

## Affective percept and voluntary action: A hypothesis

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**Abstract.** I present a hypothesis concerning the neuronal, mental and behavioral effects of all kinds of affective (emotional) stimuli, i.e., of unpleasant and pleasant stimuli. I use the term stimulus in its broad sense. Affective stimuli evoke two associated percepts: "cognitive" and "affective". A food in the mouth, for example, evokes the gustatory percept and the percept of pleasure. However, affective percepts are unstable parts of cognitive-affective compounds. Five types of affective percepts are pain, fear, pleasure, "desire" and appetite in the broad sense of these words. Desire is evoked by inadequate pleasant stimuli. Affective percepts are "lower" or "higher". The latter are not directly associated with bodily needs. Esthetic and social percepts are higher, for example. Although pain and pleasure are essentially innate, they can be modified by sensory experience. Alimentary and esthetic preferences and social values are modifiable, for example. The neurons of pain and fear and of the unpleasant components of desire and appetite motivate four types of voluntary actions. These are, respectively, escape, avoidance, "optimization" and approach actions. All these actions eliminate the motivating displeasure. In addition, avoidance actions protect from the signaled pain, optimization actions increase the existing pleasure and approach actions provide the signaled pleasure. Thus, voluntary actions associated with different percepts occur according to one universal principle. Voluntary actions are "internal" and behavioral. During internal actions a goal and then an action plan are decided. These actions often provide the images of the goal stimuli and of particular movements.

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**Key words:** affective percept, affective image, affective plasticity, appetite, behavioral voluntary action, cognitive percept, conscience, decision making, displeasure, fear, internal voluntary action, pain, pleasure

## INTRODUCTION

The present paper is a hypothesis concerning the neuronal, mental and behavioral effects of affective stimuli. The effects of all kinds of affective stimuli will be considered from one broad perspective. The term affective stimulus is regarded as a synonym of emotional stimulus and unpleasant or pleasant stimulus. The hypothesis is based on four assumptions.

1. Mental events are produced by activity of the corresponding "mental" neurons. This monistic assumption means that mental events cannot exist apart from the functioning brain and cannot be produced directly by other mental events.

2. Affective stimuli evoke two closely associated but different percepts: "cognitive" and "affective".

The pinprick is accompanied by pain, the sight of a food by appetite, the taste of a food by pleasure, etc. This assumption is consistent with earlier considerations of Young (1959), Pfaffmann (1960), Pfaffmann et al. (1977) and Cabanac (1979, 1992).

3. Mental images also can consist of "cognitive" and "affective" counterparts. When we imagine food, we feel appetite, for example.

4. Some mental events exist also in higher animals.

This assumption allows us to utilize animal data in the analysis.

Since the hypothesis is broad, some issues will be simplified. In addition, many terms will be used in their broad sense. "Stimulus", which will include stimulus situations and verbal commands, and "pain", which will include many kinds of displeasure, are important examples.

## AFFECTIVE STIMULI AND AFFECTIVE PERCEPTS: GENERAL REMARKS

Affective stimuli can be divided according to four criteria:

1. Some affective stimuli are important by their very nature and so will be called "primary stimuli", whereas some only signal the primary stimuli and will be called "secondary stimuli" (see Żernicki 1981). The food in the mouth is a primary affective stimulus, for example, whereas its sight is the secondary affective stimulus. Primary stimuli have usually innate effects, whereas secondary stimuli acquire effects. Then, they can be called, respectively, unconditioned and conditioned stimuli.

2. Some affective stimuli are unpleasant, whereas some are pleasant.

3. Affective stimuli can activate different sensory systems. Accordingly, we will distinguish somatic affective stimuli, visual affective stimuli, etc.

4. Affective stimuli can activate different functional systems. Accordingly, we will distinguish food affective stimuli, esthetic affective stimuli, etc.

Different affective stimuli evoke the corresponding affective percepts and the latter can be divided according to the same four criteria. The division of affective percepts according to criteria 1 and 2 will be discussed in detail in Section 4.

It can be assumed that the cognitive and affective counterparts of percepts have different neuronal mechanisms. The cognitive counterparts are usually evoked by groups of neurons that have been formed through integrative perceptual learning, i.e., presumably through the action of the Hebb synapse (Hebb 1949, see also Palm 1990, Milner 1993). Thus, these groups of neurons will be called "perceptual cell assemblies". On the other hand, the groups of neurons evoking affective perceptual counterparts are presumably mainly intrawired innately and so will be called simply "centers".

