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A behavioral economic approach to the defense mechanisms: Freud's energy theory revisited

The mechanisms of defense are the core of the psychoanalytic theory of psychopathology (Sjoberg, 1973, p. 1; Freud, 1914, p. 16). They are said to be the processes by which the ego deals with its greatest challenge, the "instinctual drives", which are seen as spontaneous generators of intense and frequently maladaptive motivation (Freud, 1926, pp. 63-164; A. Freud, 1966, p. 69). Although Freud originally depicted the interaction of drives and defenses as analogous to the operation of simple electric circuits, he regarded these processes as goal-directed, and began an economic theory to keep track of the "pleasure" and "unpleasure" he abstracted from them (Freud, 1895, pp. 295-307).

Later writers have greatly expanded Freud's descriptions of the defense mechanisms, and have recognized more than two dozen operations by which people alter their mental processes in response to motivational conflict (Bibring et al., 1961; A. Freud, 1966, pp. 42-53; Sjoberg, 1973, pp. 181-208). However, modern authors have not shared Freud's interest in finding the elementary rules that govern the operation of these mechanisms. The search he began for

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economic principles that could describe the interactions of personal motives has been largely abandoned. Even psychoanalysts have questioned the usefulness of his metapsychological hypotheses (Klein, 1973).

Meanwhile, behavioral psychology has begun to study the laws of motivation parametrically, and has even turned its methodology to the study of economics (Kagel et al., 1975). But until recently it has held to a scientific discipline that requires it to ignore intrapsychic events, and thus has not turned its attention to the subject of private motivational conflict. Its theorists have had such profound methodological differences with Freud that they have not asked whether their findings are compatible with his and those of his followers (e.g. Eysenck and Wilson, 1973). As a result there has been little examination of how the wide array of defense mechanisms involves motivation and choice, as these processes have been defined by parametric research. Neither dynamically oriented writers nor behaviorists have developed the conceptual tools necessary to analyze how these mechanisms act, and to answer basic questions that are often raised about them: whether all of them act against impulses, whether some of them are reducible to special cases of others (Sjoback, 1973, pp. 182-204), whether their effect is always a maladaptive one (Fenichel, 1945, pp. 145ff.; Loewenstein, 1967), and if not, whether they form a hierarchy of adaptiveness (Vaillant, 1971), whether some of them facilitate or interfere with others, and on what bases a person chooses one over another (A. Freud, 1966, pp. 173-176; Waelder, 1960, p. 181).

The behavioral research that will be described presently makes it possible to return to Freud's original description of the impulses and defenses with fresh eyes. It will be evident that his hypothesis about the origin of impulses led him to lump together two distinct processes under the name of defense mechanisms, thereby confusing later thought about the purpose of these mechanisms. It will be possible to make an alternative hypothesis about how impulses are created and what functions defenses against them must perform. This hypothesis bridges the chasm between the behavioral and psychodynamic approaches, and promises to resolve some of the basic questions raised above.

The dual psychodynamic concept of ego defense

In Freud's original concept of defense, incoming stimuli flowed reflexively into both consciousness (system) and motor activity unless blocked by opposing energy in the form of "side-cathexis" from the ego (Freud, 1895, pp. 295-307). The same "side-cathexis" could block flows into both outlets. This blockade did not eliminate the incoming stimulation, but diverted it into memory, which, like an electrical capacitor, fed it back into the original pathway when the blockade stopped. When the input was of a kind that would lead to extreme unpleasure, the blockade was maintained, creating a reservoir of energy which would keep stimulating motor actions until it was painfully discharged through the other outlet, consciousness (Freud, 1895, pp. 305-321; McCarley and Hobson, 1977; Pribram and Gill, 1976). Thus, the avoidance of conscious perceptions was said to take place on the same occasion as the avoidance of immediate behavior. Freud did not explicitly change this aspect of his early economic model, and it seems to have remained a tacit part of modern ego psychology.

This perception of consciousness and behavior as equivalent outlets which exist in a fluid equilibrium has led to the confounding of two distinct motives for ego defense: (1) The avoidance of unpleasant perceptions per se, for instance, pain, or information that the person was unsuccessful or deficient (White and Gilliland, 1975, pp. 83-85) and (2) the avoidance of impulses, that is, reward-seeking behaviors which could lead to unpleasant perceptions (Fenichel, 1945, pp. 129-167; A. Freud, 1966, pp. 30-32, 54-62; Freud, 1926, p. 164). In this usage, impulses are not meant to include behaviors which are merely spontaneous, that is, motivated by a whim. The term "impulsive" describes a motive which is disowned by the actor, and which thus might be looked forward to with apprehension and looked back upon with regret.

The avoidance of impulses is a process distinct from the avoidance of unpleasant perceptions, but both forms of avoidance have shared the same name. If a person cultivates a benign, magnanimous nature in order to avoid beating up his little brother, he is said to be defending himself against his impulses. If he cultivates this attitude in order to resemble Christ and avoid perceiving his powerlessness, this is also called a defense mechanism, even though its immediate purpose is not impulse control.

The literature does not usually distinguish between defense mechanisms whose target is an unpleasant perception and those whose target is an impulsive behavior. Where this distinction is made it is held to be unimportant:

One and the same ego can have at its disposal only a limited number of possible means of defense. At particular periods in life and according to its own specific structure, the individual ego selects now one defense method, now another. . . and these it can employ both in its conflict with the instincts and its defense against the liberation of affects (A. Freud, 1966, p. 32).

There are two reasons why this distinction has been largely ignored:

(1) Since apprehension about an impending impulse and its consequences can be considered an unpleasant perception, the impulse-avoiding function of the defense mechanisms is sometimes described as a special case of avoiding unpleasant perceptions (Hendrick, 1958, p. 97). Such a synthesis obscures the fact that these motives are potentially contradictory: A person may change his perception of a situation just to serve his impulses, and thus put this defense mechanism into direct opposition to his impulse controls.

(2) Even when this potential contradiction is recognized, it is seen as part of an integral sequence of action and reaction. Freud hypothesized that defenses against impulses are only necessitated by defenses against perceptions. The defenses guarding consciousness were said to cause the accumulation of motivational energy, leading to increasingly intense urges toward behavior. It was only this excessive accumulation of energy which could generate clinical impulses, the only forces that could not come into equilibrium with other motives (Freud, 1913, pp. 29-30; 1920, p. 20; also 1915, p. 147). If it were not for this blockage and consequent accumulation of energy, the person would simply be motivated to maximize his pleasure, and impulses would cease to occur. This theory does not specify the motives for either censoring or permitting conscious perceptions, except at the intuitive level, and as a result it resists further systematization. The researcher's attention is directed toward cognitive meanings; the therapist is advised to concentrate on reducing his patient's defense against unpleasant perceptions, since it is this defense that makes motives for impulses unconscious and thus puts them beyond restraint by his other motives.

