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INTERACTIVE EFFECT OF SELF-EFFICACY AND INCENTIVE VALUE ON PERIPHERAL PHYSIOLOGICAL REACTIVITY IN THE PERFORMANCE OF A COGNITIVE TASK

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Interactive effect of self-efficacy and incentive value on peripheral physiological reactivity in the performance of a cognitive task. The aim of the present experiment was to determine whether both self-efficacy and incentive value exert their effects on autonomic and somatic physiological reactivity in an interactive manner. 32 subjects were assigned to 4 groups resulting from combining two conditions of self-efficacy manipulation (high and low) with two conditions of incentive value manipulation (high and low). All the subjects completed a computer-aided word-chaining task, which involved verbal responses. 4 physiological variables were measured: respiratory and heart rate, electrodermal resistance and electromyography of frontalis muscle. Results suggest that both self-efficacy and incentive value partially determine autonomic reactivity manifested in situations of active coping, exerting their effect interactively. It also appears that incentive value modulates the functional relationship between self-efficacy and autonomic reactivity. However, these cognitive variables appear to determine somatic activity (in this study, represented by frontalis electromyography) in a non-interactive manner.

El presente experimento tenía por objeto verificar el supuesto de interacción entre la autoeficacia y el valor del incentivo sobre la reactividad fisiológica periférica (autonómica y somática). 32 sujetos fueron asignados a los 4 grupos experimentales que surgen de combinar 2 condiciones de manipulación de la autoeficacia (alta o baja) con 2 condiciones de manipulación del valor del incentivo (alta o baja). Todos los sujetos efectuaron una tarea de concatenación de palabras asistida por ordenador y que implicaba respuestas verbales. Se registraron 4 variables fisiológicas: frecuencia respiratoria, frecuencia cardiaca, resistencia electrodermal y actividad mioeléctrica frontal. Los resultados sugieren que la autoeficacia y el valor del incentivo determinan, en parte, la reactividad autonómica manifestada ante una situación de afrontamiento activo, produciendo su efecto de manera interactiva. Ello parece indicar que el valor del incentivo tiene un papel modulador de la relación autoeficacia-reactividad autonómica. Sin embargo, sobre la actividad somática, representada por la electromiografía frontal, tales variables parecen ejercer un efecto no interactivo.

Bandura (1977, 1986) defines *self-efficacy* as the capacity perceived by an individual to successfully execute a given behaviour. Consequently, it is a cognitive construct that contrasts instrumental behaviour demands with personal capacities.

In Bandura's Cognitive-Social Theory (1986), another construct appears: *outcome expectancy*, which refers to what the subject believes are the likely consequences of the execution of the behaviour. Thus, it is a concept that relates behaviour with contingent stimuli. This concept is in some way comparable to Tolman's concept of expectancy, though wider, given that it can contain within it various parameters involved in stimuli evaluation: the probability that they occur as a consequence of a given performance level in operant behaviour, the quantity of stimulation that will appear, the nature of such stimulation, and the reinforcing capacity of the stimulus at that moment (Sanz, 1994). It is precisely the amplitude of the results expectancy concept that causes it to overlap with the concept of *valence* or *incentive value*, which can be defined as the quantity of attractiveness or aversion triggered by a given stimulus (Brehm and Self, 1989). Those parameters which make up outcome expectancy are not functionally comparable in their effects (mainly motivational) on the determination of behaviour (Wright and Dill, 1993). It is for this reason that the present research focuses exclusively on the study of just one of these components, *incentive value*, assuming that its effect on

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determining peripheral physiological reactivity cannot be extrapolated to the whole set of outcome expectancies.

A number of works support the idea that self-efficacy determines -through the modulation of sympathetic activity- the peripheral physiological reactivity that subjects show before executing an instrumental behaviour (Bandura, Reese and Adams, 1982; Bandura, Taylor, Williams, Mefford and Barchas, 1985; O'Leary, 1992; Wiedenfeld, O'Leary, Bandura, Brown, Levine and Raska, 1990), a non-monotonic relationship being established between the two: the lower the self-efficacy, the greater the peripheral physiological response, except in the case of a low enough self-efficacy to make the subject renounce the execution of the behaviour, a case in which physiological reactivity is minimal.