Electrophysiological, lesion and functional imaging data suggest that perceptual cell assemblies are located at the high cortical levels of the sensory systems (see Paulesu et al. 1997 for vision and Zeki 1997 for somatic pain). On the other hand, the centers of affective percepts are presumably located at the high levels of the limbic system. For example, a cue structure for the perception of somatic pain is presumably the anterior cingulate cortex (Paulesu et al. 1997). However, some neurons concerned with affective percepts were found in the sensory cortex. Single-unit data show that neurons concerned with pleasure of food do exist in the gustatory cortex of monkeys (Rolls et al. 1989, 1999) and rats (Yamamoto 1989) and electrophysiological, stimulation, lesion and functional imaging data suggest that neurons concerned with pain exist in the somatosensory cortex of monkeys and humans (Paulesu et al. 1997). Single-unit data (Kreiman et al. 2000) and functional imaging data (e.g., Kosslyn et al. 1997) show that cognitive percepts and the corresponding cognitive images share common cell assemblies. Moreover, it is likely that centers of affective percepts serve also the corresponding affective images.

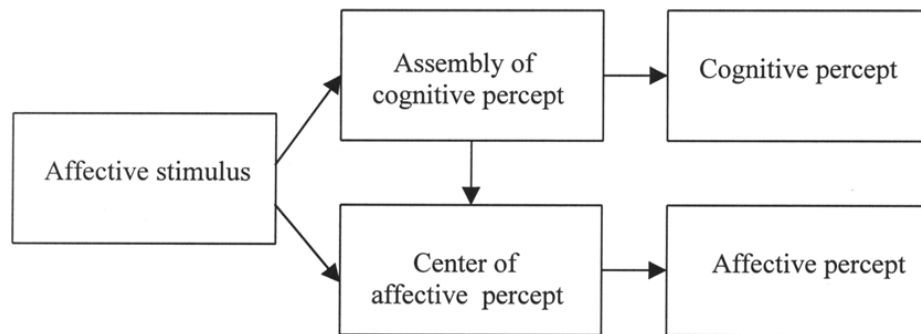


Fig. 1. The neuronal and mental effects of an affective stimulus. This and the following figures are simplified hypothetical models. Assembly means cell assembly. Arrows denote positive causal connection (within the brain, excitatory connection), whereas lines ended with a dash denote negative causal connection (within the brain, inhibitory connection).

The centers of affective percepts are presumably activated not only directly by the stimuli, but also indirectly through the corresponding cognitive cell assemblies (Fig. 1). Such cognitive-affective connections might be located in the sensory cortex (see above). Four lines of evidence show the presence of the cognitive-affective effects.

1. The specificity of affective percepts is based on their cognitive counterparts (see Section 5).
2. We usually have first a cognitive percept and only then its affective counterpart. We first see a food and only then we feel appetite, for example.
3. Affective percepts never lose their cognitive counterparts.
4. When cognitive percepts are erroneous in normal or psychotic subjects, their affective counterparts are also erroneous. When in the night we perceive a white sheet as a ghost, we feel fear, for example.

However, opposite affective-cognitive effects are certainly also possible (see, for example, Rolls 1999, p. 144-145, Bower and Forgas 2000, Ramsay and Lewis 2000).

In contrast to cognitive percepts, affective percepts show great individual differences. This is shown, for example, by marked individual food preferences. Moreover, in many subjects affective percepts are abnormal. Alimentary affective percepts are abnormal in anorexic patients and social affective percepts are abnormal in criminals.

## THE INSTABILITY OF AFFECTIVE PERCEPTS

Affective percepts are unstable parts of cognitive-affective compounds. Four lines of evidence show this phenomenon.

1. The intensity and even the sign (negative or positive) of affective percepts are not necessarily correlated with the intensity of their cognitive counterparts (Pfaffmann 1960, Cabanac 1979). Sucrose of low concentration is pleasant, whereas at high concentration, i.e., very sweet, is unpleasant. Thus, depending on its strength a given stimulus can activate neurons of pleasure or displeasure.

2. Affective percepts evoked by some external stimuli depend on the effects of the related long-lasting unpleasant interoceptive stimuli. Pleasure evoked by a food depends on the hunger produced by food deprivation, the displeasure or pleasure evoked by a cold or a warm stimulus depend on the thermic discomfort related to the temperature of a subject, etc. One can assume that the affective centers of such interoceptive stimuli activate those of the related exteroceptive stimuli.

Affective percepts show genuine plasticity (see Section 7).

4. Affective percepts depend on direct appraisal of their cognitive counterparts (Lazarus 1982). A lion seen on TV evokes less fear than seen on the street, for example. Thus, it can be assumed that the center of an affective percept can be influenced by a number of perceptual cell assemblies, in particular by those of the images of the related stimuli.

## FIVE TYPES OF AFFECTIVE PERCEPTS

Different types of affective percepts can be distinguished on the basis of two essential criteria (see Section 2).

