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Extending the Chain: Humor and Emotions in Human Computer Interaction



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ABSTRACT: *The issues of humor and emotions are strongly related to each other. Their role is recently being appreciated by HCI researchers, and numerous scientific ventures are launched to investigate this subject from various perspectives. Among others, research projects exist focusing on implementing humor generators into conversational systems, in order to facilitate their interaction with humans. In such research, evaluation experiments are often focused, if not limited to, examining users' emotive reactions towards systems (both during and after the interactions). However, in HHI (Human-Human Interaction), humor is often used, be it intentionally or subconsciously, in reaction to interlocutor's emotions, in order to change them from negative to positive, as, for instance, anxiety into joy, or at least reduce the degree of negativity. This was showed in numerous research, mostly in the field of psychology. Thus, it can be said that in HHI, both emotions preceding and following humorous acts are taken into consideration, while most research in HCI focus only on the latter, thus representing what we call a "twostage approach" to humor and emotions. In this paper we first describe current state of the art in the field of research on humor and emotions, propose to distinguish two types of approach to relation between these two issues, next we compare existing research on this matter in HHI (psychology) and HCI, and describe our research progress. In our project, launched to construct a humor-equipped conversational system, we developed a system, which 1) analyses users' emotions during the interaction, 2) uses humor as a reaction to users' particular emotional states, and 3) analyses their reactions to it. Thus, the system represents what we defined as a "multi-stage approach" to humor and emotions, taking into consideration users' emotive states both before and after humorous stimuli. We present the results of experiments conducted to evaluate our system's performance, and propose an idea of a user-adapting humor sense model, in which the humor-emotion chain can be extended even further.*

Key words: Humor, Emotion, Human-computer interaction, Humor sense model

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1. Introduction

In recent years we have seen numerous research projects in the fields of AI (Artificial Intelligence) or HCI (Human-Computer Interaction), focusing on such subjective and problematic (in terms of computing) domains as humor or emotions. The world of science started to realize that in order to create human-like artificial companions for humans, we need to equip them with such abilities as expressing and experiencing emotions and producing and understanding humorous acts.

These two issues are obviously strongly related to each other. Humor can elicit emotions, change them, reduce or increase their intensity. By observing humans' emotive reactions to humor, we can evaluate its quality or timing, as well as assess humans' sense of humor and their character in general. Thus, it seems natural that these correlations should be used also in HCI, be it in humor generation, its evaluation or any other activity involving these two issues.

Some of existing research projects in HCI do utilize the fact that emotions and humor are so closely related. Most of them focus on emotions' role in evaluation process, i.e. on checking humans' emotive reactions to humor. In other words, it is what happens AFTER the humorous stimuli that is a subject of interest in most of known research. However, as mentioned above (and presented below in more details – see Section 2), humor can also be a reaction to something (particular feelings, like sadness or depression), and thus it is also important to take into consideration emotions that occur BEFORE the humorous acts, i.e. to which humor is reaction to. To our knowledge, no existing research in HCI so far has taken this issue into consideration, at least not in an explicit manner.

In this paper we propose to define the relation between humor and emotion as a chain of events, related to each other and occurring consecutively during interaction (between humans as well as in HCI, although in our research project we focus on the latter). We make a distinction between what we call a two-stage approach (like the one described above – humor followed by emotion) and multi-stage approach (in which more links of the chain, like emotions that precede humorous acts, are taken into consideration). We analyse existing research in the field of psychology (see Section 2.1), summarize current achievements in the field of humor and emotion-related projects in HCI (see Section 2.2), and describe our work on humor-equipped conversational system for Japanese, in which jokes are told according to users' emotional states. In the system, the multistage approach to humor and emotions has actually been implemented and tested experimentally (see Section 4). Finally, we show how to extend the humor-emotions chain even further. We present results of additional analysis of the experiment data (Section 5.1), and give an outline of humor sense individualization model we are currently working on (see Section 5.2).

2. Two-and Multi-Stage Approach to Humora and Emotions Relation

As mentioned above, in this paper we perceive the relation between humor and emotions as a chain of events, occurring one after another. Thus, we propose to distinguish between two types of approaches to humor-emotions relation (see also Figure 1):

1) **two-stage approach** – in which only one pair of links is taken into consideration, regardless to their order, i.e. whether it is humor-emotion or emotion-humor (however, to our knowledge, most if not all of existing research, in which this two-stage approach is employed, use the former).

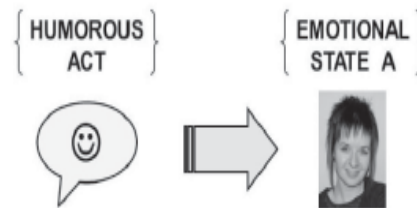
2) **multi-stage approach** – in which more links of the chain are taken into consideration (e.g. humoremotion- humor, emotion-humor-emotion-humor etc.). Most of existing research (in psychology) in which this approach is employed, is limited to three links.