From a different theoretical perspective, Wright, Shaw and Jones (1990) have apparently shown that incentive value and the *perception of task difficulty* have an interactive effect in the determination of autonomic reactivity: when incentive value is high, an increase in task difficulty implies greater physiological changes (heart rate and systolic pressure); however, when incentive value is low, task difficulty seems to have no significant effect on autonomic reactivity.

Some studies also suggest that task difficulty tends to establish its sympathetic-modulating effect in an interactive manner with other variables, such as *ability perception* (Wright and Dill, 1993): when the difficulty of carrying out a rewarded task is moderate, subjects showing greater physiological changes are those with low ability perception, but if the difficulty is very high, subjects with low ability perception are those who put fewer resources into behaviour and, consequently, experience fewer physiological changes.

However, this assumption of an interactive effect on autonomic reactivity has not been taken into account in those studies made from Bandura's Cognitive-Social Theory perspective, even though it postulates an interaction effect between self-efficacy and expectation of results on motivational and affective processes underlying behaviour (Bandura, 1982; Villamarín, 1987). It would not be surprising if physiological adjustments involved in such psychological processes also arose from this interaction.

Hence, the hypothesis being tested is that *the effect of self-efficacy and valence of result (or incentive value) on physiological reactivity in the execution of a task occurs in an interactive manner*. Additionally, we state two sub-hypotheses:

a) There should be an inverse proportional relation between self-efficacy and peripheral physiological reactivity when consequences attributed to a given level of behavioural success are highly reinforcing.

b) However, in a situation of lack of behavioural meaning with respect to the attainment of highly reinforcing stimuli, it can be expected that self-efficacy would not determine the physiological reactivity level, if this reactivity implies an adjustment proportional to the level of motivation and, hence, of effort and persistence that the subject will invest in the successful execution of the behaviour.

In other words, self-efficacy should determine peripheral physiological reactivity only when task circumstances are relevant.

Physiological changes analysed in this study are all those adjustments produced in the registered variables from the moment in which the subject acknowledges the possibility of executing a rewarded behaviour until behaviour is completed. Among them, we can differentiate at least two components: *(a)* changes produced in the waiting time prior to the start of the instrumental behaviour, related to a steady state, or *anticipatory reactivity*, and *(b)* physiological changes specifically generated during the completion of behaviour, related to anticipatory moments, or *consummatory reactivity*. Here we intend to study the global effects of self-efficacy and incentive value on physiological reactivity in an active coping situation (Obrist, 1976); hence, physiological reactivity has been quantified so that the parameters generated indicate the joint effect of the two reactivity components (anticipatory and consummatory) previously mentioned. Thus, the present paper does not aim to analyse the differential effect of the two cognitive variables on each of the reactivity components (or phases), although -as we will see- there is evidence to suggest that specific adjustments occur in each phase.

METHOD

Subjects

A total of 79 subjects, from a total population of 340 first-year students in Psychology at the Universidad Autónoma of Barcelona participated in this research.

The 79 subjects were called together for a previous session, and a set of variables necessary for selecting the sample to participate in the experimental session were quantified. 35 subjects were selected, though only 32 were considered in the data analysis. All 32 subjects were women between 18 and 35 years old (mean age = 20.6 years). They all formally agreed to participate in the study.

Instruments

1) *Questionnaires*. Two questionnaires were developed, (a) *Selection Protocol,* which contained questions about the variables allowing refinement of the sample and about the task (word-chaining), and (b) the *experimental protocol*, in which experimental control variables and post-manipulation self-efficacy were registered. Self-efficacy was measured through a 0 to 100 scale, and registration depended on the answer to the following question: "*On a scale from 0 to 100, where 50 means you have an ability to carry out a word-chaining task equal to the average person participating in the experiment, what do you think is your capacity for performing the task?"*

2) *Apparatus*. The following equipment was used:

A Jeppsen compatible microcomputer, 486 microprocessor, equipped with an experimental task control programme named *LINGUA*, specifically devised by the authors for the present purposes.

