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Coherence between Emotion and Facial Expression: Evidence from Laboratory Experiments

Rainer Reisenzein
Institute of Psychology, University of Greifswald, Germany

Markus Studtmann
Max Planck Institute for Human Development, Germany

Gernot Horstmann
Department of Psychology, University of Bielefeld, Germany

Abstract

Evidence on the coherence between emotion and facial expression in adults from laboratory experiments is reviewed. High coherence has been found in several studies between amusement and smiling; low to moderate coherence between other positive emotions and smiling. The available evidence for surprise and disgust suggests that these emotions are accompanied by their "traditional" facial expressions, and even components of these expressions, only in a minority of cases. Evidence concerning sadness, anger, and fear is very limited. For sadness, one study suggests that high emotion–expression coherence may exist in specific situations, whereas for anger and fear, the evidence points to low coherence. Insufficient emotion intensity and inhibition of facial expressions seem unable to account for the observed dissociations between emotion and facial expression.

Keywords
affect program theory, emotion, facial expression

This article presents a concise review of the evidence from laboratory experiments on the question of the coherence between emotion and facial expression in adults (including a few studies with older children). The experimental approach to answering this question, pioneered by Landis (1924), comprises (a) inducing the emotion of interest; (b) (ideally) verifying the effectiveness of the induction using appropriate indicators, among which emotion self-reports traditionally play the central role (both because of their epistemic priority and their unmatched specificity); (c) measuring facial expression; and (d) calculating an appropriate index of statistical association (for details, see Reisenzein, 2000; Reisenzein, Bördgen, Holtbernd, & Matz, 2006). Compared to naturalistic studies of the emotion–expression relationship (reviewed by Fernández-Dols & Crivelli, 2013), laboratory experiments have two main advantages: First, they allow better control of the quality, intensity, and the temporal parameters (onset, duration) of the emotions studied; second, they enable more stringent tests of hypotheses about possible moderators of the emotion–face relationship (e.g., the social context).

Because most of the research reviewed in this article has been directly or indirectly inspired by Ekman's (e.g., 1972, 1993) *affect program theory* of facial expression (APT), we discuss the empirical evidence separately for each emotion from the core set of "basic emotions" proposed by this theory: happiness, surprise, disgust, sadness, anger, and fear. As statistical indices of the coherence between emotion and facial expression, we report, whenever available: (a) between-subjects correlations between

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Corresponding author: Rainer Reisenzein, Institute of Psychology, University of Greifswald, Franz-Mehringstrasse 47, 17847 Greifswald, Germany.
Email: rainer.reisenzein@uni-greifswald.de

the target emotion (measured by self-reports) and the facial expressions predicted by APT; (b) the percentage of facially reactive participants (i.e., those who show an expression or expression component in the "emotion present" condition); and (c) the average intraindividual correlation between emotion and expression. The most informative of these indices is "c", followed by "b" and "a" (provided that the focus is on a single emotion episode; see Reisenzein, 2000; Reisenzein et al., 2006). Not included in our review are studies that report only group-level effects (e.g., mean differences in electromyographic [EMG] activity or rated expression between an "emotion present" and "emotion absent" condition). However, the inclusion of these data, which are available from the first author on request, would not change the conclusions drawn.

Happiness I: Amusement

"Happiness" in APT covers several positive emotions including amusement (Ekman, 1993). For the purpose of this review, we distinguish between amusement and other positive emotions (see also Herring, Burleson, Roberts, & Devine, 2011; Ruch, 1997a); in the reviewed studies, these were primarily joy and sensory pleasure. Although not considered a prototypical emotion by many theorists, amusement has been the most frequent target of studies of emotion–expression coherence. The core component of the APT expression of happiness is smiling (see Ekman, Friesen, & Hager, 2002), represented in the Facial Action Coding System (FACS; Ekman et al., 2002) by action unit (AU 12) (mouth corners pulled up) with or without AU6 (cheek raising, causing wrinkles around the eyes).