In below sections, we summarize existing research on humor and emotions conducted in two fields: psychology and HCI, discussing which of them represent the two-, and which multistage approaches.

2.1 Psychology

Humor in relation to emotions (and vice versa) has been a subject of psychological research for a long time. Potentially beneficial role of humor as a reaction to stress was discussed by Freud [1], while May [2] stated that humor can help distance oneself to various problems. These (and more) works, however, were of purely theoretical nature, while many others investigated the humor-emotions relation in an experimental manner. Some of them, according to what we proposed above, represent the two-stage approach, whilst other (most) go further and take into consideration more than two (in most cases three) links of the chain, by this representing the multi-stage approach. Most of the research investigate the role of humor as

TWO-STAGE APPROACH TO HUMOR-EMOTION RELATION



MULTI-STAGE APPROACH TO HUMOR-EMOTION RELATION

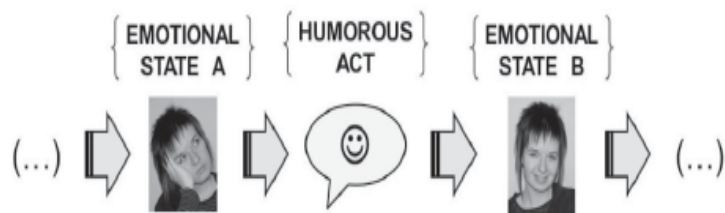


Figure 1. Two- and multi-stage approach to humor-emotions relation

a countermeasure to negative emotions, sometimes using such methods as artificial induction of negative moods in experiment participants, prior to exposing them to humorous stimuli.

Ruch, for instance [3], conducted a study in which he investigated humans' reactions to humorous contents, such as clown performance or funny videos. Not very surprisingly, most participants reacted with smile and laughter, which, states Ruch, are expressions of the emotion of mirth. This research represents the two-stage approach to humor and emotions, as only emotional reaction after humor was investigated here.

In their research, Danzer et al. [4] also used induction in order to elicit dysphoric moods in experiment participants. Those of them who were afterwards exposed to humor (comedy videotape), showed a significant decrease in dysphoria, which dropped back to the initial level. According to our division of approach to humor and emotions, this study represents the multistage group, as it investigates three links of the chain: preceding emotions (dysphoria) – humorous stimulus (funny video) – following emotional states (decrease in dysphoria).

Comedy tapes, which seem to be quite a good humorous stimulant, were also used by Moran [5], who discovered that humor can reduce anxiety level of experiment participants, and Szabo et al. [6], who showed that it can lead to increase in participants' positive moods and decrease in emotional distress.

These works also represent the multi-level approach.

To induce negative emotions, some researchers use also videos, while other refer to other methods, such as asking experiment participants to solve frustrating or even unsolvable tasks. Trice [7] showed that stress caused by such induction was mitigated by watching funny videos. Yovetich et al. [8], in turn, falsely informed experiment participants that in 12 minutes they will experience painful electric shock. Stress caused by this was smaller for this group of participants that was exposed to humor while waiting for the shock.

Needless to say, psychological research on humor and emotions are not limited to those briefly listed above. However, examples presented in this section show that there is a general tendency in this field rather to use multi-stage than two-stage approach.

2.2 HCI

As in the field of psychology, most of existing research employ the multi-stage approach to humor and emotions, one would expect similar situation also in HCI. Thus, the more surprising is the fact that, to our knowledge, no research hitherto uses this approach, and existing projects tend to take into consideration only two links of the humor-emotions chain.

In the field of computational humor, the most popular is its linguistic genre, including such types of jokes as puns, riddles or word plays. The source of ambiguity in such jokes are such features of language as homophony or polysemy, and this makes them more possible to compute using methods and tools of NLP (Natural Language Processing). Some of existing systems work in a stand-alone manner, i.e. they generate jokes in isolated forms, without integrating them into wider contexts. Other try to place humorous act during interaction between humans and computers. Evaluations of the latter type of applications often involves (or is limited to) investigating users' opinions and feelings and emotions toward the interaction. Thus, in this section, we focus on these systems, which use humor during interacting with humans.

Binsted's JAPE system [9] was a punning riddles generator for English. It would create riddle-type word plays, such as:

-What do you call a murderer with fibre?

-A cereal killer.

The system itself was a stand-alone application, i.e. it generated jokes in isolated forms, such as the one above. However, it was later used by Ritchie et al. [10] to create STANDUP - system described as "a language playground, with which a child can explore sounds and meanings by making up jokes, with computer assistance [10]." Target users of STANDUP were children with CCN (complex communication needs), which can result in lower levels of literacy. In evaluation experiments, they used numerous methods, one of which required users to make comments about the system. Some children stated that they enjoyed the interaction and that they liked the system. In other words, their emotive reactions to humor were investigated, which means that this research represents the two-stage approach to humor and emotions.