A Bondwell, 286, compatible microcomputer, equipped with the Notebook programme for registering and storing scientific data.

A Letica ISO-505 breath frequency amplifier, and a plethysmograph for registering thoracic volume change by deformation.

A Letica EMG-905 myoelectric activity amplifier, and a set of Ag-AGCl 25 mm. electrodes (two active, one referential).

A Thought Technologies HR-BVP 101T heart rate amplifier and a finger plethysmometer.

A Letica GSR-200 Skin Resistance Amplifier, and a pair of Ag-Ag-Cl 2 cm^2 electrodes.

An analogical-digital unipolar converter (0-5 volt range) connecting the 4 amplifiers to the registration computer.

Laboratory

The laboratory was composed of two rooms connected by a door and a two-way mirror. Inside a noise-free experimental room, subjects were seated in a lean-back armchair in front of the task computer screen. All the equipment for data registration was located in the control room.

Procedure

1) *Selection Session*. This was run in groups of 10 and 20 subjects for the following purposes: (a) to evaluate a set of variables affecting peripheral physiological activity in order to obtain a homogeneous sample, thus reducing physiological variability not attributable to experimental manipulation, and (b) to detect those subjects most susceptible to self-efficacy manipulation in the particular task to be executed in the experiment. Selection of experimental subjects was made using these variables. After refinement of the initial 79-subject sample, 35 were finally selected for the experimental session.

2) *Experimental Session*. This was carried out individually and lasted about 50 minutes. The subject was comfortably seated in a lean-back armchair in front of the computer screen. After setting all the electrodes in a standardised position for registration of the 4 physiological variables (breath rate, skin resistance, frontal electromyography and heart rate) the base line registration was carried out over a 5-minute period (it began after subject had been in the experiment room for 20 minutes). Immediately afterwards, subjects were informed about the task to be performed (2 min.). The next steps were (1) *manipulation of incentive value* and (2) *manipulation of self-efficacy* (2 min.). These were followed by physiological registration of anticipatory reactivity (4 min.) and evaluation of self-efficacy. Next, the computer initialised the task, which lasted for 7 minutes 30 seconds. During task execution, the four physiological variables were continuously registered.

Task

The task consisted of a word-chaining speed test. Subjects were presented with a set of words and asked to produce, as fast as possible, a word beginning with the same letters as the last syllable of the presented word. Subjects completed the task in two different ways and at two different times:

During the *selection session*. Answers were written and permitted (a) selection of experimental subjects, and (b) justification of the false feedback about their performance, in order to manipulate self-efficacy.

During the *experimental session*. Answers were verbal, so that it was a kind of behaviour virtually devoid of motor activity. Subjects responded through a false microphone, and had a time limit (8 sec.) for answering before a "STOP" signal was presented. 20 trials were carried out.

Variables

1) *Independent Variables: experimental manipulation*. The two independent variables involved in this research were: *Incentive Value* and *Self-efficacy*.

Subjects had been randomly assigned to one of two possible conditions: high valence (n=17) and low valence (n=15). If the subject was assigned to the high valence condition, the experimenter would tell her that, if she reached the success criterion (to be among the best 15% of subjects in the word-chaining task) she would be rewarded with 4,000 pesetas (35$). Subjects with a low incentive value were told that if they reached the same success criterion, they would receive a "symbolic reward" (a sandwich and a soft drink).

Subjects had also been randomly assigned to one of the two conditions: high self-efficacy (n=18) and low self-efficacy (n=14). Manipulation was made by using false feedback about performance in the word-chaining task completed in the selection session. The experimenter had prepared a sheet on which appeared a percentage value supposedly corresponding to the subject's ability in the task in comparison to the other participants. If the subject belonged to the experimental high self-efficacy group, the number shown on the paper ranged between +21% and +24%, which, she was told, *"means that you have an ability to perform word-chaining speed tasks higher than the average of the participants"*. A value between -17% and -19% was presented to subjects in the low self-efficacy group, and they were told that *"your ability to perform word-chaining speed tasks is lower than the average of the participants"*.

