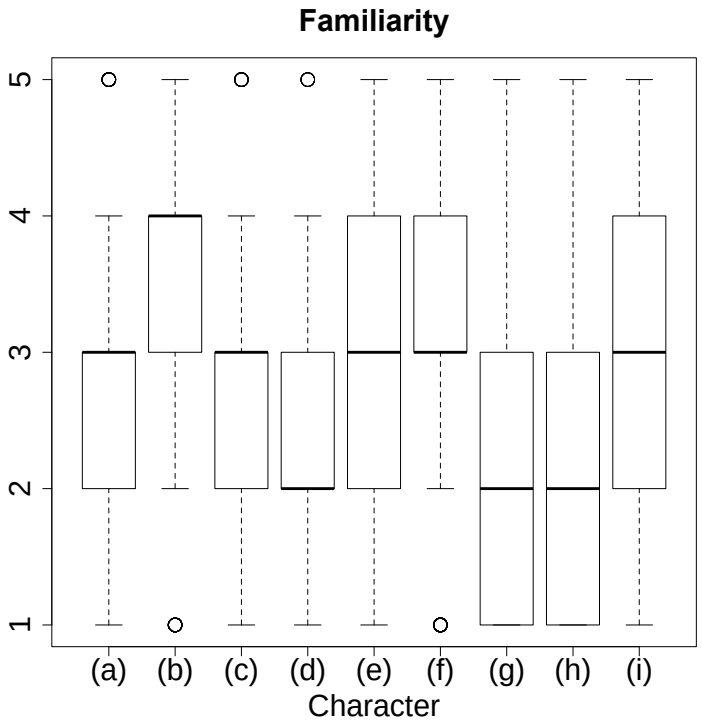
Likeability of the face, eyes, perceived ages, voice, clothes, and overall

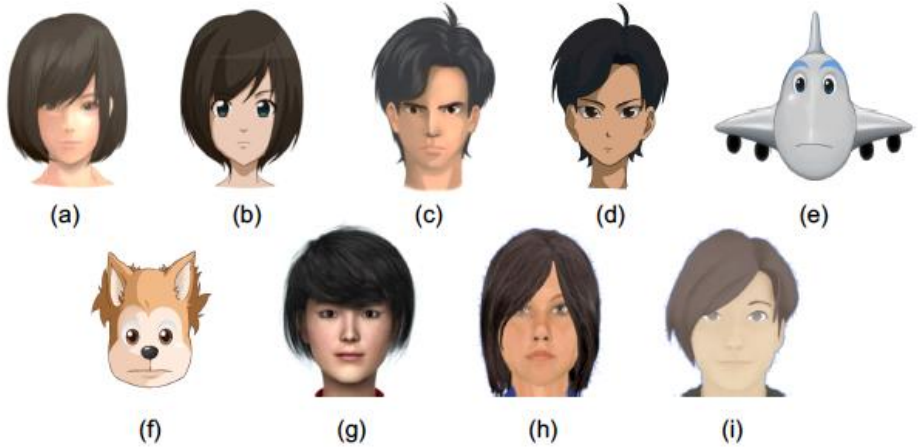
- 5-point Likert scale (1: I don't think so at all, 5: I think so very much)

