Virtual Patient Interaction via Communicative Acts

Szilas, Nicolas; Chauveau, Lucie; Andkjaer, Kasper Ingdahl; Luiu, Anna Laura; Betrancourt, Mireille; Ehrler, Frédéric

How to cite

SZILAS, Nicolas et al. Virtual Patient Interaction via Communicative Acts. In: IVA '19: Proceedings of the 19th ACM International Conference on Intelligent Virtual Agents. Paris (France). New York : ACM Press, 2019. p. 91–93. doi: 10.1145/3308532.3329457

This publication URL: https://archive-ouverte.unige.ch//unige:125287
Publication DOI: 10.1145/3308532.3329457

Virtual Patient Interaction via Communicative Acts

Nicolas Szilas [1]
Anna Laura Luiu [2]

Lucie Chauveau [1]
Mireille Bétrancourt [1]

Kasper Andkjaer [1]
Frédéric Ehrler [2]

TECFA-FPSE
University of Geneva
Geneva, Switzerland
{firstName.lastName}@unige.ch

Division of Medical Information Science
University Hospitals of Geneva
Geneva, Switzerland
{firstName.lastName}@hcuge.ch

ABSTRACT

In the context of assisting informal caregivers of Alzheimer Disease patients, this article presents the design and preliminary implementation of a serious game in which two agents —a user-controlled caregiver and a virtual patient— communicate via specifically-designed dialog acts, reflecting both pedagogically appropriate and inappropriate behaviors.

CCS CONCEPTS

• Software and its engineering~Virtual worlds training simulations • Applied computing~Psychology

KEYWORDS

Alzheimer Disease, Social learning, virtual caregiver, dialog acts

ACM Reference format:

Nicolas Szilas, et al. 2018. Virtual Patient Interaction via Communicative Acts. In *Proceedings of Intelligent Virtual Agents (IVA'19).* ACM, New York, NY, USA, 3 pages. https://doi.org/10.1145/1234567

1 Agents for Learning in a Caregiving Context

With the steady increase of the Alzheimer Disease worldwide, many unprepared individuals become informal caregivers, that is unprofessional persons who are close to the patient and help her in daily activities on a regular basis. Traditional educational material is not efficient in lowering stress or burden, compared to psychotherapeutic approaches that actively involves the caregiver [14]. But the latter are not easily accessible for most caregivers. In this context, our project proposes a computer-based 3D simulation in which users can practice by interacting as virtual caregivers with a virtual patient, in a home context. This projects enters in the field of social learning, for which a number of agent-based simulations have already been proposed, in various domains such as intercultural learning [1, 8], children bullying [2], psychological coaching for teenagers [6], risk behavior prevention [11], health intervention [10, 15] or job interviews training [9]. The domain of caregiving for Alzheimer patients has some particularities that led us to propose a specific approach for social training.

Historically, cognitive autonomous agents have been developed around the concept of rationality. Such rational agents calculate then perform an optimal set of actions to reach their goals [12]. This approach is efficient for many practical application domains, but when it comes to reproduce the behavior of, say, a couple married for 35 years with one suffering of Alzheimer Disease, such goal-oriented models do not fit well because many behaviors are characterized by irrationality rather than rationality. As stated in [7], "most current AI architectures are in some sense still too rational".

How could a system exhibit irrational yet authentic and engaging characters? We found several types of irrationalities, including reasoning flaws, emotionally influenced behaviors, breaking of social rules, rapid changes of mood or personality, etc. For some of these cases, it is conceivable to design a cognitive architecture that generates some irrational behaviors based on psycho-clinical knowledge, but irrational behaviors are hard to understand and model. In this article, we present an alternative approach that focuses less on agents' goals — and plans to reach these goals — preferring to focus on the communication between agents, in the purpose of approaching real-life situations where rationality is somewhat put aside in both pathological and normal human behaviors.