Not in all works on humor in HCI jokes are generated by computers. In their research, Morkes et al. [11] investigated the impact of preprogrammed jokes on both CMC (computer mediated communication) and HCI. In order to measure users' reactions to humor, they asked them about their feelings and impressions after the interactions, like likeability and friendliness of the partner. They also checked participants' mirth responses, i.e. number of times they smiled or laughed during the interaction. Results showed that in conversations which included humor, in comparison to those which did not, the users evaluated their computer partners as more sociable, friendly and likeable. This approach is also of the two-stage type.

In our previous research [12] we also investigated the role of humor in human-computer conversation. We constructed a pun generator for Japanese, which we then implemented into a nontask oriented conversational system (also in Japanese). The system, named Pundalin, would tell jokes in every third turn of the conversation. In order to evaluate its performance, we asked 13 users to perform conversations with it and with a similar system without humor, and then analysed the chat logs using Ptaszynski et al.'s ML-Ask Emotiveness Analysis System [13]. By doing this, we checked how many and what emotions did the users have during the interactions. The results showed, that the system with humor elicited much more emotions in users, most of which were positive [12].

2.3 The Gap

All research in the field of HCI presented in Section 2.2, including our previous work, represent the two-stage approach to humor and emotions. Thus, we can say that there is a gap between the state of the art in psychology, where most of works in this subject are of the multi-stage type, and current progress in HCI, where all projects so far represent the two-stage approach.

To us, the multi-stage approach seems far more natural, as humor not only causes emotions, but is also a reaction to them. As a matter of fact, it also works in the same manner in the HCI research presented above, as obviously humor in interactions investigated there is a reaction to something. However, this issue has not been investigated explicitly, and thus in HCI emotions preceding humorous acts are still to be taken into consideration.

3. Emotions In Evaluation

Acquiring information about people and their attitudes to products on the basis of conveyed emotions is based on a concept known as the "affect-as-information" approach, proposed by Schwarz and Clore [14]. Its main idea is based on the assumption that humans use affect in the same way as any other criteria; namely by using the informational value of their affective reactions to form opinions and judgments. This leads to the conclusion that information about peoples' attitude to a product (in this case – to a conversational system) can be derived from information about changes in their affective states during and after the interactions. Thus, analyzing users' emotions can give us significant insight into their approaches and opinions towards the systems. [12]

4. Multi-stage Approach To Humoremotions Relation In HCI-System Outline

In this section we briefly describe our research, which represents the multi-stage approach to humor and emotions. As mentioned above, in our previous work [12] we presented a humorequipped conversational system for Japanese, which tells jokes to make humans feel better. In that research we investigated users' emotions towards the system after the interactions, which means that it represented the two-stage approach.

As a continuation of that research, we constructed a new system, in which we investigate not only users' emotions after the interaction, but also their emotive states during the interaction. The system detects users' emotional states in every turn of conversation, and on this basis decides if a joke should be told to make them feel better.

Below we present elements constituting our system and an outline of its algorithm.

4.1 Components

Our new system, named Multi-PUNDA, constitutes of three components: baseline conversational system, pun generator and emotiveness analysis system.

Baseline conversational system – developed by Takahashi et al. [14], non-task-oriented conversational system for Japanese uses an Internet-based association algorithm to generate response relevant to user's input (sentence). Using query engines such as Google, it generates lists of words commonly associated with input, and then integrates them into sentences. Below we present an example of the agent in action:

User: *“Reizouko no naka ni tsumetai nomimono ga arimasu”* (There's something cold to drink in the fridge)

Agent: *“Tsumetai juusu nara sakki nomimashita yo”* (If you mean cold juice, I have just drunk it!).

For more details, see [15].

Pun generator – engine that generates Japanese linguistic jokes (puns). From users' input (a sentence) it extracts a base word, which is then transformed into list of pun candidates, using phonetic transformation patterns. Next, the candidates are queried in the Internet, and one with the highest hit rate is selected and integrated into a sentence. Below we present an example of the agent in action:

User: *Kaeru daikirai!* (I hate frogs!)

Agent: *Kaeru to ieba tsukaeru yo ne!* (Speaking of frogs, we can use that!)

For more details, see [12].

Emotiveness Analysis System – developed by Ptaszynski et al. [13], ML-Ask system detects emotions from text. It performs three types of analysis: 1) it checks if a sentence is emotive (if it contains emotive elements from database, like interjections, exclamations, or vulgar language), 2) determines the types of emotions, and 3) determines their valence (positive/negative) and activation degree (activated/deactivated). If in the second step, no emotive expressions are found in the input, ML-Ask uses Shi et al.'s [16] web mining technique to extract emotive associations for the sentence. Below we present an example of the agent in action:

Sentence: *Kyou wa atatakai desu ne.* (It's warm today, isn't it?)

Emotive elements: *-ne* (-isn't it)

Emotive expressions: Ò! none (use web mining procedure)

Emotions found on the Web: joy; valence: positive

For more details, see [13] and [16].