Interindividual Correlations

Several studies report interindividual correlations between overall self-rated amusement and some index of overall smiling or laughter evoked by humorous films. These correlations are typically moderate in size, for example: .32 (Johnson, Waugh, & Fredrickson, 2010, Experiment 1), .42 (Gross, John, & Richards, 2000), .47 (Herring et al., 2011), and .57 (Ruch, 1997a, Experiment 2). Similar between-subjects correlations were obtained in earlier comparable studies reviewed by Ruch (1990). However, these coefficients do not reflect coherence on the level of single emotion episodes because the film clips contained several amusing events.

Percentage of Reactive Participants

Several studies staged single, clearly defined humorous events and reported the percentage of facially reactive participants. Individual jokes elicited smiling (AU12) on average in 57% of the participants and cheek raising (AU6) in 28%; a Duchenne smile comprising both components occurred in 23% (Harris & Alvarado, 2005). Being tickled had similar effects (61% AU12, 24% AU6, 15% Duchenne smiles; Harris & Alvarado, 2005). Keltner (1995) found that a directed facial posing task caused smiling in 82% of the participants who felt more amused than embarrassed; Duchenne smiles were shown by 36%. An unexpected amusing event elicited smiling or laughter in 90% of the participants (Reisenzein et al., 2006, Experiments 6 and 7), and a clowning experimenter elicited Duchenne smiles in the full 100% (Ruch, 1997a, Experiment 1).

Intraindividual Correlations

Seven studies examined the coherence between amusement and smiling on the intraindividual level. The average intraindividual correlations were as follows: .63 between participant ratings of humorous cartoons and observer ratings of smiling/laughter (Roth & Upmeyer, 1985); .60 between self-ratings of amusement and observer ratings of smiling/laughter (Deckers, Kuhlhorst, & Freeland, 1987, Experiment 1); .71 between funniness ratings of jokes and cartoons and FACS-coded smiling (AU12; Ruch, 1995); .63 and .56 between funniness ratings of jokes and EMG activity over zygomaticus major (responsible for smiling; Ruch, 1990; summarized in Ruch, 1995, p. 54, and Ruch, 1997b); and .73 and .68 between continuous self-ratings of amusement during humorous films and continuous ratings of smile intensity by observers (Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005; Mauss et al., 2011).

Happiness II: Other Positive Emotions

Interindividual Correlations

Interindividual correlations between overall self-reported "happiness" induced by film clips and aggregate measures of smiling ranged from .12 (ns; Herring et al., 2011) through .35 (Matsumoto & Kupperbusch, 2001) to .60 (Ekman, Davidson, & Friesen, 1990; Ekman, Friesen, & Ancoli, 1980; however, the facially effective emotion in these studies was probably amusement; see Ekman et al., 1990). Correlations between self-ratings of overall happiness in interaction situations and codings or observer ratings of "happy" facial expressions ranged from nonsignificant (.09, Mehu, Grammer, & Dunbar, 2007; .24, Bonanno & Keltner, 2004; .31, Lee & Wagner, 2002, social condition) to moderate (.35, Keltner & Bonanno, 1997; .38, Hall & Horgan, 2003, low-power condition, Experiment 3; .42, Lee & Wagner, 2002, alone condition). However, as the films and interaction situations presumably comprised several happy events, these coefficients do not reflect coherence for single emotion episodes.

Percentages of reactive participants are not reported in the reviewed studies.

Intraindividual Correlations

Three studies examined the coherence between smiling and positive emotions other than amusement on the intraindividual level. Two of them looked at the association between pleasure–displeasure ratings of pictures from the International Affective

Picture System (IAPS) and EMG activity over zygomaticus major. The average intraindividual correlations were .04 for men and .36 for women (Lang, Greenwald, Bradley, & Hamm, 1993) and about .30 for both sexes combined (Larsen, Norris, & Cacioppo, 2003; estimated from a published dotplot of the distribution of the correlation coefficients). Lower correlations were obtained for sounds (around .20) and words (around .10) as stimuli (Larsen et al., 2003). The third relevant study obtained a mean intraindividual correlation of .19 between self-rated happiness induced by imagining happy scenes, and zygomaticus EMG (Brown & Schwartz, 1980).