2. Sustaining Rich Interaction with Dedicated Psychologically-inspired Dialog Acts

Consider the following situation : Paula, 40, is taking care of her mother, Marion, a 65-year-old woman suffering from an early

IVA'19, July 3-5, 2019, Location: Paris, France.

ACM ISBN 978-1-4503-XXXX-X/XX/XX...$15.00.
DOI: http://dx.doi.org/10.1145/XXXXXXX

stage Alzheimer Disease. Marion is apathic, stays hours on the sofa and is reluctant to have dinner. In such a situation, Paula can adopt different ways to interact with her mother, depending on her usual way to cope with stressful situations. Research in clinical psychology has identified typical *attitudes*, or *caregiving styles*, that informal caregiver adopt when interacting with the patient [4, 13]. In our model, we used the COPE scale [3] containing 15 subscales, from which nine ways of coping were selected, that we illustrate in the above concrete situation as follows: *struggling* – vent her emotions against her mother, *avoidance* - propose to postpone the dinner, *facilitating* - offer to help her mother, *dysfunctional* - slam the door and serve herself a glass of whisky, *case manager* – announce upcoming tasks, *denial* – minimizing the situation, *defensive* – taking things personally, *involving others* – looking for both emotional and behavioral support from others and *planning* – finding out new strategies. In the proposed computer model, the caregiver agent has 9 attitude attributes, one for each above-mentioned attitude, with a weighting of the attitude defining the tendency of the agent to adopt such attitude. This enables to express the fact that a person does not adopt one and same attitude when facing a caregiving situation.

Each attitude produces, in a given situation a specific communicative behavior, with a specific verbal utterance. From both literature in clinical psychology and interviews with professional and informal caregivers, we have collected and reconstructed quite a few dialog and action sequences. In order to have a more generic model and to allow more interactivity, we have abstracted from these dialog sequences a set of dialog/communicative acts, that are mapped to the nine attitudes. For example, if the caregiver tends to adopt a *facilitating* attitude, she would perform preferentially the following acts, coded as predicates: *PlanTodo*, *AskToDo*, *AskToHelp*, *Agree, Divert, Compliment* or *PositivelyReframe*. On the virtual patient side, action and communication are also driven by dialog acts, selected according to the player's current attitude, the patient's symptoms level and the environmental values. For example, if the patient experiences an apathic symptom, she would perform preferentially the following acts: *AgreeAndPostpone*, *Ignore*, *DoNotAnswer* or *WanderWithoutAWord*.

The use of dialog acts in virtual agents is not new (see for example agent communication languages). What characterizes our approach is that the set of dialog acts is established in accordance to the specific communication situation of caregiving, beyond general transactional or emotional agent models [5]. Agents' actions are coded with a predicate and three arguments: the character who performs the action (actor), the task to perform and the argument associated to the task. It is notated as: *predicate (actor, task, taskArgument).*

The task is part of a hierarchical behavior tree, that describes the various tasks the patient should perform to reach a given goal. Within the tree, tasks may be sequential or random [4] and some tasks may be optional (Figure 1). Note that the two characters share the same goal: the patient desires to reach her daily activity goal (e.g. eating), and the caregiver desires that the patient reaches this same goal.

In addition to these behavior trees, additional *simple tasks* may be performed by agents, specific to each agent and to its location. In a given situation (goal), the caregiver agent may perform a large variety of actions, coarsely the product of all predicates with all available tasks. Actions are then selected according to several mechanisms:

- Only actions concerning an unachieved task after the last successfully performed task in the tree are selected.
- Actions are then scored according to the match between the predicate and the current caregiver's attitude (as described above).
- Actions with a predicate that is assessed as appropriate given the patient's symptoms level are scored higher (pedagogical constraint).