2) *Dependent Variables*. Four physiological parameters, corresponding to 4 different organic systems, were chosen as dependent variables: breath rate, skin resistance, heart rate, and frontal myoelectric activity. These 4 parameters were chosen due to the fact that the effects of self-efficacy and incentive value (and their interaction) on different physiological parameters may not necessarily be identical. In our view, assuming, as an *a priori* postulate, that the effects observed in a particular variable are representative of unspecified physiological reactivity is rather risky. Moreover, it is of interest to have at one's disposal some physiological measures related to one of the two peripheral nervous control systems, the Autonomic N S (heart rate and skin resistance) and the Somatic NS (frontal myoelectric activity), or to both (breath rate may be considered a special case, since it receives both somatic and autonomic control) (Kaufman and Schneiderman, 1986).

The four variables were simultaneously and continuously registered during the three phases (base line, anticipatory and task) at a 1 Hz frequency.

3) *Control of Variables*. A selection of subjects participating in the experimental session was made. A subject was selected as a member of the experimental sample if she had the following values in the homogenisation variables (Ebbesen, Prkachi, Mills, D. and Green, 1992; Johnson and Lubin, 1972; Lane, Adcock, Williams and Kuhn, 1990: Prokassy and Raskin, 1973): (a) tobacco consumption lower than 6 cigarettes a day, (b) psychostimulants consumption lower than 4 units a day, (c) alcoholic drinks consumption lower than 0.25 litres a day, (d) physical activity rate lower than 15 hours a week, (e) no psychotropic drug consumption, (f) no pathologies related to the autonomic nervous system, and (g) female.

In addition, subjects were selected if their scores were between 15% and 85% of the sample distributions in (a) self-efficacy, (b) effort level and (c) real performance level in the task (when it was performed during selection session), since manipulation of self-efficacy would be more likely with these subjects (Bandura, 1986; Sanz, 1994).

Design

A factorial 2x2 independent variables design was used (self-efficacy, high and low, and incentive value, high and low) on 4 dependent variables (breath rate, skin resistance, myoelectric activity and heart rate). Thus, there were 4 experimental groups with the same behavioural requirements but with different cognitive profiles: high self-efficacy - high valence, high self-efficacy - low valence, low self-efficacy - high valence, and low self-efficacy - low valence.

RESULTS

A) *Test for manipulation of self-efficacy.* Before applying data analysis for verifying the interaction hypothesis, the success obtained in the manipulation of self-efficacy was determined. Comparison of means in the post-manipulation self-efficacy questionnaire shows that subjects in high self-efficacy condition presented higher values (M=61.1) than subjects in low self-efficacy conditions (M=43.9; t=4.13; p< 0.0005).

Success in manipulation of incentive value could not be determined, since no scale was devised to properly evaluate it.

B) *Effect of self-efficacy and incentive value on physiological variables*. Before analysing the physiological data, two transformations were made. Firstly, the averages of the values of the 4 physiological variables within each of the 3 registration phases were calculated. Secondly, values corresponding to the task completion phase were transformed to percentage change with respect to baseline value, this parameter being that which reflects global physiological reactivity (anticipatory and consummatory). As an extra parameter, the percentage change from baseline in the anticipatory phase was obtained. Proof that the percentage change during execution of behaviour phase with respect to baseline is a global variability indicator, and hence includes physiological changes generated during behaviour execution, as well as those produced in anticipatory moments, is the strong correlation existing between these two last parameters in the 4 physiological variables (breath rate: r=0.79, p<0.01); heart rate: r=0.77, p<0.01; frontal myoelectric activity: r=0.55, p<0.01; skin resistance: r=0.81, p<0.01).

Data were submitted to a univariant analysis of variance, given our interest in studying separately self-efficacy and incentive value effects on each of the four physiological variables. The data obtained from this analysis is shown in Table 1.

