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The future of emotion

L'avenir des émotions

Klaus R. Scherer

Emotional experience is subject to social and technological change: extrapolating to the future

Abstract. While the emotion mechanism is generally considered to be evolutionarily continuous, suggesting a certain degree of universality of emotional responding, there is evidence that emotional experience may differ across cultures and historical periods. This article extrapolates potential changes in future emotional experiences that can be expected to be caused by rapid social and technological change. Specifically, four issues are discussed: (1) the effect of social change on emotions that are strongly tied to dominant values, norms, goals, and self-ideals, like shame, guilt, contempt, and anger; (2) the effects of the use of emotion by the mass media on emotional experience and emotion socialization; (3) the effects of information technology on emotion expression and regulation; and (4) the possibility of producing artificial emotions in autonomous agents (robots). Special emphasis is placed on the class of emotions, defined here as "commotions", that are produced by observing affect in others.

Key words. Artificial emotions — Emotion theory — Emotional experience — Emotional expression — Emotional regulation — Shame and guilt — Social change

When reading treatises on emotion by ancient philosophers such as Plato, Aristotle, Cicero, and Quintilian — or the rather juicier descriptions of emotional upheaval to be found in the Bible — one often feels that emotion is invariable — constant across the ages in terms of both what elicits emotional experiences and their manifestations in facial and vocal expression or physiological arousal.

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In fact, theories of emotion that highlight the psychobiological nature of emotion and its evolutionary continuity, beginning with the pioneering work of Charles Darwin (1998), would seem to posit exactly that – a universal (across time, cultures, and species) mechanism of adaptive reactions to events of major importance to the organism (Scherer, 2000a, 2001b). Yet historians, anthropologists, and philosophers – as well as a few psychologists – have amassed evidence that seems to point to the existence of a sizeable amount of sociocultural diversity and historical change. The synchronic issue of universality vs cultural relativity of emotion has been intensively debated over the last few decades (see Mesquita et al., 1997, for a review) and will not be discussed in this context. In this article, the focus is on diachronic aspects, changes in the elicitation and the response characteristics of emotion over time, as linked to social and technological change.

Rather than trying to analyze changes in history (as amply documented in Elias, 1977; Harré, 1986; Stearns and Stearns, 1988; see also Benthien et al., 2000), in this article I boldly attempt to extrapolate into the future. If one accepts the work illustrating historical changes in emotional life, one needs to postulate continuous changes in emotional experience in line with ongoing changes of social conditions and life-styles. In fact, given the generally admitted acceleration in social change today, one should expect much more rapid changes in emotion processes than in any other period of human history. Most likely, our current emotional life and its evolution will be the subject of historical analysis in centuries to come. Can we anticipate the results of such analyses? Taking current thinking about the nature of emotion as a baseline, I will discuss four – admittedly highly speculative – questions concerning selected aspects of the nature of emotional experience in the third millennium:

1. Will emotions that are strongly tied to dominant values, norms, goals, and self-ideals, like shame, guilt, contempt, and anger, diminish in frequency and importance due to social change?
2. The mass media increasingly use emotion to arouse interest and persuade their public. What are the consequences for emotional experience and emotion socialization?
3. How will the increasingly widespread use of information technology for social interaction and communication affect emotion expression and regulation?
4. Can our future interaction partners, autonomous agents, be programmed to show artificial emotions as well as the capacity for commotion?

I will first summarize a model of the emotion mechanism to serve as a baseline for the extrapolation into the future. Rather selfishly, I have chosen my own “component process model” of emotion for this purpose, encouraged by the fact that component models and an insistence on the componential and process characteristics of emotion have become fairly widespread in the psychology of emotion (see contributions in Scherer et al., 2001).

Emotion as a process of component synchronization

The component process model defines an emotional episode as a sequence of state changes in all of five – functionally defined – organismic subsystems:

- the cognitive system (appraisal);
- the autonomic nervous system (arousal);
- the motor system (expression);
- the motivational system (action tendencies);
- the monitor system (feeling).

These occur in an interdependent and interrelated fashion (as compared to normal, more independent functioning of these subsystems) in response to the evaluation of a stimulus, an event, or intraorganismic changes as being of central importance to the major needs and goals of the organism (Scherer, 1982, 1984, 1986). I have postulated that a certain degree of synchronization of the subsystems should be considered a necessary condition for an emotion episode senso strictu to occur (see also Scherer, 1993a, 2000b).

The model predicts a component patterning process in which (a) the organism appraises events on the basis of a series of sequential stimulus evaluation checks (relevance, goal significance, coping potential, and norm compatibility), (b) the result of each individual check modifies the state of each organismic subsystem in the direction of adaptation to the event, and (c) the pattern of emotional reaction is the cumulative result of all these appraisal-driven state
modifications and the ensuing feedback and feedforward interactions between the subsystems, including regulation attempts (see Scherer, 2001a, for the most recent description of the model).

