***Encyclopedia of Personality and Individual Differences (Springer)***

**Title of entry: Transmarginal Inhibition (TMI) of Response**

**Synonyms:** stimulus response dynamism

**Definition**

Transmarginal inhibition (TMI) of response is an intriguing behavioural phenomenon. It refers to the disruption – usually observed as a decrement either in the quantity or quality – of response as a result of exposure to stimuli of rising magnitude (e.g., noise intensity). At high levels of stimulation, TMI is thought to reflect the functional exhaustion of neuronal processes and the evocation of a protective mechanism to prevent neurophysiological damage. TMI may also be seen as the result of psychological processes with ‘rising magnitude’ defined in terms of an increasing conflict between goal representations which impose cognitive, emotional and motivational overload – when the threshold of adaptive responding is exceeded, TMI is evoked. This breakdown in the orderly relation between stimulus (or goal representation) intensity and response quantity/quality underlies the everyday notion of a “nervous breakdown” – its epistemological origin derives from TMI-inspired biological psychiatry.

**Introduction**

The relationship between the ‘magnitude’ or ‘strength’ of a stimulus (e.g., noise) and the organism’s quantitative (and sometimes qualitative) response to it (e.g., work performance) has long fascinated behavioural scientists. This scientific interest has gone under different names. In the grand American tradition of behaviourism, it was called ‘stimulus-response dynamism’. It has a longer legacy in the work of the Russian physiologist, Ivan Pavlov, who discovered the principal properties of the ‘transmarginal inhibition’ (TMI) of response (Corr & Perkins, 2006). Its wide ranging relevance is underscored by the fact that magnitude/strength may be defined not only in physical terms (e.g., decibels) but also in a non-physically defined psychological counterpart, entailing conflict between opposing goal representations (e.g., strength of attachment to another person which could give rise to conflict between opposing motivational tendencies, e.g., approach and avoidance: “Should I stay or should I go?”.)

***Functional Exhaustion***

At high levels of stimulation or conflict, the ‘inhibitory’ aspect of TMI reflects the functional exhaustion of the brain (entailing cognitive and emotional processes), where a discontinuity is observed between the orderly relationship of increasing level of stimulation/conflict and a change in response (in terms of strength, frequency, vigour, or some other quality). This stimulus-response breakdown is the origin of the everyday notion of a “nervous breakdown” – this psychiatric term gained popularity in ‘Shell Shock’ cases in WWI when Pavlovian theories of psychiatric disorder were starting to be applied in the clinic. In such cases, and in common parlance, it is often said that “things have gotten too much” for the afflicted person, and this hints at some form of mental overload (or, correspondingly, a diminution in the resources available to respond adaptively to the strain imposed on the system).

The biological, and hence psychological, function of TMI is said to serve the adaptive function of providing a protective mechanism that breaks the monotonic link between increasing stimulus magnitude/conflict and strength of behaviour. In the absence of this ‘circuit breaker’ there may well be severe damage to the neuronal and psychological system – *primary* physical stimulation can damage the psychological system (e.g., monoamine depletion and depression), and *primary* psychological conflict can damage the physical system (e.g., via stress related hormones) - *secondary* damage to one system may be caused by primary overload of the other system.

**Drive/Arousal and Personality**

TMI has a parallel with the, perhaps better known, Yerkes-Dodson Law, which has been widely invoked to explain behaviour changes across many experimental and applied settings. The is the notion of an ‘inverted-U’ relationship between level of arousal (or more generally ‘drive’) and motivation, as measured in behaviour. As commonly assumed, too little arousal/drive (e.g., drossiness) leads to low motivation and sub-optimal behaviour - for this reason, the use of machinery under the influence of a sedative drug is ill-advised – and at very high levels of arousal-drive, adaptive motivation is impaired as is corresponding performance (in occupational setting, this might be expressed as being “stressed out”). Around the middle part of this inverted-U curve is found optimal arousal/drive and performance. However, this point of optimality is affected by two major factors. First, the complexity of the task: easy tasks benefit from relatively high arousal/drive, whereas complex ones benefit from relatively low arousal/drive. Secondly, different personality types (related to the extreme poles of Introversion-Extraversion) modify these relationships: introverts are more easily stimulated and, typically, more aroused, while extraverts need a higher level of stimulation to achieve the same level of arousal. This leads to the prediction that introverts should be more susceptible to TMI and should always show this before extraverts.

Pavlov conducted a considerable amount of research on personality and TMI effects, and laid the foundations for Soviet-era psychology (“physiology of the higher nervous system”) which emphasized the existence of “nervous system types” (Gray, 1979). In this theoretical scheme, introversion was associated with a “weak” nervous system and extraverts with a “strong” one (it is for this reason why introverts are said to be more vulnerable to clinical disorders of the internalising type, i.e., anxiety, fear, depression, OCD, and so on). According to Pavlov, the point at which TMI “shutdown” occurs represents the fundamental difference in personality between people.