If, in contrast to Freud's view, impulses are not caused by the

ensorship of perceptions, the distinct process of controlling impulses deserves examination in its own right. An economic rationale for it may yet be possible, and therapies that approach it directly may be better appreciated.

A behavioral, economic concept of defense against impulses

Recent experimental evidence supports an hypothesis about the origin of impulses which does not involve perceptual censorship: The attractiveness of a pleasure declines as such a function of delay that temporary preferences for poorer but earlier of two alternatives may often be created, whether or not the subject is conscious of his motives. This is to say that impulses are always with us. Something like the "original sin" or "natural depravity" described by some old Christian theologians exists, and requires people to achieve more than just uncensored insight if they are to avoid habitual, maladaptive behaviors.

The changing effectiveness of rewards as a function of delay

Despite his concentration on subjective perceptions, Freud himself foresaw an experimental approach to impulsiveness. He speculated that the conflict between ego and id probably occurs in animals other than man, and noted that "animal psychology has not taken into account [this] interesting problem" (1938, pp. 144-147). He implied that the difference between the id's motives and those of the ego might be one of proximity to their respective goals, a theory that should lend itself to experimental modeling. When he was first formulating the properties of the reality principle, the concept that grew to become the ego, he focused on the tolerance for delayed gratification that this mode of thinking requires (1911, pp. 218-226). He came to speak of what an experimental psychologist would call the consumption of reward as the "discharge" of "psychic energy" and hypothesized that the reality principle grew out of finding devices to bind psychic energy and thereby defer its discharge (Rapaport, 1960, pp. 90-96). Summarizing this viewpoint, Rapaport called the deferral of discharge the

defining property of the ego functions: "In contrast to the id, which refers to *peremptory* aspects of behavior, the ego refers to aspects of behavior which are *delayable*, *bring about delay*, or are themselves *products of delays*" (1959).

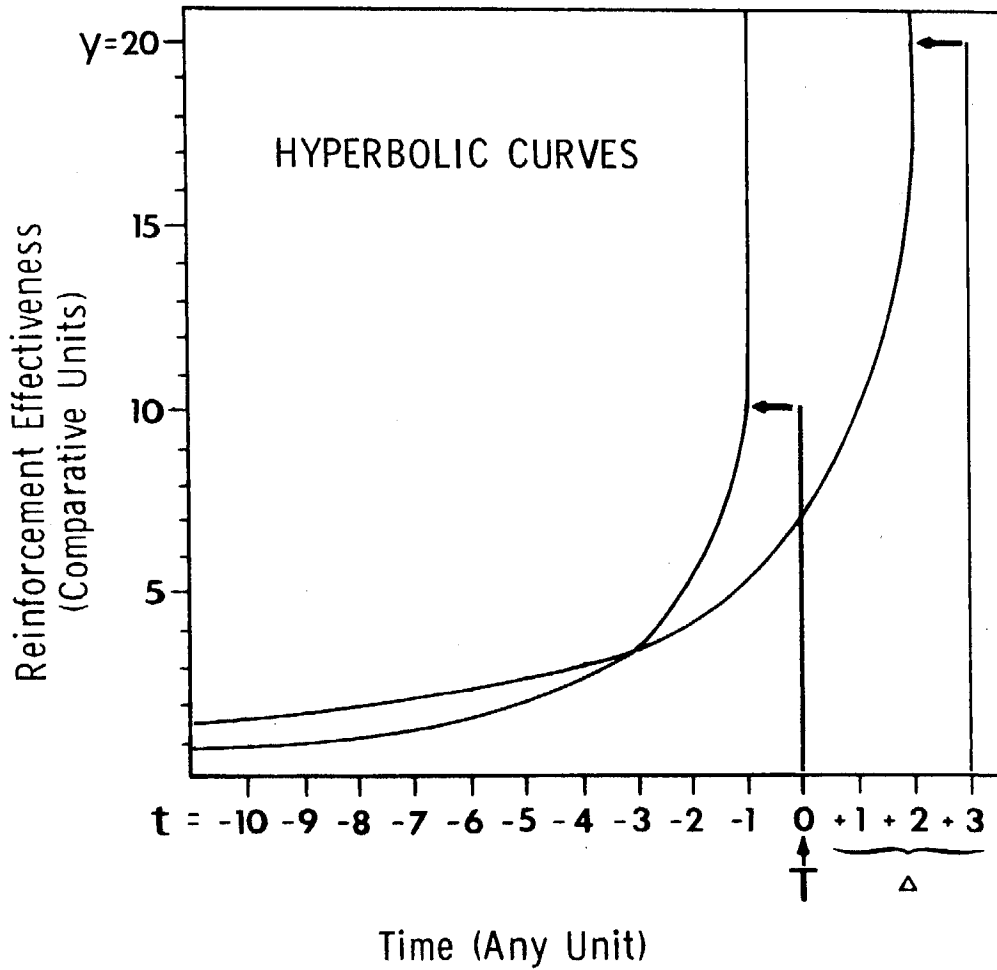
"Animal psychology" soon took up Freud's suggestion that there could be animal models of motivational conflict. However, early animal experiments that attempted to model human motivational conflict did not generally create this conflict by manipulating delay of reward or punishment. These experimental situations were described as conflictual because of the inevitability of a highly unrewarding situation, or because the ambiguity of cues predicting whether behavior would be rewarded made subjects inefficient at maximizing reward (Berlyne, 1960; Dreyer and Renner, 1971; Liddell, 1956; Masserman, 1943; Solomon and Wynne, 1954). Although the animals' affective behaviors in these cases often resembled affective behaviors observed in humans facing motivational conflict, these experiments did not suggest any means by which subjects might be struggling against their impulses. The functions of id and ego could not be discerned.

More to the point was a finding by Mowrer and Ullman (1945), that rats' ability to delay eating food for three seconds decreased as delay of punishment for eating too soon was increased from three to twelve seconds. This provocative experiment was not followed up for many years. However, there has recently been a number of well-controlled experiments in which subjects have chosen between rewards of varying expected delays and/or amounts. These experiments have shown that the effectiveness of a reward declines rapidly as the reward is delayed from the act that obtains it (Renner, 1964). Extensive experimental evidence suggests that the curve describing the effectiveness of a reward as a function of delay is markedly concave upwards (Ainslie, 1975). Such a shape implies that imminent rewards have relatively enormous motivating effect, and that the decline of this effect as the reward is delayed is steep at first but levels off into a long tail at long delays. Within the range of values that has been studied, the best evidence suggests that rewards are preferred in direct proportion to their amounts, rates of occurrence, and immediacies (inverse of delay) (Baum and Rachlin, 1969; de Villiers, 1977, pp. 233-287):

$$\frac{B}{B'} = \frac{A}{A'} \cdot \frac{R}{R'} \cdot \frac{T' - t}{T - t} \quad (1)$$

FIGURE 1

The relative effectiveness of a small, early reward versus a reward twice as large available three units of time later, as predicted by Herrnstein's matching law (Herrnstein, 1970, pp. 243-266; Formula 1). (Just before the rewards are due their curves become infinitely high; this portion is not depicted.)



where t is the moment the choice is made, B is behavior to obtain one alternative, B' is behavior to obtain the other, and the A s, R s, and T s, are the amounts and rates of the rewards and the times at which they become available. Although most of this work has been done in animals, several experiments have reproduced this proportionality phenomenon in human volunteers (Baum, 1977; Bradshaw et al., 1976; Bradshaw et al., 1977; Conger and Killeen, 1974; Schroeder and Holland, 1969). The finding that preference tends to be inversely proportional to delay may help us understand impulsiveness, since it predicts that in some choice situations preference will temporarily change as a function of time.