In consequence, the mechanism whereby emotions are elicited and differentiated consists of the process of appraising an object or event on a series of criteria or dimensions. The appraisal criteria postulated in the most recent version of the component process model (Scherer, 2001a) are organized in terms of four *appraisal objectives*. These objectives concern the major types or classes of information with respect to an object or event that an organism requires in order to prepare an appropriate reaction:

1. How relevant is this event for me? Does it directly affect me or my social reference group? (relevance)
2. What are the implications or consequences of this event and how do these affect my well-being and my immediate or long-term goals? (implications)
3. How well can I cope with or adjust to these consequences? (coping potential)
4. What is the significance of this event with respect to my self-concept and to social norms and values? (normative significance)

Concretely, for each of these major classes a number of more detailed appraisal criteria (or stimulus evaluation checks – SECs) are postulated. Table 1 shows the complete list, together with the theoretical predictions as to which major modal emotions (see Scherer, 1994a) are expected to be produced by specific appraisal patterns. It should be noted that this model is very close to several other appraisal theories, with respect to both fundamental concepts and concrete predictions (see contributions in Scherer et al., 2001).

As mentioned above, the component process model assumes that the results of the appraisal process produce emotional response patterns in different modalities according to adaptive response needs. However, in addition to these internally generated response mechanisms (which I have called *push effects*, since they push a response from the inside out), emotional reactions, in particular motor expression, are also determined by external *pull effects* in the form of normative prescriptions, cultural expectations, or socially desirable response patterns (see Scherer, 1985, for a detailed discussion). One can show that emotional expression varies on a continuum between pure push (e.g. raw affect vocalizations like a
disgust sound) and pure pull effects (e.g. a forced, conventional smile, see Scherer, 1994b). In most cases, the reaction is likely to be determined by a joint influence of push and pull effects. While the relative influence of social control is important for social interaction and communication processes, it also plays a major role in intrapersonal affect regulation since the intensity of motor expression and physiological responding is intimately linked with subjective feeling (see Gross and Levenson, 1997; McIntosh et al., 1997; Scherer, 2000c).

Finally, any model of emotion needs to consider the important social embedding of emotional episodes. Not only are most emotions produced by social factors (Scherer et al., 1986), they are almost always shared through communication with others (Rimé et al., 1998). Moreover, there are special classes of emotion, like pity, that are generated not by the normal process of appraisal, but by observing someone else live through a particular emotion. Figure 1 (adapted from Scherer, 1998) shows the processes involved. The top row of the Figure illustrates the “normal” emotion process: an individual appraises an object or event, and an emotional reaction is generated (as described above) which is externalized (through motor expression) and is thus communicated to an observer or, in communication theory language, a receiver. It is possible that the receiver, thus exposed to the object of the sender’s emotion, will appraise the object in the same way and therefore experience a real emotion. For example, if I see my neighbor get upset about a political scandal, I may get equally upset about the injustice or the corruptness of the politician concerned. In this case, the observation of the emotion of the other has only served to draw my attention to the event – I would have reacted with the same emotion had I encountered the object myself.