4.2 The System

The components described above were combined to create a system that tells jokes according to users' emotional states. Basing on existing research (summarized in Section 2.1), showing that humor can elicit positive emotions and reduce their negativity, we assumed that the system can tell jokes when users feel bad, in order to make them feel better. Also, if their emotional state is neutral, a joke can be told to induce positive feelings.

Thus, the system analyses users' emotions during the conversation – this function is performed by the ML-Ask system – and on this basis it makes a decision if a joke should be told. If users' emotions are positive or neutral, response is generated by the pun generator, otherwise – by the baseline chatterbot.

The system's algorithm is presented in Figures 2 and 3 (with the 3 stages of humor-emotions relation marked).

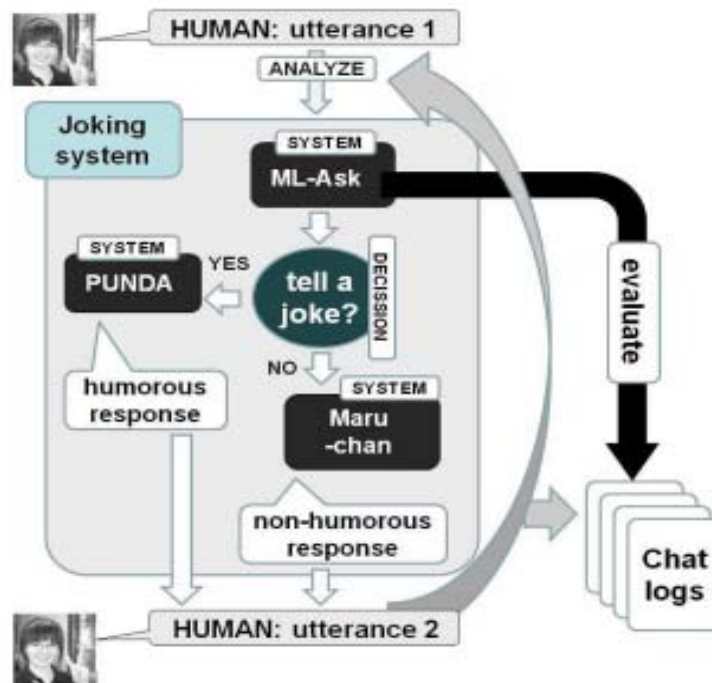


Figure 2. Joking system – algorithm outline

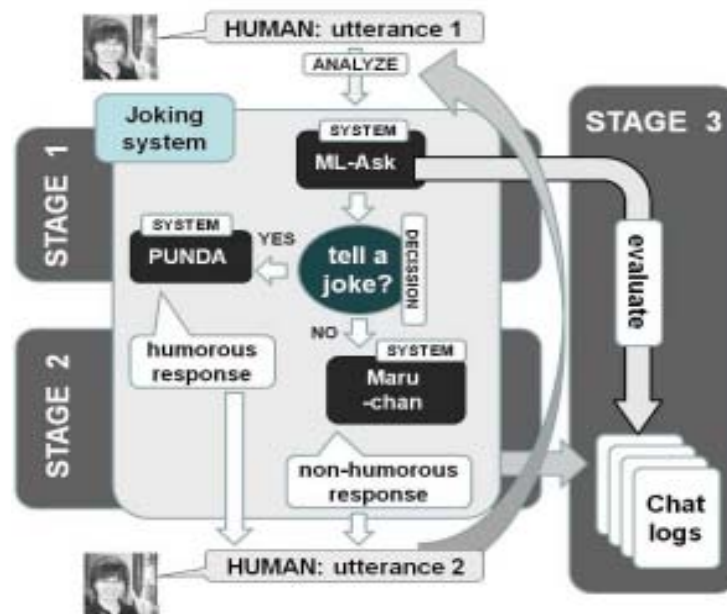


Figure 3. Joking system – algorithm outline
(with three stages of the humor-emotions relation)

4.3 Emotive Evaluation

Performance of the system described in Section 4.2 was evaluated in numerous experiments, among them user-oriented and automatic. In the former, we asked 13 users to conduct conversations with two systems (humor-equipped and a similar one without humor), and then asked them to complete a questionnaire, which (among others) included questions about their self-reported emotions towards each system. The results were then compared with our database of emotive expressions in order to check their value – every positive emotion was counted as plus 1, and every negative as minus 1. In the latter, we analysed the chat logs using the ML-Ask system in order to detect emotions in users' utterances – we checked general emotiveness of utterances as well as valence changes during the conversations.

