Decomposition and Distribution of Humorous Effect in Interactive Systems

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Abstract

We aim to identify and control unintentional humor occurring in human-computer interaction, and recreate it intentionally. In this research we focus on text prediction systems, a type of interactive programs employed in mobile phones, search engines, and word processors. More specifically, we identified two design principles, inspired by humor and emotion theories, and implemented them in a proof-of-concept tool simulating a specific type of text prediction.

Computer programs do not always work as well as we would like. Even though they are generally designed to respond efficiently to users' needs, they sometimes make foolish mistakes that make them look less smart than expected. In some cases these events are unexpectedly funny. Our aim is to identify and control unintentional humor occurring in human-computer interaction, and recreate it intentionally.

One major problem in computational humor generation is the large amount of knowledge required to model people's expectations and violate them for achieving humorous effects. We address this issue in the context of human-computer interaction, where the required knowledge can be limited to the concepts and actions on which the user is currently focused. There are several widely used tools, such as text editors or Web browsers, familiar enough that users have typical expectations about their behavior.

In this research we are specifically focused on *text prediction systems*, a type of interactive programs employed in mobile phones, search engines, and word processors. Two commonly used text prediction systems are *autocomplete* and *autocorrect*.

These systems are particularly interesting for exploring forms of humor generation through the controlled induction of surprise effects. As their name suggests, they are characterized by the capability to predict user's intentions about actions or information. For example, the autocomplete feature allows the user to input a text (e.g. a query to a search engine) typing only the first letters. If more completions are possible for the same prefix, the system predicts the most probable one, thus performing a form of expectation modeling. The humorous counterpart of a normal text prediction

system should be able to produce outputs violating the user's expectations in a funny way (see example in Figure 1).

We propose a way for designing humor in text prediction systems, as a first step for the study of more general classes of interactive programs. This approach is based on two assumptions inspired by humor and emotion theories:

- **Decomposition of humorous effect.** The humorous effect can be achieved through the separate treatment of surprise and funniness. In other words, different strategies and resources can be employed separately for inducing surprise and for making it funny.

- **Distribution of humorous effect.** The repetition of surprising and semantically related stimuli can be potentially humorous. What can make surprise funny is not the meaning of the single event but its repeated occurrence. We assume the semantically related repetition could be used as a way to simulate a sort of idiosyncratic attachment to the prefixed topic and, thus, make the program's behavior recognizable as ridiculous.

The above claims were adopted as design principles and implemented in a proof-of-concept text predictor system. At this stage of research, we focus on the control of the repetition of semantically related stimuli as a preliminary step for the investigation of more complex forms of interactive humor based on surprise effect.

The rest of the paper is organized as follows. The next section provides a brief introduction to the proposed approach, discussing some of the background ideas inspiring it. Next, the proposed design principles are introduced. Their application in a proof-of-concept prototype are then described. Finally, some of the next steps of our research are discussed.

Background

Text Prediction Systems

With the term *text prediction* we mean a set of computer program features helping users edit text more efficiently. They are integrated in a wide range of applicative programs such as word processors, email editors and web browsers, installed in computers and mobile devices. The two main types of text prediction are autocompletion and autocorrection.

Autocompletion (or *autocomplete*, or *word completion*) consists of the prediction and completion of a word, or a

Figure 1: Example of unintentionally funny autocompletion from a sms conversation.

phrase, before it is completely typed. The procedure is based on the selection of the most probable word in a limited set of possible completions. Autocompletion was originally employed in accessibility tools and mobile phone devices with limited keyboards (Garay-Vitoria and Abascal 2006). The text prediction task consists of editing text with the minimum number of keystroke possible. Perhaps the best known example is the T9 patented technology, widely employed in most of the older generation of mobile telephone devices (Grover, King, and Kushler 1998). A particular type of autocompletion, called *semantic autocompletion*, was proposed for applications in information retrieval (Hyvönen and Mäkelä 2006). It integrates semantic information in the text prediction process. For example, it could show the completed text as part of a hierarchy of concepts.

Unlike autocompletion, in *autocorrection* (or *text replacement*, or *autocorrect*) the text already typed is not (only) completed but also replaced. It can be applied either to correct text containing grammatical errors or to select the correct word in a dictionary. Although in this case the procedure starts "after" completed the word insertion, it could be consider a type of text prediction as well. In fact, the word to be replaced is generally typed by mistake, and the (predicted) replacement text is what the user want to entry.