The processes of empathy and contagion, shown by the two arrows in the center and on the right, are different. Here it is the state of the sender that produces my affective reaction. In the case of empathy the underlying mechanism has to do with putting oneself in the shoes of the sender, sensing the importance of the event and the consequences for the individual, and therefore feeling with the person (Bischof-Köhler, 1991; Eisenberg and Strayer, 1987; Feshbach, 1988; Omdahl, 1995). Based on the Latin term commotio (arousal, excitation, affect) which was frequently used for affective phenomena until Descartes popularized emotio, I suggest using
<table>
<thead>
<tr>
<th><strong>TABLE 1</strong></th>
<th>Predicted appraisal patterns for some major modal emotions</th>
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<tbody>
<tr>
<td><strong>Criterion</strong></td>
<td><strong>ENJ/HAP</strong></td>
</tr>
<tr>
<td><strong>Relevance</strong></td>
<td>low</td>
</tr>
<tr>
<td><strong>Novelty</strong></td>
<td>open</td>
</tr>
<tr>
<td><strong>Suddenness</strong></td>
<td>medium</td>
</tr>
<tr>
<td><strong>Familiarity</strong></td>
<td>high</td>
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<tr>
<td><strong>Predictability</strong></td>
<td>medium</td>
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<tr>
<td><strong>Intrinsic pleasantness</strong></td>
<td>medium</td>
</tr>
<tr>
<td><strong>Goal/Need relevance</strong></td>
<td>medium</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>medium</td>
</tr>
<tr>
<td><strong>Cause: agent</strong></td>
<td>open</td>
</tr>
<tr>
<td><strong>Cause: motive</strong></td>
<td>intent</td>
</tr>
<tr>
<td><strong>Outcome probability</strong></td>
<td>very high</td>
</tr>
<tr>
<td><strong>Discrepancy from expectation</strong></td>
<td>consonant</td>
</tr>
<tr>
<td><strong>Conduciveness</strong></td>
<td>high</td>
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<tr>
<td><strong>Urgency</strong></td>
<td>very low</td>
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<tr>
<td><strong>Coping potential</strong></td>
<td>open</td>
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<tr>
<td><strong>Control</strong></td>
<td>open</td>
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<tr>
<td><strong>Power</strong></td>
<td>open</td>
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<tr>
<td><strong>Adjustment</strong></td>
<td>high</td>
</tr>
<tr>
<td><strong>Normative significance</strong></td>
<td>open</td>
</tr>
<tr>
<td><strong>Internal standards</strong></td>
<td>open</td>
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<td><strong>External standards</strong></td>
<td>open</td>
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<td></td>
<td>FEAR</td>
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<tr>
<td><strong>Criterion</strong></td>
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<td>Relevance</td>
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Abbreviations: ENJ/HAP enjoyment/happiness, ELA/JOY elation/joy, DISP/DISG displeasure/disgust, CON/SCO contempt/scorn, SAD/DEJ sadness/dejection, ANX/WOR anxiety/worry, IRR/COA irritation/cold anger, RAG/HOA rage/hot anger, BOR/IND boredom/indifference; cha change, int intention, neg negligence, oth others, nat nature.
commotion as a technical term to describe these states (see Scherer, 1998, for a more detailed justification).

A similar but simpler phenomenon is emotional contagion (see also LeBon, 1963). Here the assumption is that the characteristics of the motor expression, quite independently of the origin of the sender’s state, produce a similar effect on the receiver (as in the well-known example of having to yawn when seeing someone else yawn). The underlying mechanism (theoretically described by Lipps, 1909) is generally called motor mimicry and some recent research is providing first empirical evidence (Eisenberg and Strayer, 1987; Hatfield et al., 1993; see also Liberman and Mattingly, 1985). I have suggested that the emotions generated by feeling with and for someone (or by being infected by an observed emotional expression) may have special characteristics, justifying distinguishing these affect states by using the term commotion rather than emotion.

The effects of social change with respect to values, norms, and moral standards on emotion elicitation

Shame and guilt are among the most difficult emotions for scientific analysis. Often, they are not counted among the list of “basic” or
"fundamental" emotions and psychologists and psychoanalysts have had a very hard time agreeing on how they differ (Lewis, 1992; Lynd, 1970; Piers and Singer, 1971). For appraisal theorists, shame and guilt are produced when a person evaluates his or her behavior (which is in these cases generally the emotion-eliciting event) as incompatible with their own self-ideal or with sociocultural norms and values. Thus I would feel shame if I were seen, in spite of considering myself an environment-conscious, ecologically minded person, dumping garbage on the road to save time. Or I should feel guilt if I am a highly religious person and yet cheat on my partner. Taking shame as an example, Borg et al. (1988), using facet analysis, have attempted to specify the conditions under which violations of values will predictably produce feelings of embarrassment or shame.

Given the intimate connection between shame/guilt and socioculturally defined values, norms, moral standards, and self-ideals, the nature and incidence of these emotions should vary considerably with social changes in the dominant norms, values, and self-ideals in a particular culture at a particular point in time. There is some empirical evidence that this is indeed the case.

In a large intercultural study conducted in 37 countries on all 5 continents, Wallbott and Scherer (1995) found relatively little difference between shame and guilt in individualist cultures (societies which place a high value on the rights and interests of individuals); in both cases, the behavior eliciting the emotion was considered to be highly immoral. In contrast, in collectivist cultures (societies giving priority to the interests of the family and of social groups), guilt experiences were provoked more frequently by events that were judged to be much more immoral than those that produced shame. Consistent with these different appraisal tendencies in collectivist and individualist cultures, the data also showed rather striking differences in the other components of these two emotions. Shame experiences in collectivist cultures were intense but brief, without major consequences. In comparison, in individualist cultures the reaction profiles for shame experiences were highly comparable to those of guilt experiences (involving long-term effects on self-evaluation). This study provides some evidence, then, that differences in the relative importance of different values can affect the occurrence and the response characteristics of different self-reflexive emotions (it remains to be established to what extent these effects are confounded with religion).
Another potential source of appraisal differences between cultures are variations in belief structures. In the large 37-country study referred to above, respondents in African countries consistently attributed greater external causality and immoralty to emotion-inducing events than respondents in other cultures. One possible explanation for this finding is the widespread belief in sorcery and witchcraft found in many African countries, which implies a belief structure that privileges external attribution and the assignment of moral blame to presumed unnatural agents of harmful events (Scherer, 1997). In contrast, respondents in the Latin and South American countries tended to judge emotion-inducing events systematically lower on the immorality dimension than respondents in the other countries studied. Since all of the Latin and South American countries showed a much higher degree of urbanization (i.e. most respondents lived in big city areas), I suggested that the more frequent exposure to norm violations of different degrees in big urban areas might lower the threshold for immorality judgement for this population. While in either case these remain speculative interpretations, these data suggest that sociocultural factors may strongly affect the appraisal dimensions that can be expected to elicit shame or guilt.