SRS2, Toronto Alexithymia Scale

Ratings of images

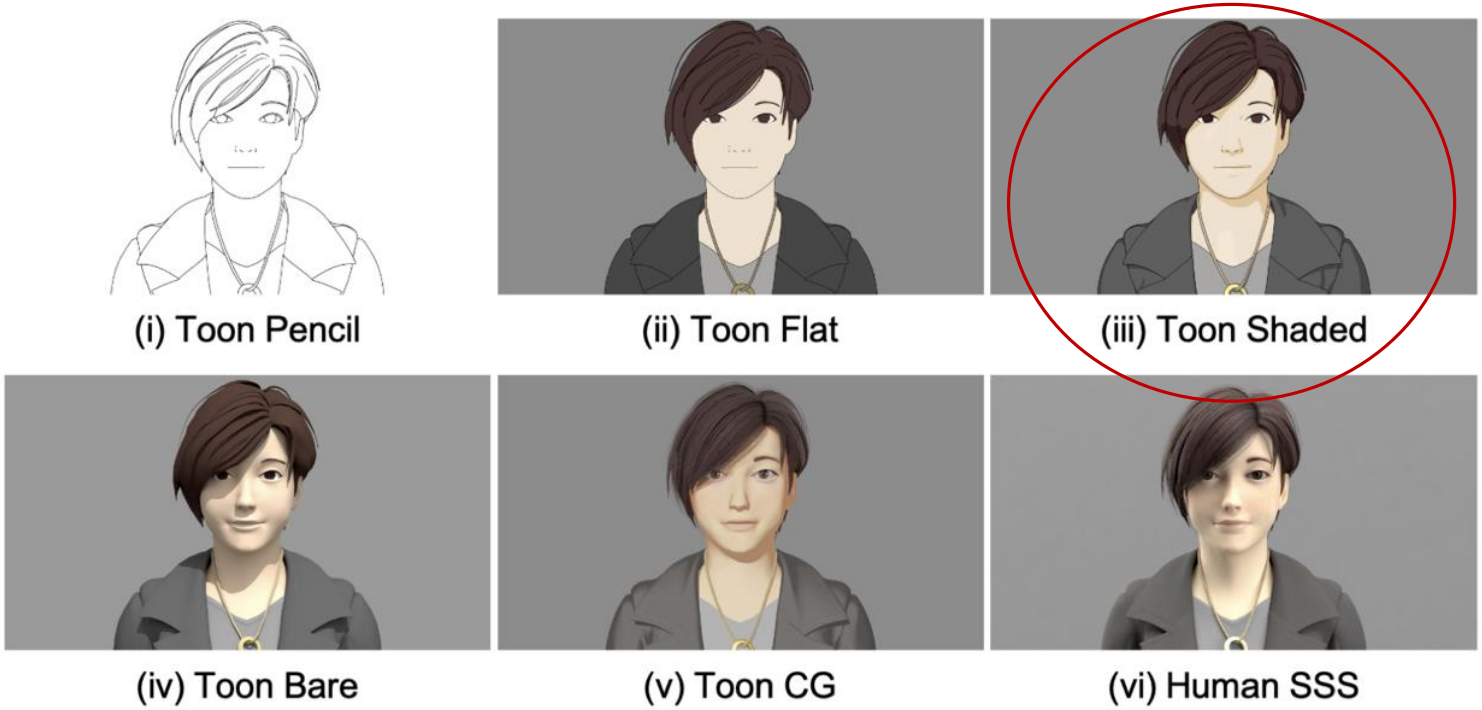


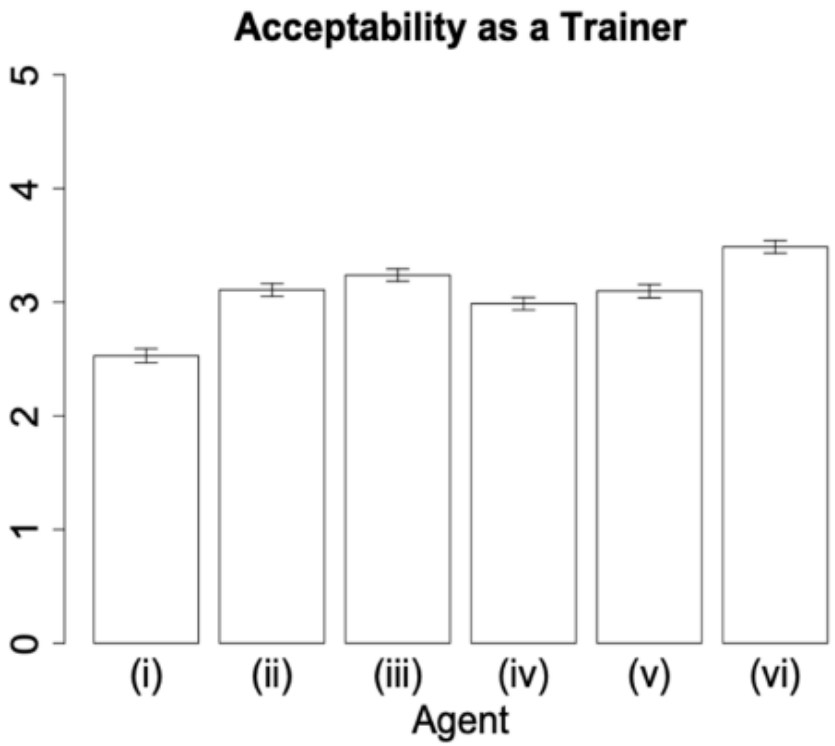




Realism

Second best





SST data collection to generate human-like feedback

Adults: Schizophrenia (N=16), Autism spectrum disorder (N=15), Healthy controls (N=21)
Children: Autism spectrum disorder (N=16), Healthy controls (N=17)

