# Influence of Personality Traits on Backchannel Selection

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**Abstract.** Our aim is to build a real-time Embodied Conversational Agent able to act as an interlocutor in interaction, generating automatically verbal and non verbal signals. These signals, called backchannels, provide information about the listener's mental state towards the perceived speech. The ECA reacts differently to user's behavior depending on its predefined personality. Personality influences the generation and the selection of backchannels. In this paper, we propose a listener's action selection algorithm working in real-time to choose the type and the frequency of backchannels to be displayed by the ECA in accordance with its personality. The algorithm is based on the extroversion and neuroticism dimensions of personality. We present an evaluation on how backchanels managed by this algorithm are congruent with intuitive expectations of participants in terms of behavior specific to different personalities.

**Keywords:** Backchannels, Personality, Action selection, Behavior, Mimicry, ECAs.

## 1 Introduction

A great challenge that is to be faced in the design of Embodied Conversational Agents (ECA) is the issue of credibility, not only in the agent's aspect but also in its behavior [1]. The ECA has to display appropriate verbal and non-verbal behaviors according to its internal variables such as personality and external variables [2].

This work is part of the EU SEMAINE project in which an Embodied Conversational Agent, called Sensitive Artificial Listener (SAL) [3], dialogs with the user. This project aims to build a multimodal talking agent able to exhibit autonomously appropriate verbal and non verbal behaviors when it plays the role of the listener. Four psychologically different characters (SAL agents) have been created to elicit different types of emotion - each employing individual dialogue strategies, and displaying uniquely different responsive reactions [4]. To this end a credible and real-time listening behaviour is important.

Trait models of personality assume that traits influence behavior, and that they are fundamental properties of an individual. We base our work in a dimensional perception of personality. We focus on the extroversion-introversion and the neuroticism-emotional stability dimensions (as defined by [5] [6]), which are central to major trait

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theories and for which we can formulate concrete predictions in terms of behavior, such as mimicry or quantity of movements.

On the individual differences level it has been shown that empathic individuals exhibit mimicry of the postures, mannerisms, and facial expressions of others to a greater extent than do not empathic individuals [7]. Researchers have shown that in general mimicry helps to make the interaction an easier and more pleasant experience, improving the feeling of empathy [8]. Empathy is the capability to share or interpret correctly another being's emotions and feelings [9]. As according to Eysenck [10] neuroticism is negatively correlated with empathy, high neuroticism might be negatively related to the level of mimicry behavior.

Studies have also shown that high extroversion is associated with greater levels of gesturing, more frequent head nods, and general speed of movement [11].

In this paper, we focus on the influence of personality on the selection of backchannels [12]. We propose a backchannel selection algorithm working in real-time to choose the type and the frequency of backchannels to be displayed according to the personality of the ECA. Linking the extroversion and neuroticism dimensions with the two backchannel variables, unstable characters should perform less mimicry than stable ones and extravert characters should perform more backchannels than introvert ones.

The next section is a brief description of related work. Section 3 presents our real-time algorithm. It selects backchannels according to ECA's personality: extroversion is associated with the frequency of the backchannels, while neuroticism with their type. In section 4, we detail the evaluation study that we performed to verify our hypotheses and in the section 5 we discuss the results.

## 2 Related Work

Previous works on ECAs have provided first approaches to a backchannel model. Thórisson [13] developed a talking head, called Gandalf, able to produce real-time backchannel signals during a conversation with a user. The Listening Agent [14], developed at ICT, produces backchannel signals based on real-time analysis of the speaker's non verbal behavior (as head motion and body posture) and of acoustic features extracted from the speaker's voice. Kopp [15] proposed a model for generating incremental backchannels. The system is based both on a probabilistic model, that defines a set of rules to determine the occurrence of a backchannel, and on a simulation model that perceives, understands and evaluates input through multi-layered processes.

## 3 Listener Backchannel Selection Algorithm for ECA

The proposed work is part of a pre-existing system for the generation of backchannels for an ECA listener. In this architecture, two types of backchannel modules have been implemented: mimicry and response backchannels [1].

