Embodied Conversational Agent to Motivate Learners towards Communication in English

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Willingness to communicate (WTC) in a second language (L2) is believed to have a direct and sustained influence on learners' actual usage frequency of the targeted language. To help overcome the lack of suitable environments to increase L2 learners' WTC, our approach is to implement a WTC model based conversational agent. In this paper, we focus on the dialogue management aspects of our approach and propose a model based on set of communication strategies (CS) and affective backchannels (AB) in order to foster the agent's ability to carry on natural and WTC friendly conversations with L2 learners. An evaluation of the proposed method led to two main findings. First, combining CS and AB empowers the conversational agent, making possible highly significant WTC gains among L2 learners in English as a foreign language context. Secondly, the results also showed that even a single implementation of AB has the potential to enhance L2 learners' WTC to some extent.

1. Introduction

One of the fundamental goals of second language (L2) learning is to provide learners with the ability to communicate effectively using their L2 when given the opportunity to do so. The key factor to ensure such communicative readiness is the willingness to communicate (WTC) and therefore increasing learners WTC should be the goal of L2 learning [MacIntyre 98]. Moreover, MacIntyre and his colleagues proposed a pyramidal heuristic model of variables affecting WTC in which it appears that the environment where learners experience or practice the L2 plays an important role in motivating them to actively take part or not in L2 conversation. The ultimate goal of this study is to contribute in enhancing L2 learners' WTC by providing them opportunities to simulate and enjoy immersive and realistic daily conversations using a computer-based conversational environment. However, L2 communication is problematic in most of cases mainly because it involves learners' ability to communicate within restrictions on their own vocabulary, grammar, etc. Thus, unlike communication between L1 learners, breakdowns or pitfalls in communication occur more often here. Therefore, any conversational agent intended to support communication in L2 should adopt some strategies adapted to such interactions.

In this paper, we propose, implement and evaluate a dialogue management model, based on a set of specific conversational strategies, namely Communication Strategies (CS) and Affective Backchannels (AB), in order to foster dialogue agents' ability to carry on WTC effective conversations with learners in English as a Foreign Language (EFL) context.

2. Conversational Strategies to Increase WTC

2.1 Contribution and novelty

When it comes to propose effective approaches to make learners more willing to communicate in L2, so far studies have mainly been conducted in the fields of communication studies or language learning studies. In the fields of computer-assisted language learning or artificial intelligence in education, the topic seems to be a conspicuous rarity in the literature since traditional spoken dialogue frameworks seem to not particularly take into consideration aspects related to L2 learners' WTC.

Following our previous work [Ayedoun 16] in which we showed that a dialogue agent based conversational environment might be effective to increase L2 learners' WTC, we propose a dialogue management model dedicated to facilitate the implementation of intelligent dialogue agents that are effective in increasing L2 learners' WTC. The originality of our approach lays in the fact that the proposed model takes into consideration both aspects related to communicative breakdowns that occurs very often in L2 learners-agent interactions and those related to affective variables influencing L2 WTC according to MacIntyre's WTC model.

2.2 Proposed dialogue management model

The model aims first, by the way of Communication Strategies (CS) to foster the dialogue agent's ability to autonomously detect and robustly handle recognition errors as well as learners' pitfalls in L2 communication, making possible achievement of more or less smooth interaction between L2 learners and dialogue agent. Secondly, by the way of Affective Backchannels (AB), this model aims to make possible achievement of a warm interaction where learners feel less anxious about L2 communication and progressively get confidence about their own linguistic proficiency.

Communication Strategies (CS): CS are "a systematic technique employed by a speaker to express his or her meaning when faced with some difficulty" [Dörnyei 97]. These difficulties might arise either from the speaker (lack of linguistic resources) or from the interlocutor (impossibility to understand the speaker). It is worthwhile for learners to have a repertoire of such strategies at their disposal, whereby they achieve a degree of communicative effectiveness beyond their immediate linguistic means [Thornbury 05]. Nevertheless, in the case of learners with a low WTC, mastering such strategies does not necessarily guarantee that learners will be able to use them

Table 1 Examples of CS implemented in this study

Strategy	Description	Example
Simplification or Approximation	Use an alternative or a shorter term, which expresses the meaning of the target lexical item.	**Agent**: May I have your order please? **Learner**: ... (*silent*) **Agent**: Order please
Code switching	Use a L1 word with L1 pronunciation or a L3 word with L3 pronunciation in L2.	**Agent**: May I have your order please? **Learner**: ... (*silent*) **Agent**: Go chūmon wa ikagadesu ka? (Code switching from English to Japanese)
Ask clarification	Request explanation of an unfamiliar meaning structure.	**Learner**: One xxx please. **Agent**: What do you mean?

when they face some trouble during conversation since they are more likely to remain silent.