1. The first division concerns both cognitive and affective perceptual counterparts. Some percepts are evoked by primary stimuli and some by secondary stim-

uli. Accordingly, "primary" and "secondary" cognitive and affective percepts can be also distinguished.

Two types of purely primary affective percepts are pain and pleasure, whereas two types of purely secondary ones are fear and appetite (Table I). On the other hand, "desire" is partly primary percept and partly secondary. It is evoked by inadequate pleasant stimuli, which signal the adequate ones. A small amount of food in the mouth and barely audible music are some examples. All these terms are used in their broad sense.

Secondary stimuli often evoke images of the signaled primary stimuli. The sight of a restaurant can be followed by the image of food in the mouth, for example. However, affective images of painful stimuli are not only pain but also fear and those of pleasant stimuli are not only pleasure but also appetite. The affective image of food in the mouth is not pleasure but appetite, for example. It can be assumed that the affective center activated by a secondary stimulus can be co-activated by the assembly of the cognitive image of the signaled primary stimulus. The sight of a food and the cell assembly of the corresponding image of its taste would coactivate the center of the appetite, for example. (That the images of primary stimuli often do not include pain and pleasure, but fear and appetite, is important for distinction between the cognitive percepts of primary stimuli and the corresponding images. Pain and pleasure might give a primary cognitive percept the mark of reality of which some images are devoid.)

A secondary affective stimulus can signal more than one primary stimulus. Moreover, the signaled primary stimuli can have not only synergic but also antagonistic effects. The sight of an attractive food can not only signal a pleasant oral stimulus but also a painful stimulus of overeating. Thus, a given affective center can be simultaneously excited and inhibited by cognitive assemblies

of several signaled primary stimuli. In other words, it is submitted to algebraic summation of different effects.

As a whole, primary affective percepts are the essence of our life. Secondary affective percepts have only an assistant role. Furthermore, primary and secondary cognitive percepts assist the primary and secondary affective percepts, respectively.

2. The second division is hedonistic and thus concerns only affective percepts. Some affective percepts are unpleasant and some are pleasant.

Pain, fear and pleasure are hedonistically pure percepts (Table I). On the other hand, one can assume that desire and appetite are simultaneously unpleasant and pleasant, i.e., they are evoked simultaneously by neurons of displeasure and pleasure (Fig. 2). Both desire and appetite are able to motivate voluntary actions (i.e., they must be unpleasant) on the one hand and have some rewarding value on the other hand. Strip-tease is an example of the rewarding value of appetitive stimuli.

It can be also assumed that the neurons of pleasure inhibit neurons of displeasure (Fig. 2). When the pleasure becomes intense, the displeasure disappears (see also Section 9).

Numerous data on animals and humans indicate that the centers of different types of affective percepts are differentially located in the limbic system. A key structure for somatic pain is presumably the anterior cingulate cortex (Paulesu et al. 1997, Vogt and Sikes 2000) and that for fear is the amygdala (see LeDoux 2000). Appetite and perhaps also desire are related to mesolimbic/mesostriatal dopamine systems. As pointed out by Berridge and Robinson (1998) dopamine-depleted rats "fail to want rewards they like". Pleasure is related to many limbic structures (see Bishop et al. 1963, McBride et al. 1999).

Table I

Five types of affective percepts		
Stimulus	Percept	Affective content
Painful	Pain	Primary displeasure
Fearful	Fear	Secondary displeasure
Pleasant	Pleasure	Primary pleasure
Inadequate pleasant	"Desire"	Primary pleasure and secondary displeasure
Appetitive	Appetite	Secondary displeasure and pleasure

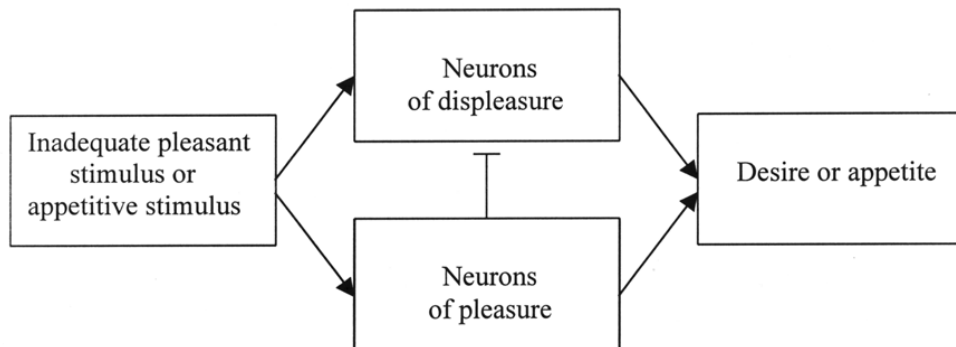


Fig. 2. The hedonistic complexity of desire and appetite.

