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# TWO DIFFERENT EXPLANATIONS FOR THE ALTERATION OF PERFORMANCE ON HIGH LEVELS OF ACTIVATION

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*In experiments on the level of aspiration during sports activities the correlations between series of predictions and series of subsequent performances, computed for single subjects, were generally positive in shot putting ($r = 0{,}25$), but negative in a pilot study with shooting ($r = -0{,}29$). The predominance of low or even negative coefficients in subjects with high goal discrepancies and weak performance within their reference group (Fenk, 1981) may be interpreted in terms of the [shaped] function between levels of activation and performance, with shooting being more susceptible to a decrease in performance in moments when activation rises beyond an already (« habitually ») heightened level (Explanation I).*

*Some other authors explained comparable findings — interindividual differences in the direction of performance alteration in situations involving stress (e. g. distracting activities) — not (only) on the basis of different intensities but different qualities of motivational states (Explanation II).*

*Mechanisms proposed in these 2 explanations are not mutually exclusive. But while emotional « colouring » of arousal and its effects upon performance are largely unknown processes, there is increasing evidence for Expl. I regarding interindividual differences in the amount of arousal in a specified situation and in the « habitual » level of activation, as defined in psychological, hormonal and electrophysiological measures.*

## INTRODUCTION

The object of this paper is to present some results of a previous sport-psychological experiment [5] and to confront the explanatory power of the interpretation given (Expl. I) with that of another interpretation (Expl. II) of comparable findings (e. g. 14). The results to be explained is that the demand or the motivation for higher performance in a specified situation may lead to higher performance in some persons and to lower

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performance in some others. Both explanations for this result are derived from a psychophysiological theory of activation (e. g. 27, 28), but differ in what has to be regarded as the decisive factor: The intensity of activation, which is curvilinearly related to performance and varying between subjects in a specified situation (Expl. I), or different types of motivational and emotional colouring of activation respectively (Expl. II).

The experiment [5] should, with a more elaborated method, test an assumption which can be drawn from classical experiments [22] on the level of aspiration (= AL): A subject's prediction of his own performance depends upon cognitive components (mainly estimation of previous performance) as well as motivational components. Moreover, these motivational components — setting goals for the next attempt — were expected to have (« retroactive ») effets upon performance.

The relevant question here ist the direction in which « high » ALs (high in relation to the ALs of other subjects; high in relation to a subject's capacity) influence performance in different types of performance and in different subjects.

## Method

The effects of goala-serting upon performance can be analysed in two different ways:

1. Isolating strength of motivation to some extent (from cognitive components of AL) and relating it to the momentary performance.

2. Using goal-discrepancy data as a measure for « need for achievement ».

Subjects were asked to perform a series of sports activities, to do their best in this performance and in predicting precisely the performance of the forthcoming trial. (Pilot study: shooting; 4 students with 2, 1 student with 1 series of 40 trials. Main experiment: shot putting; 29 soldiers, each with 1 series of 25 trials).

Predications were correlated with results of preceding trials (= $r_1$, indicating the influence of experience upon predictions) and, more relevant for the question at hand, with results of subsequent trials (= $r_2$, indicating the influence of goal-setting upon predictions).

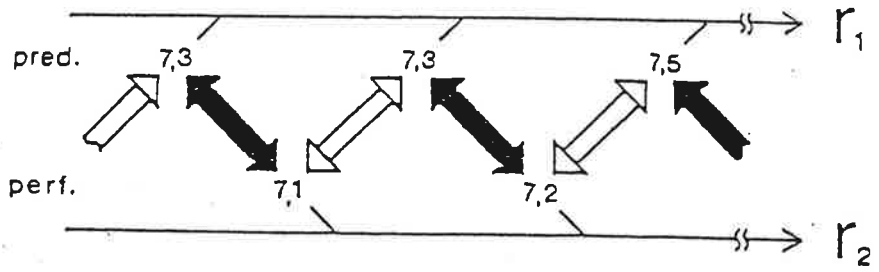


Fig. 1. - Two different correlations derived from two series of data.

## Results

The results for $r_2$ — coefficients — and, for comparison, $r_1$ — coefficients — are listed in Table I.

Most subjects showed a tendency to over-estimate. The frequency distribution of predictions and performances (Fig. 2) illustrates the overall goal discrepancy and the (asymmetrical) «group pressure» on AL.