Assessments (ADOS, SRS2, third party trainers' ratings etc), eye gaze

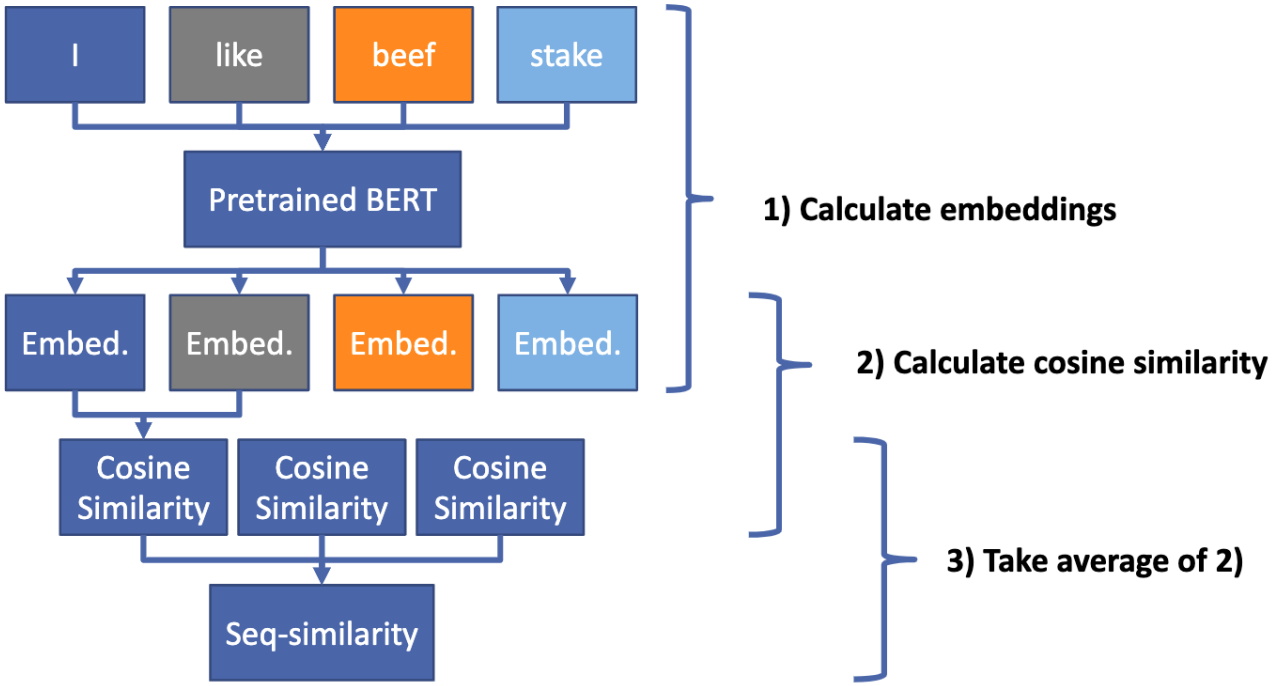
2*Kinect
2*Face
1*whole

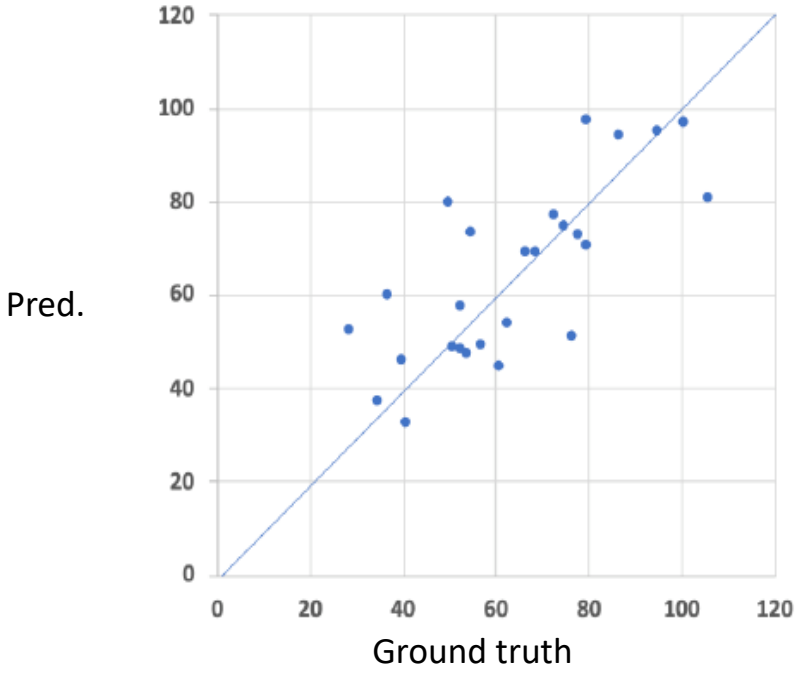
Behavioral measurements (basic module for SST)

Multimodal prediction model for SRS2 (N=27)

Audio speech, facial action units, and BERT similarity in speaking [Saga+2022]

Correlation coefficient for SRS 2 = 0.76





Feedback generation using prediction model

Can multimodal features predict trainer's score? [Saga+2022]

Applied the behavioral measurements model to the collected data

Four SST tasks: ASK, DECLINE, TELL, LISTEN

Ground truth evaluation: 1 to 5 by two third party trainers

Labels
- Eye contact
- Body direction and distance
- Facial expression
- Vocal variation
- Clarity
- Fluency
- Social appropriateness

Multimodal features
（Praat: F0, Intensity, Openface: AUs, Openpose: Gesture BERT Score）