Consider two alternative rewards, one of which, A , will be available at time T , and the other, A' , twice as great, will be available at time $T + \Delta$ (Figure 1).

The matching law predicts that subjects will prefer them equally when

$$\frac{B}{B'} = \frac{A}{A'} \cdot \frac{(T + \Delta) - t}{T - t} = 1 \quad (2)$$

where t is the time the choice is made, and the "rates" of reward are equal (a single occurrence in each case). Solving for t ,

$$t = \frac{A(T + \Delta) - A' T}{A - A'} \quad (3)$$

If Δ were 3 units of time as in Figure 1, then at all choice points before $T - 3$ units the alternative rewards should be preferred in the order of their amounts, which is to say that later, larger alternative rewards should be preferred. (For instance, at $t = T - 5$ units,

$$\frac{A}{A'} \cdot \frac{(5 + 3)}{5} = .80, \text{ and at } t = T - 1000 \text{ units, } \frac{A}{A'} \cdot \frac{1003}{1000} \cong \frac{1}{2}.)$$

However, at all choice points after $T - 3$ units, the smaller alternative should be preferred over the larger one. (E.g. at $t = T - 2$ seconds, $\frac{A}{A'} \cdot \frac{(2 + 3)}{2} = 1.25$.) Direct evidence for change of

preference as a function of $(T - t)$ has been obtained in both animals (Ainslie, 1974; Ainslie and Herrnstein, in press; Navarick

and Fantino, 1976; Rachlin and Green, 1972) and human subjects (Ainslie and Haendel, in press; Solnick et al., 1980). This effect is heightened by change from a concurrent schedule to the more clinically relevant discrete choice, which abolishes behavior to obtain the less-preferred alternative; a rationale for this winner-take-all effect is given in Ainslie and Herrnstein (1981).

To predict change of preference as a function of delay, it is not necessary to ascertain the relationship between the physical dimensions of the rewarding events and their value to the choice-maker. It is not even necessary that the intrapsychic rewarding process depend on an environmental event. If we know only that an earlier reward would have been seen as poorer than a later alternative if the two had been available simultaneously, we can expect there to be a range of durations of the lag between the two ($T-t$) within which preference will change from the later, better to the earlier, poorer alternative as a function of the passage of time. When the lag is within this range, a choice-maker who chooses early (e.g. at point A) will pick the better alternative. If he chooses late (e.g. at point B), he will pick the poorer alternative. And if, at the early point, he perceives that this preference for the better alternative is apt to change, he will be motivated to include in any plan he makes to obtain the better alternative some means of forestalling the temporary attractiveness of the earlier, poorer alternative. It should be this motivation, represented in Figure 1 by vertical distance between curves of reward effectiveness before they cross, which is available to cause the learning of defense mechanisms of the impulse-controlling type.

Henceforth in this article, poorer alternatives that can be expected to become temporarily preferred to better alternatives will be spoken of as *specious* with respect to the better alternative. This term characterizes a relationship between alternatives, and states nothing about the poorer alternative taken by itself.

Ways of coping with the changing effectiveness of rewards

The problem an individual faces in trying to forestall his own future change of preference is the same as that faced by Homer's Ulysses in trying to sail past the Sirens (Homer, trans. Reiss, 1946).

At one point in his journey, Ulysses was told by Circe that he would have to pass within earshot of the Sirens, and that upon hearing them he and his crew would have an irresistible urge to sail towards them, even though they would be wrecked on the nearby rocks. Ulysses found two devices that committed himself and his crew to stick to their original course: he had himself bound to the mast so that he would be unable to act on his new preference when it arose, and he filled his crew's ears with wax so that they would not receive the stimulus that would give rise to the new preference.

Purely intrapsychic devices were not open to Ulysses, because the Sirens were defined as irresistible. However, intrapsychic devices to forestall temporary change of preference are usually available in real life. Psychodynamic writers have developed no way of categorizing defense mechanisms according to their mode of functioning, which might have been adaptable to describing these precommitting devices. However, a search of the literature on impulse control in several behavioral sciences (Ainslie, 1975; a rich variety surveyed in Elster, 1979) has turned up no intrapsychic precommitting device which does not fall within three categories, two of which are closely related to each other. Added to the category of extrapsychic devices just motivated, these categories make an exhaustive list of four:

- (a) Extrapsychic devices, which operate by physical or social means.
- (b) Attention-controlling devices, which keep the person from noticing the availability of occasions for speciously rewarded behavior. These are the intrapsychic equivalents of the wax in the crew's ears.
- (c) Devices that change the future contingencies of reward by intrapsychic means. There seem to be two types of devices within this category:
 - (c.) The control of affects which have intrinsic psychological momentum. Included in this category are the cultivation of affects which are incompatible with the impulse and the inhibition of affects which facilitate it.
 - (c.) Private rules, a device often spoken of as will power, acting on principle, making promises to one's self, etc. A precise definition of this device is given in Ainslie (1975) and is discussed further in this article.

Few writings since Homer's time have dealt with the concept of precommitment. Experimental studies specifically about precom-

mitment have been even fewer, and can be summarized in two paragraphs.

Mischel and Ebbeson (1970) gave children their choice of an unpreferred food immediately or a preferred food if they could wait fifteen minutes without eating. The children devised "self-distraction techniques" to take their attention off the food. These gradually succeeded if the food was not present. A similar study by Mischel, Ebbeson and Zeiss (1972) found that children could defer eating longer if given things to play with or think about. Mischel and Baker (1975) found that children waited longer in a similar choice situation if they had been told to think of a different food or to think thoughts unrelated to eating the food they were waiting for. In these experiments, subjects were told ways of manipulating both their attention and their affect (hunger).