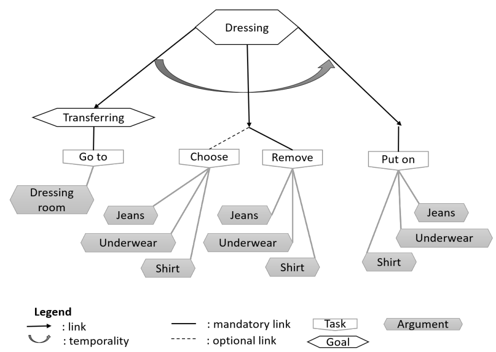

Figure 1: Hierarchical task tree for a specific daily activity

The patient responds to the caregiver's action according to the following mechanisms:

- Only actions based on a predicate in coherence with the player's conversational action are selected (e.g. an acceptance will follow a demand).
- Actions are scored according to the way they fit with the patient's symptoms (as explained above regarding an apathic patient). Two symptoms are implemented so far, apathy and agitation.

After the patient responds with a conversational act, either she does not perform the task mentioned in the act, or she performs and succeeds or she performs and fails. She fails if the task is not right after the last one or if the predicate indicates so.

In order to increase variability and personalize the simulation, several additional mechanisms have been designed and implemented: the current attitude, initialized according to a psychological questionnaire, is dynamically adapted according to the acts effectively chosen by the user; if the user quickly achieves goals, her game ability attribute is increased, which leads to more task being proposed to the user; the caregiver's stress level increases with the patient's failures.

As a result, the choice list includes non-appropriate narrative acts because it fits to the user's known attitudes that, in general, are not optimal. From a pedagogical perspective, it is expected that the user will observe the negative consequences of her sub-optimal choices, such as the patient's repeated refusal, and further evolve toward better choices.

Last but not least, the user interface for selecting an action is also structured according to communicative acts. As illustrated in Figure 2, the user is first proposed a cluster of personalized conversational acts (e.g. *Ask*, *Order to*, *Beg*), and then is proposed a list of all tasks related to the goal achievement (e.g. *Sit on the chair*). These two choices together create the player's abstract action (e.g. *beg(paula,sitOn,chair)*) that is then transformed as text to be displayed as a speech bubble in the game. The underlying idea of this explicit interface is to favor the user's understanding of the various ways to undertake a communication with the patient.

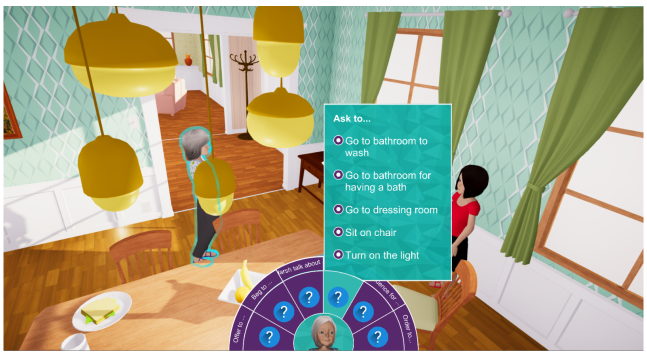

Figure 2: Interaction via speech acts – the user (character on the right) is interacting with the patient (on the left)

3. Preliminary Simulations

In order to produce interactive simulations of the caregiver-patient interaction, an architecture has been implemented that includes an engine running above-described mechanisms (developed in *Java* and *Drools*); a template-based text realizer for dialogs and menus (developed in *Java*); a 3D world and a Graphical User Interface for controlling the virtual caregiver (developed in *Unity*).

Below is displayed an excerpt of an interactive session, between Marion, 65, the virtual patient (M) and her daughter Paula, 30, the user-controlled virtual caregiver (P). It is dinner time. Actions in the 3D world are written in italics, and underlying speech acts in brackets for your information.

P: This cannot continue. You have to turn on the light... now! [aggressively order]

Marion turns on the light without a world.

P: Marion, could you please sit on the chair? [ask]

M: Please let me alone! I don't need your help and I don't want it. [reject care]

P: Marion, let me help you to sit on the chair! - M : No! - P : Please be kind for once... [propose]

M: Please be kind for once... Please be kind for once... [repeat]

Paula feeds the dog then Marion cuddles the dog.