The alternative and indeed interesting approach that we propose is to foster the dialogue agent's own strategic competence. Mastering of CS might help dialogue agents not only to overcome their own difficulties (impossibility to understand the learner…) but also and more importantly to anticipate or handle more effectively communication pitfalls (difficulty in understanding or answering) that learners may encounter during conversations. When the learner knows that he can rely on a supportive dialogue agent to help him recover from difficulties, he may feel a "sense of security" that can reduce his communication apprehension, leading to a higher level of WTC. In the present study, we targeted about 9 strategies among those defined in the comprehensive review of definitions and taxonomies of CS [Dörnyei 97]. The selected strategies were chosen according to two criteria: (i) their effectiveness towards encouraging WTC and (ii) the feasibility of their implementation from the technical standpoint. Table 1 shows a non-exhaustive list of the selected strategies as well as examples of their usage in this study.

Affective Backchannels (AB): Backchannels are generally defined as a type of short utterances or feedbacks such as *uh-huh*, *yeah…* given by the listener to show interest, attention or a willingness to keep the communication channel open. They play an important role in human agent conversation [Smith 11].

Although actual competence might encourage communication, it is the perception of that competence that will ultimately determine the choice of whether to communicate or not [Clément 03]. Thus, L2 learners who don't get enough supportive feedbacks from their interlocutors may easily perceived themselves as being incompetent communicators and therefore tend to be reticent to communication. All this gives much evidence that it might be effective for a conversational agent intending to enhance learners' WTC, to be able to convey a sufficient amount of interest or sympathy to learners during the interaction since doing so might contribute to creating a WTC friendly atmosphere. In order to achieve such empathetic support, we identified and defined a set of backchannels that we call Affective Backchannels (AB). Table 2 shows the different categories of AB that we defined in order to cover the full range of situations the learner can be in during the interaction.

Table 2 Implemented AB in this study

Strategy	Description	Example
Congratulatory AB	Employed when the conversation with the learner is going well as expected	Okay, that's nice!
Encouraging AB	Employed when the learner seems to hesitate to the extent that he/she remains silent.	Come on, you can do it!
Sympathetic AB	Employed when the learner's utterance does not match the agent expectations.	Sorry I couldn't get you dear
Reassuring AB	Employed when the learner seems to face much difficulties in the conversation.	Don't worry dear!

3. Conversational Strategies Enhanced Dialogue Management

The overall conversational flow is under the supervision of a Dialogue Manager, which controls the various phases of dialogue and their timing, as well as the level of system initiative, in an integrated fashion. As described in figure 1, the dialogue management routine goes from *Start* to *End* (top to bottom of the figure) passing through checking of the different possible dialogues states represented in the diamond symbols. The occurrence of each of such dialogue states automatically leads to triggering of adapted conversational strategies (as indicated in square symbols) that are pull out from their respective databases (as indicated by dotted lines) in order to keep the learner motivated using AB (represented in orange database symbols on the right of the figure), and try to move the dialogue forward using CS (represented in blue database symbols on the bottom of the figure). The decision to engage a specific conversational strategy is mainly based on the following triggering events or dialogue states:

The learner is silent: when the system is expecting some input from the learner but cannot get any after a certain amount of time is elapsed. In such case, the system will first apply a set of *Reassuring* and *Encouraging* AB and then investigates the reason why the learner remains silent.

The learner is NUNA (Not able to Understand, Nor to Answer): when the learner is not able to get what the agent is expecting from him. In such case, the system will fire up specific CS such as *Simplification* in order to let the learner understand and hopefully utter the expected information.

The learner is UNA (able to Understand but Not able to Answer): when the learner understands what is being requested from him but can't or don't know how to answer. In this case, CS such as *Suggest an Answer Pattern* will be applied in order to help the learner overcome his current difficulty.

The learner is asking for help: when the learner expresses that he is NUNA, UNA or specifically requests a CS such as repetition or simplification. In this case, the system will fire up a *Reassuring* AB and then apply appropriate CS according to the nature of the help requested by the learner.