## THE SPECIFICITY OF AFFECTIVE PERCEPTS

The specificity of affective percepts is mostly based on the specificity of the cell assemblies of their cognitive counterparts. Affective percepts always concern something cognitively specific. In addition, the specificity of secondary affective percepts can be influenced by the cell assemblies of the images of the signaled primary stimuli (see Section 4).

However, three lines of evidence indicate some specificity *per se* of affective percepts:

1. There are five types of affective percepts (pain, fear, pleasure, desire and appetite).

2. Affective percepts evoked by stimuli of different sensory systems or different functional systems (alimentary, sexual, etc.) also seem to differ. This assumption is supported by the findings that in the sensory cortex there are neurons concerned with affective percepts (see Section 2). There are also some other supporting data. Olds (1958) found that self-stimulation rates within the lateral hypothalamus were inversely correlated with presumable alimentary and sexual feelings in rats. Also using self-stimulation techniques, Gallistel and Beagley (1971) found that rats choose stimulation at one hypothalamic site when hungry and at a different site when thirsty. Using functional imaging techniques Francis et al. (1999) found three different areas for pleasure of touch, taste and smell in the orbitofrontal cortex.

3. Some affective specificity seems to exist even within one sensory or functional system. Rolls et al. (1983, 1984) have shown that when subjects are allowed to eat as much of one particular food as they wished, the pleasure of the food eaten decreased more than the pleasure of other foods which had not been eaten, while it tasted almost as intense as when the subjects were hun-

gry. Moreover, in monkey gustatory cortex, some neurons decreased specifically their response to the food with which the monkey has been fed to satiety (Rolls et al. 1989, 1999). In other words, there are possibly different kinds of alimentary pleasure.

## HIGHER AFFECTIVE PERCEPTS

Some functional systems are directly associated with bodily needs, whereas others are not. On this basis, they can be divided into "lower" and "higher", respectively. The alimentary system is lower, for example, whereas the esthetic system is higher. Accordingly, we can distinguish lower and higher affective percepts. This division is consistent with that of needs proposed by Maslow (1982). Primary affective percepts of some higher systems will be briefly described.

- (i) Esthetic affective percepts. Pleasant esthetic percepts are usually evoked by complex visual and auditory stimuli. Paintings and music are good examples.
- (ii) Affective percepts of ignorance and competency. Some stimuli evoke unpleasant percepts of ignorance, whereas others evoke pleasant percepts of competency.
- (iii) Social affective percepts. The ability for social feelings is called conscience. Social pain and pleasure can be evoked by stimuli showing that another subject is experiencing pain or pleasure. We feel pain seeing a drowning child and we feel pleasure seeing a child enjoying a new toy.

The source of a social feeling can be, however, also a voluntary action itself. In short, we are pleased to help another subject. We are more pleased when we rescue a drowning child than when it is rescued by somebody else, for example. Such a feeling can be the affective component of the image of the actions and also of the percept of the occurring action. Finally, a social feeling

can be associated with the image of the earlier stimulus. Remorse for giving no help to the drowning child is an example.

The social percepts are usually accompanied by "pseudosocial percepts" based on law, customs and religious views accepted by a particular group of people. A social feeling can be accompanied, for example, by fear of being a prisoner, disgraced and in hell.

Higher affective percepts show three outstanding features:

1. They are often evoked by complex stimuli.
2. They show marked individual differences. These are particularly great in social percepts. We differ from being criminals to saints. These differences, responsible for different goals, count socially more than differences in memory and intelligence important for achieving these goals. We certainly do not respect intellectually gifted criminals. Interestingly, our love of pets is based on an assumption that they have some social feelings.
3. They show marked plasticity and can change relatively easily not only their intensity but also their sign (see Section 7). This concerns particularly social percepts (see Eisenberg 2000).

Higher affective percepts are presumably associated with the highest levels of the limbic system. Lesion and functional imaging data suggest that social affective percepts are related to the functions of the prefrontal cortex (Anderson et al. 1999, Nichelli et al. 1995).

## THE PLASTICITY OF AFFECTIVE PERCEPTS

As mentioned in section 2, the assemblies of cognitive percepts are usually formed due to perceptual integrative learning (Hebb 1949). Afterwards, however, they are virtually not plastic. Even a drastic method of using inverting prisms and mirror spectacles seems to be perceptually ineffective (Linden et al. 1999).

In contrast, secondary affective percepts can be easily acquired or changed. A fearful stimulus can be easily transformed into the appetitive, for example, without any change in its cognitive counterpart.

Although originally usually innate, primary affective percepts (pain and pleasure), particularly higher, are often modified by learning. This is an effect of two factors.

