

Belief Systems, Social Input, Behavior, and Physiology

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Resumé:

Sociální vklad a kognitivní funkce spojené se systémem víry ovlivňují fyziologii CNS (centrálního nervového systému) různými způsoby. Jeden z nich prostřednictvím organizace a prioritizace myšlení, což redukuje nejistotu a její disregulační efekty. Další cesta je prostřednictvím systému myšlení v rámci určité víry, což může také měnit fyziologii. Třetí cesta je prostřednictvím efektu pozitivních sociálních vztahů s jedincem sdílejícím stejnou víru. Čtvrtá cesta je znalost s kým na sebe vzájemně působit, aby bylo dosaženo fyziologického optima. O tom, že tyto efekty jsou netriviální, můžeme usuzovat na základě řady poznatků: Například existuje pozitivní korelace mezi náboženskou vztahou (účast na obřadech a sociální podpora) a stupni biologického a mentálního zdraví (Larsen et al 1992).

It was Karl Marx who declared, “Religion is the opiate of the masses”. Nearly 100 years later James Danielli (1980) suggested that Marx’s assertion was more accurate than Marx realized or could have known: many religions – belief systems – have the effect of releasing enkephalins and endorphins, endogenous neurotransmitters that reduce pain and promote feelings of integration, control, and well-being. In effect, embracing a belief system – systems about man’s place in the world or how the world works – amounts to the self-administration of an “opiate” and a way of achieving desirable physiologic and psychologic states.

This paper has its origins in Marx and Danielli’s insights and Regulation-Dysregulation Theory and updates an earlier paper (McGuire et al., 1998). It begins with a review of Regulation-Dysregulation Theory and recent findings from the neurosciences and ethology that are consistent with as well as potentially troublesome for the theory. The Physiologic and behavior features of belief systems are then discussed. The paper ends with a summary.

Regulation-Dysregulation Theory and new findings

Regulation-Dysregulation Theory (RDT) (McGuire and Troisi, 1987a) was developed to model the influence of social and internally generated information (thoughts and feelings) on central nervous system (CNS) physiology. The idea that social information can influence the brain is not new. It extends back to antiquity although experimental confirmation had to await the work of Walter Cannon early in 20th century. The idea that internal information – thoughts and feelings – influence CNS physiology also is not new: it is only too easy to think and feel one's self into a state of elation or despair.

“Regulation” refers to CNS physiologic homeostasis, a state in which multiple physiologic systems (biochemical and neuronal) are balanced. It Describes a state of optimal CNS functioning associated with cognitive clarity, feelings of well-being and self-control, interest and participation in valued events in the world and it is closely tied to frequent and satisfying social interactions. “Dysregulation” describes a state of CNS physiologic non-homeostasis or sub-optimal functioning. It is associated with inefficient cognition, unpleasant feelings such as boredom, fear, anxiety, depression, loneliness, ennui, and the absence of interest and participation in normally valued events in the world. It is closely tied to unsatisfactory and dissatisfying social interactions.

Social information, thoughts, and predictable social environments have different CNS effects.

The basic idea of RDT is this: frequent positive social input (e.g., recognition by others, praise by others) and positive thoughts about one's self are essential requirements for regulation. In their absence, selected CNS physiologic systems “drift” to dysregulated or suboptimal states. CNS drift mirrors what happens with glucose: brain and peripheral glucose levels decrease (drift) from optimal (high) to suboptimal (low) levels without frequent glucose replenishment. Low levels are associated with unpleasant feelings, a reduced ability to concentrate, and the search for food.

Applying the glucose analogy to social information, infants require holding, touching, and verbal input to attain and maintain their optimal physiologic state (Hofer, 1984). In the absence of such information they become irritable and fail to thrive. They die if deprivation is extreme (Spitz, 1945). Information deprivation studies conducted during the 1960s on normal, healthy, young adults led to such a high frequency of physiologic and psychological disturbances that the studies had to be discontinued (Schultz, 1965). Similar findings have been reported for well-controlled studies of prisoners of the same age and sex who were free to

engage in social interactions, those who were confined exhibited significant increases in psychosis, depression, and attempted suicide (Volkart et al., 1983) – psychosis, depression and attempted suicide are among the more dramatic indices of CNS dysregulation.