In addition to these studies with children, it has been shown that pigeons will learn an extrapsychic precommitting device (Ainslie, 1974). Pigeons were periodically offered a choice between a small, immediate food reward and a larger food reward a few seconds later. All subjects made their choice in favor of the immediate reward on virtually all trials. If, however, several seconds before the choice was due to come up again they were allowed to make a response that rendered the smaller reward unavailable, some of the birds came regularly to choose this precommitment. These birds did not make this response in control conditions where it had no effects, where it was *necessary* to make the earlier reward available, or where it was made possible only a very short time before the choice was due to come up. This is evidence not only that preference for a larger reward can change to preference for a smaller alternative just because the smaller alternative is drawing closer, but also that a device to forestall this change of preference can be learned in the absence of "higher" mental functions. Precommitting devices seem to be learnable entirely on the basis of the differential effect of the larger reward before the smaller reward becomes dominant.

Compatibility with Freud's two principles of mental functioning

Although more research is obviously called for on the properties of delayed reward, these experimental studies suggest an origin of im-

pulses which does not entail censorship of the impulse motivation. Despite this difference with Freud's hypothesis about the origin of impulses, the temporal discounting model accords well with his economic approach to motivation.

In choice situations that can be described by the diagram in Figure 1, the crossing curves of reward effectiveness define two principles of mental functioning. Functions based on the differential effectiveness of smaller, earlier rewards in the period after the curves have crossed will necessarily be functions that seek instant gratification. There will be as many of these mental functions as there are situations that create specious reward. These functions will be transient and will have no necessary connection with each other, except that they will share a negative relationship to the long-run interests of the decision maker. They will be reward-seeking functions and hence will operate according to Freud's pleasure principle, and because they are closely followed by reward they will be the functions a person will learn first.

However, as a person discovers delayed rewards that are more valuable, the mental functions that seek the poorer, earlier alternatives will become a nuisance to him. The functions based on the delayed rewards, which will be dominant before the curves of effectiveness cross, will be farsighted but must stay in control of behavior over the long run if they are to obtain the rewards that are their *raison d'être*. In particular, they must include devices to forestall the temporary attractiveness of the poorer alternatives. If they succeed in preventing change of choice based on the poorer rewards, they could be said to be "safeguarding" the pleasure principle. This sounds like the relationship Freud described between the reality and the pleasure principles (1911, pp. 219-223) and between the ego and the id (1923, pp. 24-25).

If what Freud referred to as psychic energy (1916-1917, pp. 339-340; Rapaport, 1960, pp. 91ff) comes from the differential effectiveness of the available rewards at a given moment, then the energy of the ego functions will be the differential effectiveness (Rapaport, 1960, pp. 92-94) of the better, delayed rewards in the period before specious alternatives become dominant. Since these better rewards are not consumed in this period, the energy could be spoken of as bound. On the basis of this energy the ego functions must prevent the discharge of enormous but temporary concentrations of id energy which occur when a specious reward is imminent, using the leverage afforded by foresight, i.e. by their being domi-

nant at an earlier time. Freud described a similar relationship between id and ego when he compared the id to a horse controlled by a weaker but more intelligent horseman, the ego (1923, p. 25; 1926, p. 97).

Some differences with Freud's economic assumptions

Three differences should be noted between Freud's economic assumptions and the behaviorally derived precommitment hypothesis presented here. First, Freud believed that psychic energy was conserved in all transactions, i.e. that it was neither created nor destroyed, but only moved from one object to another (Freud, 1938, p. 148; Rapaport, 1960, pp. 76-77). There seems to be no need to postulate this strict conservation of energy. In fact, the reward process must necessarily operate with greater intensity at some times than others if it is to establish differential motives. It is presumably subtended by a neurophysiological process, which can vary in its activity like any other physiological process. However, if one source of reward ceased to be productive, a person would be motivated to find other sources, and sources which had previously been unable to compete for his attention would become able to do so. A person's continuing susceptibility to reward would seem to be all that is needed to account for the substitution phenomena Freud was trying to explain by the conservation of energy.

Second, Freud said that the demands of "reality" for gratification delay came from social authorities, particularly parents (1920, pp. 20-21; Rangell, 1968). But a highly concave time curve of reward effectiveness (Figure 1) predicts that a person will be confronted by the need for gratification delay even in the absence of any social demands. His ability to get fast, costly reward will be a threat to his more adaptive, long-range skills, and he will be motivated to adopt precommitting devices purely to suit himself. He may even want to guard against the rapid but wasteful consumption of the same reward he seeks in the long run (Ainslie, 1975). Entirely personal motivation for the use of defense mechanisms was indeed suggested by Anna Freud as "instinctual anxiety" (A. Freud, 1966, pp. 58-61, 152-172), but this proposal has been controversial (Fenichel, 1945, p. 140; Waelder, 1960, pp. 160-162). It has recently been amplified by Kohut (1977, pp. 93-111).

Third, Freud implied that the cost of using a defense mechanism is the energy spent in operating the mechanism itself, and that this energy matches the energy of the target impulse. Specifically, he held that dangerous cathexes had to be restrained by opposite and equal "anti-cathexes" (1895, pp. 323-324; 1920, pp. 29-30; 1926, pp. 157-158). Psychodynamic writers have often referred to the ego's use of bound energy to block the discharge of free energy, and have spoken as if the bound energy were itself the substance from which the blockade is formed:

In the course of development, hierarchically layered structures arise (defenses and controls) which act as "dikes". These not only delay or prevent discharge, but also diminish the drives' tendency toward immediate discharge. These structures are conceived of as built by "binding" drive energies to heighten the originally given drive-discharge thresholds. Their effect of diminishing the drives' tendency toward immediate discharge is conceptualized as "neutralization," special instances of which are referred to as delibidinization, deaggressivization, or sublimation (Rapaport, 1960, p. 51).

Precommitment to avoid a specious reward could certainly be described as a binding of energy, in that it prevents the consumption of reward, but the differential in reward effectiveness needed to set up a precommitment bears no fixed relationship to the future reward differential that is thereby rendered ineffective, and is apt to be much smaller because it acts at a longer distance from the rewards. To further confound prediction, there may be added to this cost a variable amount of harmless reward which also bears no necessary relationship to the particular reward being avoided; the wider the berth a person must give his impulse, the more sources of harmless reward he may incidentally have to give up. An alcoholic, say, who must stay away from parties and all his drinking friends in order to stay off the bottle will lose more sources of reward than will an alcoholic who can simply use "will power". If Ulysses had not found an easy way to forestall the Sirens, he would have had to use the much more costly device of not sailing in that direction at all — although this might still have been less costly than letting himself succumb to the Sirens. Thus, the cost of avoiding a given impulse may vary from one device to another, and, given one device, may vary as environmental opportunities vary. The most costly defenses will be those that are the most restricting and inflexible.