These examples suggest that ongoing social change implying changing values, norms, and self-ideals should have a strong impact on the experience of shame and guilt. While there is little hard empirical evidence, there is much insistence in social commentary that normative constraints, at least in many western societies with a high standard of living, are weakening and values are losing their control functions. The symptoms that are often evoked are apparent increases in undesirable or immoral behaviors as well as rule violations that are not directly sanctioned. Whereas in the past one would not have done certain things because of internal moral qualms (or being afraid of feeling shame and guilt), one now engages in such behaviors if there is no fear of punishment. The tell-tale signs invoked in much of the current social criticism, to name but a few, are increases in vandalism, sexual permissiveness, petty crime, economic crime, bad manners, and violence.

If this analysis is correct, one could assume that the increasing de-emphasis of prosocial values and self-ideals will diminish the incidence of shame and guilt in modern society. Such a tendency would undoubtedly have important effects on society as a whole. The self-reflexive emotions, in particular shame and guilt, have
often been considered as “socializing emotions”, as part of the internalization of social values and moral standards, thus serving an important function in social control (Scheff, 1990). Given that the normal mechanisms of social control, through explicit interdictions, supervision, and punishment, are extremely expensive and ineffective, most societies have relied on the internal control mechanisms, set up in the child’s socialization process, that work through shame and guilt induction. In fact, one of the standard socialization techniques has been to invoke shame or guilt feelings in response to a transgression (“Aren’t you ashamed of yourself?” or “You should be ashamed of yourself!”). Such shaming techniques, as a socialization device for children and adolescents, as well as adults, seem to be disappearing fast. If used, they often only provoke derision in their targets. If the tendency towards the moral evaluation of behavior is waning, one might also expect that emotions like contempt will diminish in frequency or intensity. Conversely, if egoism is on the increase, as suggested by many social critics, the potential for anger due to frustration should tendentially rise.

If shame and guilt diminish in importance, or disappear, as socialization devices inducing socially responsible behavior and preventing deviance, it will be interesting to see whether other emotions will take their place. In the heyday of anti-authoritarianism it was often claimed that shame and guilt were repressive emotions, reflecting unjustified principles arbitrarily imposed by authoritarian structures. The claim is that respect for the interests and the rights of others is a more democratic principle that should govern social interaction. In other words, it should not be anticipated shame that prevents me from acting in a certain way but the realization that this will hurt another person or society as a whole. The underlying assumption seems to be that one can replace shame and guilt by empathy. Unfortunately, there is reason to worry that this capacity is also waning. The huge impact of Goleman’s (1995) popular book on emotional intelligence, advocating measures to augment the emotional skills of children and adolescents, including empathy (Bischof-Köhler, 1991), on the education community at an international level shows the depth of concern. Interestingly, courses in life skills or emotional skills are increasingly becoming part of the curriculum in many countries. Unfortunately, there seem to be major individual differences in the inclination to show empathy, making emotional skills training a rather daunting task.
Emotion display in the mass media

The process of emotion described by the component process model above is characteristic of the large majority of instances in which emotions are elicited by objects or events such as accidents, threats, success or failure experiences, acts of other people, etc.; events that directly concern the person because of their significance to important needs, goals, or values. However, one should not underestimate the frequency of cases in which emotions are elicited indirectly, through the reporting or commenting on events in the mass media or through virtual interactions in computer games or chats.

In a cross-culturally comparative study of emotional experience in 8 European countries, Scherer et al. (1986) found that approximately 20 percent of the emotional experiences reported by the respondents in this large survey had been elicited by radio or TV news, newspaper articles, etc. At the time, we were rather surprised by this rather large percentage but subsequent research has confirmed the importance of emotional consequences of media exposure (Cantor and Nathanson, 1996; Gleich and Groebel, 1993; Hoffner, 1995; Johnston and Davey, 1997; Winterhoff-Spurk, 1997). It would be instructive to study whether the percentage of media-induced emotions has risen since our cross-cultural study was conducted in the early 1980s (Wallbott and Scherer, 1986).