Table I.
*$r_2$ and $r_1$ computed for single subjects.*

| | Type of sport | Number of Neg. coeff. | Number of Posit. coeff. | Mean. coeff. | Range of coeff. From | Range of coeff. To |
|---|---|---|---|---|---|---|
| $r_2$ | shooting | 7 | 2 | −0,29 | −0,59 | +0,20 |
| | shot put. | 4 | 25 | +0,25 | −0,14 | +0,65 |
| $r_1$ | shooting | 1 | 8 | +0,37 | −0,38 | +0,72 |
| | shot put. | 0 | 29 | +0,69 | +0,27 | +0,96 |

Further analysis showed some more significant results: Interindividually high AL is associated with interindividually high performance and high variability of performance, while an AL, which is high in relation

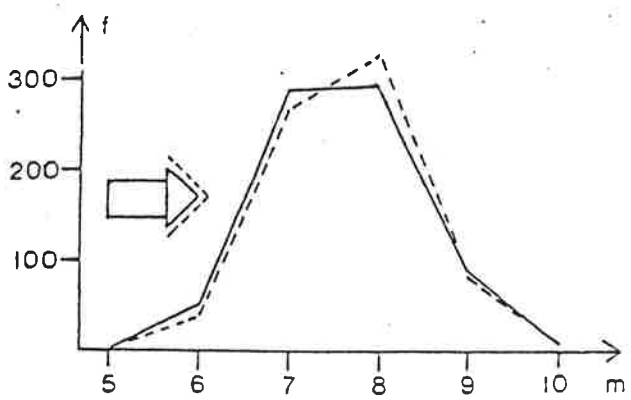


Fig. 2. - Frequency distribution of predictions (— — —) and performances (———). Arrow illustrates asymmetrical group pressure.

to a subject's performance (= high goal-discrepancy), is associated with interindividaully weak performance and low variation of AL. High variability of AL goes along with high performance level and high positive values for $r_2$.

## Discussion

Obviously good performers allowed themselves to cut back in their AL, while weaker performers kept very rigidly to much too high an AL. This might be discussed in terms of a « theory of social comparison processes » (8; for a review see 18), which predicts an orientation of individual ALs to the mean performance in the relevant reference group [7]. It is argued [26], that training focusing a subject's attention explicitly on intraindividual progress produces a shift from a normoriented to a more realistc goal-setting behaviour.

Explanation I deals with the effects of (upward) shifts in AL on performance. The existence of low or even negative coefficients for $r_2$, indicating that goal-setting and achievement were drifting apart, and the existence of negative $r_2$-coefficients preferably in persons with weak performance (main experiment) and in shooting (pilot study), which demands a very fine sensorimotor coordination, may be explained in terms of the inverted-U-shaped function between level of activation and level of performance. This function predicts reduced performance for persons or situations or moments associated with a very low or a very high level of activation: Highly activated subjects were operating constantly (lower variance in performance) near to the personal limit — each increase in goal-setting had the opposite effect on performance.

Our knowledge on overactivation as a performance-restricting factor and the different susceptibility of different types of performance with regard to this factor [28] is quite old (for an overview see 17) and is still growing concerning interindividual differences in the amount of activation and arousal in specified situations and in the « habitual » level of activation as defined in psychological [12], hormonal [9] and electrophysiological measures [24]:

Glanzmann & Laux (1978, p. 162) reported, that « high scoring subjects on trait or state anxiety as measured by the STAI performed more poorly than low scoring subjects on the difficult list ».

Forsman's (1980, p. 95) study showed, « that individuals who were less sensitive in their adrenaline response to variations in external demands

for activity and inactivity and who more constantly remained on the same level of excretion were high in neuroticism and had a higher strainful arousal level ».

In sportsmen as compared to non-sportsmen Kirkcaldy (1980, p. 285) found lower baselines for muscle tonus and pulse frequency and « some indication that the sportsmen score slightly higher along the dimension of extraversion, thus suggesting that they show lower levels of activation generally ... A lower level of activation would have the distinct advantage of allowing athletes whose activation level will be likely heightened through exercise itself, to improve their efficiency at performing (performance being curvilinearly related to arousal) ».

Probably the most sensitive and most direct indicator for task-relevant activation is the negativity of slow cortical potential shifts. In a previous study of the author [6] using visually presented problems, the comparison between CNV-data and recording of « spontaneous » EEG-activity showed that $\alpha$-blocking was determined by the duration of dia-exposition while CNV was unaffected by optical stimulation and determined by the duration of task-solving. Two theoretical conclusions drawn from this and some other findings such as shorter latencies of sensory evoked patentials [30] and shorter reaction times (e. g. 23) during states of high cortical negativity:

1. We have to distinguish between at least two different, relatively independent working systems of cortical activation, reflected in the EEG as the frequency of spontaneous activity and as the negativity of slow potential shifts. Negative shifts reflect tonical depolarisations of cortical areas, preparing them for information processing and operant response.