Summary of the precommitment model of impulse control

Behavioral research has suggested a motivational basis for the two goal-directed processes which Freud said can exist in the same person, and which often seem to behave toward each other as if they were separate people. Mechanisms by which the ego processes forestall the id processes, as these processes have just been defined, perform the second of the functions that have been attributed to the defense mechanisms: the avoidance of behaviors that lead to unpleasant consequences. Examination of the literature on motivational conflict in light of the temporary preference hypothesis suggests four kinds of impulse-forestalling mechanisms, the detailed examination of which will suggest some answers to the basic question about defense mechanisms raised at the beginning of this article. The first three kinds are readily discernible both in clinical writings and in everyday speech and will not require a great deal of exposition. They seem to represent simple steps taken in advance to forestall the temporary preference for a poor reward. The fourth kind, private side-betting (c_2), has lacked a clear definition or an economic explanation, and will be examined in detail. This mechanism is apparently more complicated, and involves the interaction of whole sets of choices.

Simple defenses

Extrapsychic mechanisms

Devices of the extrapsychic kind involve arranging for either physical or social action upon the person's future self. They are widely proposed in behavior therapy manuals (Stuart and Davis, 1972, pp. 61-98; Thoreson and Mahoney, 1974). A person who is trying to avoid overeating, for instance, has been variously advised to take a drug that suppresses his appetite, to keep fattening foods out of the house (perhaps by the expedient of going shopping only when he has just eaten), or even to have his jaw wired together. If he can enlist the cooperation of a friend, he might ask the friend to put pressure on him when he seems about to overeat, deposit money with the friend which is to be given away whenever he overeats, or simply make a public statement of his intention to lose weight so that he will look foolish if he does not.

Psychodynamic writers have described how a person may act up in order to attract the attention of someone in authority, who will then guard him and prevent the occurrence of more serious impulsive behavior. This maneuver has been called *asking for controls*.

The potential committing power of these devices is obviously variable, and their usefulness also depends on whether the environment makes them available. Devices which enlist other people's influence, probably the most widely applicable of the extrapsychic devices, also depend on the person's social style — whether he is someone who leaves himself vulnerable to the opinions of other people.

Control of attention

Repression, which Freud at one time held to be the cornerstone of all defensive processes (1914, p. 16), is said to operate by keeping attention away from thoughts that might lead to impulses:

A repressed instinctual impulse can be activated (newly cathected) from two directions: from within, through reinforcement from its internal sources of excitation, and from without, through the perception of an object that it desires. The hysterical anticathexis is mainly directed outwards, against dangerous perceptions. It takes the form of a special kind of vigilance which, by means of restrictions of the ego, causes situations to be avoided that would entail such perceptions, or if they do occur, manages to withdraw the subject's attention from them (Freud, 1926, p. 158).

This passage seems to describe device b: avoiding information about the availability or proximity of the specious reward. A similar process has been recommended by some behavior therapists, under the name of "stimulus control", as a useful way of avoiding impulses (Kanfer, 1975, pp. 309-355; Goldiamond, 1965). *Denial* may also serve this purpose by keeping attention off environmental opportunities for impulses, although in many of the examples that have been described it seems to be serving mainly to avoid painful perceptions rather than as a precommitting device. For instance, White and Gilliland give as examples of denial: (1) a mother denying the recent accidental death of her child; (2) a scientist denying a failure to get a professorship; (3) a widow denying the death of her husband; and (4) a child denying culpability

(White and Gilliland, 1975, pp. 78-80).

The disadvantage of attention control as a defense against impulses is that it may hinder the gathering of useful information, possibly leading to serious gaps in the person's orientation to reality.

Control of affect

Freud initially included in his concept of repression the disconnection of thoughts from feelings (1894, p. 58), a distinct process he later named *isolation of affect*: a person pays attention to experiences that would be expected to cause emotionality, but reports feeling no emotion (1926, pp. 120-122, 163-164). This may be understood as an example of precommitment if we notice the effect that an emotion has on subsequent motivation. It is commonly recognized that basic emotions such as anger, sexual arousal and fear are, up to a point, vicious circles. After the emotion has gotten under way, there is a lower threshold for further emotional activity of the same kind, until some satiation point has been reached (Skinner, 1953, pp. 235-236, 239-240). If a person expects an emotion to make an otherwise unpreferred reward temporarily dominant, he may commit himself not to choose the reward through early inhibition of that emotion.

A concrete example of this strategy is the advice that used to be given to teenagers in dating manuals on how to avoid sexual intercourse by avoiding foreplay. Avoidance of the affect usually produced by foreplay would be expected to have the same result. Although there has been little research on voluntary control of the affective processes, Lazarus has described credible examples from everyday life (1975a, b). With his collaborators, he has demonstrated experimentally how human subjects can learn to voluntarily "distance" themselves from a stressful film and concomitantly reduce their galvanic skin responses (Koriat et al., 1972). The recent discovery that people can learn extensive voluntary control of vegetative functions like blood pressure, organ perfusion and brain waves (Di Cara, 1970; Kimmel, 1974; Schwartz, 1975) tends to confirm the practicality of voluntarily controlling affects. Early inhibition of affects is probably a powerful means of precommitment, although this device costs whatever reward is dependent on that affect for its consumption. For instance, the per-

son who controlled his sexual temptations by the early avoidance of sexual affects might run the risk of losing his capacity for sexual enjoyment.

A person can also decrease the attractiveness of a particular activity by cultivating a contradictory affect. For instance, when entering a situation which he expects to provoke unwanted tender feelings he might forestall these feelings by summoning his rage at the earliest opportunity. Conversely, if he is worried about rage he might cultivate tender feelings. Examples of this device have been discussed under the name of *reversal of affect* (A. Freud, 1966, pp. 29-40; Freud, 1914, pp. 126-127). This device has also been proposed by behavior therapists, under the name "convert sensitization", as a means of spoiling a person's appetite for addicting substances (Cautela, 1967). This device seems to represent a special case of general strategy: finding activities that reduce one's appetite for, or increase one's appetite for the alternative to, a particular reward. This general strategy has been called *reaction formation* (A. Freud, 1966, pp. 37-38; Freud, 1926, pp. 157-158).

Hirschman has recently pointed out that the description of this strategy antedates Freud by nearly three centuries, having originated in Bacon and Spinoza, and that in the eighteenth century it was sometimes held out as the only practical precommitting device: "Nothing can oppose or retard the impulse of passion but a contrary impulse" (Hume, quoted in Hirschman, 1977).

The disadvantage of this strategy seems to be that the activities which counteract a particular specious reward may not happen to be otherwise productive. The need to maintain a close balance of emotions might greatly reduce the person's reward-getting efficiency.

Complex defenses

Private side bets

Only a few of the many defense mechanisms that have been described in the literature seem to be simple precommitting devices: asking for controls, repression, denial, isolation of affect, reversal of affect, and reaction formation. Furthermore, simple precommitment does not seem to account for the kind of impulse control we call will power, which allows a person to resist impulses while he is both attracted by them and able to pursue them. However, it is

possible to deduce a mechanism for will power from the existence of highly concave reward effectiveness curves, if we assume only that curves from multiple rewards combine in an additive fashion.