With regard to *breath rate,* the ANOVA shows the existence of an interactive effect of self-efficacy and incentive close to statistical significance. When an analysis of simple effects was made, a statistically significant effect of self-efficacy was found in high incentive subjects F (1,28) = 4.55; p= 0.04: while high self-efficacy subjects decreased their breath rate by 5.2 % with respect to baseline, low self-efficacy subjects increased their breath rate by an average 14.2 %. No statistically significant effect was found in low incentive subjects. Nor was there an effect of breath rate in the sample as a whole.

ANOVA on heart rate values shows an interactive effect between self-efficacy and incentive value. When this interaction was analysed a simple effect of self-efficacy was found in low incentive subjects: high self-efficacy subjects show greater heart reactivity (M=19.6 %) than those with low self-efficacy (M=7.3%) when faced with the task (F(1,24)=5.14, p=0.03). No significant differences were found among high incentive subjects. A main effect of heart rate in the total sample was also found (M=15,1 %; F(1,28)=43.75, p<0.0005).

ANOVA on *myoelectric reactivity*, with respect to the global reactivity index, shows the presence of a self-efficacy main effect, with low efficacy subjects showing a greater increase (M=57.5 %) with respect to baseline than high self-efficacy subjects (M=22.2 %; F(1,28)=4.51, p<0.04). No significant effect of valence on myoelectric activity was found, nor any interactive effect between the two factors. In addition, there is a muscular activation effect in the total sample (M=38.4 %; F(1,28)= 9.98, p<0.004).

There is no significant effect, nor interactive nor main effect, of self-efficacy and incentive value on *skin resistance* in task execution. There is, however, a decreasing main effect with respect to baseline in the total sample (M=-28.5%; F(1,27)=93.78, p<0.0005).

What the above-described statistical analysis appears to suggest is that the interactive effect only occurs with certain variables. In particular, the interactive effect of self-efficacy and incentive value is demonstrated in breath and heart rates. However, frontal myoelectric activity and skin resistance do not appear to be determined by any interactive effect between the two cognitive variables, although for different reasons: while there are main effects of self-efficacy in myoelectric activity without any suggestion of interaction, skin resistance does not seem to be modulated in any way by either self-efficacy or incentive value. However, a trend towards interaction can be observed, which merits more detailed study. When carrying out the data analysis corresponding to the anticipatory stage, where the pattern of averages is exactly the same but there are more marked differences between averages than in global reactivity, it can be detected that the interaction between self-efficacy and incentive value is closer to significance level. When an analysis of simple effects was made, self-efficacy was shown to be significant for high incentive cases: subjects with high self-efficacy show less electrodermal reactivity (M=15.6%) than low self-efficacy subjects (M=26.3%; $F(1,27)=3.87$, $p<0.06$). If skin resistance values are compared (global and anticipatory reactivity), an identical structure is detected, with subtle differences among experimental groups in global reactivity, due to a variance increase and a slight convergence of values with regard to the anticipatory phase; both factors may explain the fact that differences between groups did not show up as significant, when they were significant in the analysis on anticipatory reactivity. This leads us to consider that changes caused by self-efficacy and valence on skin resistance are almost exclusively produced during the anticipatory stage; hence, such anticipatory changes may be taken as representative of global changes generated in this variable.

On analysing myoelectric changes during the anticipatory phase, an interactive effect can also be found: in the case of high incentive subjects, those with higher self-efficacy increase their myoelectric activity (M=15.6%), while those with low self-efficacy decrease it (M=-2.1%); inversely, in the case of low incentive value, those with high self-efficacy decrease their myoelectric activity with respect to baseline (M=-7.9%), while low self-efficacy subjects increase it (M=11.3%; $F(1,28)=3.89$, $p=0.05$).