Different types of social information influence CNS physiology in different ways. For example, information about the loss of an important kin or friend can initiate changes in the CNS neurotransmitters norepinephrine and serotonin and feelings of depression and social isolation. Social exclusion activates the same brain area (anterior cingulate cortex) as physical pain (Eisenberger et al., 2003). Ambiguous stimuli presented to nonhuman primates lead to dramatic electrical changes in the amygdala (a CNS region that has a critical role in processing information associated with emotion) (Lloyd and King, 1991). Winning a competitive, non-physical contact sporting event (e.g., tennis) between two males is followed by an elevation of the hormone testosterone in the winner and no changes in the loser (Mazur and Lamb, 1980).

Similarly, positron emission tomography (“PET”) studies show that different parts of the brain are involved in processing different types of social information. Recognizing others’ emotions is associated with increased activity in the right anterior cingulate and bilateral inferior frontal gyri (George et al., 1993) while listening to others talk about emotions activates both superior temporal gyri (Wise et al., 1991). And an angry face coupled with an averted gaze activates the amygdala far more than the same face coupled with a direct gaze (Adams Jr., et al., 2003; see Helmuth, 2003 for a review of related studies).

Personality is also a factor. For example, the higher a person’s extroversion score the greater the amygdala’s activation when viewing happy faces (Canli et al., 2002). And different personality types have characteristic ways of moving (Grammar, 20003) – motion too is social input. These findings are consistent with the idea that different parts of the brain specialize in certain functions (see Richmond et al., 2003; and Matsumoto et al., 2003; for recent findings) and that personalities distinguish themselves by their different ways of processing information and action.

Most of the studies described in the two paragraphs above used PET or fMRI technology which identify areas of the brain that respond to specific stimuli and, in the case of PET, provide approximations of the degree of activation. What they don’t clearly reveal are the details of concurrent physiologic (biochemical) changes. These are perhaps best illustrated by studies of the neurotransmitter serotonin in adult male vervet monkeys (*Cercopithecus aethiops*

sabaucus). In this species, high social status is associated with peripheral serotonin levels that are twice as high as those of low social status males (Raleigh et al., 1984). Differences in CNS serotonin sensitivity (as measured by behavior responses to changes in CNS serotonin levels) are equally striking (Raleigh et al., 1985). And if high-status males become low-status, their peripheral serotonin and CNS serotonin sensitivity measures change to those characteristic of low-status males. Conversely, if low-status males become high-status, the opposite changes occur (Raleigh et al., 1984).

The social information that is primarily responsible for initiating serotonin changes is the frequency of submissive displays received by a high-status male from low-status adult males. High-status males receive submissive displays from low-status males throughout the day at a 5-6:1 ratio. Should the number of displays decrease, as happens for example when high-status males are temporarily removed from their groups, serotonin measures decline (McGuire et al., 1983a, b; Raleigh et al., 1984). In this model, low-status is viewed as a dysregulated state, one that is experimentally associated with poor performance on cognitive tests and indecisive and fearful behavior in social settings (McGuire and Troisi, 1987). High-status is viewed as a regulated state and it is associated with superior performance on cognitive tests and decisive and relaxed behavior in social settings. Serotonin changes do not occur rapidly in response to external information as is often the case with the neurotransmitter norepinephrine and the hormones cortisol (a stress-related hormone) and epinephrine (McGuire et al., 1986). Days to weeks are required for change, and the absence of submissive displays by low-status males must be continuous for CNS changes to occur.