RF

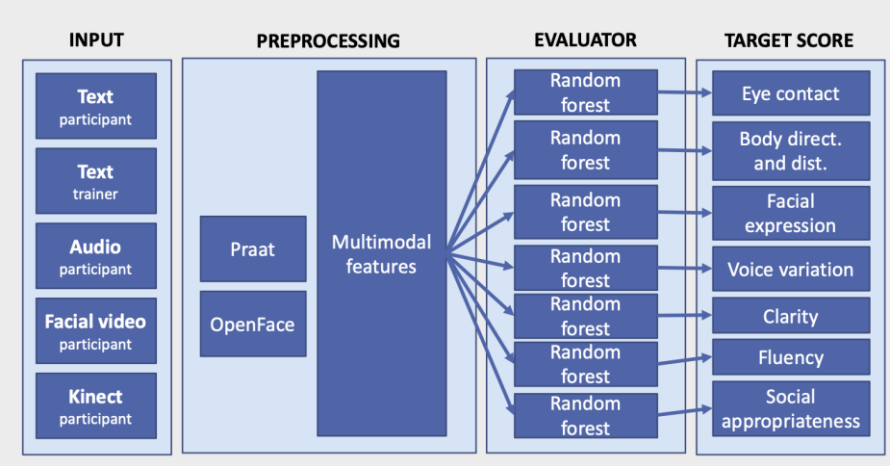
1-5 scale for 7 labels in 4 tasks

Feedback generation: prediction accuracy

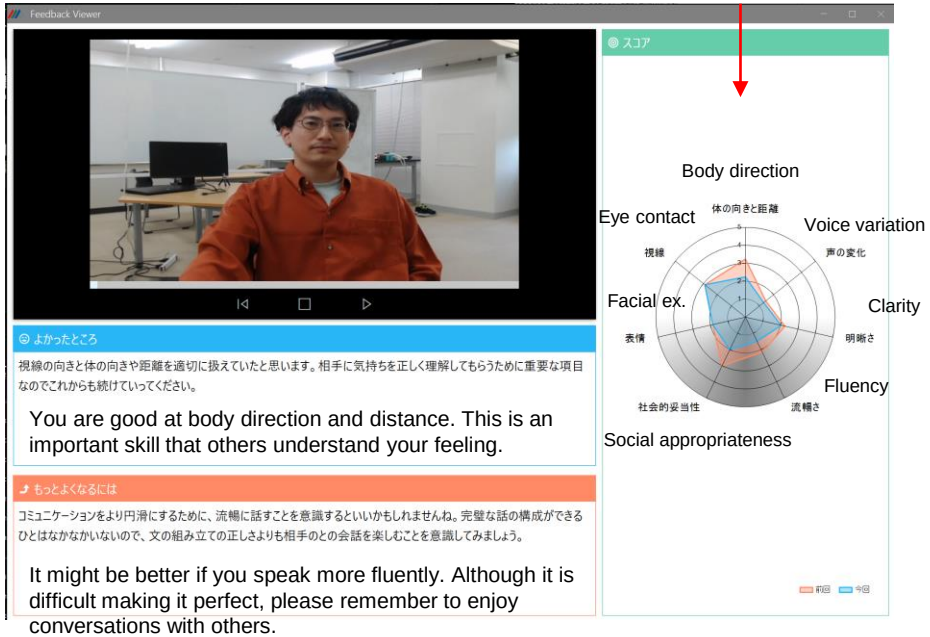
TASK	LABEL	R2	RMSE	CORREL	TASK	LABEL	R2	RMSE	CORREL
TELL	Eye contact	-0.20	1.07	0.06	ASK	Eye contact	-0.87	1.74	-0.22
	Body direct. and dist.	-0.18	1.12	0.16		Body direct. and dist.	-0.15	0.76	0.20
	Facial expression	0.26	1.17	**0.53**		Facial expression	0.09	1.41	**0.42**
	Voice variation	-0.05	1.40	0.24		Voice variation	-0.03	1.60	0.28
	Clarity	-0.41	2.25	-0.14		Clarity	0.03	1.55	**0.37**
	Fluency	-0.14	1.81	0.19		Fluency	-0.42	1.92	-0.06
	Social appropriateness	0.14	1.39	**0.40**		Social appropriateness	0.18	1.25	**0.47**
LISTEN	Eye contact	0.16	0.71	**0.46**	DECLINE	Eye contact	-0.11	1.34	0.28
	Body direct. and dist.	-0.15	0.91	0.17		Body direct. and dist.	-0.09	1.03	0.26
	Facial expression	-0.04	1.40	0.23		Facial expression	-0.19	1.76	0.14
	Voice variation	-0.18	1.70	0.14		Voice variation	-0.24	2.40	0.09
	Clarity	-0.10	1.44	0.14		Clarity	-0.20	2.26	0.08
	Fluency	-0.20	1.68	0.05		Fluency	-0.17	2.01	0.01
	Social appropriateness	0.13	1.11	**0.40**		Social appropriateness	-0.05	1.82	0.29