These results are summarized in Table 1 and Figures 4, 5 and 6.

	baseline system			joking system		
emotiveness	91 (average: 7.0 per utterance)			125 (average: 9.6 per utterance)		
valence	to +	to -		to +	to -	
changes	68%	32%		94%	6%	
self-reported	+	-	sum	+	-	sum
emotions	5	14	-9	15	7	+8

Table 1. Emotive evaluation-results

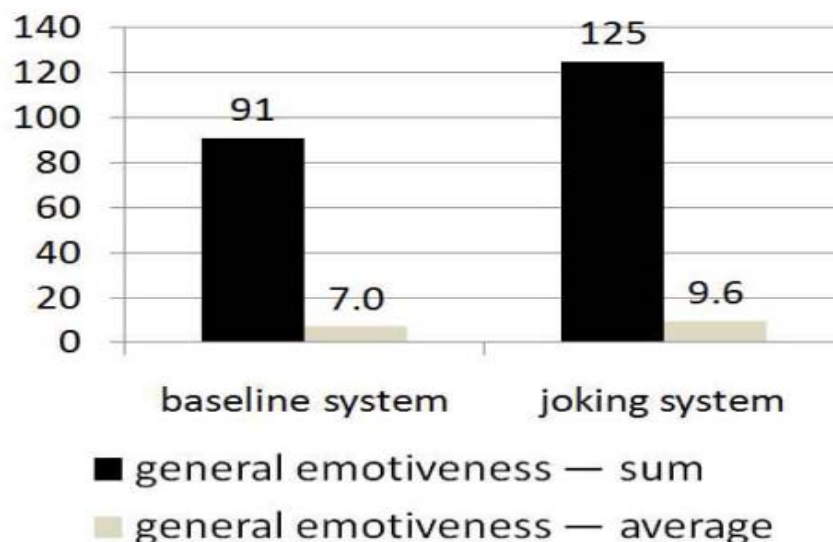


Figure 4. Emotive evaluation-results: emotiveness

4.4 Summary

An overall message coming from these results is that the system with humor elicited generally more emotions in the users, and most of them were positive. However, what is more important for this paper, is that the approach described above is multistage, as we take into consideration users' emotions both before and after humorous acts. In other words, we treat the

humoremotions relation as a chain of events, which is being monitored during the interaction between humans and our system. To our knowledge, this is the first research in the field of HCI representing such an approach.

