taste paired with LiCl can be anticipated and avoided—that the anticipation of a taste, rather than the taste itself, can be aversive. The usual taste-aversion experiment demonstrates only escape from an aversive taste. As a historical side-light, this is a particularly clear demonstration in the rat of what Tolman called “an insight” or “foresight” mechanism (a sign-gestalt-expectation). More than 40 years ago, Miller showed that such a mechanism could be deduced from Pavlovian conditioning principles in the form of Hull’s fractional anticipatory goal response (13).

Experiment 2 adds the finding that PRF training can (immunize the rat against) the suppressive effects of the anticipation of the conditioned aversive taste and that such training attenuates the suppression of drinking of such a taste solution. If rats are reinforced intermittently and inconsistently with a particular flavored solution, they will avoid that flavor less and drink more of it when it is subsequently paired with gastrointestinal illness. Such a finding has potential practical as well as theoretical implications. One practical application might be to therapeutic situations in which taste aversions and anorexia frequently result from drug or radiation treatments or chemotherapy (14). The theoretical implications are for broadening the range of generalization and transfer of persistence in responding across motivational-reward systems (15).

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References and Notes
3. Experiments were performed at P. J. Best, M. Best, and R. N. Ahlers (ibid. 25, 281 (1971)) and with E. W. Holman (Learn. Motiv. 4, 338 (1975)). Both of these experiments were performed to investigate the effect of taste-aversion conditioning on an operant lever press with the aversive stimulus as the reward. In the first experiment, baseline lever-press training was with water rather than with the later conditioned (aversive) taste. The procedure of the second was similar to those in our first experiment, but contrary to our findings, extinction was hastened with the aversive taste (saccharin) as reward.
6. For clarity of presentation, we reported only the total speed (centimeters per second) over the entire runway, although all measures showed the effects and start speed was perhaps the most sensitive measure.
7. Analysis of variance on extinction data revealed a significant groups effect (F(3, 36) = 5.41, P < 0.05) and a groups by trials interaction (F(12, 144) = 2.45, P < 0.01). Subsequent Newman-Keuls tests of the overall means for the four groups showed that the free control group ran faster than the vinegar-LiCl (P < 0.01), the saccharin-LiCl (P < 0.05), and the water-LiCl (P < 0.01), but that the saccharin-LiCl and water-LiCl groups ran faster than the vinegar-LiCl groups (P < 0.05).
8. The group design was probably unnecessary in view of recent research showing that (i) after a single preliminary exposure to sucrose, neither additional exposures nor duration of delay between successive exposures has any additional effect on taste transfer to the conditioning [J. W. Kalat and P. Rozin, J. Comp. Physiol. Psychol. 83, 198 (1973)], and (ii) under conditions of severe water deprivation, preliminary exposure to saccharin does not greatly attenuate the taste-conditioning extinction [M. Domjan, ibid. 56, 522 (1972)].
9. Analysis of variance yielded a significant effect of reward [F(1, 48) = 45.93, P < 0.001] and a significant interaction of reward by trials [F(4, 432) = 18.99, P < 0.001], indicating a clear PRF extinction effect. The interaction of poison-LiCl versus PRF-NaCl was not significant (F(9, 432) = 4.37, P < 0.001), indicating that the poisioned groups (CRF-LiCl and PRF-LiCl) extinguished faster than the saline controls (CRF-NaCl and PRF-NaCl). Perhaps more important is the significant interaction of reward and poison [F(1, 48) = 5.95, P < 0.025]. Subsequent Newman-Keuls tests showed that the PRF-LiCl group extinguished at about the same rate as PRF-NaCl and the CRF-LiCl group extinguished at about the same rate as CRF-NaCl.
10. After extinction, the poisoned groups (CRF-LiCl and PRF-LiCl) consumed less of the saline solution than the saline controls [F(1, 48) = 346.09, P < 0.001]. The PRF animals (PRF-LiCl) consumed less than their CRF counterparts [F(1, 48) = 12.38, P < 0.001]. Newman-Keuls tests among the means of the four groups showed that the PRF-LiCl group drank more saccharin solution than the CRF-LiCl group (P < 0.01); the PRF-NaCl and CRF-NaCl groups did not differ from each other.
11. C. L. Hull, Psychol. Rev. 38, 487 (1931); E. C. Tolman, ibid. 46, 246 (1933); N. E. Miller, ibid. 42, 280 (1935).
14. Grants were received by NIH grant RO1-MH-30778. We are indebted to M. Domjan for a very helpful critical reading of the manuscript and for bringing several references to our attention.
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Asymmetry in Facial Expression