The agent is NUNA: when the system is unable to detect the learner's intention due to a very low confidence score or the occurrence of a recognition error of the learner's utterance. In this case, the system will first output a *Sympathetic AB* and then try to recover by applying CS such as *Ask repetition* in order to give the learner another chance to express his intention.
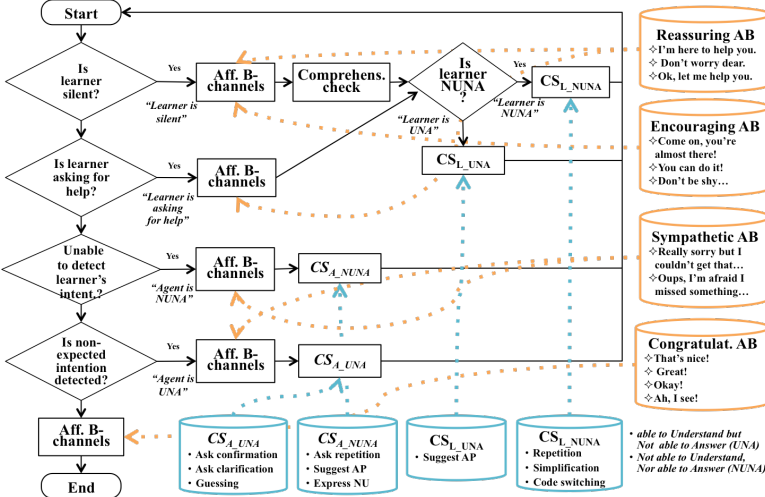
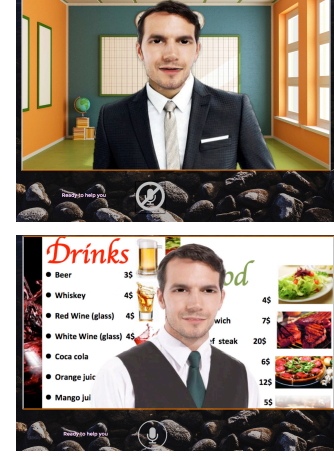**Fig. 1** Dialogue management flow based on CS and AB

Fig. 2 System interface showing the agent

The agent is UNA: when the system is able to detect the learner's intention with an acceptable confidence rate but is not expecting such intention in the current dialogue context (for example, the learner asking for the nearest supermarket while the agent is expecting him to make an order in a restaurant context). In this case, the agent will first apply a *Sympathetic* AB and then try to get the learner reformulate his intention by using CS such as *Ask confirmation* in order to make sure that what the system understood from the learner's utterance is actually what the latter meant.

We expect that the modular and domain independent nature of the proposed dialogue management model will not only facilitate its reusability across different dialogues domains, but will also make easier the development of conversational spoken languages interfaces that are fully adapted to L2 learners from the WTC standpoint.

4. Experimental Study

We conducted an evaluation of the proposed dialogue management model in this paper to clarify the following preoccupation: *Does the combination of CS and AB really have the potential to empower the conversational agent to the extent to foster L2 learners' WTC?*

4.1 Procedures and materials

We built a conversational agent based on the system architecture proposed in our previous work [Ayedoun 16], and enhanced it with the management model described above. The system makes possible interactions between the conversational agent personified as Jack, on one hand and learners on the other.

For this study, the participants were 32 Japanese undergraduate and graduate students currently attending a Japanese university. The evaluation was conducted following 5 procedures as described in Table 3.

Procedure 1 and Procedure 3 (Measures of WTC): We used the same WTC questionnaires as in [Ayedoun 16] to evaluate learners' WTC before (procedure 1) and after (procedure 3) they interacted with the system in procedure 2. We carefully designed learners' interactions with the system in each group applying the counterbalancing method [Howitt 11], as described in procedure 2 below. It is important to mention that each participant

Table 3 Overview of the evaluation flow

Procedure	Group 1 (n=8)	Group 2 (n=8)	Group 3 (n=8)	Group 4 (n=8)
Procedure 1	First WTC questionnaire (Pretest)			
Procedure 2	CS+AB	CS+AB	CS	AB
Procedure 3	Second WTC questionnaire (Posttest)			
Procedure 4	CS	AB	CS+AB	CS+AB
Procedure 5	System preference survey			

interacted individually with the system in a room specially prepared for the evaluation.

Procedure 2 (First Interaction with Jack): All the participants were first asked to interact with Jack, who would teach them how to pronounce some words in English. They were requested to listen and repeat the words according to Jack's instructions. In reality, our intention here was to let all learners sympathize with Jack and understand how the system works.

Then, participants were divided in four groups (Group 1 to Group 4) of 8 participants each, and asked to interact with the system, the conversation being held this time in a restaurant context with Jack interacting with them as a waiter. We prepared 3 different versions of the system: the CS+AB version (with both CS and AB implemented), the CS version (with only CS implemented) and finally the AB version (with only AB implemented). Participants interacted with a version of the system according to their group. For example, participants in Group1 interacted with the CS+AB version, those of Group 3 with the CS version and so on, as indicated in Table 3.

Procedure 4 (Second Interaction with Jack): After taking the second WTC questionnaire (posttest) in procedure 3, participants were asked again to interact with the system in a restaurant context. As in Procedure 2, participants interacted with different versions of the system according to their groups.