For reward effectiveness curves that are hyperbolic and additive, a series of larger, later rewards and their smaller, earlier alternatives is described by equation (4):

$$\frac{B}{B'} = \frac{A_1/(T_1-t)}{A'_1/(T_1+\Delta-t)} + \frac{A_2/(T_2-t)}{A'_2/(T_2+\Delta-t)} + \frac{A_n/(T_n-t)}{A'_n/(T_n+\Delta-t)} = \sum \frac{A_i/(T_i-t)}{A'_i/(T_i+\Delta-t)} \quad (4)$$

where each A_i is available at time T_i and its alternative A'_i is available at time $T_i + \Delta$. Since the rewards in each series are available with equal frequency, the $\frac{R}{R'}$ term from equation (1)

again drops out. If the non-prime reward is specious with respect to the prime alternative in each choice, which requires that each $A'_i > A_i$ and $T'_i < T_i$, then the crucial time at which preference between the whole series of rewards changes is represented by t when $B = B'$:

$$\sum \frac{A_i/(T_i - t_{\text{cross}})}{A'_i/(T'_i - t_{\text{cross}})} = 1$$

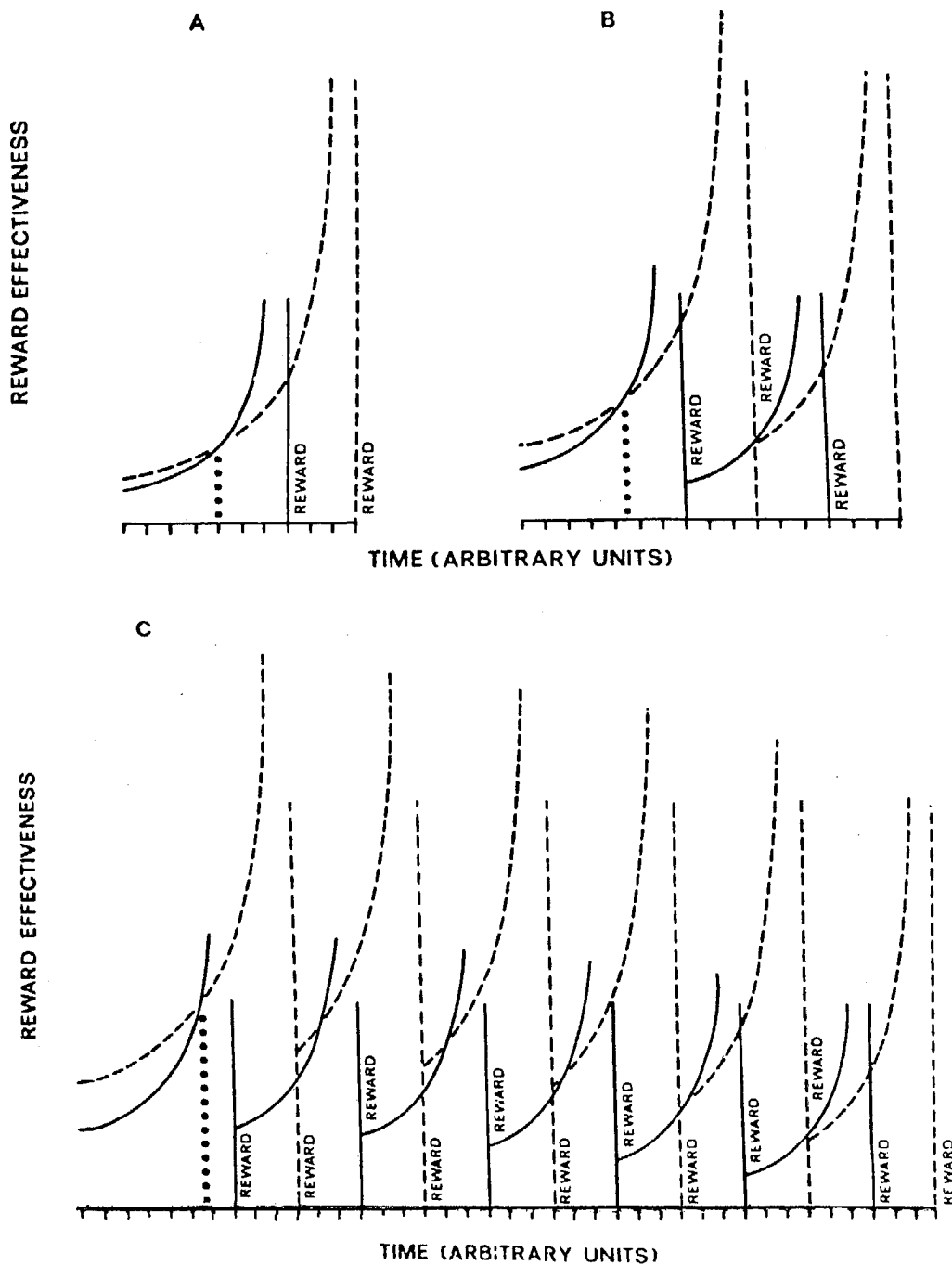
If the choice is made before this t_{cross} , it will favor the series of larger, later rewards, and if it is made after t_{cross} , it will favor the series of smaller, earlier ones.

This would be a trivial application of equation (1) to the case of multiple rewards except for an important phenomenon: The cross-over point from preference for the prime (larger) series to the non-prime (smaller) series will move closer to the time the first smaller reward is available as the series is made longer. That is, the period $(T_1 - t_{\text{cross}})$ becomes shorter; it may approach zero. The period of temporary preference for the smaller reward is reduced or eliminated. To illustrate this effect: Preference between a reward, A , at time, T , and a reward twice as great, A' , at $T+3$ units of time, will change 3 units of time before each earlier member of a pair is due ($\frac{1}{T-(T-3)} = \frac{2}{(T+3)-(T-3)}$; Figure 2a). If the

choice recurs every 6 units of time, summed curves from two pairs

FIGURE 2

Summed hyperbolic curves of the effectiveness of two alternative sets of rewards — small rewards (solid lines), and rewards twice as great (dashed lines): A, sets of one reward each; B, sets of two rewards each; and C, sets of six rewards each (from Ainslie, 1975). In A the smaller reward becomes preferred three units of time before it is due; in B, the smaller rewards become preferred 2.4 units of time before the first one is due, and in C, 1.6 units.



of alternatives will cross 2.4 units of time before the earliest reward is due $\frac{1}{T-(T-2.4)} + \frac{1}{(T+6)-(T-2.4)} \cong \frac{2}{(T+3)-(T-2.4)} + \frac{2}{(T+9)-(T-2.4)}$;

Figure 2b) and summed curves from six pairs of alternatives will cross 1.6 units of time before the earliest reward is due (Figure 2c; Ainslie, 1975).