The conclusion of Sackeim et al. (1) that there is “greater right-hemispheric involvement in the production of emotional expression” is unwarranted. They found that observers judge double-left composite faces as showing more intense emotion than double-right composite faces. However, they failed to consider the possibility that peripheral neural and anatomical differences rather than differences in the activity of the right and left cerebral hemispheres could explain such results. Facial surgeons note (2) that the two sides of the face differ in the size of the muscles, in fatty deposits (3), and in the neural supply from the facial nerve to the facial muscles. Without controls for such differences, the findings of Sackeim et al. cannot be interpreted as being due solely to differences in the impulses sent from the two cerebral hemispheres to the facial nuclei.

There is also reason to question whether Sackeim et al. were justified in talking about lateralization in emotional expressions, since they studied a different type of facial movement. Neurologists distinguish between voluntary facial movements (by which they usually mean the ability to perform requested actions) and spontaneous emotional expressions. The evidence is clear that these two types of facial activity depend upon different neural pathways (4). The potential independence of these two types of facial actions is dramatically shown in clinical cases in which lesions in the pyramidal system (for example, the precentral gyrus) impair requested facial movements but leave emotional facial movements intact, whereas lesions in nonpyramidal systems produce the reverse pattern. This evidence emphasizes the need for caution in generalizing from studies of requested facial movements to emotional expression and vice versa. Thus, it is crucial to know whether the facial movements studied by Sackeim et al. were requested or more spontaneous emotional expressions.

Sackeim et al. did not accurately describe the photographs they used, which W. V. Friesen and I supplied to them. They wrote that the pictures showed “posed” emotions, or “subjects deliberately attempting to convey particular emotions.” Posing may involve either deliberate performance or some attempt to reexperience an emotion to produce the expression. If our photographs had been posed it would be unclear which kind of facial movements Sackeim et al. had studied. With few exceptions, however, the photographs they used were not even poses, but the most deliberate
performance of requested facial movements. In describing how the photographs were taken, Friesen and I wrote that the photographic models "were not told to feel an emotion, but rather given instructions such as lower your brow so that it looks like this, . . . or tighten your lower eyelid" (5, p. 170). Because our photographs were of requested facial movements, not of emotional poses, there must be even more caution in generalizing to spontaneous facial expression of emotion.

The fact that they found no left-right differences in judgments of the happy photographs is important since, unknown to Sackeim et al., these were the only photographs of spontaneous emotional expression rather than deliberately performed facial actions. In making the happy photographs, we caught the models off guard during a spontaneously occurring happy moment in the photographic session. It might be argued that the reason no left-right differences were found in these happy pictures was not because they showed spontaneous rather than requested actions, but because positive emotions alone are not asymmetrically in appearance (6). However, Ekman, Hager, and Friesen (7) found that symmetrical deliberate smiles are usually more intense on the left than on the right side, and they replicated findings by Lynn and Lynn (8) that asymmetrical spontaneous smiles are relatively infrequent and are not usually more intense on a particular side of the face. These findings suggest that facial asymmetry (with left stronger than right) is apparent only with deliberate and not spontaneous expressions, but studying muscle movements involved in the negative emotions is necessary to generalize beyond the smile.