In the SEMAINE project, four SAL agents have been designed with their own personality traits. Poppy is outgoing and cheerful; Spike is aggressive and argumentative; Prudence is reliable and pragmatic; and Obadiah is pessimistic and gloomy. We can place the four SAL agents on Eysenck's two dimensions (see figure 1) of extroversion and neuroticism (emotional stability) [5].

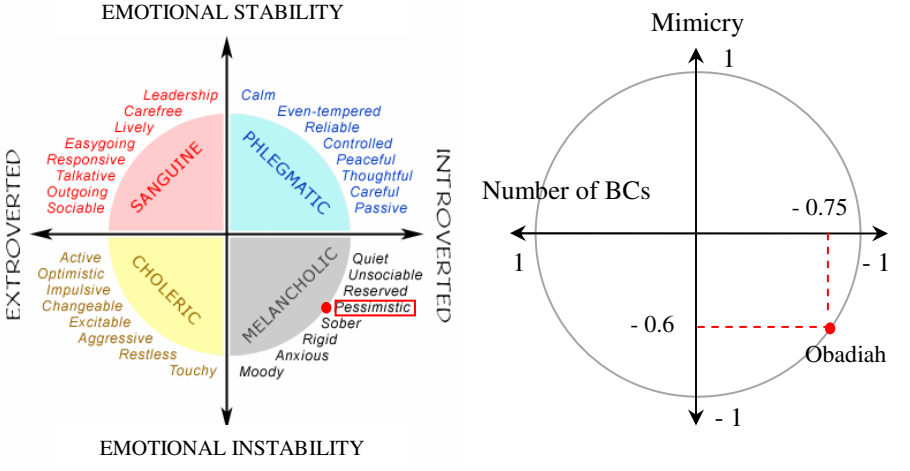


**Fig. 1.** Eysenck's two dimensional representation and our hypothesis of its implication on mimicry and number of backchannels. Example of deduction for Obadiah.

Our aim is to test how backchannels influence the perception of the agent's personality. To concentrate only on the behaviors and to avoid having to consider extra variables, we are considering only one facial model.

We formulate two hypotheses:

H1 : the extroversion dimension can be associated with the frequency of the backchannels (mimicry and response backchannels). Poppy (outgoing) should perform more backchannels and Obadiah (pessimistic) less [11].

H2 : the emotional stability dimension can be linked with the type of backchannels displayed by the ECA (mimicry tendency). Prudence (reliable) should mimic more than Spike (aggressive) [8].

**Table. 1.** Setting of BC priority and frequency for the four SAL agents

| | Obadiah | Poppy | Prudence | Spike |
|---|---|---|---|---|
| BC priority (mimicry) | - 0.6 | 0.25 | 0.90 | - 0.85 |
| BC frequency | - 0.85 | 0.95 | - 0.5 | 0.55 |

Following our two hypotheses, we can easily set frequency and priority of backchannels for our listener backchannel selection. We locate the personality on Eysenck's representation and by translating to our graph we obtain values for the

frequency and priority of backchannels. For example, Obadiah who is pessimistic, performs few backchannels (-0.75) and only some mimicry (-0.6). We obtain these values for the four personalities (see table 1).

## 4 Evaluation

We performed our evaluation study on internet using a web browser showing videos. In our video corpus the woman is telling a story to a virtual agent and the agent is performing some backchannels showing listening behavior (see figure 2). We evaluate two variables: the type and the frequency of backchannels according to personality. We show to the participants a set of interactions and ask them to evaluate for each animation the appropriateness of the frequency and type of backchannels for a described personality (pessimistic, outgoing, reliable and aggressive).


**Fig. 2.** Image of a video evaluated by participants: a user interacting with an agent

Each evaluation page is composed of the description of a virtual agent personality, a reminder of instructions, and two videos. For each video participants answer on a likert scale if the agent reacts appropriately (BC type: from "not at all" to "completely) and sufficiently (BC frequency: from "not enough" to "too much") accordingly to the described personality. Finally, the participants have to determine which video matches the defined personality best.