Surprise

The APT surprise expression comprises three components: eyebrow raising (AU1/AU2), eye widening (AU5), and mouth opening/jaw drop (AU25/26).

Interindividual Correlations

Reported interindividual correlations between self-rated surprise intensity evoked by unexpected events and facial surprise expressions are typically low and sometimes not significant (e.g., .23/.24 for widened eyes/raised eyebrows, Ludden, Schifferstein, & Hekkert, 2009; −.03 for frontalis EMG, Vanhamme, 2000).

Percentage of Reactive Participants

Across different studies, the frequency of three-component surprise expressions elicited by diverse unexpected events ranged from 0% (e.g., Reisenzein et al., 2006; Vanhamme, 2000; Wang, Marsella, & Hawkins, 2008) to 7.6% (Vanhamme, 2003, Study 3). Even two- and one-component expressions were usually shown only by a minority of the participants. For example, unexpected audiovisual changes after a series of no-change trials elicited components of the surprise expression in maximally 25%; all were one- or two-component expressions (Reisenzein et al., 2006, Experiments 1, 4, 5, and 8; Reisenzein & Studtmann, 2007, Experiments 2 and 3). Confronting participants with a picture of their own face at the end of a picture-rating task had the same meager effect (Reisenzein et al., 2006, Experiments 6 and 7). Unexpected solutions to quiz items (Reisenzein, 2000) and incongruous consumer products (Ludden et al., 2009) elicited surprise expressions (at least one component) in maximally 34% and 38% of the participants respectively; being told that the prize of a lottery in which they participated had been raised, in 52% (33% if a stricter coding criterion was used; Vanhamme, 2000). Players who felt subjectively surprised by the sudden appearance of enemies in a computer game showed raised eyebrows in 21% and widened eyes in 11% of the cases (Wang et al., 2008). Even finding oneself in a new, strange room when leaving the lab elicited individual components of the surprise expression only in a minority (21–33% depending on experimental condition and expression component; Schützwohl & Reisenzein, 2012). Only two studies found individual components of facial surprise in more than a third of the participants: The sudden appearance of enemies in a computer game elicited mouth opening in 53% (Wang et al., 2008); when product testers unexpectedly learned that they would receive a coupon for a free book, or detected that a promised foldable plastic spoon was missing from the wrapping of yogurt, up to 50% showed eyebrow raising and up to 47% eye widening (Vanhamme, 2003, Experiment 3). We suspect, however, that some of these expressions may have been shown deliberately to communicate, respectively, doubt or appreciation, and dismay.

Intraindividual Correlations

Reisenzein (2000) obtained an average intraindividual correlation of .46 between self-rated surprise intensity and an index of overall facial surprise (the sum of the three facial components).

Disgust

The two central components of the APT disgust expression are raising of the upper lip (AU10) and nose wrinkling (AU9) (Ekman et al., 2002).

Interindividual Correlations

Between-subjects correlations between self-ratings of experienced disgust evoked by diverse disgusting stimuli and facial expressions reported in several studies were low to moderate (e.g., .37–.55, Ekman et al., 1980) and sometimes nonsignificant (e.g., $r < .20$, Jäncke & Kaufmann, 1994, Experiment 1).

Percentage of Reactive Participants

A workshop accident film elicited raising of the upper lip, nose wrinkling, or both in 37% of the participants (Ekman et al., 1980). Approaching a spider elicited at least components of facial disgust (as judged by observers) in 26% of a highly and 11% of a mildly distressed group of spider phobics (Vernon & Berenbaum, 2002). Although Lumley and Melamed (1992) reported that particularly aversive scenes from a surgery film caused a disgust expression in 79% of a sample of blood phobics and 67% of a control sample, these authors unconventionally also coded brow contraction (AU4) as an expression of disgust. Furthermore, all of these studies likely overestimated coherence because the participants were counted as having shown a disgust expression if they reacted to at least one of several disgusting events. This problem was avoided in studies by Soussignan and Schaal (1996) and Fernández-Dols, Sánchez, Carrera, and Ruiz-Belda (1997). In the Soussignan and Schaal study, up to 37% of the participants (5- to 12-year-old children) displayed nose wrinkling/upper lip raise when smelling fecal and fishy odors. In the study by Fernández-Dols et al., 8 of 22 (36%) participants who experienced disgust as a dominant emotion in response to a specific scene in a horror film showed nose-wrinkling, but none showed lip-raising.

