

Spoken Dialog Systems for Health Interventions using Fully Autonomous Humanoid Robots

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1 Motivation



Health Interventions

- Robots in health care: tele-operation, logistics in hospitals, autism spectrum disorders
- Provide therapy with the help of an intelligent robotic agent, e.g. KASPAR
- NAO robot: tele-operated for well-being after marrow-transplants, children with diabetes

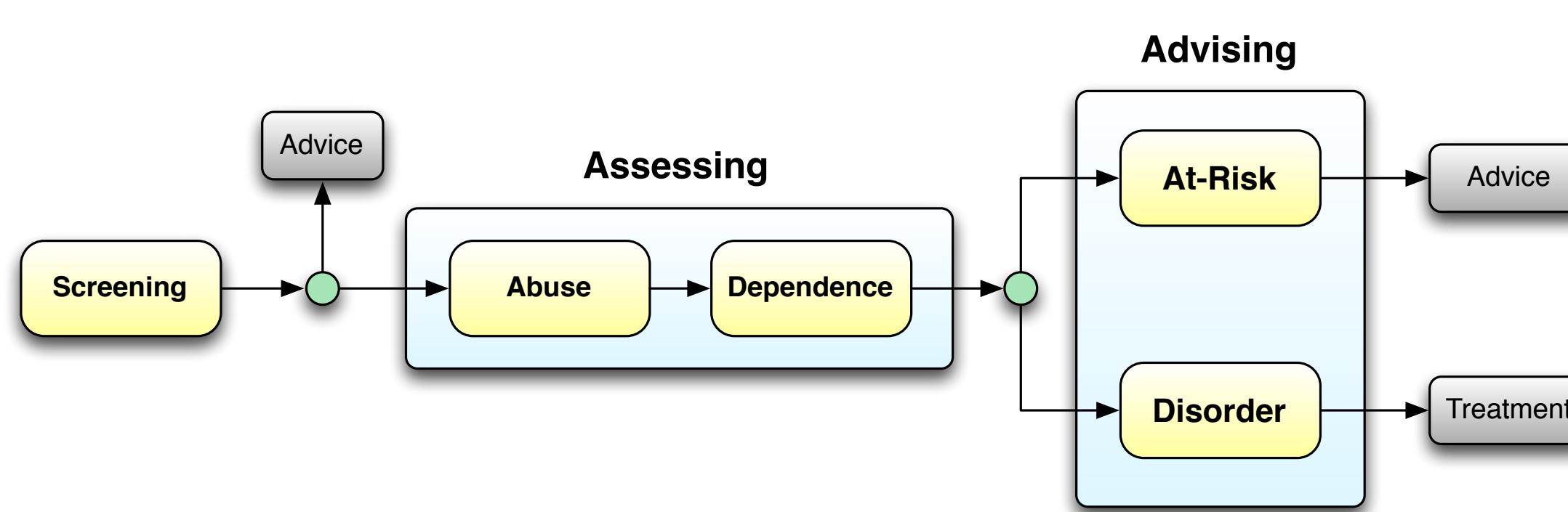
Dialog Systems

- Systems based on RL in SDS community, although dialog system still hand-crafted
- Hand-crafted systems including dialog systems