One condition is evaluated by page for the four personalities. On each page, we have one video with BC influenced by personality in terms of three conditions:

C1 : variation of the backchannel frequency (with BC types baseline)
C2 : variation of the backchannel type (with BC frequency baseline)
C3 : variation of both of them

The second video corresponds to one of the two personalities of the other personality dimension. For example, if the defined personality is outgoing (extroversion dimension) and the condition is focused on BC frequency (with a BC types baseline), the second video is chosen randomly between videos displaying frequencies characteristic of Spike or Prudence (neuroticism dimension).

## 5 Results

Ninety three participants (57 women, 37 men) mainly from France (80%) took part in the study. 54 % of the participants chose the video that suited the described personality in terms of backchannels. The most recognized was Spike (62%), followed by Poppy (53%), Obadiah (53%) and Prudence (52%).

**H1 Hypothesis:** The majority of the participants answered that the frequency of backchannels of the agent is adequate for the four personalities. This was not the default choice and the participants actively chose this response. We performed an ANOVA and Paired samples tests to verify our H1 hypothesis about the selection of BC frequency (see section 3.2). We expected the C3 condition to be evaluated better by participants than the C2 condition.

The answers of the participants to the question on the frequency of the backchannels show an effect of the personality and of the condition (ANOVA, $p < .05$) but not of the interaction of personalities and conditions (ANOVA, $p > .05$). The variations of BC frequency (difference between the conditions C2 and C3) for Poppy (outgoing) and Prudence (reliable) were significative (t test, $p < .05$) and not signicative for Obadiah (pessimistic) and Spike (aggressive) ($p > .05$). The participants consider that the C3 condition for Poppy and Prudence is better than the C2 condition. The variations of BC types (difference between the conditions C1 and C3) for the four personalities are significative ($p < .05$). The participants consider that the C3 condition is better than the C1 condition for all the personalities.

**H2 Hypothesis:** Concerning the type of backchannels, 40,6% of the participants have evaluated better the appropriate video and 25.9% have evaluated both equally. Except Spike, the backchannels are evaluated as appropriate, particularly Poppy. We performed Friedman's ANOVA and Wilcoxon Signed Rank Test to verify our H2 hypothesis about the selection of BC type (see section 3.2). We expect the C3 condition to be evaluated better by participants than the C1 condition.

The answers of the participants on the appropriateness of the backchannels (type) are significative (Friedman test, $p < .05$). The variation of BC type (difference between conditions C1 and C3) for Obadiah (pessimistic) is significative ($p < .05$) and not signicative for the other personalities ($p > .05$). The participants consider that only for Obadiah the C3 condition is better than the C1 condition.

## 6 Discussion

The aim of this evaluation study was to check if the variation of the generated BC type and frequency have an impact on participant's perception. The first hypothesis

was partially verified: although the attributions were higher with the selection of BC frequency than that of alternatives, the difference was not significative for some personalities. The second Hypothesis was verified only for Obadiah (pessimistic).

Concerning hypothesis H1, the participants judge by a majority that the frequency of backchannels are adequate for the personalities but it is only significative for Poppy (outgoing) and Prudence (pragmatic). When an agent performs many backchannels, it is associated with extroversion. When a agent performs a little less than the normal, it is associated with pragmatism. However the inversion is not recognized in this evaluation. Obadiah (pessimistic) should maybe have performed very few backchannels in order to see a real difference. For Spike who is aggressive, people may expect a higher frequency of backchannels. We also see that the BC type has an effect on the perception of the BC frequency. Participants evaluate better the BC frequency when only the BC types vary.

Concerning hypothesis H2, we believe it is the adjective describing the personalities that might not have been optimal in conveying the meaning we were looking for. Many comments say that participants didn't understand the adjective "pragmatic" and they do not really know how an outgoing person reacts. This miscomprehension of the terms may explain why the participants do not really see a difference between BC types selected by the listener backchannel selection. If they do not have a clear idea about how the agent should react, they cannot see the difference in the evaluation. These names need to be clarified for the next evaluations. Moreover it is difficult to show aggression for Spike only with backchannels. We believe it could explain the bad evaluation from the participants.