Intraindividual Correlations

Three studies investigated the coherence between disgust and facial expression on the intraindividual level. Rosenberg and Ekman (1994) collected retrospective emotion self-ratings for several time points during two disgusting film clips and aligned them with the facial expressions shown at these moments. Overall (i.e., when pooling across different emotions and facial expressions), *P*(expression | emotion) was around .50. The corresponding statistic for disgust is not reported, but was almost certainly lower; correlations are not reported. Stark, Walter, Schienle, and Vaitl (2005) failed to find a significant intraindividual linear or quadratic relation between disgust ratings and EMG activity over levator labii (responsible for nose wrinkling and upper lip raise) in response to disgusting and neutral IAPS pictures; the largest obtained beta coefficient was .13. Miener (2007) confronted participants in three studies with disgusting pictures and real objects (e.g., live mealworms, a dead cockroach). The average intraindividual correlations of self-reported disgust with an index of video-coded facial disgust ranged from .20 (Experiment 3) to .35 (Experiment 2); the mean correlation with EMG activity over levator labii (Experiment 3) was .04.

Sadness

Core components of the APT expression of sadness are oblique eyebrows (a combination of AU1, inner brow raise, and AU4, brow lowering) and pulling down the lip corners (AU15).

Interindividual Correlations

Self-reported sadness induced by film clips did not significantly correlate with sadness expressions (defined as oblique eyebrows, AU1 + AU4) in a study by Jakobs, Manstead, and Fischer (2001), but was significantly related to observer ratings of sadness expressions in Gross et al. (2000; $r = .45$) and to increased EMG activity over the corrugator supercilii muscle (responsible for furrowing the brow, AU4) in Johnson et al. (2010, Experiment 1; $r = .22$).

Percentages of reactive participants are not reported in the reviewed studies.

Intraindividual Correlations

Four studies broadly relevant to sadness estimated coherence between experience and expression on the intraindividual level. Two reported intraindividual correlations between corrugator EMG activity and displeasure–pleasure ratings of IAPS stimuli. For pictures as stimuli, they were on average .40 for men and .29 for women (Lang et al., 1993), and about .35 for both sexes combined (Larsen et al., 2003; estimated from the published dotplots). For sounds and words, they were about .25 and .10, respectively (Larsen et al., 2003). Brown and Schwartz (1980) found that self-rated sadness induced by imagery correlated on average .24 with EMG activity over corrugator supercilii. In marked contrast, Mauss et al. (2005) obtained an average correlation of .74 between continuous observer ratings of facial sadness elicited by film scenes and continuous self-ratings of sadness.

Anger

Core components of the APT expression of anger are frowning (AU4), lid tightening (AU7), and lip tightening/lip pressing (AUs 23/24); but there are many variations (Ekman et al., 2002).

Interindividual Correlations

The between-subjects correlation between self-reported anger and EMG activity over corrugator supercilii was not significant in two studies by Johnson et al. (2010; $r = .02$ and $-.06$, respectively, anger induced by a film clip or the Velten technique) and Jäncke (1996; $r < .20$, anger induced by insulting negative performance feedback). In a study by Underwood and Bjornstad (2001), third to sixth graders were provoked by a peer actor during a computer game; the correlation between anger self-reports and emotion-FACS (EMFACS) style-coded anger expressions were .07 (for “feeling mad”) and .18 (for “feeling bothered”; significant because of the large sample size). Hubbard et al. (2002) induced anger in second graders by making them lose a game and prize to a confederate who cheated; the overall correlation between self-reports of anger and rater-judged facial expressions of anger was .06 (ns). Correlations between the frequency and intensity of EMFACS-coded lower-face anger expressions and experienced anger during a stress challenge test that included harassment by the experimenter were .27 and .35, respectively (Lerner, Dahl, Hariri, & Taylor, 2007).