1. The first factor is simply the contact with an affective stimulus. Changes in alimentary preferences and addiction are some examples. Some data in cats show the role of a contact with alimentary stimuli in the plas-

ticity of primary affective percepts. Wyrwicka (1978) showed that when kittens are provoked to eat a disliked food, they will accept it also in later life. Stasiak and Żernicki (2000) showed that kittens deprived of alimentary gustatory stimuli, and so of alimentary pleasure, will later find them less rewarding. A contact with an affective stimulus can presumably strengthen or create a connection between a stimulus and its affective center, or a connection between the cognitive assembly and the affective center, or both connections. This process can be considered as *sui generis* affective perceptual learning.

2. The second factor is complex, poorly understood and can be denoted as contact with a new idea or information. It is particularly important in the plasticity of social feelings. The recent case of John Walker, who joined the Taliban, is a good example. We also know that conscience of criminals can be cured and so violence prevented (Gilligan 2001). (However, since such treatment of criminals is expensive and not always effective, they are regrettably not isolated in hospitals but in prisons and in some countries legally killed.) One can assume that as a consequence of a new knowledge, the new cognitive cell assemblies influence the affective perceptual centers.

The plasticity of primary affective percepts is a crucial feature of the brain. This plasticity changes our goals and thus our personality.

## VOLUNTARY ACTIONS: GENERAL REMARKS

It is likely that groups of mental neurons commanding voluntary actions are formed through the Hebb synapse. In particular, the effects of kinesthetic stimuli would be integrated in that way (for discussion on kinesthetic integrative learning, see Konorski 1967, p. 139-157). Thus, such groups of neurons will be also regarded as "cell assemblies". Such assemblies might include neurons engaged in unconscious initiation of voluntary actions (Libet 1985).

The cell assemblies of voluntary actions of different functional systems are activated according to one universal principle. It can be assumed that this activation occurs in two ways: (1) through the cell assembly of the cognitive percept and (2) through the neurons of *displeasure* having a motivating role (Fig. 3, see Żernicki 1981).

On the other hand, it is reasonable to assume that neurons of pleasure do not have any direct motivating effect. Pleasure is simply enjoyed.

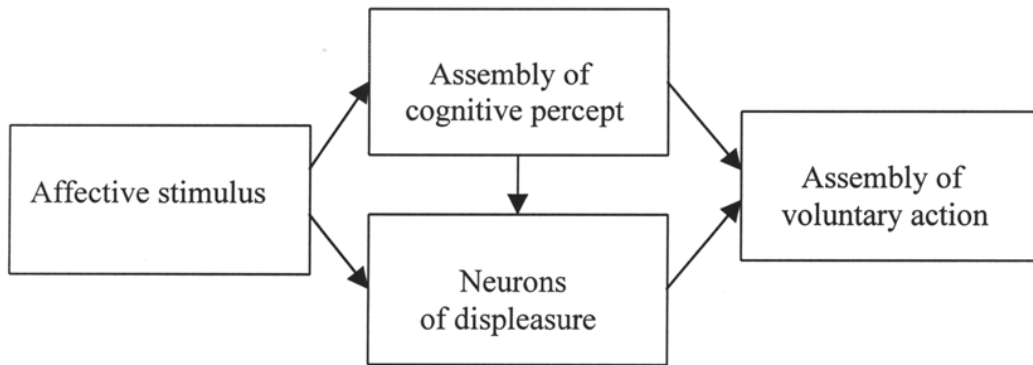


Fig. 3. Two ways of activation of the assembly of a voluntary action.

Our introspective experience suggests that voluntary actions can be influenced by some mental events themselves. In other words, mental events would have causal effects on activity of the cell assemblies of voluntary actions (Sperry 1980, see also Doty 1998). A belief that we have free will is indeed the basis of our social life, in particular that based on religion and love. However, the role of this hypothetical free will would be certainly limited. A murderer, for example, has usually simply a poor conscience because of genetic and early environmental factors and he often commits a crime only in a favorable situation. In conclusion, one can speculate that both cognitive and affective percepts *themselves* can somewhat influence the assemblies of voluntary actions. For simplicity, however, such effects will be neglected.

The goal of a voluntary action is sometimes achieved straightaway. We may remove the painful agent from the skin, for example, or place the available food into the mouths. More frequently, however, a preliminary goal, or a sequence of preliminary goals, must be achieved before the final goal. Accordingly, the preliminary action or the sequence of preliminary actions can precede the ultimate action. A preliminary goal is often the necessary stimulus situation or the cue stimulus. We find the

restaurant (stimulus situation) and then the menu (cue) before we enjoy the dinner, for example.