P: Marion, let me help you to sit on the chair! – M : No! – P : Please, be kind for once... [propose]

Marion sits on the chair.

This scenario illustrates how the user/caregiver is trying, with more or less success, to have the patient taking her dinner. While the resulting story remains basic so far as it turns around a single behavior tree, it has a certain variability through the choice of dialog acts.

4. Conclusion and Future Work

In the context of a serious game for helping informal caregivers, an original approach for driving the simulation has been proposed, based on a set of speech acts that reflect the specific care situation. The approach provides variability and flexibility and appears suited to the informal care situation.

As the system will be further developed, more content will be assed and it will include a facial animation system that will greatly help in expressing dialog acts in a more subtle and convincing way than the pure verbal approach that is implemented today.

ACKNOWLEDGMENTS

This study was funded by the Swiss National Science Foundation Grant 205321_166243.

REFERENCES

[1] Aylett, R. et al. 2009. But that was in another country: agents and intercultural empathy. *Proceedings of the 8th International Conference on Autonomous Agents and Multiagent Systems* (Budapest, Hungary, 2009), 305–312.

[2] Aylett, R. et al. 2005. FearNot! - an experiment in emergent narrative. *Intelligent Virtual Agents* (Heidelberg, Sep. 2005), 305–316.

[3] Carver, C.S. and Scheier, M.F. 1989. Assessing Coping Strategies : A Theoretically Based Approach. *Journal of Personality and Social Psychology*. 56, 2 (1989), 267–283.

[4] Corcoran, M.A. 2011. Caregiving styles: A cognitive and behavioral typology associated with dementia family caregiving. *Gerontologist*. 51, 4 (2011), 463–472.

[5] Guiraud, N. et al. 2011. The face of emotions : a logical formalization of expressive speech acts. *The 10th International Conference on Autonomous Agents and Multiagent Systems - Volume 3* (Englewood Cliffs, NJ, 2011), 1031–1038.

[6] Habonneau, N. et al. 2012. 3D Simulated Interactive Drama for Teenagers coping with a Traumatic Brain Injury in a Parent. *5th International Conference on International Digital Storytelling (ICIDS 2012). LNCS 7648* (Heidelberg, 2012), 174–182.

[7] Horswill, I. 2007. Psychopathology , Narrative , and Cognitive Architecture. *AAAI Fall Symposium on Intelligent Narrative Technologies* (2007).

[8] Kim, J.M. et al. 2009. BiLAT: A game-based environment for practicing negotiation in a cultural context. *International Journal of Artificial Intelligence in Education*. 19, 3 (2009), 289–308.

[9] Konig, C. et al. 2018. Serious Games for Training Social Skills in Job Interviews. *IEEE Transactions on Games*. (2018), 1–1.

[10] Lindsay, A. et al. 2015. Generation of Non-compliant Behaviour in Virtual Medical Narratives. *International Conference on Intelligent Virtual Agents* (2015), 216–228.

[11] Miller, L.C. et al. 2011. Socially Optimized Learning in Virtual Environments (SOLVE). *4th International Conference on International Digital Storytelling (ICIDS 2011). LNCS 7069* (Heidelberg, 2011), 182–192.

[12] Russel, S.J. and Norvig, P. 1995. *Artificial Intelligence: A Modern Approach*. Prentice Hall.

[13] Sun, F. 2014. Caregiving stress and coping: A thematic analysis of Chinese family caregivers of persons with dementia. *Dementia*. 13, 6 (2014), 803–818.

[14] Zarit, S. and Feima, E. 2011. Behavioral and Psychosocial Interventions for Family Caregivers. *American Journal of Nursing*. 108, Supplement (2011), 50–57.

[15] Zhou, S. et al. 2017. A Relational Agent for Alcohol Misuse Screening and Intervention in Primary Care. *CHI'17 Workshop on Interactive Systems in Healthcare* (2017).