Percentage of Reactive Participants

Hubbard et al. (2002) report that anger expressions were shown on average by 4% of pupils in response to cheating by a confederate.

Intraindividual Correlations

Brown and Schwartz (1980) obtained an average intraindividual correlation between self-rated anger induced by imagining anger-evoking scenes and EMG activity over corrugator supercilii of .19.

Fear

Core components of the APT expression of fear are brow raising (AU1/AU2) and eye widening (AU5) combined with brow knitting (AU4) and retraction of the mouth (AU20); but there are several variations (Ekman et al., 2002).

Interindividual Correlations

EMFACS-coded fear expressions were not significantly correlated with self-reported fear before and during a stress challenge test (Lerner et al., 2007).

Percentage of Reactive Participants

Tomarken and Davidson (1992, summarized in Davidson, 1992) found zero complete EMFACS fear expressions in participants watching a fearful film, and only 18% showed at least one component of the fear expression. According to Davidson (1992), similar findings were obtained for snake and spider phobics exposed to their feared objects (details are not reported). In support, a more recent study found that at least individual components of facial fear were shown by 33% of highly and 6% of mildly distressed spider phobics (Vernon & Berenbaum, 2002). Mothers showed on average 0.36 components of facial fear during the 10 s before their infants received an immunization injection (Horton & Pillai Riddell, 2010). Harrigan and O'Connell (1996) FACS-coded facial expressions while participants talked about the "most anxious" event they had experienced. No complete fear expressions were found, but significantly more components of the fear expression were observed during high (1.54) than low (0.76) anxiety segments. However, because neither the lengths of the segments nor the number of fearful incidents they contained were reported, these data are difficult to evaluate. Also, the most frequently observed action unit, mouth stretching (AU20), could have been part of talking or a conversational signal.

Intraindividual Correlations

Brown and Schwartz (1980) reported average intraindividual correlations of self-rated fear induced by imagining fearful scenes to corrugator EMG (AU4) of .11 and to frontalis EMG (AU1/AU2) of .06.

Summary

With the exception of amusement—which, as mentioned, is not usually considered a prototypical emotion—there is at present no convincing evidence that people undergoing the "basic emotions" of APT typically show the patterned facial expressions predicted by the theory. Even in the case of amusement, usually only smiling (AU12), but not smiling plus cheek raising (AU6), is shown. For positive emotions other than amusement, as well as for surprise and disgust, the available evidence suggests that these emotions are typically *not* accompanied by "their" APT expressions: Percentages of reactive participants are low, as are the inter- and intraindividual correlations. As Ruch (1997b, p. 109) noted, "[correlation] coefficients between .30 and .40 do not suggest a coherent response pattern." For sadness, anger, and fear, the evidence is very limited but points to the same conclusion, with the exception of Mauss et al.'s (2005) study of sadness. This study should, however, be treated with caution because, as the film clip showed a crying woman, some facial expressions may have been due to mimicry (Hess & Blairy, 2001). In addition, because observer judgments rather than objective expression codings were used, the expression ratings could have been influenced by additional bodily or facial cues (e.g., a lowered head).[1]

Although for all APT emotions, at least isolated components of the proposed facial expressions have been observed in a minority of the participants undergoing the emotion, the most frequently observed APT expression component for sadness, anger, and fear is furrowing of the brow (AU4). Counter to APT predictions, AU4 has also been found to be the most frequent facial reaction to disgusting stimuli in Miener (2007; see also Lumley & Melamed, 1992) and to be as often elicited by some kinds of surprising events as the components of the APT surprise expression (e.g., Ludden et al., 2009; Schützwohl & Reisenzein, 2012). These findings support the hypothesis, advanced by several authors, that AU4 is not caused by emotion-specific affect programs, but by a common component or regular concomitant of the negative "basic" emotions (and perhaps surprise), such as an unpleasant feeling, the appraisal of goal frustration, or mental effort (e.g., Russell, 2003; Scherer & Ellgring, 2007; Smith & Scott, 1997).