2. Several findings in persons with high (neurotic) anxiety — they produce (maybe because of operating on an already heightened baseline) lower CNV-amplitudes in general [25] and show, in addition, a stronger reduction in amplitude under condition of distracting stimuli [31] — reflect difficulties of these persons in the timing of readiness (high negativity) and restitution of « relevant » cortical areas according to the demands of a specified situation or task.

Both conclusions are confirmed in a more recent study [29] reporting less marked positive shifts terminating CNVs of neurotic subjects. Negativity, after all, facilitates learning and information processing [1 2 13], while positivity may be associated with internal inhibition and information defense [3].

Relevant findings of the Psychological Inst., University of Vienna, with testing « under load », « under pressure », « under stress » (e. g.

distracting activities): « ... some subjects show a marked reduction under stress, whereas others show an unchanged or even increased performance level under stress » [14]. Sportsmen, and especially those who are successful competitors in their discipline, preferably belong to those who perform better under stress [32].

These results fit well into the model underlying Expl. I: Subjects differ — according to their relevant pre-experimental » experiences, their attributional styles and (other) personality features — in the amount of arousal evoked by a certain situation (test, competition) or/and in the starting point of this shift (Fig. 3). Type A and Type B subjects, for instance, differ in the preferred work pace, in the performance level and in adrenaline excretion in baseline condition and during the performance of a choice reaction task [10], and Type As were found to be more aroused than Bs during inactivity but not during work in terms of catecholamine and cortisol excretion and heart rate [11].

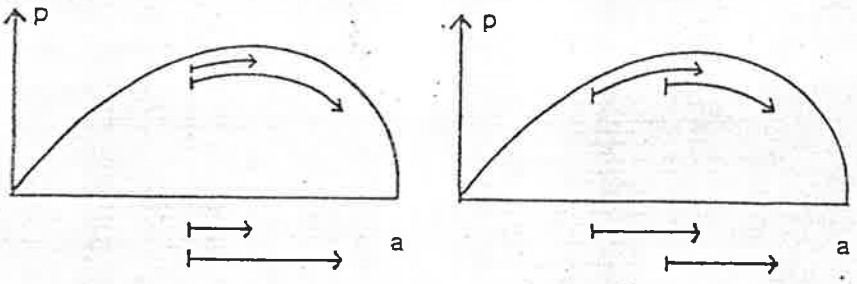


Fig. 3. - Direction of performance (p) alteration depending on amount (left figure) and starting point (right figure) of arousal (a).

Explanation II does not — or not exclusively [32] — refer to different activation levels, but to different approach motivations during coping [14 15], determined by the personal attributional style [32]. The decisive factor are the differences in the quality, not the intensity, of motivational states. Similarly, the two behavioral patterns found in rock-climbing-beginers are, « because aversion is almost the same in both groups » (19, p. 105), interpreted in terms of Boisen (1975): « Fear can have two influences on performance (Boisen): it can be activating and improve motor skills (type Y) and it can inhibit the movement (type X) » (20, p. 2).

Some critical remarks on Expl. II:

1. In the studies quoted stress and load are not defined in subject-related, physiological variables indicating similar arousal between subjects, but only in terms of the situation subjects were exposed to. Interpretations do not take into consideration that one and the same situation (in a certain moment) may involve stress and critical load for X, but not — or not to the same extent — for Y and that the experimenter-defined performance (basis for performance scores) is not necessarily identical with the subject's goals (e. g. cling as long as possible to a crevice and to wait for help).

2. The theory of an unspecific level of activation becoming its emotional, motivational) direction by cognitions available and attribution respectively (for an overview see 21)

— is associated with the (negative) argument (e. g. 16, p. 336) that we do not know (up to now or for principal reasons?) any physiological parameters discriminating between different emotional states. But on the other hand we do know that the topographical patterns of cortical arousal, regulated by an interchange between cortical and thalamic systems, vary in accordance with the demands of a task, with most marked CNVs in task-relevant cortical areas (6, p. 108). In this sense, activation is never unspecific.

— gives no reasons, why aversive running should be faster or slower than appetitive running, while it sounds plausible that the intensity (of fear and aversion or of appetence) is a decisive factor.