Table 1

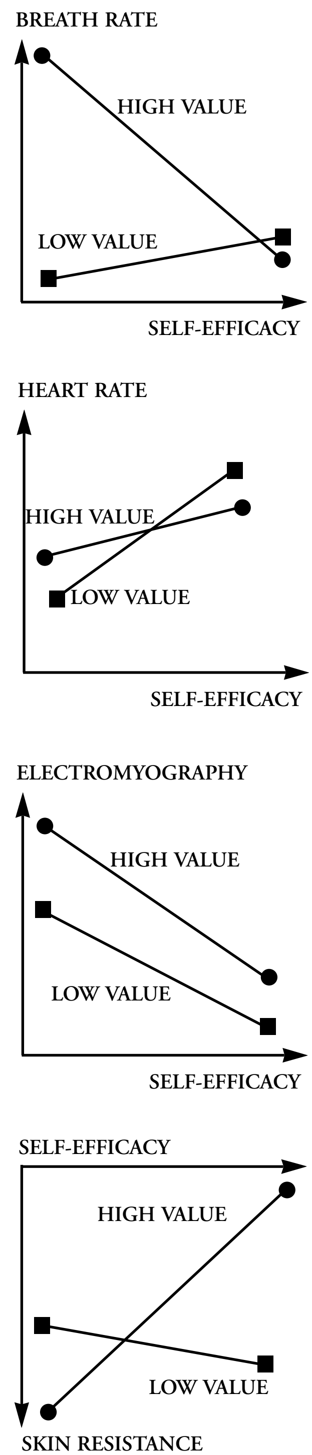
Global or anticipatory changes in the four experimental groups, expressed in percentage change with respect to baseline (Legend: BR breath rate; HR heart rate; EMG: frontal electromyography; SR: skin resistance. HSEF: High self-efficacy; LSEF: Low self-efficacy; HI: High incentive; LI: Low incentive)

	HSEF-HI	HSEF-LI	LSEF-HI	LSEF-LI
Global BR	-5.2 %	-3.8 %	14.2 %	-6.6 %
Global HR	16.5 %	19.6 %	11.5 %	7.3 %
Global EMG	33.5 %	13.2 %	65.9 %	42.4 %
Global SR	-24.9 %	-29.1 %	-31.7 %	-30.4 %
Anticipat. SR	-15.6 %	-22.2 %	-26.3 %	-21.3 %
Anticip. EMG	15.6 %	-7.9 %	-2.1 %	11.3 %

DISCUSSION

Before entering into a deeper analysis, the initial macroscopic observation that can be derived from the graphics (Figure 1) is that one of the 4 experimental groups, that with high incentive value and low self-efficacy, is notable for the high magnitude of its physiologi-

Figure 1



cal changes. Apparently, those subjects believing themselves to have a low capacity for instrumental behaviour, and attributing great importance to the consequences of behavioural success, are those that present higher peripheral activation when confronted with the execution of the behaviour with respect to which they show this cognitive pattern. This rule has a clear exception in heart rate, which -as we mentioned above- does not fit with the predictions made in sub-hypotheses a) and b).

On visual analysis of the results (Figure 1), a common trend is observed in the three parameters controlled by the autonomic nervous system (skin resistance, heart rate and breath rate -the last-named also being under somatic control). It can be seen how the slopes of the straight lines generated for groups of subjects with high and low valence are different. This causes the functions of self-efficacy on reactivity in the three parameters autonomically measured to diverge among groups of different incentive value. Thus, graphical analysis suggests that this parameter modulates the relationship between self-efficacy and autonomic reactivity.

With regard to the statistical analysis, it also seems that the assumed interactive effect between self-efficacy and incentive value on global physiological changes (anticipatory and consummatory) involved when faced with the execution of a cognitive task is verified in the three variables controlled by the autonomic nervous system (heart rate, breath rate and skin resistance). However, this contrasts with the results obtained in frontal myoelectric activity, which confirm the existence of an inverse proportionality effect of self-efficacy, and the trend (non-significant) to a direct proportionality effect of incentive value. Thus, muscular reactivity seems to be modulated by both factors, but in an additive (not interactive) manner. The different ways in which the two cognitive variables tend to exert their activating effect on muscular activity, on the one hand, and on heart rate, breath rate and skin resistance on the other, may be an indicator that such regulation affects differently the autonomic nervous system and the somatic nervous system; it should be pointed out that breath rate behaves in the same way as the variables under autonomic control with regard to the effects on it of self-efficacy and incentive value.