SST system

Roleplay w/ CA → Prediction → Feedback



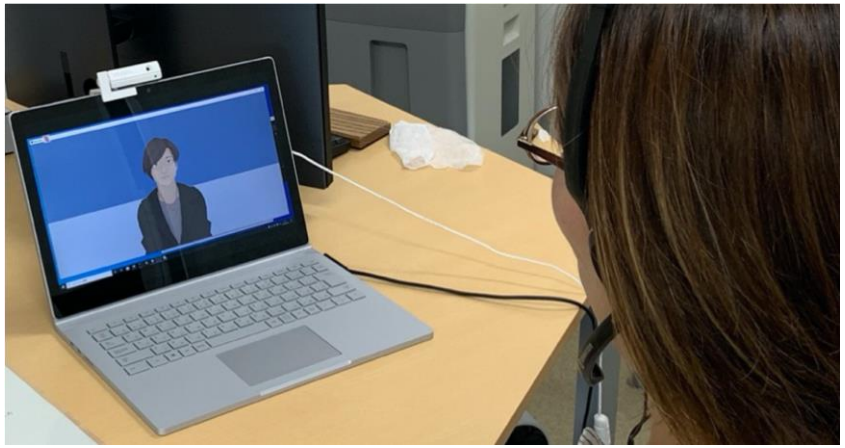
Predicted scores

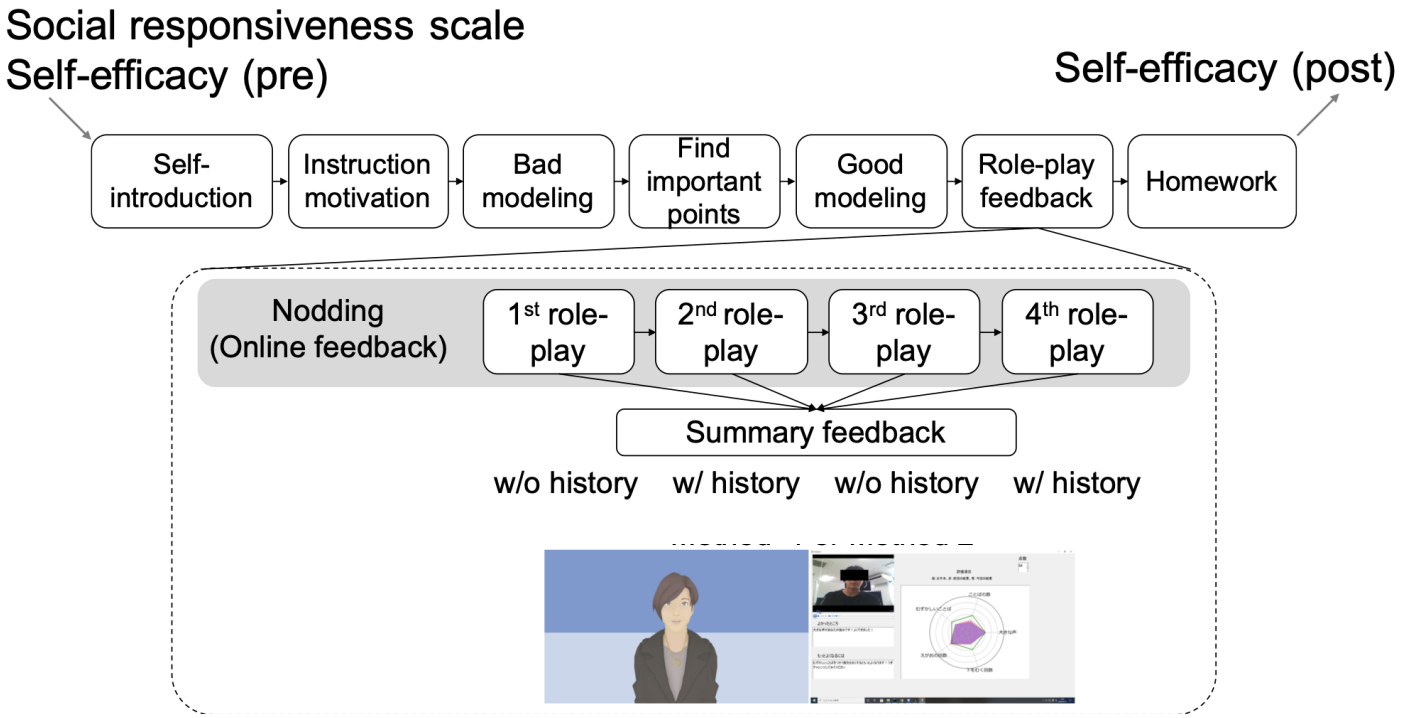


Demo video

Experiment

Using the developed system





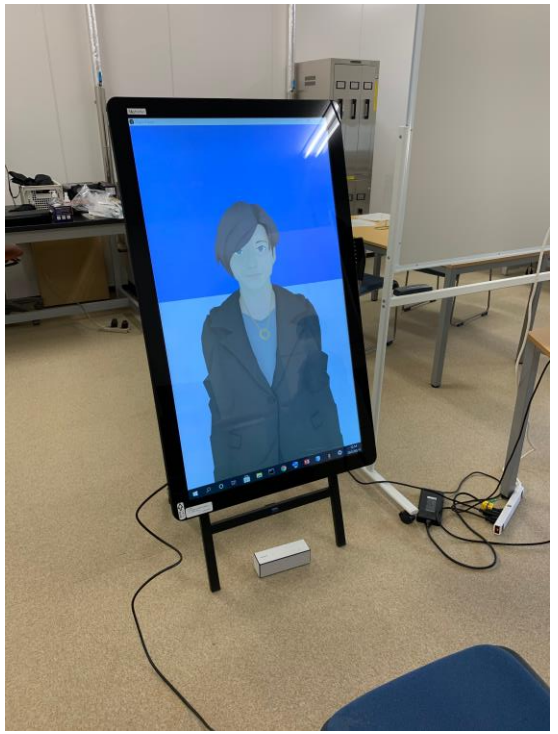
Experimental evaluation

Participants: Healthy