## 7 Conclusion

In this paper, we presented an evaluation of a backchannel selection algorithm working in real-time. It chooses the types and the frequency of backchannels to be displayed by the ECA. We evaluate that behavior is interpreted as appropriate for a personality when 1) backchannel frequency is linked with the extroversion dimension and 2) backchannel type with the neuroticism dimension. The frequency-extroversion link is verified for outgoing and pragmatic personalities. The type-neuroticism link is verified only for the pessimistic personality. We have to keep in mind that the personality terms need to be clarified for the participants, as the term “pragmatic” was clearly misunderstood by participants and biased these results. We conclude that the selection of type and frequency of backchannels by the presented algorithm does contribute to the interpretation of behavior in terms of personality traits.

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## References


1. Bevacqua, E., Mancini, M., Pelachaud, C.: A Listening Agent Exhibiting Variable Behaviour. In: Prendinger, H., Lester, J.C., Ishizuka, M. (eds.) IVA 2008. LNCS (LNAI), vol. 5208, pp. 262–269. Springer, Heidelberg (2008)
2. de Sevin, E., Pelachaud, C.: Real-time Backchannel Selection for ECAs according to User's Level of Interest. In: Ruttkay, Z., Kipp, M., Nijholt, A., Vilhjálmsson, H.H. (eds.) IVA 2009. LNCS, vol. 5773, Springer, Heidelberg (2009)
3. Douglas-Cowie, E., Cowie, R., Cox, C., Amir, N., Heylen, D.: The Sensitive Artificial Listener: an induction technique for generating emotionally coloured conversation. In: LREC 2008 (2008)
4. McRorie, M., Sneddon, I., de Sevin, E., Bevacqua, E., Pelachaud, C.: A Model of Personality and Emotional Traits. In: Ruttkay, Z., Kipp, M., Nijholt, A., Vilhjálmsson, H.H. (eds.) IVA 2009. LNCS, vol. 5773, Springer, Heidelberg (2009)
5. Eysenck, H.J.: Dimensions of personality: Criteria for a taxonomic paradigm. Personality and Individual Differences 12, 773–779 (1991)
6. Costa Jr., P.T., McCrae, R.R.: Four ways five factors are basic. Personality and Individual Differences 13, 653–665 (1992)
7. Sonnby-Borgstrom, M.: Automatic mimicry reactions as related to differences in emotional empathy. Scandinavian Journal of Psychology 43, 433–443 (2002)
8. Chartrand, T.L., Maddux, W., Lakin, J.: Beyond the perception-behavior link: The ubiquitous utility and motivational moderators of nonconscious mimicry. In: Hassin, R., Uleman, J., Bargh, J.A. (eds.) The new un-conscious, pp. 334–361. Oxford University Press, New York (2005)
9. Decety, J., Jackson, P.L.: The functional architecture of human empathy. Behavioral and Cognitive Neuroscience Reviews (3), 71–100 (2004)
10. Eysenck, S.B.G., Eysenck, H.J.: Impulsiveness and Venturesomeness - Their Position in a Dimensional System of Personality Description. Psychol. Rep. 43(3), 1247–1255 (1978)
11. Borkenau, P., Liebler, A.: Trait inferences: Sources of validity at zero acquaintance. Journal of Personality and Social Psychology 62, 645–657 (1992)
12. Bevacqua, E., de Sevin, E., Pelachaud, C., McRorie, M., Sneddon, I.: Building Credible Agents: Behaviour Influenced by Personality and Emotional Traits. In: Proceedings of International Conference on Kansei Engineering and Emotion Research 2010, KEER 2010, Paris, France (2010)
13. Thórisson, K.: Communicative Humanoids: A Computational Model of Psychosocial Dialogue Skills. PhD Thesis, MIT Media Laboratory (1996)
14. Maatman, R., Gratch, J., Marsella, S.: Natural Behavior of a Listening Agent. In: Panayiotopoulos, T., Gratch, J., Aylett, R.S., Ballin, D., Olivier, P., Rist, T. (eds.) IVA 2005. LNCS (LNAI), vol. 3661, pp. 25–36. Springer, Heidelberg (2005)
15. Kopp, S., Stocksmeier, T.: Incremental multimodal feedback for conversational agents. In: Pelachaud, C., Martin, J.-C., André, E., Chollet, G., Karpouzis, K., Pelé, D. (eds.) IVA 2007. LNCS (LNAI), vol. 4722, pp. 139–146. Springer, Heidelberg (2007)