In most cases, text prediction is reduced to a word selection task. There are different possible selection strategies. Some of them are based on frequences of words in textual corpora, in order to identify the most common ones. Other techniques employ lexical databases representing common sense associative information such as *OpenMind Commonsense* (Stocky, Faaborg, and Lieberman 2004), list of bigrams, or the analysis of the previous words typed in the ongoing editing text (Hasselgren et al. 2003).

Humor and Incongruity

A set of theories known as *incongruity theory* are probably the most influential approach to the study of humor and laughter. One of the first descriptions of incongruity in humor is provided by the 18th century poet Beattie (1971): "Laughter arises from the view of two or more inconsistent, unsuitable, or incongruous parts or circumstances, considered as united in one complex object or assemblage, or as acquiring a sort of mutual relation from the peculiar manner in which the mind takes notice of them".

Other historically important treatments are by Schopenhauer (1883) and Freud (1905). One of the most interest-

ing presentations of the notion of incongruity came from Koestler (1964), who defined *bisociation*:"[...] the perceiving of a situation or idea in two self-consistent but habitually incompatible frames of reference." Raskin (1985) formulated the incongruity concept in terms of *scripts*, where a script is a structured configuration of knowledge about some stereotyped or familiar situation or activity. This has been developed further, into the *General Theory of Verbal Humor* (Attardo and Raskin 1991).

When jokes are examined in the light of the incongruity theory, they reveal a semantic incompatibility (e.g., an inconsistency inside the same interpretation, or an opposition between two different interpretations). Hence, the incongruity can be defined as the perception of this incompatibility. According to other instances of this class of theories (called *incongruity-resolution theories*), the humorous effect is not caused by incongruity, but rather by its resolution (e.g., when a new consistent interpretation is found, or when one of two interpretations is chosen). A cognitive treatment of incongruity in humor is described by Summerfelt et al.(2010).

One specific form of jokes frequently discussed in the literature consists of the so called *forced reinterpretation* (FR) *jokes*. A detailed description of this type of jokes is provided by Ritchie (2002). These jokes are characterized by the ambiguity in the setup, to which at least two interpretations can be associated: one "obvious" and not funny, the other one "unusual" and funny. Moreover, the potentially funniness of the unusual interpretation could be either "intrinsic" (e.g. communicating some form of oddness) or "relational" (e.g. expressing a contrast with the obvious interpretation). Finally, the punchline is only consistent with the unusual funny interpretation.

Two examples of FR jokes are shown below.

(1) *Alcohol isn't a problem, it's a solution... Just ask any chemist.*

(2) *I woke up in the Police station this morning with no memory of the previous night. I really need to stop drinking on duty.*

While in (1) the two interpretations of the setup are based on the double meaning of the word 'solution' (or at least triggered by its polysemy), in (2) the reinterpretation cannot be explained in terms of a mere word disambiguation.

In his analysis of FR jokes, Ritchie emphasizes the distinction between three different elements of the joke processing:

- CONFLICT is the initial perception of incompatibility, according to the initial obvious interpretation, between punchline and setup;

- CONTRAST denotes the perception of the contrastive connection between the two interpretations;

- INAPPROPRIATENESS refers to the intrinsic oddness characterising the funny interpretation.

All three corresponding concepts are often mentioned, in literature, as connected to the notion of incongruity. In particular, CONTRAST seems to recall, in different ways,

Koestler's 'bisociation' and Raskin's 'script opposition', and INAPPROPRIATENESS seems to be connected to the 'residual incongruity' described in several versions of the incongruity-resolution theory.

Design Principles

Decomposition of Humorous Effect

Ritchie's choice to specify incongruity as CONTRAST (at least in the context of FR) is interesting for different reasons. First, it makes sense to identify incongruity with violation of expectations. Second, it supports the claim that neither incongruity nor resolution are sufficient for the achievement of the humorous effect. In the case of FR jokes, in order to make incongruity/CONTRAST funny it is necessary to induce CONTRAST and/or INAPPROPRIATENESS.

These two aspects inspired us to emphasize the potential usefulness to consider expectation violation as a separate function from humorousness. More generally, we call *decomposition* the design principle according to which the surprise induction and funniness induction should be achieved separately (i.e., using different strategies). In our research we choose to see verbal incongruity as a form of surprise, and to identify surprise and expectation violation, although there is an open debate about possible correlation of these concept (or even their precise definition).