Our idea

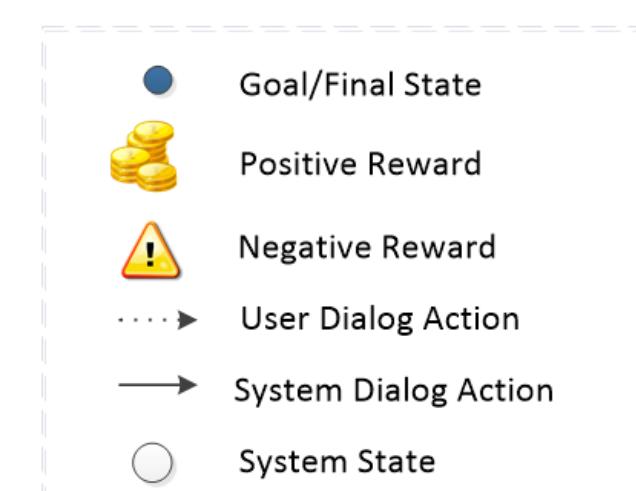
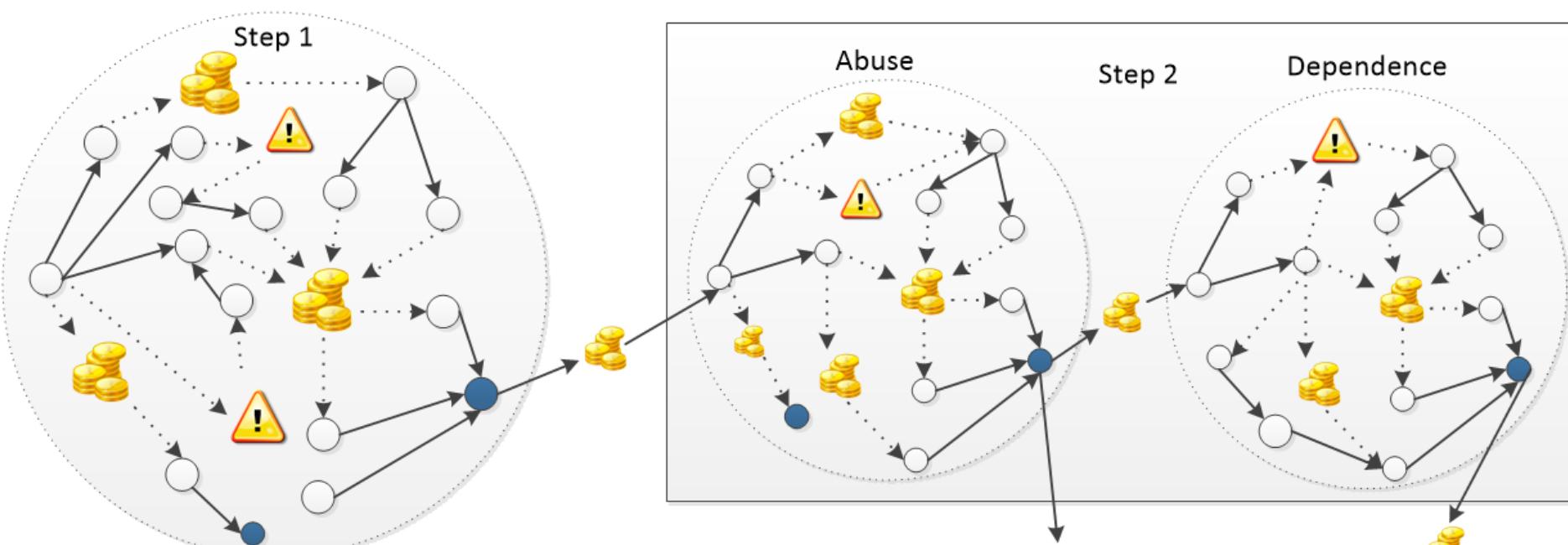
- Integrate a RL-based spoken dialog system on a NAO robot for brief health intervention

2 Approach



Dialog Structure

- Ideal for screening purposes
- Assessing step: questions for abuse and dependence
- Advising step for At-Risk and Disorder patients