Explanations of Low Emotion–Expression Coherence

APT offers two substantive explanations of low emotion–expression coherence (Reisenzein et al., 2006): (a) insufficient intensity of the emotion to cause a facial expression (at least a visible one) and (b) inhibition or masking of the expression in accordance with display rules. In addition, a standard response of APT proponents to data suggesting low coherence has been to blame method problems associated with inducing the target emotion or with the measurement of emotion or facial expression (e.g., Rosenberg & Ekman, 1994). While space restrictions do not allow us to discuss method problems in detail (see Mauss et al., 2005; Reisenzein, 2000; Ruch, 1995), we believe that at least blatant methodological errors were avoided in the majority of the reviewed studies. Furthermore, the fact that high coherence has been obtained for amusement, but not for other emotions with conceptually identical induction and measurement procedures, suggests that method problems are not the main reasons for low coherence.

Insufficient Emotion Intensity

Insufficient emotion intensity can account for observed emotion–face dissociations if one assumes, as is plausible, that emotion intensity needs to exceed a threshold for an expression (at least a visible one) to occur and that this threshold was not exceeded by part of the stimuli or participants. Whatever the worth of this explanation of low emotion–expression coherence in specific cases, as a general explanation it is implausible. First, fairly strong emotion inductions seem to have been used in some studies for all APT emotions (see also Fernández-Dols & Crivelli, 2013). Second, coherence does not increase if more sensitive

EMG measurements are used; in fact, due probably to the lower specificity of EMG measures, coherence coefficients are typically lower. Third, in the case of amusement, high coherence has been found even with moderate emotion intensities (e.g., Ruch, 1995). Fourth, direct tests of the hypothesis that the coherence between emotional experience and facial expression increases with intensity found no support for surprise (Reisenzein, 2000; Reisenzein et al., 2006) and sadness (Mauss et al., 2005), although support was obtained for amusement (Mauss et al., 2005). Although APT could perhaps still "explain away" the first three findings by positing very high expression thresholds for emotions other than amusement, it cannot easily account for the negative outcomes of direct tests of the intensity-coherence hypothesis (see Reisenzein, 2000).

Inhibition of Expressions

Inhibition or masking of expressions explain some cases of emotion–face dissociation, but not all. This conclusion is suggested by the results of experiments that studied the moderating effects of a manipulation of sociality (the presence of others) on facial expressions. For *surprise*, no effect of social context has been found (Reisenzein et al., 2006, Experiments 3, 6, and 8; Schützwohl & Reisenzein, 2012). For *amusement*, the presence of another person, particularly a friend, has typically been found to increase smiling and laughter, even if the intensity of the emotion is not changed (e.g., Devereux & Ginsburg, 2001; Fridlund, 1991; Hess, Banse, & Kappas, 1995; Jakobs, Manstead, & Fischer, 1999). This speaks against an inhibition of amusement-related smiling in the presence of others; on the contrary, the presence of others, particularly friends, seems to lower the threshold of showing amusement. For *positive emotions other than amusement*, both enhancement effects (e.g., Fridlund, Kenworthy, & Jaffey, 1992; Lee & Wagner, 2002) and inhibition effects (e.g., Friedman & Miller-Herringer, 1991) have been found. (For more detailed reviews of this literature see Fischer, Manstead, & Zaalberg, 2003; Wagner & Lee, 1999.) For *disgust*, too, both facilitation effects (Jäncke & Kaufmann, 1994) and inhibition effects (Miener, 2007, Study 2; Soussignan & Schaal, 1996) have been found, at least under certain conditions. Likewise, for *sadness*, facilitation effects (Fridlund et al., 1992), null effects (Gehricke & Shapiro, 2000), and inhibition effects (Jakobs et al., 2001; Lee & Wagner, 2002) have been found. For *anger*, there is, on the one hand, suggestive evidence that the imagined presence of an adversary increases frowning (Jäncke, 1996) and reduces smiling (Fridlund et al., 1992). On the other hand, similarly low anger expressions have been found in solitary (Brown & Schwartz, 1980; Johnson et al., 2010) and interactive situations (Hubbard et al., 2002; Underwood & Bjornstad, 2001). For *fear*, Fridlund et al. (1992) found potentiation effects of imagined sociality (mainly in the brow and lip regions).