It thus appears to be confirmed, as Obrist suggests (1976), that there is some divergence between the control exerted by the central nervous system on autonomic activity and on somatic activity in this active coping situation. In view of these results, we suggest that self-efficacy and incentive value participate in this dissociated control.

However, such a statement may be considered somewhat general and vague, if we take into account that, probably, these reactivity effects attributable to the two cognitive variables are not produced in every situation. In particular, statistical analysis suggests that muscular tone may also be determined by the interaction between self-efficacy and incentive value, even though this not a general effect, but exclusive to the anticipatory component. It is not the intention of the present work to make a comparison between anticipatory and consummatory reactivity, but results seem to indicate the convenience of making a functional distinction between the two stages, at least with regard to myoelectric activity.

Thus, data analysis and observation from the graphics mostly suggest the need to consider simultaneously the two cognitive factors, since most of the changes operated by self-efficacy on physiological reactivity differ depending on the relevance of the consequences of behavioural execution.

The omission of this second factor may explain why, in the literature on the effect of self-efficacy on physiological reactivity (Bandura et al., 1982; Bandura et al., 1985; Barrios, 1983; Biran and Wilson, 1981; Feltz, 1982; Feltz and Mugno, 1983; Wiedenfeld et al., 1990), contrasting results are found; the explanation for this may stem from the use of subject samples that are not comparable in their perception of the magnitude of incentives associated with behavioural execution. This lack of consideration of the parameters involved in the expectancy of results may explain why, in some studies, no relationship between self-efficacy and physiological reactivity is found; in fact, as has been empirically shown, if we had considered self-efficacy as the only independent variable, we would only have detected a significant effect of it on global myoelectric reactivity (not on anticipatory activity), though in the sense of inverse proportionality initially postulated by Bandura (1977).

A similar conclusion was reached by Wallston (1992; Fernández and Edo, 1994) in a recent theoretical work in which research generated on the cognitive construct of *Health Locus of Control* is critically reviewed. According to Wallston, a high score on *internality* dimension (a variable related to self-efficacy, since they both belong to the group of concepts about *perceived control*), only determines the execution of behaviours (in this case, those promoting health) in those subjects in which behavioural consequences (health) are evaluated as highly relevant; this is why few significant relationships are found between internality and health behaviour in those studies in which incentive value was not quantified. Even though Wallston (1992) concludes that a generalised expectancy such as internality is not a good predictor of behaviour in itself, he insists on the need to study the effect on behaviour of this and other more specific constructs of perceived control (such as personal competence and self-efficacy), starting from the assumption that they exert their influence by interacting with incentive value.

The two mentioned sub-hypotheses do not appear to be strictly confirmed in the set of autonomic variables. As expected, self-efficacy presents an inverse proportionality relation to breath rate and skin resistance only when incentive value is high, and it does not seem to generate differences in reactivity when incentive value is low. In clear contrast to the above, heart rate is regulated by an interactive effect, but in the opposite direction: self-efficacy appears to determine heart rate reactivity only when incentive value is low. In addition, it is convenient to remark that obtained results on heart rate do not fit with the inverse proportionality relation suggested by Bandura, given that, in subjects with low valence, greater heart rate is found among those with higher self-efficacy, and the same trend (although not reaching significance level) is detected among subjects with high valence. All of this leads us to make the following considerations:

-There are some indicators that the interactive effects of self-efficacy and incentive value are not identical for each of the autonomic variables.

It is obvious that Bandura's postulate is based on empirical data from a different paradigm, with a different kind of task; it is supposed that the physiological adjustments required by the two types of situation would not necessarily be the same, since the demands for each of the tasks are different.

In particular, in the instrumental behaviour required of our subjects, a high behavioural success necessarily implied a high attentional level. It is well known that a high attentional demand reduces heart rate through vagal parasympathetic activation (Vila y Fernández, 1990; Edo, 1991). Thus, it seems reasonable that those subjects feeling partially (not absolutely) incapacitated to perform the behaviour try to compensate this inadequacy with an increase of effort which, in the present task, must imply an attentional increase and a consequent heart rate deceleration. An indicator of the greater effort made by subjects is the higher electromyographic reactivity shown. As it may be noted, the same factor (effort level, only postulated as an explanatory factor, since it was not registered during the experimental session) could explain divergent effects of self-efficacy on two different physiological parameters.