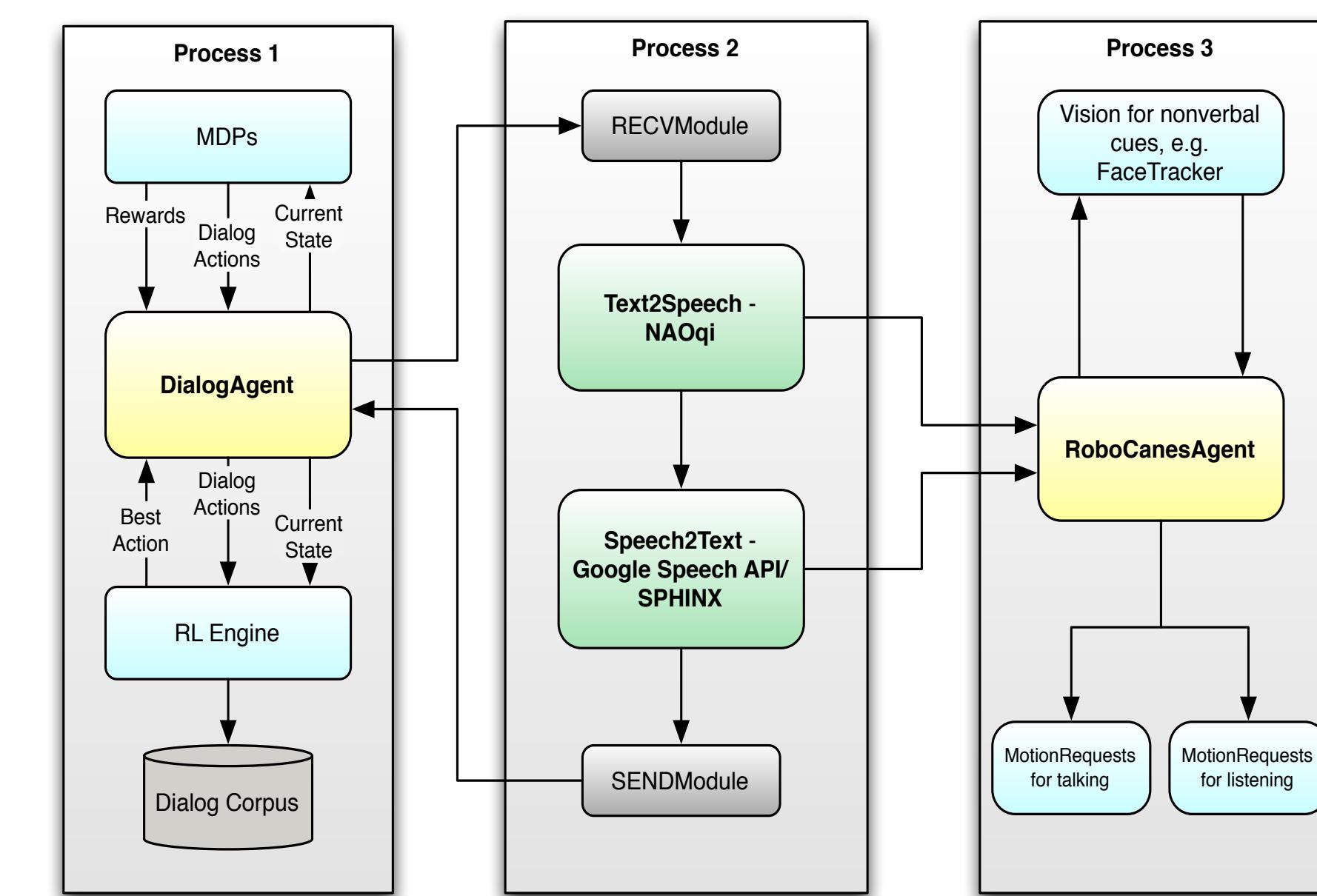
RL Framework

- Five RL subproblems, state with five features
- Each question produces 34 potential states
- 578 total states
- Each state: 2 actions, either initiative and confirmation type
- Reward designed to complete each RL problem with min. possible steps.

State features and its domains for screening about alcohol consumption.

Feature	Domain	Description
Greeting	0,1	Whether the system has greeted the user.
Question	1,2,3,4	Which question is being queried.
Confidence	0,1,2,3,4,5,6	0,1,2 for low, medium, and high confidence of speech recognizer. 3,4 for confirmed or not confirmed. 5 to indicate system is waiting for confirmation. 6 is for to indicate system transit to next question without confirmation.
Value	0,1	Is the value obtained for current question.
Grammar	0,1	What type of ASR grammar used, restrictive or dictation (non-restrictive) grammar.
Auxiliary	0,1,2	Multiple purpose attribute. Use to indicate number of ReAsks and semantic valence of the received answer. If it is 0, it indicates, it is not used in that state.

3 Implementation



Sample Dialogs for each Intervention Step

Asking about Alcohol Use

Hello, my name is Doctor House. I am a humanoid robot created to have conversations about healthy lifestyle. Today, I am here to talk about drinking to figure out if you have any issues. May I ask you few questions about your drinking?
Yes, sure you can.
 Do you sometimes drink beer, wine, or other alcoholic beverages?
Well yes, I drink wine or beer sometimes!
 ...
 Ok, thanks for the information you have provided to me about your drinking. Next, I will try to determine some important effects of your drinking.