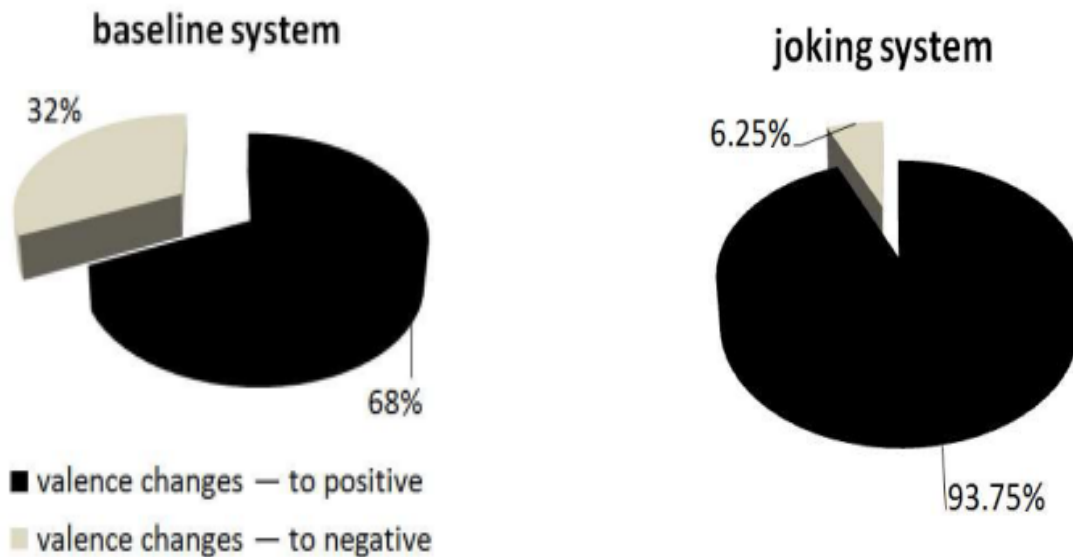


Figure 5. Emotive evaluation-results: valence changes

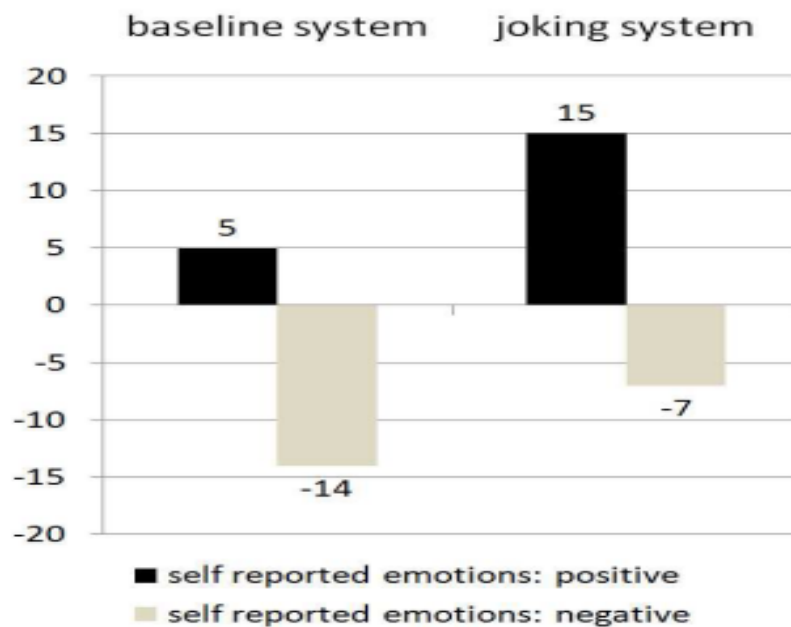


Figure 6. Emotive evaluation-results:self-reported emotions

5. Multi-Stage Approach-Morethan Three Links

The system presented above represents the multi-stage approach to humor and emotions. That said, the approach is actually threestage (emotions-humor-emotions), and as such, in our opinion it does not exhaust the subject, as the relation between humor and emotions should not be limited to only three stages. Immediate emotive reactions to humor have also implications in the long run – they can induce further emotion changes and influence the way of perceiving further humorous acts. Thus, it is necessary to broaden our view and take into consideration more links of this chain of events.

In this section we first show describe the outcome additional analysis of the above-mentioned evaluation experiment (see Section 4.3), in which we investigated users final emotions in the interactions (5.1), and summarize our idea of a user-adapting joking system. To the previous system (presented in Section 4), we are planning to add a procedure, allowing to build users' humor sense models, which will lead to personalization of the system.

Both of these subsections describe how the three-stage approach to humor and emotions can be extended to take into consideration more links of this chain.

5.1 Final Emotions

The results of the emotive evaluation (see Section 4) were promising enough to encourage us to conduct more analyses of the acquired data. In one of them we assumed that among all emotive states during the interaction, the last one (at the end of the conversation) is of high importance. Thus, in this analysis, the goal was to investigate what the users felt when they were finishing the dialogue. To investigate this issue, users' final emotional states (last emotive expressions found in each conversation) were analyzed, and compared the results for both systems.

	baseline system			joking system		
final	pos.	neg.	neut.	pos.	neg.	neut.
emotions	69%	31%	0%	85%	0%	15%

Table 2. Emotive evaluation-final emotions

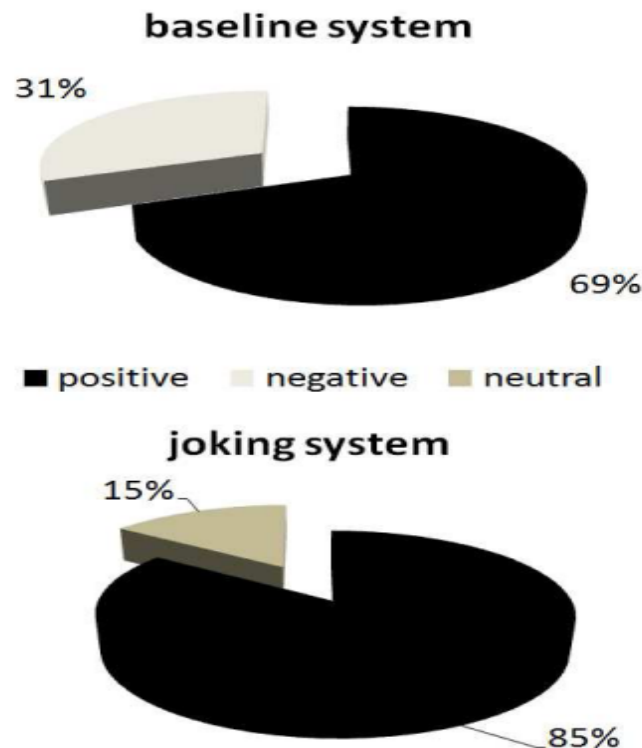


Figure 7. Emotive evaluation-results:final emotions

As showed in Table 2 and in Figure 7, 69.2% of users' final emotions in conversations with the baseline system was positive and 30.8% negative. In conversations with the joking system, 84.6% of users finished conversations in positive, and 15.4% in neutral moods. None of the final emotions showed towards the joking system was negative.

These results are important in several ways. First, from the evaluational point of view, knowledge of in what moods the users finished the interactions is of high importance, as it forms their general attitudes towards systems. If, as it was in the case of the joking system, users finish interactions in positive moods, it is more likely that they will be willing to interact with the system in the future.

Second, analyzing emotions that occur not only immediately after humorous acts, but generally at the end of conversations, can be seen as broadening our view on the humor-emotions relation. Not being itself another link in the chain, this still is of high importance, as we extend the spec of our interest even further.

5.2 User-Adapting Joking System

Humor is a very individual treat. We all perceive it differently, and what is funny to one person, may be boring or insulting for someone else. These individual aspects of sense of humor should also be taken into consideration in HCI. Joke telling systems should be able to adapt themselves to each user's personal preferences and his/her type of sense of humor.

To answer that need, we proposed an algorithm of a useradapting joking system [17]. To the system described in Section 4, we added an emotiveness analysis based procedure, in which users' reactions to humorous acts are used to built their individual models of sense of humor. Currently we are working on implementation of the algorithm.