In sum, sociality effects are absent for surprise, generally facilitative for expressions of amusement, facilitative in at least some situations for anger and fear, and inconsistent (either facilitative, or inhibitory, or null) for positive emotions other than amusement, sadness, and disgust. Therefore, and because with the exception of amusement, high emotion–expression coherence has typically not been found even when the participants were alone, inhibition or masking of expressions due to display rules is unlikely to be the general explanation of the observed emotion–face dissociations. Furthermore, in view of the consistent effects of sociality on amusement displays, the possibility needs to be considered that the high coherence obtained for amusement even in solitary situations is due to the inherently social nature of most humor stimuli.

Modifications of APT

If method problems associated with the induction and measurement of emotions, insufficient emotion intensity, and inhibition of expressions do not explain low emotion–face coherence, APT must be modified or abandoned. The most conservative modification of APT consists of assuming that the presence of emotion and the absence of control are insufficient for facial expressions, and that some additional condition (or a combination of conditions) is needed. That is, the original APT model (emotion + absence of control → expression) is expanded to (emotion + absence of control + factor X → expression) (Reisenzein et al., 2006). Following this suggestion implies a research program aimed at identifying factor X for each APT emotion. So far, this path has been followed only for surprise and until now, the crucial additional condition X for the surprise expression could not be identified. However, the available evidence speaks against the following candidates for factor X in the case of surprise: The surprising event is complex or of long duration, valenced, goal-relevant, novel, requires rapid visual orienting, or exceeds the visual field (see Reisenzein et al., 2006; Schützwohl & Reisenzein, 2012).

Alternative Theories

If the proposed modifications of APT do not work, then APT including modified APT needs to be abandoned. Several alternative (partly overlapping) theoretical accounts of facial expressions and their relations to emotions are available, including Fridlund's (1994) behavioral ecology account, combinations of APT with ideas from behavioral ecology (Fischer et al., 2003; Frijda, 1995), Fernández-Dols' (1999) situationist account, appraisal-theory-based componential accounts (Scherer & Ellgring, 2007; Smith & Scott, 1997), the theory that facial expressions are components of evolutionary action tendencies (Frijda & Tscherkassof, 1997) or of inherited and learned relational orientations (Parkinson, 2013), the dimensional account of facial expression based on pleasure–arousal theory (Russell, 2003), and the proposal that facial expressions are coordinative motor structures (Camras, Lambrecht, & Michel, 1997). Parkinson (2005) reviews some of these theories. Although these alternative theories are better able to account for some of the reviewed findings than is APT, none of them provides an explanation of the complete pattern of findings. This explains in part why many researchers are reluctant to abandon APT despite the weak empirical support that exists for the APT model of the production of spontaneous facial expressions.

We end this review with four proposals for future research. First, systematic experimental research programs investigating possible reasons for low emotion–expression coherence should be conducted for the different APT emotions. Second, this research should be flanked with naturalistic studies (see Fernández-Dols & Crivelli, 2013) that aim to identify situations in which the full APT facial expressions are shown by most people. If such situations are found, they could then be experimentally dissected. Third, an experimental research program combining state-of-the-art cognitive, behavioral, and neuroscience methods should be initiated to reconstruct, in detail, the causal processes that lead from emotion elicitors and contextual cues to facial expressions. Fourth, a premium should be placed on the further development of existing, and the creation of new theories of facial expression.

Note

1 As pointed out to us by Brian Parkinson.

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