Hans Eysenck (1967) employed TMI-related notions to account for the systematic relationship between introversion-extraversion and a wide range of behaviours. His biological theory of personality uses the inverted-U curve - with level of induced arousal/drive and performance on the vertical axis and level of stimulus strength/magnitude on the horizontal axis – to show the curve shifted to the left for introverts and the curve shifted to the right for extraverts, both relative to ambiverts. A crucial point to bear in mind is that the introvert is optimally aroused *only* at a low level of stimulus intensity, as compared to the extravert, who is optimally aroused at a higher level of intensity. Therefore, under low stimulation (e.g., quiet or placebo) introverts are more aroused/arousable than extraverts, but under high stimulation (e.g., noise or caffeine), introverts experience over-arousal which, with the evocation of TMI, leads to lower increments in arousal and *actual lower* arousal. This latter effect may seem paradoxical, but there is good experimental evidence for it (Corr, Pickering & Gray, 1995). Something very similar is seen in the ‘paradoxical’ effects of caffeine and amphetamine, which in some people (*ex hypothesi*, already-aroused introverts) can be sedating (for discussion of this literature, see a biography of Eysenck, Corr, 2016).

*Personality and Drugs*

In relation to the effects of alcohol, ingestion of a sufficient amount leads the introvert to behave in a more extraverted manner because, according to Eysenck’s theory, they are now less aroused and, thus, seek by behavioural means to increase external stimulation to bring them back to their preferred (optimal) level of arousal, which they find hedonically satisfying. Conversely, a stimulant drug (e.g., caffeine) taken by an extravert should lead them to behave more like an introvert because, according to Eysenck’s theory, they have become over-aroused and now are motivated to shy away from further (hedonically dissatisfying) stimulation.

It is interesting to note that the recommended pharmacological treatment for behavioural hyperactivity (e.g., ADHD) in children is *stimulant* medication with Ritalin, which is related to amphetamine. One suggestion is that drug-induced brain over-stimulation evokes TMI and, thereby, reduction in behavioural activity because it makes the hyperactive, inattentive child more introverted, and thus stimulus shy. Clearly, there may be other ways such stimulant medication works, but it is remarkable that *hyperactivity* can be treated with a *stimulant* drug and this is what TMI-inspired theory predicts – the greater attentiveness of ADHD children under Ritalin may be cited as further evidence that the drug is moving them along the personality dimension in the direction of introverted behaviour.

**TMI Phases**

Pavlov identified three discrete TMI-related phases.

1. *Equivalent phase*: This first phase is where the strength of the response monotonically matches the strength of the stimulus, and it is adaptive;
2. *Paradoxical phase*: This second phase, also known as ‘quantity reversal’, is seen in the breakdown of the orderly relationship between the strengths of the stimulus and response (e.g., when increases in stimulus strength produce smaller responses) – this has already been discussed above;
3. *Ultra-paradoxical*: The last stage, also known as ‘quality reversal’, is seen when positive stimuli lead to a negative response, and vice versa. This has been subject to much speculation as a technique of interrogation and occasional reports indicate that it has been attempted (e.g., interrogation and political conversion of American GIs in Korea in the 1950s). The biological psychiatrist, William Sargant (1957), used these Pavlovian techniques in his clinical practice, and he wrote extensively on their use in “brain washing”, of the political and religious types.

In the case of interrogation, it is hoped that this “breaking-down” process leads to truth and lies becoming confused, and with the *ultra-paradoxical* process leading to an unintentional revealing of the truth. In political “brain washing” the intention is to generate such a degree of psychological conflict that relief (i.e., conversion to new ideas) is readily accepted, accommodated and assimilated into the reconstructed self. It is for this reason, special operation soldiers are trained not to engage with the process of interrogation, and especially not to refute ideas put to them which may be the start of the process of TMI-related breakdown and, potentially, psychological reconstruction. The potential importance and threat of these psychological techniques have not eluded film makers (e.g., 1960, Cold War film, *The Ipcress File*, staring Michael Caine).

Whether TMI-related notions are merely a conceptual device to think about issues related to the dynamics of behaviour, or whether they represent something more fundamental about the organisation and functions of the nervous system, is still not known. In any case, TMI is now something of an historical object of curiosity and does not play any significant role any more in psychological or psychiatric thinking – however, they are reasons to believe that it still represents something important about the functional organisation of the brain and, thus, the mind.

**Conclusion**

Although still something of an elusive concept, TMI does seem to say something important about the relationship between stimulus intensity and the quantity and quality of response. It played a large role in early attempts to develop a biological model of psychiatry based on the extensive work of Ivan Pavlov who did much to forge scientific links between neural processes, personality and psychopathology – the ‘experimental psychopathology’ he pioneered remains important to this day.

**Cross References:** Yerkes-Dodson Law; Inverted-U curve

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