The practical effect of choosing a whole series of rewards at once would be to increase the choice-maker's tendency to choose the larger rewards. He could approach much closer to the specious rewards, and thus be more flexible in his behavior, without succumbing to an impulse to choose the specious rewards. Furthermore, since there must actually be some finite limit to the immediacy with which any reward can be obtained, the increase in the effectiveness of the larger rewards might itself be sufficient to prevent a temporary preference for the smaller alternatives.

But how does a person arrange to choose whole series of rewards at once? In fact he does not have to physically commit himself. He need only stake his *expectation* of getting the whole series of larger rewards on a single choice, and the relative values of the two alternatives, B and B', will be determined by equation (4). In behavioral terms, if he has reason to predict that he will get the series of larger rewards, he will derive a secondary reward from this prediction (Longstreth, 1971; Wyckoff, 1959). If this prediction changes he will lose this secondary reward, and gain only the secondary reward induced by the series of smaller alternatives. But in choices between impulsive and non-impulsive alternatives, the best predictor of what rewards he will obtain in the future is what reward he is obtaining in a similar situation in the present. If he sees himself choosing the specious alternative in a current choice, he will probably lose any expectancy he may have had of obtaining the larger rewards in similar, future choices. Thus he will, in effect, be choosing between a whole group of specious rewards and a whole group of larger rewards whenever he chooses between one specious reward and one larger reward which he perceives to be members of those groups. The current choice could be said to have become a precedent for future choices.

Take for example the predicament of a person on a weight-reducing diet who has been offered a piece of candy. He knows that the calories in one piece of candy will not make any noticeable difference in his weight, and yet he is apt to feel that he should not eat the candy. What would it cost him? Common experience tells us: his expectation of sticking to the diet. He will face many chances to

eat forbidden foods, and if he sees himself eating this one, it will not seem likely to him that he will refuse the others. If he succumbs to the temptation to eat the candy, it will cost him not only its small caloric load, but also the expectation of getting whatever benefits he had hoped for from his diet. And yet the very knowledge that he is in this predicament may make him refuse the candy where he would otherwise accept it. His behavior will then be controlled by equation (4) rather than equation (1).

This amplification of impulse control can be expected to occur spontaneously whenever a choice-maker perceives a series of confrontations with impulses as similar to each other. He will not necessarily notice the process itself, or develop any way of describing it. He might develop an extensive practical understanding of it by trial and error, but have only tangential theories about how it works. However, insofar as he has become aware of this phenomenon, he will be able to induce it where it has not occurred spontaneously, by arbitrarily defining a set of gratification-delaying behaviors which will thereafter prevail or not as a set (cf. Ainslie, 1980).

This means of precommitment is an example of side betting, since it works by putting additional reward at stake in each individual choice. Schelling (1960, pp. 21-80) and Becker (1960) have described side betting as a way people sometimes commit themselves to a course of action by arranging to forfeit things of value — money, reputation, freedom — if they do not make a particular choice in a specified direction. For instance, a person may commit himself not to tell lies by cultivating a reputation as a truthful person, which would be lost if he were caught lying. In Schelling's and Becker's examples, however, the side bets are held by other people, who exact the penalty if the person does not behave as he bet he would. Public side bets like those are an example of an extrapsychic precommitting device. In the interdependent series of behaviors described above, no one need hold the bet; if the bettor perceives himself not to have waited for a large reward he will automatically pay the forfeit, by losing his expectation that he will wait for similar rewards in the future. Thus a person can bind his behavior by a *private side bet*, which does not depend on the cooperation of any other person.

Preconditions of private side bets

The effectiveness and the cost of a private side bet depend on what is included in the set of choices that must all be made in the same direction: (1) The series of rewards to be waited for must be long enough and valuable enough so that it will be preferred over each specious alternative. (2) Each member of the series and its specious alternatives must be readily identifiable, without ambiguity. And (3) the features that exclude a choice from the series must either occur independently of the bettor's behavior or have such a high intrinsic cost that the bettor would not be motivated to bring them about just for the sake of evading the bet.

These three requirements can be illustrated if we pursue the example of a person trying to lose weight: (1) To succeed, he must expect enough cumulative reward from weighing less to motivate each of the many acts of abstinence which will be necessary. (2) He must also have clear guidelines that identify which food choices are permissible: he might find it hard not to see his eating a piece of candy as a violation of his plan to reduce, but what about eating a relatively large piece of steak? Or a medium-sized piece of steak? In the absence of clear boundaries between impulsive and adaptive eating behaviors, there can be no criterion on which a private side bet might spontaneously come to depend. Similarly, deliberate bets which require the person not to have "large" helpings or to eat "only when hungry" are apt to be defeated by shifts in the person's threshold for detecting largeness or hunger, since this detection must be done during the period when the temptation to overeat is temporarily dominant. Doubtless it is the absence of a simple cue distinguishing adaptive eating from overeating that makes people turn to the cumbersome legalism of formal diets. What a dieter gains from the trouble of classifying, counting and sometimes weighing foods is a two-way division of his eating behaviors into good and bad. (3) Finally, it would be evident folly for a person to bet that he will eat only what he puts on his plate or only what he buys. However, it might be practical to permit himself to eat all the caviar he buys or all the food he wants when he gives a party, if the cost of buying caviar or the effort of giving a party would deter him from doing these things more often than usual.

Redefining private side bets

The three requirements listed above — adequate size, adequate clarity, and criteria which do not depend on the bettor's behavior — are all that should be necessary for the success of private side bets made in advance and maintained without modification. However, in a changing environment, a bettor is apt to find that he has committed himself to forego an unexpectedly large amount of reward. Such a commitment will lead him either to lose the bet or to forego more reward than he had expected to in order to win it. He might be able to get more reward out of the situation if he could redefine his bet without undermining its effectiveness. For instance, our dieter might find that he had committed himself to forego a meal with great sentimental value (Thanksgiving dinner, say), or to offend a host by refusing food, or simply to avoid a kind of food which he liked more than he had thought. There are any number of ways he could make the necessary loopholes in his diet: calling it off on major holidays, or in company, or when the food would be wasted if he did not eat it, or just this once, and so on. It is almost always possible to formulate a principle that will grant an exception in the case at hand; but that very fact makes indiscriminate redefinitions fatal to a private side bet. If our dieter is going to redefine his bet in such a way that he keeps his expectation of losing weight, the occasion he used must not only be rare but must also stand out in some way from other possible occasions which are not rare enough. He must detect a *bright line* that separates his current, adequately rare excuse from other excuses that would be available too often. If for him Thanksgiving stands out against Sunday or a cousin's birthday, if he can name only a few infrequent hosts who might be hurt if he refused large portions, or if an infrequently encountered dessert actually has a unique place in his heart, only then might he make an exception without losing the credibility of his bet. The interest based on the smaller, earlier reward finds countless ways to say, "just this once", and the long-term interest must defend itself by arguing, "It's a matter of principle."