One to one training in SST: conveying feelings, listening, making a request, declining

Training period: 1-month (once per week) = 4 trainings

Place: Visit to Lab.



Comparison

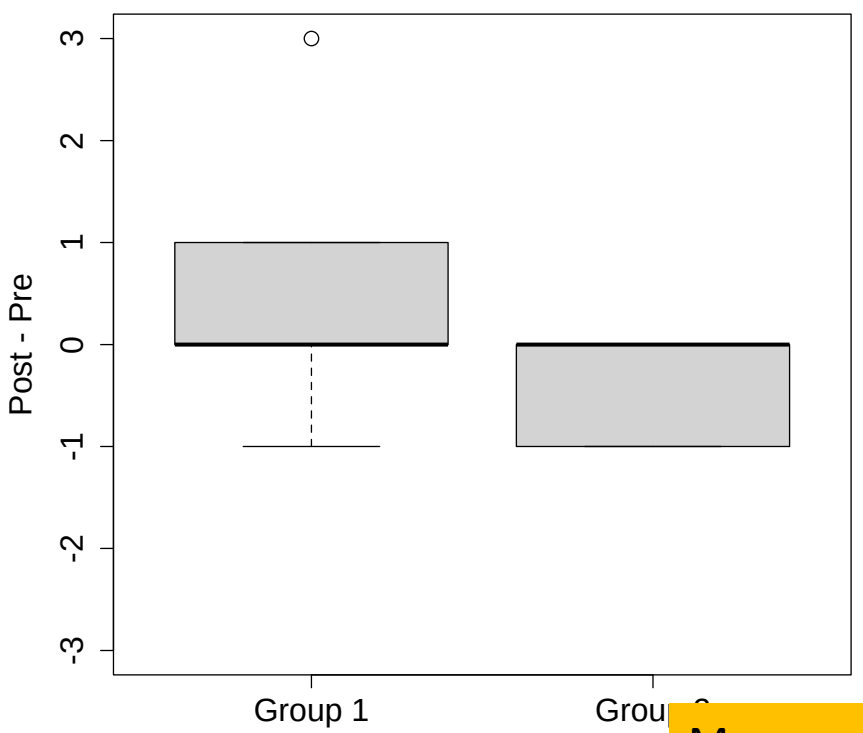
- Group 1: system training (N=9)
- Group 2: without training (N=9)