Procedure 5 (System preference survey): After procedure 4 described above, all participants were asked to choose which version of the system they preferred the most as well as the reason supporting their choice. For example, participants in Group 1 had to choose between the CS+AB and the CS version, those of Group 2 between the CS+AB and the AB version, and so on for participants in Group 3 and Group 4.

From the WTC standpoint, we assume that the results would be viewed as positive if the interaction with the conversational agent led to improving participants' *confidence* and *desire to communicate* while reducing their *anxiety* since those variables
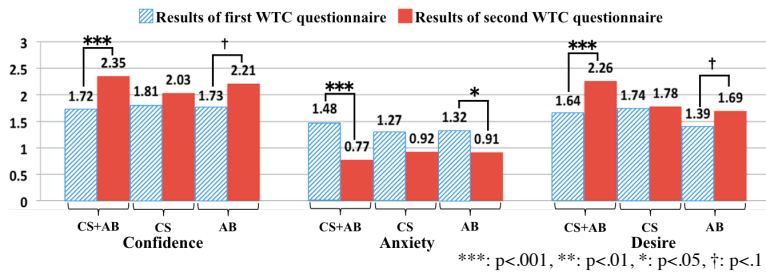
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Fig. 3 WTC variations among participants according to their groups

Fig. 4 System preference survey results

have been identified to have a direct influence on L2 learners' WTC [MacIntyre 98].

4.2 Results

Figure 3 shows WTC variations observed across the 4 groups before and after participants interacted with the system. For the sake of simplicity, we combined results obtained in Group 1 and Group 2 since in both groups the second WTC survey was administrated after learners interacted with the CS+AB version of the system.

- There were **statistically highly significant differences** between the first and the second WTC questionnaires administrated to participants in Group 1 and Group 2 after they interacted with CS+AB version. Actually, their *confidence* and *desire to communicate* increased respectively by +0.63 [t(15) = -8.16, p<.001] and +0.62 [t(15) = -8.60, p<.001] while their *anxiety* decreased by -0.71 [t(15) = 6.89, p< .001].
- **Statistically significant differences** between the two WTC questionnaires were also confirmed among learners in Group 4 after they interacted with AB version. Actually, their *confidence* and *desire to communicate* increased respectively by +0.48 [t(7) = -2.18, p<.1] and +0.3 [t(7) = -2.20, p<.1] while their *anxiety* decreased by -0.41 [t(7) = 2.47, p< .05].
- Small gains in terms of WTC were observed among participants in Group 3 but the differences between the two WTC measures were not statistically significant.
- The preference rate of the **CS+AB version was high** across all the 4 groups, being preferred by 25 participants out of 32 (78%) in total, while the CS and AB version have been preferred respectively by 4 participants out of 16 (25%) and 3 participants out of 16 (19%) as shown in figure 4.

4.3 Discussion

The results suggest that even a single implementation of AB could be quite effective in significantly reducing learners' anxiety and contributing to increase their WTC.

More interestingly, the combination of CS and AB proved to be really effective in motivating L2 learners, much more than just implementing CS or AB alone. This is supported by both the statistically highly significant WTC gains observed among group of participants that interacted with the CS+AB version of the current system and the positive feedbacks that we got from them regarding the reason why they preferred the CS+AB version. Participants who preferred the CS+AB version actually mentioned that they found natural and warm the way Jack (the conversational agent) showed some empathy throughout the interaction and also appreciated the help they got from him when facing difficulties in understanding or expressing what they have got to say. This confirms our initial beliefs that making possible smooth and interactive conversations by using CS is not, by itself,
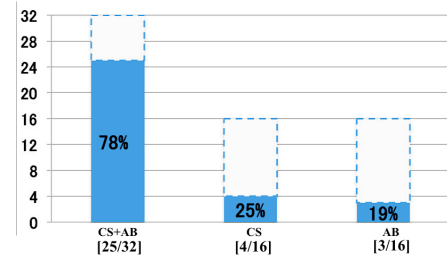
sufficient to increase effectively L2 learners' WTC, which also requires the ability to convey a sufficient amount of warmness or sympathy to learners during the interaction via AB. The proposed dialogue management model in this paper covered both of these requirements and the results obtained are meaningful in terms of validating our approach.

5. Conclusion and Future Research Directions

This paper has described a dialogue management model based on a set of two conversational strategies (CS and AB) aiming to empower conversational agents in order to foster L2 learners' WTC in EFL context.

The evaluation results showed that the combination of CS and AB as proposed here is particularly effective considering the high WTC gains observed among participants who interacted with the CS+AB version of the system. We also found that even a single implementation of AB has the potential to enhance L2 learners' WTC to a certain extent. Future research should be directed to evaluating in more details effects associated with each strategy (CS or AB), and determining approaches for strengthening their impact in enhancing L2 learners' WTC.

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