#### FOUR TYPES OF VOLUNTARY ACTIONS

Voluntary actions eliminate the motivating displeasure. Extending the meaning of terms used in behavioral research one can assume that four types of voluntary actions, i.e., escape, avoidance, "optimization" and approach actions, eliminate four categories of motivating displeasure (Table II, see Žernicki 1981). In addition to these effects, avoidance actions protect from the signaled pain and optimization and approach actions increase the existing pleasure (Table II). (However, all these actions are *sensu stricto* of escape character.) These four types of voluntary actions will be briefly described.

Escape action usually eliminates pain by a direct abolition of the painful stimulus (Fig. 4A).

Avoidance action usually provides an "antifear" stimulus, which inhibits fear processes (Fig. 4B). Contact with the mother inhibits a child's fear, for example. The antifear goal stimulus signals that the painful stimu-

Table II

The effects of four types of voluntary actions		
Action	Main effect	Additional effect
Escape	Pain is eliminated	None
Avoidance	Fear is eliminated	Pain is avoided
Optimization	Displeasure of desire is eliminated	Pleasure is increased
Approach	Displeasure of appetite is eliminated	Pleasure is much increased

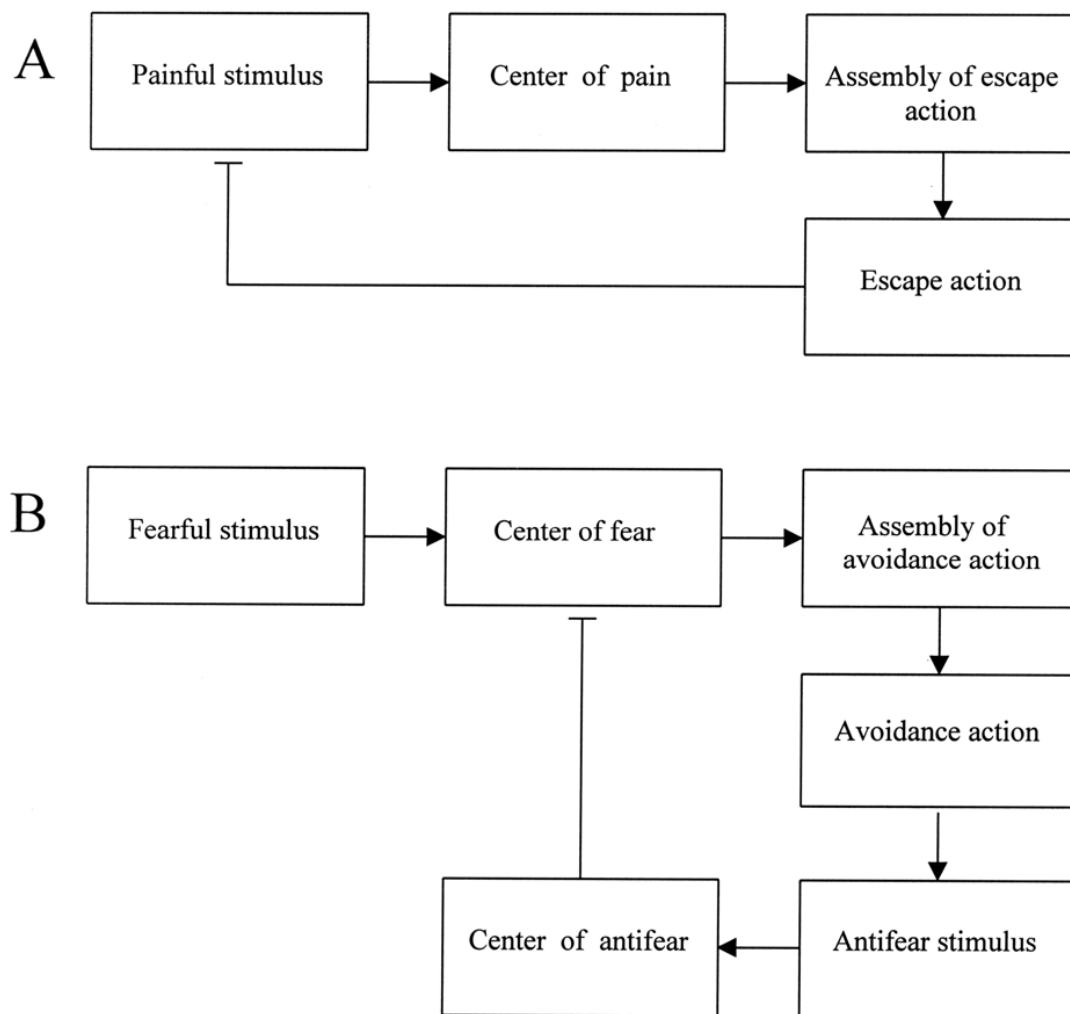


Fig. 4. The elimination of pain by escape action (A) and fear by avoidance action (B).

lus will not appear. The notion of antifear is consistent with a concept of antidrive proposed by Konorski (1967, p. 41).