Further, among high-status males, high levels of serotonin positively correlate with prosocial behavior (e.g., grooming), increased tolerance of other animals such as threats by low-status males, and infrequent aggression. Males with low levels of serotonin show the opposite behavior (McGuire et al., 1983a, b). Among humans, low levels of serotonin are repeatedly linked to feelings of depression and aggressive and violent behavior while high levels are linked to feelings of relaxation and satisfaction (reviewed in Masters and McGuire, 1994; Knutson et al., 1998; Tse and Bond, 2002).

Similar findings from studies of other species and other CNS physiologic systems have been reported (e.g., Sapolsky, 1990; Reite and Field, 1985; Higley et al., 1996; Mehlman et al., 1995; Morgan et al., 2002; Shizgal and Arvanitogiannis, 2003; Phillips et al., 2003; Holden, 2003). These findings are consistent with

predictions from RDT and underscore two basic features of the theory: selected CNS physiologic systems interact with specific types of social information and, in the absence of such information, these systems drift to dysregulated states. Among nonhuman primates, a possible confounding factor is the finding that CNS physiological systems may be partially under genetic control (Clarke et al., 1995). And among humans, CNS serotonin production is (on average) 52% greater among males than females (Nishizawa et al., 1997). In addition, for some adult males, physical abuse during childhood activates genetic systems which initiate the production of enzymes (MAOA) that breakdown critical CNS neurotransmitters such as serotonin and increase the probability of violent behavior (Caspi et al., 2002).

For individuals who meditate, meditation often results in reduced cortisol and other stress-related hormone levels as well as in a lowering of blood pressure (a chemically mediated event). Sexual fantasies and anticipation of victory in competitive events increases CNS serotonin activity and reduces CNS dopamine and norepinephrine activity (reviewed in McGuire and Troisi, 1987b). PET studies show that unpleasant thoughts alter CNS glucose utilization, particularly in the inferior and orbital frontal regions of the brain (Prado et al., 1993); memory activates hippocampus function (Squire et al., 1992); attention activates the right prefrontal and superior parietal cortexes (Prado et al., 1991). Studies of cerebral blood flow demonstrate that induced temporary sadness and happiness among healthy women lead to significant changes in regional blood flow in the limbic system and other brain regions. These transient emotional states influence different brain regions in divergent directions and are not merely opposite activities in identical regions (George et al., 1995). Physiologic changes are associated with each of these events and a clear implication is that, within limits, one can work oneself into a state of regulation or dysregulation through what one thinks and feels.

Human beings and nearly all of the other 250+ primates species are far from passive recipients of social information. High-status vervet monkeys seek out low-status monkeys and initiate dominance displays to which low-status animals respond submissively (McGuire et al., 1983a). Further, the fact that nearly all primates compete for high-status, not low-status, suggest that one of the motivations for doing so is that high-status is associated with a desirable physiologic state relative to low-status (irrespective of the other "benefits" of high status such as priority access to females and resources). Analogous events occur among humans. Only certain friends are sought out when one is bored or

depressed and persons who are critical or socially unresponsive are avoided. Social environments such as rock concerts are attractive in part because of their predictable effects on one's emotions (see Shore, 1994). A common characteristic of these situations is positive social input. The desirable effects of such input and why certain social environments are favored can be conveniently illustrated by recalling one's feelings and thoughts following a meaningful social rejection, severe criticism, or a serious threat.

Related findings tie some of the preceding points to personality or, if not that, to behavior traits that have social consequences. For example, among human males, peripheral measures of serotonin differ as a function of social status. Individuals who perceive themselves and are perceived by others as possessing high social status exhibit higher levels of peripheral serotonin compared to those who perceive themselves and are perceived by other as possessing low social status (Madsen and McGuire, 1984; Madsen, 1985, 1986). There are some exceptions, however. A small percentage of individuals with high levels of peripheral serotonin are deferential, submissive, and yielding to others (Madsen, 1985, 1986). Other studies show that many personality features can be explained if ratios among the three classical monoamine neurotransmitters – serotonin, dopamine, and norepinephrine – are taken into account (Cloninger, 1986). Thus, for serotonin, there appears to be at least a four-way interaction between serotonin measures, personality, social status, and other neurotransmitters. And that social information can significantly influence CNS physiology is the most parsimonious interpretation for findings showing that different types of enduring CNS glucose utilization patterns (as measured by PET) result from behavior modification therapy – a type of therapy involving information exchange, not drugs or physical contact (Baxter et al., 1992).