It is interesting to speculate about ways in which emotions generated through media content differ from those elicited directly by objects and events encountered by a person in daily life. One major difference might be that events shown or reported in the media are generally of relevance to large numbers of people, and thus necessarily of less immediate relevance for each individual. It is possible that the type of concern (Frijda, 1993) or the motivational class (Scherer, 1988) affected by the mediated event consists rarely of individual motives, such as personal well-being, self-esteem, or a particular goal or need, but rather of culturally shared values such as justice or conformity with norms and moral obligations. In addition, the experience of the media exposure and the resulting emotional state is shared with many other people, potentially producing social comparison, amplification, or contagion. If indeed mediated emotions are potentially a class apart from “direct” emotions, it is of great import to analyze the nature of mediated emotions in greater detail.
Above I discussed the elicitation of emotion through media content. What is potentially even more interesting is the emotional form of this content. While empirical data are again largely absent, I have the distinct impression that the mass media, especially television, are relying increasingly on highly emotional material to keep the interest of their public as well as to sell products. Thus it seems that systematic analysis of events has been replaced by highly emotionalized interviews with concerned individuals. For example, rather than analyzing the structural sources of discontent that has led to a strike, news shows will often interview an angry worker who speaks his emotion. Similarly, dramatic coverage of wars and catastrophes, sparing no gory detail, as well as first-hand interviews with victims at the apex of emotion, has become commonplace. In the same vein, reality shows, many game shows, and the recent “Big Brother” shows seem to have the exclusive purpose of showing emotions on the screen – and thus eliciting emotion in the viewer.

It is interesting to speculate about the emotional effects of watching other people’s emotions on TV. One could argue that the model shown in Figure 1 covers this case as well – with the only difference that the observation of the sender’s emotion occurs via media coverage rather than direct observation. However, this is not quite true. Even if the media report real cases without any attempt to dramatize the situation, what is shown on the screen is invariably only a small selection of the original emotion episode. The receiver will often lack a comprehensive understanding of the precise nature of the event that triggered the emotion, will know very little about the person and his or her habitual reaction tendencies, and will often see only a very brief and highly selective glimpse of the expressive behavior. So far, we know little of the emotional effects of such “reality emotions” in the media (but see Schorr, 1995).

In contrast, the effects of fictional media emotions have been intensively discussed, mostly in the context of the debate on the effects of TV violence. Most of this discussion has been concerned with the status of the evidence on the incitatory effect of media violence on aggressive behavior, particularly in the case of adolescents. While social scientists overwhelmingly consider the evidence persuasive and have requested political regulation, the media industry keeps denying the existence of such effects and has thus far successfully avoided effective self-regulation or sanctioning by the supervisory government agencies.
However, there has been relatively little interest in better understanding the effect of fictional emotion displays on the affective reaction of the viewer. Figure 2 shows an attempt to analyze the phenomenon along the lines of the case of observed real emotions (as shown in Figure 1). The major difference is, of course, that there is no real object or event that is appraised by the sender. Rather, there is a fictional idea, a plot or script that justifies the expressed emotion. The sender or actor represents this idea in his or her mind in order to portray the desired emotion through appropriate expression. Depending on the respective acting school, the actor may actually try to simulate a realistic appraisal of the situation (putting herself or himself fully into the situation and trying to live through it) to produce, at least in part, a felt emotion (as is the case with Stanislavsky and method-acting techniques).

What is the potential for emotion production in the receiver via one of the three mechanisms? Although it is probably rare, it cannot be excluded that the receiver, using techniques similar to those of a Stanislavskian actor, can put himself or herself into the fictional situation to such an extent as to actually experience the targeted emotion. More likely, and the classical explanation for emotional experience in the theater and cinema, is a mixture of induction and empathy: the receiver empathizes with the actor, possibly through a process of identification or role-taking, and experiences the emotions in the fictional situation vicariously.
As mentioned above, the third mechanism, emotional contagion, has recently gained added attention. There is now increasing evidence that emotional contagion can be produced by mere exposure to expression, without having to assume processes of empathy or identification with the sender (Dimberg, 1997; Hatfield et al., 1993). The assumption that contagion is possible without explicit identification with a protagonist is also suggested by the emotion-producing capacity of music. It is well known that certain types of music can produce trance states in traditional societies (Gregory, 1997; Saperston, 1995). Similar mechanisms can be expected for modern rock and especially techno music. In consequence, it seems likely that emotional contagion works via expressive patterns (e.g. facial configurations in the visual channel, rhythm in the auditory channel).