However, such a mechanism is also in operation in some escape actions. Then, the "antipain" stimulus inhibits the pain processes and signals that the painful stimulus will be eliminated. A cold shower (antipain stimulus), for example, inhibits immediately the pain of heat and then the body temperature is decreased.

"Optimization action" transforms an inadequate pleasant stimulus into the adequate (optimal) one. The intensity of the stimulus is often increased (Fig. 5A). In consequence of optimization, the displeasure is inhibited (see Fig. 2). Optimization action is a new term. It seems to be more appropriate than the old term "consummatory action".

Approach action eliminates displeasure by providing a pleasant stimulus (Fig. 5B). Since the displeasure is inhibited, it disappears even when the appetitive stimulus is still in operation.

Different types of voluntary actions can collaborate simultaneously and sequentially. Here are some examples. Escape actions evoked by interoceptive stimuli (see Section 3) often collaborate with approach and optimization actions evoked by related external stimuli. An escape action evoked by a hunger stimulus produced by deprivation of food, for example, collaborates with the approach and optimization alimentary actions. Actions based on social percepts usually collaborate with those based on pseudosocial percepts (see Section 6). Approach and optimization actions often occur in a sequence. We turn on a radio (approach) and then we regu-

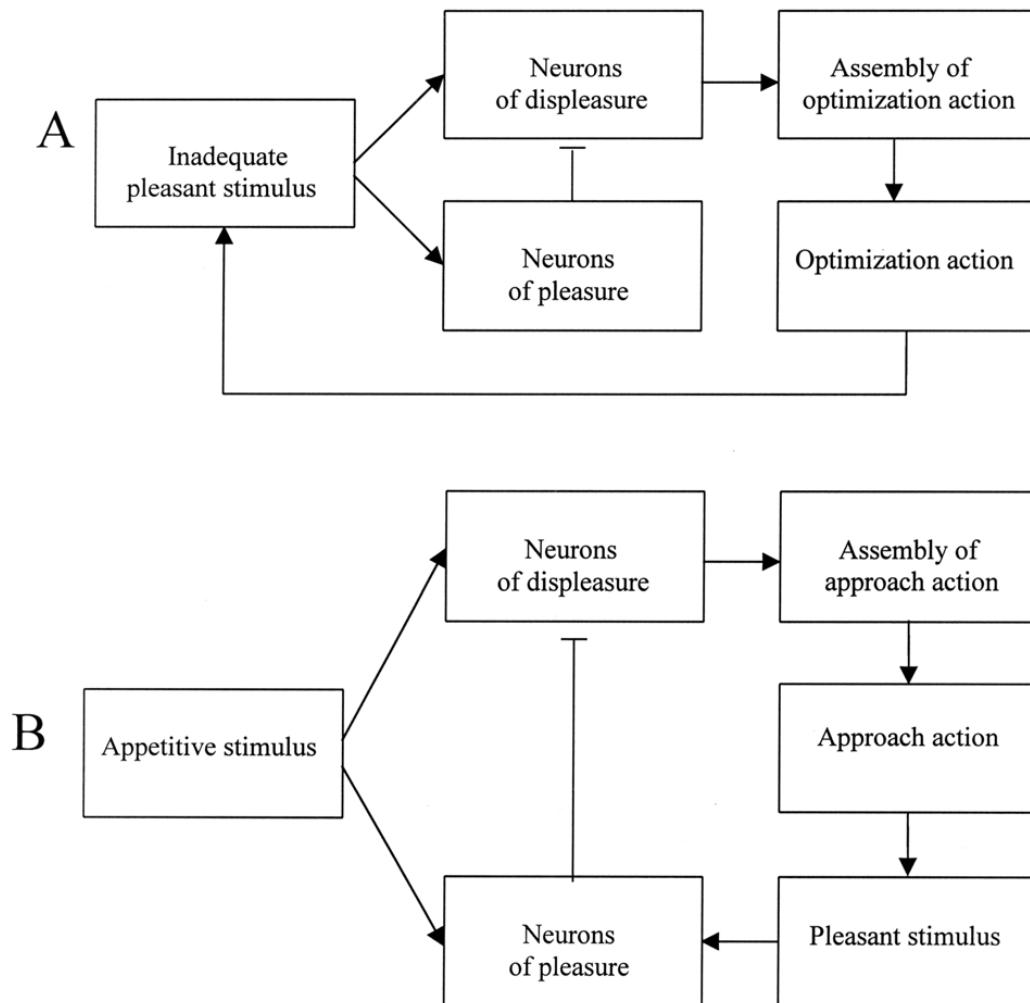


Fig. 5. The elimination of the unpleasant component of desire by optimization action (A) and of the unpleasant component of appetite by approach action (B).

late the intensity of the voice (optimization). Different types of actions usually occur sequentially when preliminary goals must be first attained.