The issue of left-right differences is not resolved for either emotional expression or requested facial movements. Both types of action need to be studied, ideally in the same subjects and in situations that clearly differentiate the type of facial movement elicited. The methods must control or bypass the type of peripheral differences in facial anatomy that cloud results based solely on observers’ judgments of emotion. For now, more caution is needed in interpreting the findings from studies based on observers’ judgments of emotion to either requested facial movement or emotional expression, and in generalizing from studies of the former to the latter.

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References and Notes
2. As a facial surgeon with wide experience with face-lifts, parotid gland operations, and surgery to remedy facial paralysis (personal communication, 1 February 1980) has stated that he has little doubt that asymmetry of facial structure is the rule rather than the exception.
3. Data on consistent differences in the relative size of the left and right sides of the face are reported in P. H. Burke, Hum. Biol. 43, 536 (1971).
6. There are still ambiguities about asymmetry in smiling. R. Campbell [Cortex 14, 327 (1978)] found asymmetries in requested smiles, but has said, "I did find expression asymmetries. . . . These have turned out to be due to the left side of face . . . being rated 'more sad' in a relaxed, upposed rather than the right side of face. In fact, of the eighteen right-handers I used I did not find that a posed smile was stronger on the left of the face. So the discussion in the paper is a bit misleading" (personal communication, 3 December 1977). G. E. Schwartz (personal communication) has found asymmetries in electromyographic activity in the facial area relevant to the smile, but it is not certain that he was studying spontaneous emotional expression.
9. I thank W. V. Friesen, J. Hager, H. Oster, and M. O’Sullivan for their comments.
10. April 1979: revised 15 February 1980

The conclusion of Sackeim et al. (1) that the greater perceived intensity of emotional expression on the left side of the face "points to greater right-hemispheric involvement in the production of emotional expression" is probably premature.

Having access to the same set of stimuli as Sackeim et al., we tested the equality of the sides of the face directly. Of the 110 slides of facial affect (2), 34 were selected on the basis of their "measurability." Measurability was determined by the extent to which precise measurements could be taken from vertical midline of the face to the edge where the head and ear merge. The remaining 76 slides were rejected because such things as interfering sideburns or hairlines made it difficult to obtain accurate measurements.

The 34 stimuli chosen consisted of five male and two female models and the same six expressions used by Sackeim et al. Each slide was projected onto a white background, to a chin-to-eyebrow height of approximately 13 cm. Measurements were taken from the edge where the ear and head meet (easily distinguishable in a two-dimensional photograph) to the vertical midline of the head. A comparison of means for the left and right sides of the face was thinner ($\bar{X} = 6.44$ cm, standard deviations = .70) than the right side ($\bar{X} = 6.75$ cm, standard deviations = .58) (Wilcoxon matched-pairs signed-ranks tests, $T = 30$, $P < .001$). In 25 of the 34 slides the left side was thinner than the right, in two they were equal, and in only seven did the left side exceed the right in width.

The significant difference in the width of the left and right sides of the face leads us to suggest that the greater apparent intensity of expression on the left side of the face is not a function of differential right-hemispheric control of expression but rather results from the fact that the left side of the face provides a smaller area on which to distribute the same features.

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References

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In the example set of original and derived left- and right-side composite photographs of a posed facial expression furnished by Sackeim et al. (1), the original full-face photograph is not uniformly illuminating. The left side of the model’s face shows a greater proportion of shadow than does the right side. Thus the derived left-side composite photograph appears darker and more “dramatic” than does the composite right-side photograph. Disparities in amount of shadow present between right and left composite photographs could influence subjects’ assessments of expression intensity irrespective of actual facial differences.

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Reference

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We reported (1, 2) that voluntary expressions of emotion are rated as more intense on the left than on the right side of the human face. We interpreted our finding as supporting the hypothesis of hemispheric asymmetry in the control of facial emotional expression.

Nelson and Horowitz, Spinrad, and Ekman submit that our finding may be
Asymmetry in facial expression

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