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VISUAL DECODIFICATION OF SOME FACIAL EXPRESSIONS THROUGH MICROIMITATION[1]

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Summary.—We examined the level of muscular tension of mentalis muscle of 36 students in graphic design at rest and during the presentation of three slides reproducing facial expressions. Analysis showed an increase in the myographic level of mentalis muscle from the third second of measurement onwards after the presentation of the slide in which contraction of the chin was involved. We interpret this result by hypothesizing that the decodification of some facial expressions is realized through a microreproduction of the stimulus from the decodifying subject.

The aim of the present research was to examine some aspects of visual decodification.

Generally stimuli evoke two orders of processes, the first related to the simple decodification and the second related to the interpretation of the stimuli which is personal and emotionally connotated. For this last process the cognitive and emotional components of responses are strictly related to each other. Within the psychological literature on the emotions, some authors (Woodworth, 1938; Ekman, *et al.*, 1972; Izard, 1977) tend to classify emotions as discrete patterns (anger, fear, etc.), while others point out the dimensional components of emotions (Schlosberg, 1954; Osgood, 1966; Frjida, 1970).

We think that each stimulus potentially can evoke both cognitive and emotional processes, and emotional processes develop along the dimensional continuum of the experience of pain-pleasure which represents the subjective feeling of different behaviors (avoidance, approach, attack, etc.). The dimensional axis of pain-pleasure has naturally a physiological substratum as for example the centre of Olds (1967) located in the brain stem reticular formation. Different stimuli can activate this centre to evoke the subjective components of feelings related to those stimuli. In other words, we hypothesize that each stimulus is also evaluated along the dimension of pain-pleasure, and the evaluation is related to the level of activation of this psychophysiological process (arousal plus pain-pleasure connotation). For example, the so-called neutral stimuli can evoke little or no activation of this functional area, while emotionally connotated stimuli can provoke both more intense activation of the dimension pain-pleasure and a complex pattern of phenomena which interest somatic (muscular) and autonomic effectors. Now we remember that in the so-called James-Lange theory of emotions the peripheral modifications of the autonomic

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activity represent the physiological component of the subjective feeling related to the reafferentation from the periphery to the nervous centres. We think that this hypothesis is substantially acceptable but also that the somatic muscular components of the emotional patterns play an important role in generating the subjective feeling which is centrally integrated by the above mentioned circuits. In this sense some authors (Gellhorn, 1964; Izard, 1977) emphasize the role that the muscular components of the facial expression of emotions play for generating the subjective feeling of emotion.

Then we infer a strict relationship between the emotional processes and the function of decodification from a cognitive point of view and the element which links cognition and emotion could lie in some cases in bodily experiental processes. Studies showed that during mental imagery there are significant modifications of cardiac, respiratory, and muscular activity (Jones & Johnson, (1980). Schwartz (1971) observed autonomic and somatic modifications related to self-induced arousal and neutral thoughts. Jones and Johnson (1980) showed that autonomic and somatic activity were related during imagery more closely to the level of activity of the image than to its emotional valence. We think that the process of decodification is substantially similar to the process of imagery. In this last case the mental representation is self-induced, while in the process of decodification external stimuli evoke the mental representations. A particular form of bodily components in the process of decodification is the subjective evaluation of effort. In fact, tension in flexors and biceps of the forearm increased in relation to the subjective sensation of effort and not in relation to the increase in actual physical strength (Eason, 1963). The sensation of effort during perceptual cognitive tasks is also accompanied by an increase in myographic score: in this case the literature refers to the myographic activity during concentration (Eason & Branks, 1963). We hypothesize that the increase of the myographic score represents the peripheric information which is the basis of subjective sensation of effort. Shaw (1940) observed that, if a subject was asked to lift progressively increasing weights, the level of myographic activity of the involved muscles increased also. It is interesting that the relationship between myographic activity and weight persisted even when the lifting of weights was only imagined. Other authors (Jacobson, 1931) hypothesized that the muscular system had a role in imagining of motor activity. To interpret these results we hypothesize that the subject who evaluates effort practically reproduces in response to the stimulus some motor activity related to the real experience of effort (for example, lifting a weight) and that this somatic and autonomic experience is the basis of the mental central evaluation. We would call this process experiential judgement.