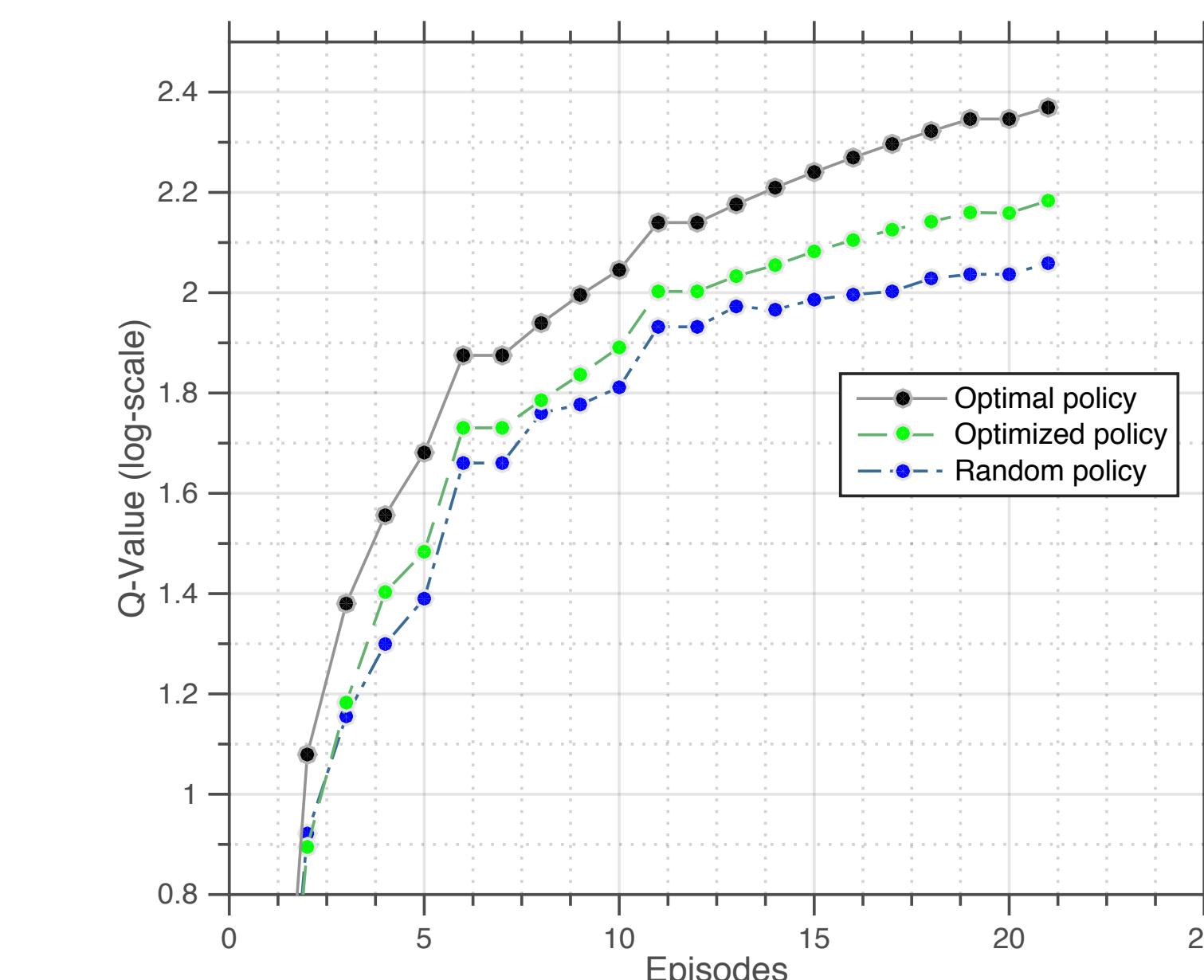
Assessing for Alcohol Use Disorders

Have you ever taken risks under the influence, such as drinking and driving, operating a motor vehicle, or swimming?
No I have not.
 I see, so you are careful to avoid high risk situations after or while having drinks, right?
Yes, I try to be careful.
 ...
 Have you had a period when you spent a lot of time drinking? Or being sick or getting over the bad aftereffects of drinking?
Yes several times.