### INTERNAL AND BEHAVIORAL VOLUNTARY ACTIONS

Two kinds of voluntary actions can be distinguished: "internal" (mental) and behavioral (motor). A subject can obtain with an internal action a piece of necessary information from his memory, for example, or with a behavioral action from his notebook or from his colleague. Both internal and behavioral actions take similar time (see Jeannerod 1997, p. 98-102). Internal actions usually precede behavioral actions. In some voluntary actions, two stages, internal and behavioral, can be clearly distinguished.

The internal stage can consist of two substages. During substage 1 a goal is decided and during substage 2 a plan of further action is decided. Substage 1 occurs when we are confronted with motivational alternatives. This occurs in two situations; first, when a given goal is simultaneously desirable and undesirable. Rescue of the drowning child is socially pleasant but also dangerous, eating a cake is pleasant but also unhealthy, etc. The second situation is when there are two incompatible goals, e.g., two restaurants. Thus, there occurs a rivalry between different kinds of displeasure. It is desirable that social feelings dominate in such rivalry.

Internal voluntary actions often provide images of preliminary and final goal stimuli, of antifear or antipain stimuli, and of particular movements. In general, a given voluntary action can be first motivated by the neural cor-

relates of affective percepts and then by those of affective images (Section 4). This is consistent with Beritoff's notion (1965) of image-driven behavior.

In routine voluntary actions, the internal stage is reduced or absent. The same occurs in quick actions, e.g., during driving a car (see Jeannerod 1997, p. 83-87). On the other hand, the behavioral stage can be absent, when the mental stage has already eliminated the displeasure. The displeasure of ignorance can be removed by mentally solving a given problem, for example.

Some voluntary actions are not evoked by neurons of percepts but exclusively by neurons of other mental events, often by those of images appearing during thinking. When exclusively internal voluntary actions are evoked in such a way, they occur in isolation from the external world. Mental events produced by these actions can in turn produce new exclusively internal actions. Indeed, we can be meditating for hours. This is consistent with clinical data on humans with locked-in syndrome (see Bauby 1997, Damasio 1999) and laboratory data on animals (see Żernicki 1986) showing that a cerebrum isolated almost completely from the external world (by a transection or lesion at the pontine level) functions virtually normally.

Functional brain imaging studies suggest that internal voluntary actions are based on the frontostriatal circuits (see Jahanshahi and Frith 1998). Clinical studies on lesioned patients indicate that substage 1 of decision-making is related also to functions of the amygdala and the ventromedial prefrontal cortex (Bechara et al. 1999, Baxter et al. 2000) and substage 2 to functions of the prefrontal cortex (see Jeannerod 1997, p. 126, Tanji and Hoshi 2001).

## CONCLUSIONS

1. Affective (emotional) stimuli, i.e., unpleasant and pleasant stimuli, can activate the affective centers not only directly but also through the corresponding cognitive cell assemblies.

2. Affective percepts are less stable than their cognitive counterparts.

3. Five types of affective percepts are distinguished: pain, fear, pleasure, desire and appetite. All these terms are used in their very broad sense. Pain and pleasure are primary percepts, whereas fear and appetite are secondary, i.e., they signal the primary percepts. Desire, which is evoked by inadequate pleasant stimuli, is mixed in this respect. Pain, fear and pleasure are hedonistically

pure percepts, whereas desire and appetite are simultaneously unpleasant and pleasant.

4. The specificity of affective percepts is mostly but not completely based on the specificity of the cell assemblies of their cognitive counterparts.

5. Higher affective percepts are not directly associated with bodily needs. Individual differences in these percepts, particularly in social percepts (percepts of conscience), are the basis of different personalities.

6. Secondary affective percepts are usually acquired. Some primary affective percepts, particularly higher, are also acquired or modified by experience and thus our goals are modifiable.

7. The centers of pain, fear and of the unpleasant components of desire and appetite motivate, respectively, the neuronal assemblies of escape, avoidance, optimization and approach voluntary actions (optimization actions transform inadequate pleasant stimuli into optimal ones). In turn, voluntary actions eliminate the motivating displeasure. In addition, avoidance actions protect from the signaled pain and optimization and approach actions increase the existing pleasure. Thus, voluntary actions associated with different percepts appear according to one universal principle.

8. Internal and behavioral voluntary actions are distinguishable. During internal action a goal and then the plan of a subsequent behavioral action are often decided. Goal selection is the result of the rivalry between different kinds of displeasure. During the internal stage different kinds of images are provided.

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