

On the Expressive Competencies Needed for Responsive Systems

Nigel Ward

Computer Science, University of Texas at El Paso
El Paso TX 79968-0518 USA. nigelward@acm.org

ABSTRACT

Subtle emotions and their expression often arise in the context of managing involvement levels and turn-taking in task-oriented interactions. This paper presents some thoughts regarding their importance for effective and efficient interaction, their essentially real-time nature, and their relation to social conventions.

Keywords

reflex, attitudes, feelings, social conventions, real-time, communication

RESPONSIVENESS

In human-human interaction, people sometimes are able to pick up and respond sensitively to the other's internal state as it shifts moment by moment over the course of an exchange. Table 1, taken from [6], suggests what some of these feelings might be. A literature survey and systematic inventory appears in Cowie et al. (2001).

People who can do this are generally known as good communicators and sensitive listeners. We would like computer systems ultimately to be able to do the same.

One exploration of this was a semi-automated tutoring-type spoken dialog system [6]. The system inferred information about the user's 'ephemeral emotions', such as confidence, confusion, pleasure, and dependency, from the prosody of his utterances and the context. Then, for each user utterance, the system adopted an appropriate "emotional" posture, such as being business-like, patiently supportive, encouragingly supportive, sharing in the user's triumph, being reassuring, and so on. This was conveyed by selecting an appropriate acknowledgement form, such as *yes*, *yeah*, *mm-hm*, *right*, *okay*, and *that's right!*. Although the differences in meaning between these expressions are quite subtle and hard to identify, even after careful analysis, users preferred the system with this ability to use these expressions appropriately.

In building this system the initial aim was only to mimic human behavior, on the belief that the pleasantness of dialog was due, in part, to successful exchanges of in-

I want to express my thoughts
(by taking a turn soon)
I'm uncomfortable
(with this topic)
I'm amused
(by your story)
I'm frustrated
(that I've not been able to convince you)
I'm pleased
(that you appreciate the irony in my words)
I'm missing something
(so you need to be more explicit)
I need a moment
(to digest that statement)
I know what I'm talking about
(so just listen a minute)
I'm not committed to any opinion
(so you're welcome to keep talking)
I'm bored
(so let's talk about something else)
I'm concerned
(that I'm not expressing myself well enough)
I'm really interested
(in your opinion on this)
I'm aware of that already
(so we can go on to talk about something else)
I'm getting restless
(so let's close out this conversation)
I'm feeling a twinge of irritation
(at the tone of your last remark)

Table 1: Examples of Feelings that Occur as 'Ephemeral Emotions' in Dialog, as suggested by studies of prosody, back-channel lexical items, disfluency markers, and gestures, as they occur in tutorial-like dialogs, casual conversations and narrations (Bavelas *et al.* 1995, Ward and Kuroda 1999, Ward 2000)

formation about the participants' states, in real time as they change moment-by-moment during the dialog. However it became clear that doing so was in fact also functional: endowing the system with this sort of subtle emotional expressivity can not only make interactions more pleasant, it can make them more effective and more

efficient.

In particular, it seems that these sorts of expressions often convey attitudes regarding the flow of conversation and the general cast of the conversation, with implications for conversation control functions, such as determining who will speak how much and how slowly and at what level of detail. To summarize these meanings in terms of a communications engineering metaphor, they are out-of-band, and like out-of-band signals in communications systems, they are generally priority messages, status indicators, and control signals relating to the transmission of the main message [9].

DISCUSSION

While “subtle expressivity” is necessarily an imprecise term, it is worth attempting to roughly characterize what is involved.

It is often **task-related**: in comparison to expressions of classic emotions such as anger, fear, and joy, it can be closely related to task achievement.

It is often purely **communicative**, rooted in guiding and responding to the user, rather than in manifesting some deeply felt internal state. Producing subtle expressions usefully, or even just avoiding inappropriateness, may require a system to monitor and direct the dialog at a very fine grain, and involves dimensions of interaction different than those usually handled by user models or by dialog managers.

It is often a reflection of correctly following **social conventions**, rather than being doing anything clever, creative, or distinctively original. This may need to be programmed at a near-reflex level, where system expressions are directly determined by prosodic, gestural, and contextual properties of the user’s actions. In a sense, it may be part of a low-level reactive sub-system, in the spirit of models where appropriate social behavior is explained and implemented without use of inference about the other’s internal state, and without implementing any internal state for the agent [2, 4, 7]. On the other hand, even if subtle expressivity is reflex-level, when building a system it is often useful and appropriate to relate it to the expression of feeling or emotion. Certainly, when trying to discuss peoples’ perceptions of system behavior it is hard to avoid explaining it in terms of intentions and emotions.

It is often highly **real-time** -constrained. At least in some applications, if subtle expressions appear within the window of acceptability they are convincing and effective, but if they come even a fraction of a second too late, users may fail to relate them to the proper context, and their meaning can be weakened or changed.

It is of course **subtle**, by definition. This has several implications, including the difficulty of measuring their value. One technique that is sometimes useful is to

have users evaluate them off-line, in a second evaluation phase. That is, after interacting with a system, if the user can then observe a video or audio recording of his own interaction, while following along on an automatically generated transcript, he may be able to more accurately judge the quality of the system’s contributions. This technique can be an effective way to amplify weakly-detected user preferences [5].

References

1. Janet Beavin Bavelas, Nichile Chovil, Linda Coates, and Lori Roe. Gestures specialized for dialogue. *Personality and Social Psychology Bulletin*, 21:394–405, 1995.
2. Rodney A. Brooks. Intelligence without representation. *Artificial Intelligence*, 47:139–159, 1991.
3. Roddy Cowie, Ellen Douglas-Cowie, N. Tsapatsoulis, G. Votsis, S. Kollais, W. Fellenz, and J. G. Taylor. Emotion recognition in human-computer interaction. *IEEE Signal Processing Magazine*, 18:32–80, 2001.
4. Alan J. Fridlund. The new ethology of human facial expressions. In J. A. Russell and J. Fernandez Dols, editors, *The Psychology of Facial Expression*, pages 103–129. Cambridge, 1997.
5. Wataru Tsukahara and Nigel Ward. Evaluating responsiveness in spoken dialog systems. In *International Conference on Spoken Language Processing*, pages III: 1097–1100, 2000.
6. Wataru Tsukahara and Nigel Ward. Responding to subtle, fleeting changes in the user’s internal state. In *CHI ’01*, pages 77–84. ACM, 2001.
7. Nigel Ward. Responsiveness in dialog and priorities for language research. *Systems and Cybernetics*, 28(6):521–533, 1997.
8. Nigel Ward. The challenge of non-lexical speech sounds. In *International Conference on Spoken Language Processing*, pages II: 571–574, 2000.
9. Nigel Ward. A model of conversational grunts in American English. submitted to *Cognitive Linguistics*, 2002.
10. Nigel Ward and Takeshi Kuroda. Requirements for a socially aware free-standing agent. In *Proceedings of the Second International Symposium on Humanoid Robots*, pages 108–114, 1999.