— neglects that cognitions available have effects not only in the sense of attributing emotional colour to an « unspecific » level of activation, but also in the sense of changing this level: To see the boss of X may be an indifferent situation for all Ys, but releases an arousal reaction in X.

Mechanisms proposed in Expl. I and II are not mutually exclusive and they may even interact. But as long as there are no findings, which cannot be interpreted quite simply in terms of the more elaborated Expl. I, there is no need for other explanations.

RÉSUMÉ

Le but de cette étude est de comparer deux modèles d'interprétation sur l'explication des niveaux d'aspiration pendant l'activité sportive; le deuxième modèle souligne pour la

plupart les aspects de la motivation. Ces deux modèles ne s'excluent pas réciproquement, mais les caractéristiques émotives de l'activation et ses effets sur la performance sont à la base de processus très connus. Autrement, les études sur le premier modèle permettent d'analyser les différences inter-individuells dans la quantité d'activation pour un situation spécifique aussi bien que de définir « le niveau normal » d'activation, ainsi qu'il résulte des déterminations électrophysiologiques, hormo et psychologiques.

## RESUMEN

La finalidad de este trabajo es la de comparar dos modelos de interpretación referentes a la explicación de los niveles de actividad y prestancia deportiva; el segundo modelo subraya myormente aspectos motivacionales. Estos dos acercamientos no se excluyen entre sí pero las características emotivas de la actividad y sus efectos sobre la prestación están sometidos a procesos bastante desconocidos. Por el contrario, los estudios relativos al primer modelo permiten analizar las diferencias interindividuales en la actividad para una situación específica y definir el 'nivel normal' de actividad, tal como se hace notar por las medidas electrofisiológicas, de hormonas y psycológicas.

## ZUSAMMENFASSUNG

In Experimenten zum Anspruchsniveau bei sportlicher Betätigung (Fenk, 1978a) wurden für jede einzelne Versuchsperson Serien von Vorhersagen eigener Leistungen mit den Serien der vorhergesagten Leistungen korreliert.

Im Kugelstoßen ergab dies im allgemeinen positive Koeffizienten ($r = +0{,}25$), in einem Vorversuch mit Scheibenschießen hingegen negative ($r = -0{,}29$). Das Überwiegen niedriger oder sogar negativer Korrelationen bei Personen mit hoher Zieldiskrepanz und einer in Relation zur jeweiligen Bezugsgruppe (Fenk, 1981) eher schwachen Leistung kann auf Basis der umgekehrt-u-förmigen Beziehung zwischen Leistung und Aktiviertheit interpretiert werden, und das Zielschießen als besonders anfällig für Leistungseinbußen in jenen Augenblicken, in denen die Aktiviertheit einen bereits (« habituell ») erhöhten Wert übersteigt (Erklärung I).

Andere Autoren (z. B. Guttmann et al., 1981) erklärten vergleichbare Resultate — interindividuelle Unterschiede in der Richtung der Leistungsverschiebung in « Stress- » Situationen (z. B. Simultanleistung) — nicht (nur) auf der Basis verschiedener Aktivierungsgrade, sondern auf Basis unterschiedlicher Motiv-Qualitäten (Erklärung II).

Die in diesen beiden Erklärungen apostrophierten Mechanismen schließen einander nicht aus. Aber während man über das emotionale « Einfärben » von Arousal und eine entsprechende Wirkung auf die Leistung recht wenig weiß, mehren sich die Argumente für Erklärung I, insbesondere bezüglich interindividueller Unterschiede in der Arousal-Wirkung umschreibbarer Situationen und im « habituellen » Aktivierungsniveau, gemessen an psychologischen (Glantzmann & Laux, 1978), hormonellen (z. B. Forsman, 1980) und elektrophysiologischen Kriterien (Fenk, 1978b, Kirkcaldy, 1980).

## RIASSUNTO

Scopo di questo lavoro è di confrontare due modelli interpretativi relativi alla spiegazione dei livelli di aspirazione durante l'attività sportiva. Il primo modello studia il rapporto fra livelli di attivazione e prestazione sportiva; il secondo modello sottolinea maggiormente aspetti motivazionali. Questi due approcci non si escludono reciprocamente ma le caratteristiche emotive dell'attivazione e i suoi effetti sulla prestazione sottostanno a processi largamente sconosciuti. Diversamente gli studi relativi al primo modello, permettono di analizzare le differenze interindividuali nella quantità di attivazione per una specifica situazione e di definire il « livello normale » di attivazione, come rilevato dalle misurazioni elettrofisiologiche, ormonali e psicologiche.

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