Following this general introduction, we might ask what these mechanisms bode for the future of emotion. One distinct possibility is that the relative proportion of commotions to emotions will increase, i.e. given the ubiquity with which emotional displays are offered in the media, viewers may experience more frequently than in the past commotions produced by empathy and contagion. It is not clear what consequences for emotional life this might have. One possibility is that commotions, especially when they are of high intensity, will flood out the emotional capacity of viewers, leaving little for genuinely felt emotions due to real, experienced events. Another possibility is that such constant affective stimulation actually activates emotional sensitivity. So far, we have neither the theoretical concepts nor the research tools to devise studies to examine these alternatives. However, it may well be of educational relevance to study the effects of commotion induction in a similar fashion to violence portrayal. One of the adverse results may be that children grow up doubting the authenticity of much of what they see with respect to emotional expression.

The impact of information technology on emotional expression and affect regulation

Scherer et al. (1986) showed that the large majority of emotion episodes occurs in the context of social interaction, produced by
the behavior, and often the communicative behavior, of other people. While in the not so distant past most emotion episodes occurred in face-to-face interactions, the explosively increasing use of modern information technologies in human communication (cellular phones, email, Internet chat) leads to an ever increasing proportion of interpersonal emotions that are elicited in the process of mediated communication. Yet there have been few specific studies on how the use of modern information technology changes the elicitation, regulation, and communication of emotional states.

Let us take the example of the ubiquitous cellular phone. The growth rate in ownership and use of these portable phones has been tremendous, and there is little reason to think that it will abate in the near future. In the industrialized countries with a high standard of living, many children and adolescents grow up thinking that it is the most natural thing in the world to carry a cell phone, to be able to reach (or be reached by) anybody at any time. While there is some censoring of the use of portable phones in public places (e.g. concert halls, churches), most people seem to be quite tolerant of the use of the device in most public contexts.

How will this continuing tendency to use portable telephones affect the emotions? One obvious consequence of the use of cellular phones in public is that the elicitation of emotions in public settings is likely to increase. Much pleasant and unpleasant news, giving rise to immediate eruptions of positive or negative emotions, is communicated by telephone. Similarly, the increasing use of the telephone for all kinds of negotiations and arrangements would seem to favor the display of emotion in public. The increasing tendency toward experiencing telephone-communication-induced emotions in public has interesting consequences. This is particularly true for emotion regulation. In many societies in the world, it has been the custom to treat emotions as private affairs and to discourage free expression of emotion in public (a phenomenon, already described by Wilhelm Wundt in his Völkerpsychologie, 1900, that has been popularized under the term “display rules” by Ekman and Friesen, 1969).

One possibility for the future development of portable telephony consequent on its increasing acceptance in all public contexts is that it will lead to a change in these display rules – people finding it perfectly natural that the person next to them in a bus or at the next table in a restaurant weeps in sadness, cries out in happiness, or shouts in anger. The individuals experiencing the emotions may
also find it increasingly natural to express their emotions in an unhampered fashion in public. After all, if one does not care about discussing rather private matters in a loud voice in public places why should one worry about emotional expression – which is part and parcel of dealing with intimate matters? Such a general relaxation of the display-rule constraints may lead to a general increase in expressivity and, consequently, in the importance of emotional expression in interpersonal interactions conducted in public (and also possibly in private). This is all the more likely since the media, at least in the case of game shows, rely heavily on exaggerated expressions.

Another phenomenon of interest is emotional expression and experience while actively participating in group sessions on the Internet, e.g. interactive computer games, chat rooms, and the like. The sociologist Sherry Turkle (1995) has intensively studied these forms of electronic communication (see also Andersen et al., 1993). One of the intriguing features of these net-based interactions is the fact that the participant often redefines his or her self, creating a virtual “persona”, often with a different personality and affective behavior dispositions, sometimes even changing gender. Thus participants in such virtual game or chat settings can try out many different selves. This, combined with the anonymity of the setting, often leads to highly emotional and expressive interchanges. Interestingly, the emotional content is explicitly coded in purely verbal, typed forms of communication (e.g. X denotes “grinning broadly”). In the more vocal/verbal, graphical, or video interaction form that future development of these multi-user domains will offer, one can expect even stronger affective expression.

Turkle’s analysis of chat-room interactions shows that the affective intensity of such interactions reaches often quite remarkable levels, requiring in some cases the application of “Netiquette” rules by administrators or coalitions of users. The emotional intensity of such virtual interactions can attain levels that may actually produce long-term psychic problems. In many cities, psychiatric clinics have established consultation services for problems linked to the excessive use of the Internet. The problem may be not only addiction to the medium (to such an extent that normal functioning becomes impossible), but also a deregulation of emotional life.

self and role, self and simulation”. Given the important role of the self, and of current goals and values, for emotion generation, one can imagine that emotion elicitation in such virtual settings is highly complex and potentially far removed from reality. In particular, participants in these interactions can not only define their selves but also, given the fictional nature of much of the interaction, define, rather than appraise, evaluation criteria such as the capacity to control or power. Turkle (p. 189) cites a case in point: “I like to put myself into the role of a hero, usually one with magical powers . . . sometimes I use a few rounds of MUD triumphs to psych myself up to deal with my boss”. This suggests that differently from other forms of games, in which emotions remain limited to the game, the high identification of virtual players with their imaginary identity and their ability to manipulate emotions can merge game and reality affects. In this way, there may be a fusion of emotional experiences from different origins and a spill-over of virtual emotions into reality.