As showed on the Figure 8, in the humor sense individualization procedure, users' responses to humor are analysed by ML-Ask in order to check their emotive reactions. Results of the analysis are then used to build a model of users' preferences.

If, for instance, during a conversation with User A, the system detects that he is angry, it tries to make him feel better by telling him a joke about blondes. The user reacts to it with a utterance, in which the system detects irritation. On this basis, the system can state that: 1) User A may not like jokes about blondes, and 2) User A may not like being told jokes when he is angry. These informations are stored in a database, and on this basis User A's humor sense model can be build. The more data the system acquires about User A's reactions to humor, the more accurate model can it build and the better it can adapt to this particular users' preferences.

5.3 More Links of the Chain

After adding the procedure described in Section 5.1 to the system described in Section 4, we can see that the approach to humor-emotions relation was broadened. In the new system, equipped with the humor individualization algorithm, we take into consideration not only emotions that occur immediately after the particular humorous act, but also forthcoming humorous acts and users' reactions to them. Thus, the number of links of the humor-emotions chain can be continuously extended, and the more links (or sets of links) we add, the better the system will be, i.e. the better it can adapt to each user's personal needs.

Summary of this mechanism is presented in Figure 10.

6. Conclusion

In this paper we proposed to distinguish between two types of humor-emotions relation: two- and multi-stage. We summarized existing research in the fields of psychology and HCI, stating that in the latter no work so far is representing the multi-stage approach. Next, we presented our works, which represent the multi-stage approach to humor-emotions relation. This brings HCI closer to psychology, in which such an approach is far more common.

Needless to say, there is still much to be done in the subject of humor-emotions relation, and some issues need to be addressed and discussed. For instance, in all works described in this paper, links of the humor-emotions chain occur interchangeably, i.e. humor is always proceeded and preceded by emotion(s), and so on. This, however, does not have to be true – emotions, rather than isolated events, are in many cases by themselves small chains of events. Anger, for example, can be followed by sadness or resignation, or other emotions, and these changes also need to be taken into consideration. Thus, in the multi-stage approach, the relation between humor and emotions does not have to look like this:

(...) emotion – humor – emotion – humor – emotion (...), but could, for example, look like this:

(...) emotion – humor - emotion – emotion – emotion (...).