As regards the relationship of this process to emotion, we think that often the experiential component of judgement interests consistently also the dimension of affectivity (pain-pleasure). In both emotional and cognitive process what is "experienced" is an integrated pattern coming from the periphery of the body. In other words, the autonomic and muscular modifications occurring in these cases are not single bodily events correlated with emotions, but they are always part of an integrated pattern (behavioral Gestalt). This pattern should appear not only in response to emotional stimuli but generally also in the process of decodification. We, extending this concept, think that also the decodification of facial attitudes or facial emotional expressions is realized through a complex perceptual activity involving both the visual system (from the peripheral receptor to the corresponding cortical analyzer) and the muscular system. In other words, we hypothesize that the perception of visual messages of facial emotional expressions determines in the decodifying subject a sort of imitative microbehavior which "reproduces" the stimulus. The sequence hypothesized would be the following one: (a) a facial expression as stimulus, (b) visual decodification which is accompanied or immediately followed by (c) reproduction through the muscular system of the stimulus, (d) during the production of peripheral muscular pattern, modifications of muscle spindle appear which provoke retroactive "reading" of somatically produced events from the central nervous system. This process would transform, in our opinion, the simple perception into what we might call the experiential perception. In this regard, we recall that a part of the psychological literature on emotion (Izard, 1977) has hypothesized that the subjective sensation of emotion is determined by the specific pattern associated with the facial expression. Our hypothesis, however, refers to perceptual processes imitative of facial expressions, not necessarily of an emotional type.

To verify our hypothesis we measured the level of myographic tension of a facial muscle during the observation of different facial expressions. We suggest that the myographic score increases during the observation of the facial expression in which the measured muscle activation is directly involved.

METHOD

Subjects

Our experimental group included 10 male and 26 female students in graphic design. They were aged between 18 and 30 yr., with a mean of 24 yr.

Procedure

The subject, comfortably seated on an arm-chair, was shown in a random order three slides on a screen. From each subject a measurement of electromyographic activity of the muscle of the chin (mentalis) was taken both at rest and during the exposure of the slides. For this measure two electrodes were placed on each subject, an active one in the middle of the chin and a neutral one in the middle of the forehead from which no myographic recording was taken.

The ground was placed on the left wrist. The electrodes were tin cups 8.5 mm in diameter and spaced one every 7 mm, filled with electrode jelly and strapped on with adhesive plaster. The electromyographic potentials were sent to an amplifier with a band passing between 20 and 1000 Hz. Then the signal was sent to an integration system (with an integrator with double semiwave) which drew an area reproducing the variations of amplitude in time. The analogic signal of the area was digitalized through a 1-sec. period. The arbitrary units obtained are proportional to the area corresponding to that period.

Both at rest and for each slide 10 myographic measures of mentalis muscle were taken, each measure lasted 1 sec. spaced by 1-sec. intervals. In all, 10 subsequent measures were obtained during 20 sec. of presentation of each slide. The myographic measures at rest were carried out after a 5-min. relaxation, always before the presentation of the slides.

The subject was given the following instructions: "This is an experiment about the perception of images. Now I show you some slides of facial expressions. All that is required of you is to observe these slides."

During rest the experimental room was lighted diffusely (ft-c = 2.50); during the presentation of the slides the light of the room was 3.50 ft-c, an increase in the light from the stereopticon, only because the subject looked at the stereopticon light.

Stimuli

The slides presented to the subjects reproduced three different facial expressions: the first slide showed a face with raised eyebrows and a wrinkled forehead; the second showed a face with raised skin on the chin and protusion of the lower lip; the third showed a face with the eyes turned to the right.

RESULTS

The mean variations of the levels of the myographic tension of the mentalis muscle (arbitrary units) at rest and during the 20 sec. of presentation of the slides are shown in Table 1. In addition, standard deviations of these values are indicated. As can be seen, while the values for the mentalis muscle corresponding to the slides "forehead" and "eyes" are relatively similar, those corresponding to the slide "chin" show a biphasic response: from the third measure an increase of muscular tension appears which persists until the last measure. In fact, while there are no statistically significant differences ($p > 0.05$) among the subsequent 10 measures of the means of "forehead" and "eyes", as regards that for "chin" the second measure is statistically significantly different from the fifth, the sixth, seventh, and ninth measures (t for dependent means are respectively −2.37, −2.59, −2.09, −2.26; $df = 34$, $p < 0.05$). This last datum is also confirmed by the F ratio for repeated measures applied to the second, fifth, and seventh measures ($F_{2,35}$