In (Lang, Bradley, and Cuthbert 1990), surprise is described as a type startle reflex associated to two different responses. While the primary response shows no definite hedonic valence, the secondary response is either pleasant or painful and associated to different possible emotions. It is reasonable (even though not experimentally supported yet) to guess a connection between incongruity induction and primary response, and between incongruity resolution and secondary response. The generalization of verbal incongruity allows us to consider interesting researches on different types of incongruity and their humorous use. For example, (Ludden and Schifferstein 2007) investigate the role of visual-auditory incongruity in the induction of surprise. In (Ludden, Schifferstein, and Hekkert 2008), the sensorial incongruity is explored as a way to design products and characterize the user's experience.

The comparative study of incongruity in humor studies and surprise in emotions studies, just mentioned above, let us to believe that the decomposition principle could be applied to a wider range of humorous effects not limited to verbal humor but also characterized by multi-modality and interactivity.

Distribution of Humorous Effect

While the decomposition principle suggests to consider the surprise effect as a precondition for the achievement of the humorous effect, the distribution principle emphasizes the advantage to use repetition and generate a multiplicity of simple stimuli, each of which is not necessarily funny if considered alone.

Repetition is, with exaggeration, one of the most known types of comic device. It is often employed in stand-up comedy (Schwarz 2010) and typically retrieved in canned jokes and spontaneous humor (Norrick 1993).

We are interested to identify semantic elements contributing to make perceive this sequence as funny. As initial step, we consider semantic relatedness as possible condition characterizing a type of stimuli typically recognized as mistakes in an interactive computer program. We suppose that, even without the introduction of specific semantic constraints for funniness (e.g. funny domains or forms of semantic opposition), the repetition of semantically related computer "mistakes" can be potentially funny. One possible reason is that the events are perceived as intentional and, thus, the interaction can be reframed as playful. Another possible reason is that mistakes might induce the attribution of ridiculous personality traits. The repetition of messages related to the same topic can express a sort of obsessive, idiosyncratic behavior.

We observe that the repetition of surprising stimuli might be considered as a form of incongruity induction, and the semantic relatedness as a type of resolution. In order to make resolution funny, we would probably need an interactive context in which the repeated stimuli are interpreted in the playful/ridiculous way mentioned above, or introducing additional semantic constraints, such as forms of semantic opposition.

Prototype

In this section we briefly describe the main characteristics of a text prediction system, which we have developed according to the design principles introduced above. In this proof-of-concept prototype, both decomposition and distribution principles are expressed as lexical constraints. In particular each of them corresponds to a different set of constraints.

The system simulates a simple T9-like text predictor for mobile phone reduced keyboards. It takes a sequence of keystrokes (each associated to three or four letters) as input and outputs the English word it expects the user to be writing. This predicted word has a prefix that matches the keystrokes, and among such words it ranks highest on a function that estimates how likely a word is to occur. This task can be viewed as a lexical selection problem.

Implementation of the Decomposition Principle

In order to identify the lexical constraints for the surprise effect and for the humorousness, we considered a previous work (Valitutti 2012) presenting DEWN, an extension of WordNet (Fellbaum 1998) lexical database, consisting of "ambiguous" words in the English lexicon, called *double edged words*. The ambiguity was defined according to three different lexical relations: *homonymy* (i.e., words with more than one sense in WordNet), *homophony* (i.e. words phonetically similar), and *idiomatic ambiguity* (i.e., words with both literal and idiomatic or metaphoric meanings). The double edged words are characterized by the following attributes:

- AMBIGUITY is the association of multiple "meanings" to the word.

- DEPTH expresses the different expectedness of the multiple meanings.

- SLANT is a set of additional semantic properties associated to the hidden meaning, and characterizing it as potentially humorous. Slant labels can be used to emphasize the humorous role of hidden meaning. For example, slant labels can be selected in order to evoke ridiculous trait of people.

At this stage of our research, we decided to apply the decomposition principle only to the surprise part. In order to give a surprising prediction, an unexpected matching word has to exist. This existence is now broken to two parts: there being more than one word, and one of them being less expected than another one.

Implementation of the Distribution Principle

As introduced above, the distribution principle claims that the repetition of semantically related surprising stimuli is potentially humorous. In the specific case of the prototype, the surprising stimulus is the currently predicted word, selected according to the lexical constraints mentioned in the previous section.

As a first simple way to achieve semantic relatedness, we employ WORDNET-DOMAINS (Magnini and Cavaglià 2000). We consider words in WORDNET-DOMAINS as semantically related if they are tagged with the same domain label.