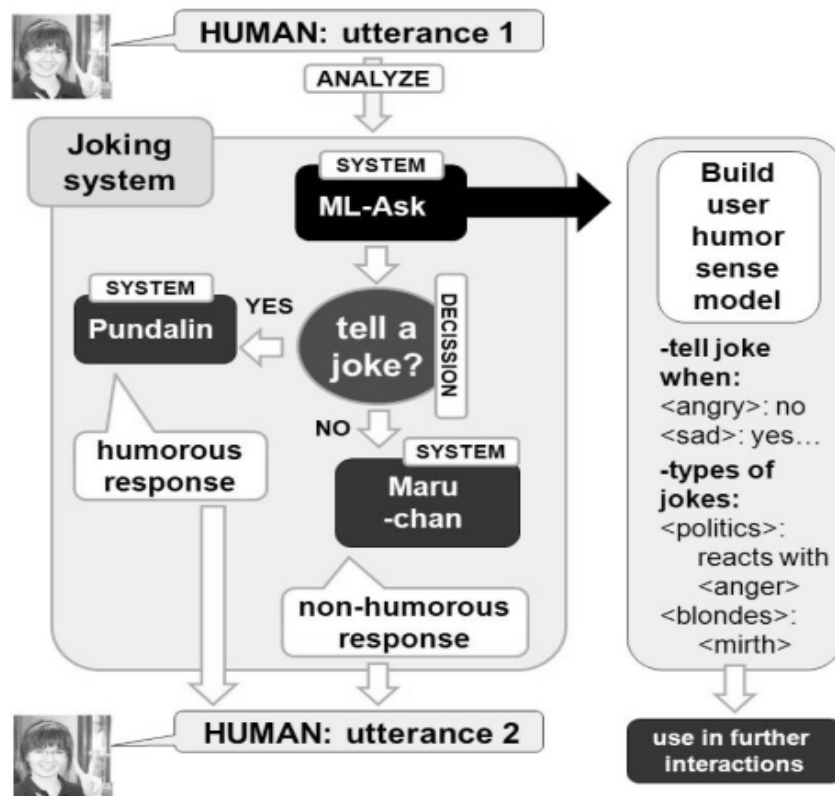


Figure 8. Joking system adapting to users' humor sense – algorithm outline

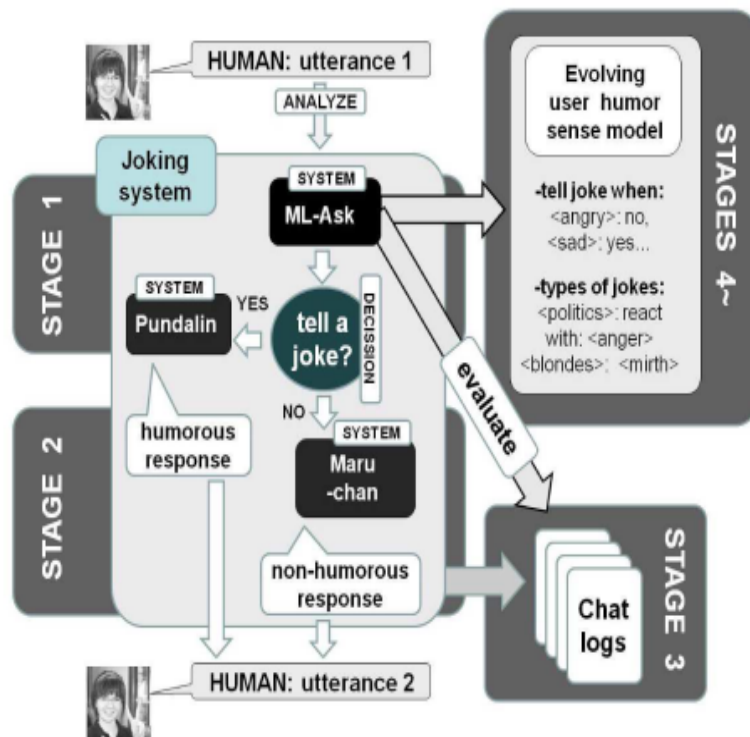


Figure 9. Joking system adapting to users' humor sense – algorithm outline (with multiple stages of the humor-emotions relation)

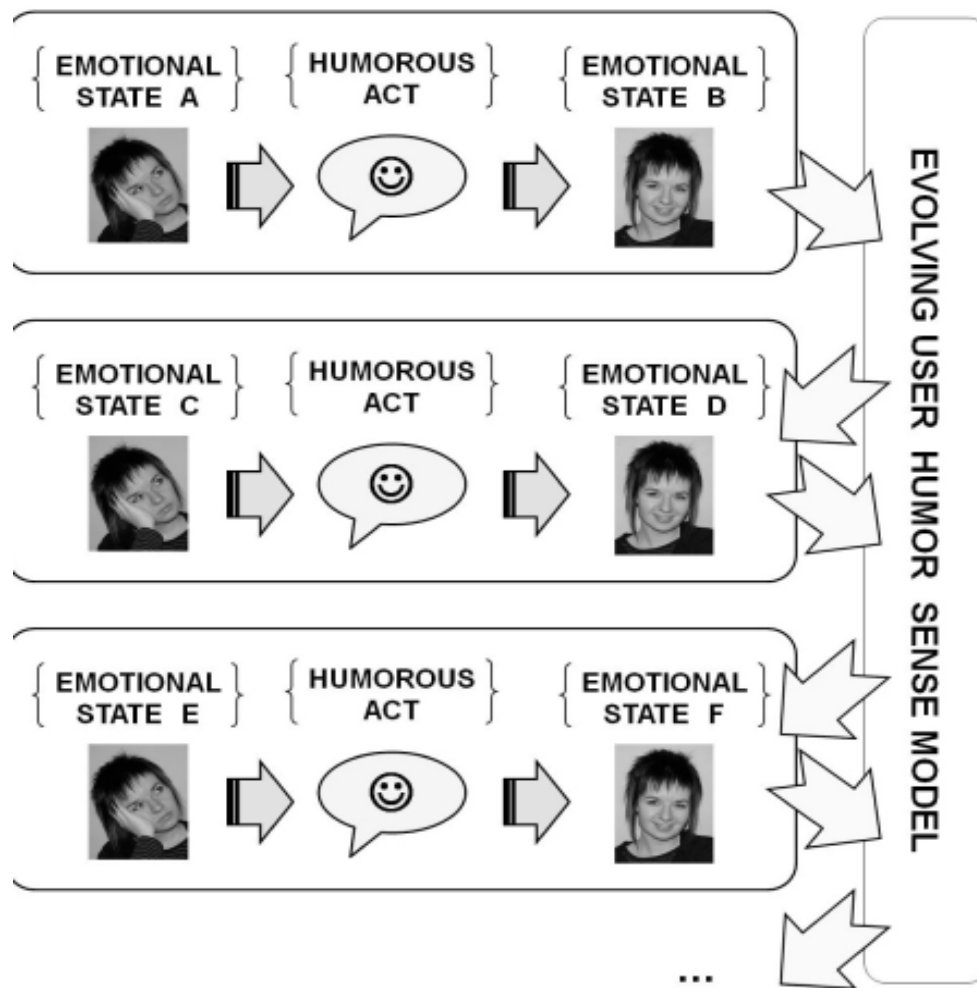


Figure 10. Extending the humor-emotions chain by implementation of the individualization of humor sense algorithm

This gives us some new, interesting possibilities of analysis, which we are planning to address in the nearest future in our research.

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