The social, cognitive, feeling, and physiological features of belief systems

Persons explore and adopt belief systems for many reasons. One is the anticipation that a belief system, much like certain thoughts, will be associated with a desired feeling state. There are interesting implications.

Three key points have been discussed. One deals with the way in which social information alters CNS physiology, e.g., the absence of social information and positive and negative social information. A second deals with thoughts (e.g., meditation) that can also alter CNS physiology. The third deals with individual preferences for desired social environments and their association with desired physiologic and psychologic effects. In this context, belief systems are both

thought and social sources of information: a thought source when one thinks about the belief system and a social source when others respond either positively or negatively to one's beliefs. That is, in part the attractiveness of a belief system will be a function of the CNS effects which result from embracing or rejecting it. Should one embrace a socially unpopular system, as currently would be the case for communism in the United States, dysregulating effects would be expected because of others' negative responses. There is of course a difference – it was the case with serotonin levels in vervet monkeys – between moment-to-moment CNS physiologic adjustments and longer-term CNS changes. In most instances individuals embrace belief systems for extended periods of time. The suggests that repeated, same-direction CNS changes are essential for explaining belief system-physiology interactions. (If only intermittent short-term changes in neurochemical or hormonal states were involved – that is, minor, moment-to-moment CNS adjustments – strong physiology-belief system relationships would not be expected.).

What is it about belief systems that can be expected to alter CNS Physiology?

Belief systems organize and prioritize thoughts. Whatever their form (e.g., religious, political, social), belief systems organize and prioritize thoughts and thereby reduce ambiguity and uncertainty about events both within and outside one's control. Meanings are given to symbols, myths, doctrines, and behavioral scenarios. Specific ideas and acts are valued while others are not. Causal explanations are usually present (e.g., "God put humans on earth to carry out His plans", "The free market is the most efficient economic system"). In short, many of the complexities of daily life attain order, and direction, purpose, and place are brought into focus. And as noted, primate studies show that a reduction in uncertainty and ambiguity correlates with diminished amygdala electrical activity and cortisol release. Among humans, uncertainty and ambiguity reduction lead to similar physiologic changes, changes that are likely to be reinforcing and rewarding and contribute to the perpetuation of one's beliefs.

Belief systems are associated with high self-esteem and the sense that one has a place in the world. Embracing a belief system, especially one that is respected in one's social group (e.g. rule of law), provides one with social information about the self. Positive social input from others translates, "You are a group member", "You are recognized", "You are important" – such thoughts have physiologic effects (Eisenberger et al., 20003). Self-reports by persons who undergo religious (including cult) conversions or who develop new (positive) ways of viewing themselves are consistent with this point.

Belief systems facilitate the identification of in-group and out-group members and their behavior. Revealing one's beliefs to those who share the same belief signals that one is committed to specific ways of interpreting events, that one will behave in predictable ways and use certain in-group "buzz" words, and that specific responses can be expected in social interactions. Revealing the same beliefs to those who do not share them often has the opposite effect and invites negative feedback.

Similar points apply to in-group reciprocation rules. Explicit and implicit reciprocation or helping rules differ among groups and they are influenced by rules associated with specific belief systems, e.g., when one can request help, the conditions under which one is expected to help, the degree of helping that should be provided in different circumstances, the time frame within which helping should be reciprocated, etc. A key feature of such rules is that they increase the predictability of in-group interactions that have desired physiologic outcomes. When they are an integral part of belief systems, rituals such as praying, singing, chanting, and marching, contribute to a sense of solidarity and belonging and positive CNS physiology both through enacting rituals and via others' input.

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