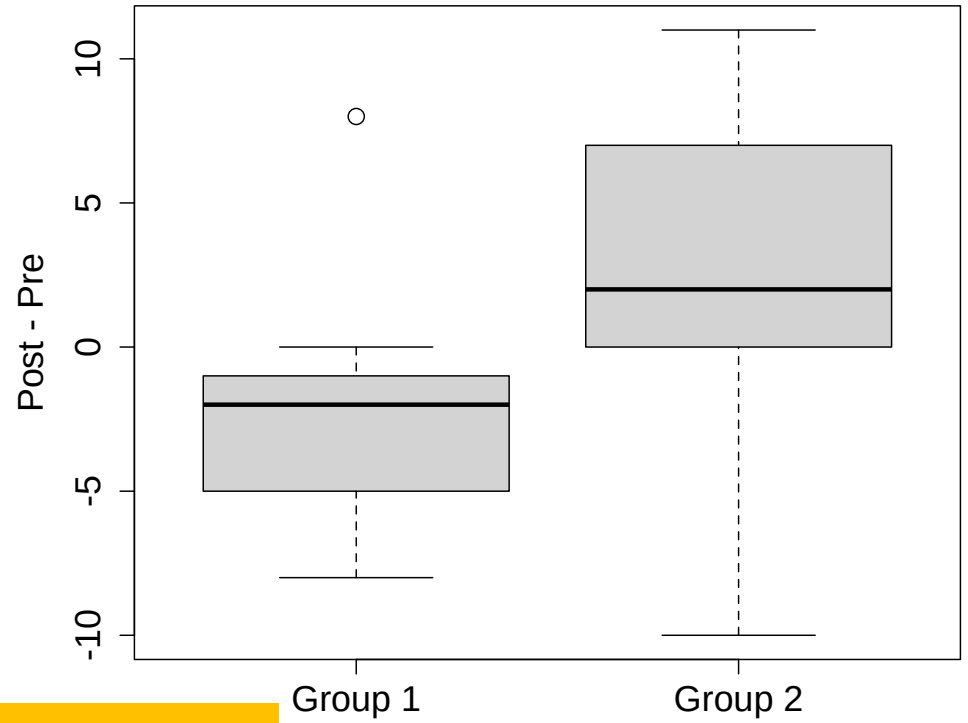
Training effect

- General Self-efficacy scale, State-Trait Anxiety Inventory (STAI), Kiss-18, SRS2 Liebowitz Social Anxiety Scale
- Role-play with human trainers, SST Role-play scale by third party raters

Results

Significant change in the generalized self-efficacy scale and state anxiety [Tanaka+ under review]





More experiments are to be done!

General self-efficacy scale (p=0.02)

STAI, state anxiety presence (p=0.04)

Summary

- Communication difficulties
  - Social anxiety disorder
  - Autism spectrum disorder
- TAPAS Project
  - Social skills training
  - Data collection
  - Embodied conversational agent
  - Skill prediction and feedback generation
  - TAPAS system and evaluation
- Future works
  - Field experiments in hospitals and further improvements
  - SST in AR environments and Training in various situations
  - Cognitive behavior therapy

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Thank you for your attention