There are two possible problems that could have implications for the feasibility of this approach. First, the constraints might be too strict, so that there is no output word for any of the input keystroke sequences typed during the current editing session. The second problem is related to the preliminary indexing of the associations between each keystroke sequence and the corresponding predicted words (needed for generating output in real time). If the number of domain words is too high, the indexing might be expensive in terms of computational resource.

In order to address the above problems, we proceeded as follows:

1. We considered a list of 100 sentences randomly extracted from the Enron Email Corpus [1].

2. We call *optimal condition* the capability to predict at least one word (according to the lexical constraints) for each sentence, and *coverage* the percentage of sentences in which a prediction was made.

3. Thus, for each domain we checked the minimum number of semantically related words (randomly selected by the WORDNET-DOMAIN list) for which the coverage is approaching the optimal condition.

The graph in Figure 2 shows the variation of coverage respect to the number of slanting words, according to 5 different semantic domains. We can observe that the differences between the domains are reducing at highest number of domain words, and the variation are converging towards the optimal value when the number of slanting words is ranging from 30 to 50.
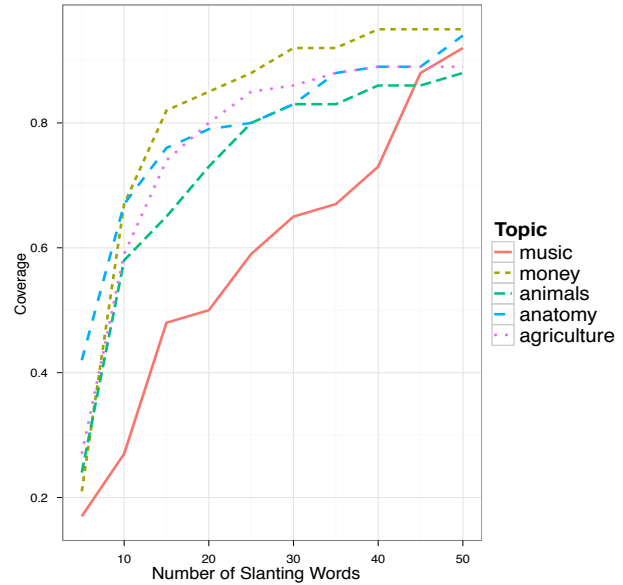
Figure 2: Variation of coverage with to the number of slanting words for 5 semantic domains in WordNet-Domains.

Conclusions and Future Work

We explore computational humor generation techniques in real-time interactive contexts, using text prediction systems. With the term "real-time" we mean that the output is generated during the temporal interval between two keystrokes and is quick enough to be perceived as instantaneous.

We have developed a method for the design and implementation of specific forms of humor generation based on lexical selection. The model emphasizes the distinction between two types of strategies: those that exploit linguistic ambiguity and achieve a surprise effect, and those that make surprise funny.

We are planning to evaluate the validity of this distinction and other aspect of our approach such as the different weights of textual content and interactivity to the humor appreciation. We aim to use the system as a generator of surprising stimuli for cognitive experiments focused on the measure of event-related potentials (ERPs) (Coulson and Williams 2005) (Derks et al. 1997).

At this stage of our research we have neglected the possible interference of humor to the writing activity. Nevertheless there are studies showing that, in some contexts, the cognitive load, introduced by the text suggestion, can decrease the efficiency of the text editing (Dunlop and Crossan 2000). It is reasonable to believe that a "humorous text predictor" might even be perceived as annoying. This effect has to be evaluated and taken in account for possible practical applications. We believe that in some cases it might be useful to interrupt the user's task-oriented activity in a playful fashion. For example, the humorous functionality could be integrated in sort of "funny reminder".

We intend to improve the procedure in different ways.

More commonly used types of text prediction will be taken in account, for example autocompletion to multiple words, generally employed in the input field of search engines. To this aim it will be useful to employ n-gram tables such as Google N-grams. Moreover, we plan to consider the sentence context, in order to perform a better simulation of the standard text prediction and the detection of more complex forms of ambiguity. Finally, we want to put effort into the key aspect of funniness. A possible strategy would consist of identifying typical scenarios in which machine or users' mistakes make them appear ridiculous. The obsessive behavior potentially dramatized by the semantically related text prediction is only one of the several way to achieve it.

In the longer time we aim to extend the text completion at the sentence level. The improved version of humorous autocomplete could be interfaced to a speech recognition system and should capable to anticipate the completion of a sentence while it is being uttered a human conversational partner. If successful, it would be an interesting step towards the automatic generation of appropriated witty remarks in a conversational context.

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