TABLE 1

MEANS AND STANDARD DEVIATIONS OF SINGLE MYOGRAPHIC MEASURES OF MENTALIS MUSCLE IN ALL SUBJECTS AT REST AND AFTER EACH VISUAL STIMULUS

Measures		Rest	Visual Stimuli		
			Chin	Forehead	Eyes
1	*M*	184.80	166.69	163.02	159.47
	SD	190.40	180.32	165.69	175.64
2	*M*	180.25	161.38	167.75	159.94
	SD	179.60	170.23	163.78	169.62
3	*M*	188.94	175.22	168.22	163.94
	SD	183.30	174.12	165.77	172.87
4	*M*	194.38	173.91	164.75	165.00
	SD	183.83	173.87	167.63	177.61
5	*M*	177.47	179.61	170.86	164.97
	SD	184.59	177.13	171.34	169.11
6	*M*	184.83	180.86	173.05	164.88
	SD	187.50	179.93	173.74	164.72
7	*M*	182.08	178.91	158.94	165.58
	SD	185.50	180.81	166.22	165.11
8	*M*	187.94	178.75	166.80	163.66
	SD	177.99	180.62	170.68	163.53
9	*M*	187.88	178.33	167.19	166.27
	SD	180.22	172.05	172.19	164.79
10	*M*	189.22	177.97	163.41	169.88
	SD	182.08	181.68	166.52	163.89

Note.—Units are arbitrary.

$= 4.45, p < 0.05$). Moreover, there are no statistically significant differences among the myographic scores of mentalis muscle obtained in response to the different slides.

DISCUSSION

We hypothesize that the decodification of facial expressions takes place through a process of imitation from the decoding subject. However, we think that, when it happens, this process must be of little substance. Also the results obtained by Dimberg (1982) can be interpreted in accordance with our hypothesis. This author pointed out that images of happy and angry facial expressions evoked, respectively, an increase in zygomatic and corrugator muscles' activity. The data of Dimberg (1982) refer essentially to responses to positive and negative emotional stimuli. This author hypothesized that the myographic responses from the decoding subject depend on carrying out patterns of emotional expressive type. In this case it would be an emotional response to particular stimuli which we can interpret as a response of imitative-reproductive type, though the author does not affirm it.

On the contrary, we pay attention to some pecularities of the cognitive process. In fact we hypothesize some links between cortical areas of visual decodification, points of arrival of visual patterns, and areas of motor responses in which facial expressive patterns are programmed. By virtue of these links the decodification of particular external signals is enriched with a somatic activity of response. Such a response would produce proprioceptive reafferences which would be added to the initial sensorial visual afferences. Such functional schema, following the James-Lange theory of emotions, refer not only to emotional process but also to the process of simple recognition. Our hypothesis is that the process of recognition is extended by utilizing components of bodily responses: so the recognition becomes experiential. An emotional response is nothing but an enlargement of this schema to which are added components of subjective feelings. Obviously this supposed process would be automatic and the subject should not be aware of it. In other words, the imitative-reproductive process of the stimulus pattern is not usually macroscopically evident.

All this reasoning is useful to discuss our results. In our research we showed the subject slides reproducing different facial attitudes and measured the variations of the activity of mentalis muscle in response to each slide. The myographic variations, according to our hypothesis, appear after the presentations of the stimulus pattern and engage the same measured muscle (the muscle of the chin). In fact, after the presentation of the slide representing the lifting of the lower lip with modification of the skin of the chin, an increase of the myographic level of the mentalis muscle appears from the third second onwards of the presentation of the stimulus. The increase of the myographic score is statistically significant ($p < 0.05$) compared to the first period of the response (Seconds I and II). The subject would reproduce the stimulus pattern. Such a trend does not appear for the myographic scores of the same muscle of the chin after the presentation of the other slides showing facial expressions with poor engagement of the muscle of the chin. So, in some way, these data confirm our hypothesis. However, the limit of our results is no statistically significant differences for the myographic scores of the mentalis muscle in response to the different slides, but we think this makes sense because the phenomenon can be but little manifest. Even with this limit our results deserve further extension and verification.

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