Advising

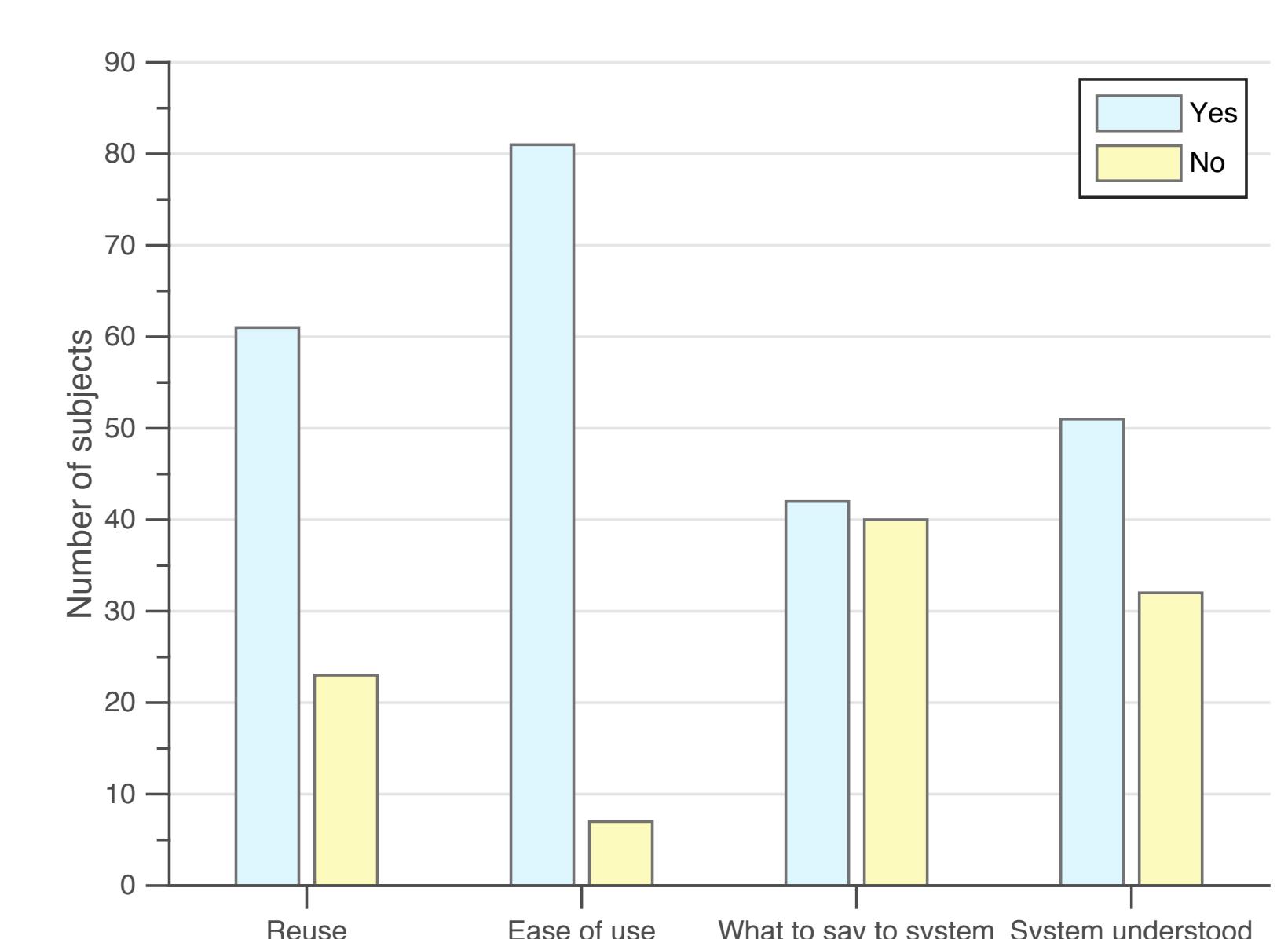
Thank you very much for all your answers. Now I'd like to just take one or two more minutes of your time. Is that okay?
Yes, please go ahead.
 ...
 Thanks for talking with me. I hope you've learned something useful about your drinking pattern. Good bye and let's talk again in 3 months!

4 Evaluation



Objective Evaluation

- For 3D virtual character system
- 89 subjects, 63 male, 27 female
- 51 native english speakers, 38 non-native speakers



Subjective Evaluation

- Subjects answered survey wrt. experience during test, "Would you use the system in the future?"
- Ease of Use: 81 yes, 8 no
- Intention to Reuse (63/26)