The preceding discussion suggests that the use of modern information technology may produce a tendency towards more uninhibited expression and living-out of affect. Such a development would undo the tendency towards increasing affect control that Norbert Elias (1977) has considered as the hallmark of the “civilizing process”. If this were the case, one could expect consequences not only for social interaction (e.g. returning to the somewhat rougher medieval forms of unbridled affect expression that were common before courtly manners required affect control) but also for internal affect regulation. For example, if one were to adopt the prediction of the catharsis hypothesis, such uninhibited affect expression should have a generally positive, “cleansing” effect (see also Pennebaker, 1989). Conversely, if one adopts a variant of the proprioceptive feedback hypothesis (see Cappella, 1993), the opposite might be the case – the unchecked emotion expression might actually intensify the emotion (see Scherer, 2000, for a comparative evaluation of these two alternatives and an effort at integration). In any case, if indeed there were to be trends in the direction of more intense emotion expression and experience due to the massive use of information technologies encouraging affective intensification, this would constitute a topic of research of primary importance for students of emotion in social settings.
Artificial emotions in autonomous agents and their potential shortcomings

The robot used to be one of the standard fixtures of science fiction, being at the beck and call of human beings or, as HAL in the movie 2001, a dangerous adversary. Science fiction is about to become reality — in many contexts of our work life, but also in our private lives, we work with automata (from assembly-line robots to automatic bank-tellers) that have many of the features of the fictional robots without having the aluminum humanoid look that used to define the stereotype of a robot. While there are steady advances in developing the sensory and motor capacities of automata, as well as the control architectures that allow the machines to function rather independently (at least in constrained contexts), the current preoccupation of researchers and engineers in robotics is artificial emotion — providing robots, now more often referred to as autonomous agents (software and robotic entities that are capable of independent action in open, unpredictable environments), with the capacity to perceive and interpret human emotions as well as have emotions themselves (see Picard, 1997, on affective computing).

The reason for this somewhat playful activity, teaching emotion to autonomous agents of all kinds, is the realization on the part of the robotics industry that skillful but emotionally illiterate robots will not be acceptable to users in the long run.

A telling example is provided by the acceptance problems encountered by the speech technology industry. In the past 20 years, speech-technology engineering has advanced at a tremendous rate. It is now possible for speaker recognition algorithms, after training on a group of speakers transmitting a spoken string of numbers by telephone, to identify them with about 95 percent accuracy. While not quite as advanced in performance, speech recognition systems have come a long way, as demonstrated by commercially available dictation software. With appropriate training on the individual user’s voice and speech characteristics and reasonable speech discipline during dictation, these algorithms achieve a rather remarkable degree of recognition. Finally, the most impressive achievements have been made in speech synthesis, where the use of concatenation of phonemic units of a real speaker allows a quality of synthetic speech that is quite astounding. Applications such as automatic, often semi-interactive, information services are now used in a limited manner and are likely to mushroom in the near future.
Despite this staggering progress in providing computers with reasonable capacities in speech production and understanding, a domain which represents one of the most complex human skills, acceptance of speech technology by the public at large has been disappointingly low. Much of the hesitation to embrace these new technologies seems to be linked to the "unemotional" character of the performance of these devices. Synthetic voices are often considered to be cold and disagreeable, lacking the warmth and friendliness one expects of one's interaction partners. Even more important, while generally highly intelligible, synthetic speech often lacks the prosody that constitutes an essential part of spoken messages. Engineers very often have concentrated on getting the segmental aspects of speech right, i.e. the phonemic units making up the words, and using syntactic structures to allow proper placement of pauses and accents, while neglecting prosodic cues that carry attitudinal and emotional meaning (Ladd et al., 1986). With respect to speech and speaker recognition, the existing algorithms often cannot adjust to changes in voice and speech that are due to emotional arousal of the speaker. Emotion and stress change, sometimes dramatically, the features that normally allow recognition of speaker identity (e.g. energy distribution in the spectrum) or individual phonemic units (e.g. formant structure). Currently interdisciplinary teams of engineers, phoneticians, and psychologists, including our own research group, are attempting to develop methods to train the computer-recognition algorithms to take affect-produced speech and voice variations into account (Karlsson et al., 2000; Scherer et al., 1998).