Thus, in the light of the present data, and considering previous comments, we suggest that autonomic activation in this active coping situation would not be exclusively sympathetic. As previous work on the concept of *autonomic space* suggests (Bernston, Cacioppo, Quigley, 1993**;** Bernston, Cacioppo, Quigley and Fabro, 1994; Cacioppo, 1994), autonomic changes underlying an adjustment in heart rate when faced with a task may imply various combinations of sympathetic-parasympathetic activation. The suspicion of a dominant parasympathetic activity which could explain the heart rate adjustments observed here, however, contrasts with Obrist's (1976) postulate that, in such active coping situations, heart rate control is primarily sympathetic.

On the other hand, our results, considered globally, are similar to those found by Wright and collaborators (Wright and Dill, 1993; Wright and Gregorich, 1989; Wright et al., 1990; Wright, Williams and Dill, 1992) in that variables referring to the evaluation of behavioural demands, and of the incentives contingent upon them, usually exert their effect in an interactive manner. Our results seem to partially fit with Brehm and Selfs' (1989) cardiovascular reactivity model, also defended by Wright and collaborators. According to this model, it should be expected that a subject exposed to a difficult task and attributing high importance to success in its execution would show greater cardiovascular reactivity than a subject exposed to a difficult task but giving low relevance to success in its execution. Our data seem to indicate that, analogously, subjects with low self-efficacy and high incentive value show greater reactivity in the four physiological variables than subjects with low self-efficacy and low incentive value. However, according to this model, cardiovascular differences should not be expected among subjects exposed to tasks with different instrumentality (high or low) when task difficulty is low; our data, however, suggest that, in the high self-efficacy condition, it is the subjects with lower incentive value who show greater reactivity in the three variables under autonomic control (breath rate, heart rate and skin resistance). In any case, it should be borne in mind that we are comparing parameters that are not strictly identical, but merely related, and that this may explain the lack of complete fit with the above-mentioned model; moreover, the model refers only to cardiovascular activity, while our study, in terms of the physiological field, is wider.

Up to now we have made an interpretation of the physiological changes detected in motivational terms. According to Brehm and Self's model (1989), cardiovascular adjustments produced when faced with a task are the manifestation of the quantity of effort and, thus, of the energy resources that subjects put at the disposal of instrumental behaviour. This effort is proportional to task difficulty and the perception of ability to perform it, there being a maximum limit of effort (called *potential motivation*) and, consequently, of physiological activation, determined by the multiplied effect of three factors: need, incentive value, and behaviour instrumentality.

However, it does not seem to us completely justifiable to attribute all the physiological changes observed in our study to the energy consumption demands of the execution of behaviour, since the task completed by the subjects involved very low-intensity and localised muscular activity, and considerable cognitive activity of a linguistic nature; neither of the two activities explains the great physiological adjustments observed in the total group of subjects in our experiment; thus, such changes cannot be exclusively explained in terms of preparation for action.

A part of the changes should probably be understood as being related to emotional-type processes. In fact, as mentioned at the beginning of this report, Bandura (1982, 1986) proposes that each one of the combinations of self-efficacy and expectancy of results generates a particular affective state. This is coherent with the fact of finding, additionally, physiological changes determined interactively by the two factors. We therefore suggest that future research in this area should consider the analysis of emotional processes that may underlie the physiological changes detected.

Also, in order to study physiological reactivity as a system of adjustment to behavioural demands, the congruence of such changes with subject's level of performance and effort should be determined.

Within this prospective final analysis, it is appropriate to make a further methodological comment. Results obtained in this research demonstrate that the experimental operation aimed at manipulating incentive value (verbal instructions) partially determined physiological changes shown by subjects; however, is not possible to state firmly that this was necessarily due to the effect of manipulation on the perceived incentive value: it could well have been due to the effect of such manipulation on other cognitive variables not properly detected. Thus, it seems necessary to include, in future research, instruments for the evaluation of perceived incentive value.

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