Similarly, as far as synthesis is concerned, there is now a determined effort to add appropriate prosody, including attitudinal and emotional variations, to synthetic speech. Using the accumulating evidence from studies on prosodic signaling of human speaker attitudes and emotion (Scherer et al., forthcoming), engineers and phoneticians are now increasingly attempting to add the capacity for emotional nuancing of messages to synthetic announcements and information systems. The aim is to achieve an affective quality of speech that makes these automatic systems more acceptable to large numbers of users. The designers of these systems also expect that the capacity for emotionally toned synthetic speech will improve the efficiency of automatic dialog systems. For example, if the user of a device keeps making the same mistake, the repetition of an instruction in a very determined, if not irritated, tone of voice
might be more efficient than a repetition in the same bland voice used initially.

Just as computers are learning to understand and produce speech, they are increasingly powerful in recognizing emotional expressions in the face and in producing appropriate facial expressions themselves. Using as a base the comprehensive coding system for facial muscle movements (FACS) developed by Ekman and Friesen (1978), computer scientists and psychologists have now developed programs that can reliably detect certain facial expressions of emotion in an automatic fashion (Bartlett et al., 1999; Wehrle and Kaiser, forthcoming). Similarly, the FACS system is at the basis of facial-expression synthesis, equipping “talking heads” with artificially created facial expressions. Such facial-expression synthesis approaches are used in the creation of virtual characters for movies (Kshirsagar and Magnenat-Thalmann, 2000) and dialog and information systems, as well as in research on emotion perception (Massaro et al., 2000; Wehrle et al., 2000). Similar research and engineering efforts are currently under way for emotional expression via body movement and posture.

The capacities for expression understanding and production currently implemented in the form of computer algorithms are obviously part of the fundamental equipment of autonomous agents and robots. One can thus assume that they will very soon have fairly sophisticated capacities for understanding even subtle attitudinal and emotional messages from their human interlocutors and being able to put on a reasonably convincing display of certain emotions and interpersonal attitudes. In fact, it might actually be possible, in the not so distant future, for a well-coached robot to pass an emotional Turing test. However, it is one thing for autonomous agents to fake the appearance of emotional arousal by displaying the appropriate expressive appearance and another to actually have an emotion.

The possibility of producing “real artificial emotions” by designing an appropriate architecture for autonomous agents is hotly debated. Adherents of the view that human emotions necessarily encompass irreducible subjective feeling qualities, *qualia*, deny the possibility of ever being able to induce something even remotely comparable to human emotions in artificial beings (Harnad, 1994). Researchers in the area of artificial life, on the other hand, find it perfectly natural to think that one can create states in robots that, for all practical purposes, are structurally equivalent to emotions
in human beings – being based on similar appraisal mechanisms, entailing predictable internal changes and expressive displays, and, most importantly, leading up to specific action tendencies (Dörner, 1994; Wright et al., 1996). As is often the case in scientific debates of this nature, both positions are likely to be correct. Clearly, it is unlikely that robots will ever have human emotions, simply because they are not human. And if qualia are defined in such a way that only humans can experience them, robots are unlikely to ever profit from that experience. The issue then becomes one of the degree of structural equivalence one can obtain and the difference such artificial emotions will make in the efficiency of the robot’s performance and capacity to smoothly interact with human beings.

With respect to structural equivalence, there are some first indications from prior work. In one of the pioneering publications in this area, Toda (1982) has suggested a simple autonomous agent, the fungus eater, that already displays some of the basic motivational and behavioral characteristics that constitute the necessary conditions for emotion (see also Wehrle, 1994). Frijda and Swagerman (1987) have shown that it is possible to write a computer program that will come up with seemingly reasonable emotion labels to refer to specific contingencies. Scherer (1993b) has shown that the appraisal process can be modeled by a computer-based expert system, allowing it to “postdict” real human emotions on the basis of appraisals requested by the computer from human users (see also Wehrle and Scherer, 2001). While all of these first attempts are necessarily primitive, it seems easily possible to improve on the computer modeling of artificial emotions.

Thus it can be expected that we shall soon see a reasonably convincing simulation of emotion processes on a computer, demonstrating many structural similarities with human emotion, albeit in a highly restricted context. In fact, the scope of such simulations may be the crux of the matter. Many scientists would agree that it is child’s play to model the frustration of an autonomous agent in the form of embodied arousal accompanied by aggressive behavior upon being blocked on a goal gradient prescribed by its internal program. But what does it take to produce artificial shame, guilt, jealousy, love, envy, contempt, or nostalgia? And will it ever be possible to have autonomous agents experience commotions as defined above? One of the problems is that scholars in the area of emotion do not readily agree on the definitions of these emotions in the
human case. Thus the difference between shame and guilt, the question of whether love is an emotion, how many, if any, emotions are universal, are all issues that are hotly debated (see Ekman and Davidson, 1994). In consequence, it is difficult to model or simulate states in artificial beings that are as yet more readily defined by words than by psychobiological features.

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