Making and redefining private side bets are obviously learnable skills similar to the skills required of a lawyer or a negotiator. Indeed, recently described principles of interpersonal negotiation closely fit the interaction of impulses and impulse controls (Schelling, 1960, pp. 21-80; Shefrin and Thaler, 1978; Taylor, 1975). As has just been described, the most important relationship between

these processes arises from the fact that they must operate together over a long and repetitive lifetime, so that current decisions may become more important as precedents for future decisions than as events in their own right. The need of the "ego" or "reality principle" to draw a line against impulses is like the interest of the negotiator who must face an opponent not just once but repeatedly, a position well defined by the bargaining theorist, Schelling:

To persuade the other that one cannot afford to concede, one says in effect, "If I conceded to you here, you would revise your estimate on me in our other negotiations; to protect my reputation with you I must stand firm." (Schelling, 1960, p. 30)

This logic does not change if it is the self, not the other, who must be convinced. By similar logic players in experimental bargaining games like the Prisoner's Dilemma are motivated to choose the cooperative solution if this choice will be seen as a precedent for future games, but often choose the non-cooperative solution if it will not (Taylor, 1975, esp. chapters 3 and 5). Theories of bargaining and games may let us make explicit much of the logic of impulse control, which, like bargaining itself, has long been left to intuition.

Compulsive defenses

Reliance on interdependent series of choices can be expected to foster a compulsive style of ego defense. This mechanism accounts for compulsive symptoms in much greater detail than have previous explanations derived from learning theory, which have held that compulsions arise from superstition or excessive timidity (Carr, 1974). Interdependency of choices transforms a diffuse array of choices into a single, highly charged dichotomy, which results in more consistent behavior toward temptation. Depending on the person's skill in defining series of choices and his degree of reliance on this means of impulse control, this consistency will be called strength of will, moral rigidity, or nitpicking legalism.

A person with little skill at formulating rules or with unusually strong impulses might compensate for these problems by increasing the scope of his private side bets. He could do this by increasing the number of behaviors which he classifies as covered by each private

side bet, or by connecting each bet with some or all of his other private side bets. Either way of making his choices more interdependent would increase the differential reward for turning down each temptation, but at the expense of making his behavior more rigid: Increasing his tendency to classify his behaviors as impulsive or not would give his experience a dry, rational, lawyerly quality, since he would choose his actions less and less for their intrinsic value, and more according to whether they met the terms of a bet. Increasing the interdependency of his bets would give every choice a cataclysmic, life-or-death quality, since his expectation of being able to resist a wide realm of impulses would be riding on it. He would be likely to make diehard stands on small matters of principle, even if they exemplified the principle only by the most far-fetched flight of symbolism, since he would incur an enormous fall in expectations if he perceived himself to have lost any private side bet. He would come to feel that he acted at great peril, and begin to examine each choice with such care as to render himself utterly indecisive.

If, despite his precautions, he did behave in a way that could be perceived as impulsive, he would fear that he would lose his ability to control impulses. He might call this fear anxiety, guilt, or foreboding, and unless he was conscious of his side betting system in some way that made sense to him he would be apt to say that the fear was unaccountable, that he "knew" there was nothing to be afraid of. Another perception might be that his self-esteem or self-respect was in danger. In any case, his discomfort would motivate him to: (1) ignore the fact that he had broken his rule, (2) classify the behavior in some way to make it legitimate, (3) assure himself that he was not likely to do it again, or, (4) enlarge the scope of his private side bets still further (Ainslie, 1975, p. 486).

Avoiding information about his lapses (1) would indeed temper the severity of the person's principles, but in an indiscriminate fashion that would undermine the effectiveness of his principles across the board, and lead him to formulate increasingly rigid principles in an attempt to maintain impulse control. The same could be said for facile reclassification (2), that is, the kind of effort called *rationalization* (Hollitscher, 1939), as was discussed above in the section on redefining private side bets. In fact, the use of these two dodges might have been the very mistakes with side betting which evoked this person's hyperactive betting activity to begin with: obsessional traits are said to start with an act of hysterical repres-

sion (A. Freud, 1966, p. 47; Freud, 1918, p. 75). It is easy to see how the sequence of overly demanding bets and blind evasions might become a vicious circle, leading to "tyranny tempered by anarchy".

However, there is a way that a person might compensate for his lapse without weakening his expectation that he will continue to avoid impulses (3). He could administer some kind of punishment to himself, and redefine his rule from "I will not do X" to "I will not do X without incurring punishment Y", — a rule which he will not have violated. The difficulty with this strategy lies in finding a punishment which is sufficiently aversive but which the person will not avoid when it becomes imminent. To do this he might either set up a long-lasting punishment which never reaches great intensity (drudgery, for instance) or else yield to some impulse that usually commits him to being punished (fighting with family or authorities, say, or getting drunk), hoping that the punishment part of the sequence will deter further lapses more than the opportunity for his new impulsive behavior will encourage them. Preserving private side bets by permitting lapses followed by punishment may account for some clinical examples of self-punitiveness (White and Gilliland, 1975, pp. 87-89), which are said to arise from a *turning against the self* of sadistic impulses (Freud, 1915, p. 127), or from an "unconscious sense of guilt" or "need for punishment" (Freud, 1924, pp. 165-167). As Freud pointed out (1924, pp. 168-170), it may be hard in practice to tell whether a person is seeking deprivation as a penance or is simply being scrupulous about avoiding impulses.

If the person still had room to do so, he could further enlarge the scope of the bet he had lost (4). For instance, if he had lost a bet against drinking, he might make a resolution to reform his whole lifestyle. A reduced possibility of obtaining a broader category of rewards may have the same secondary rewarding effect as the original, narrower category that was more likely to be obtained.

If the person could not repair his expectation of winning his bet by one of these four maneuvers, he would have to avoid the impulse by processes that do not involve side betting, viz. the manipulation of affect, manipulation of attention, or submitting to controls outside of himself. However, he might preserve part of his private side betting structure by abandoning his most vulnerable private side bets, thus accepting some impulsive behavior in return for a greater likelihood of winning narrower, perhaps more fun-

damental bets. Here is Freud's migratory horde retreating to hold a less exposed position, a move he called *regression* (1916-1917, pp. 340-341).

The person we have been talking about, who has enmeshed himself in an unusually restrictive set of rules, would clearly have his problems diagnosed as compulsive in nature. Clinical observation tells us that he would also be apt to exhibit the "compulsive" defense mechanisms: undoing, reaction formation, isolation of affect, and regression (A. Freud, 1966, p. 43; Sandler and Joffe, 1965). But his symptoms — the inordinate fear of impulses, over-concern with principle, rigid behavior guarded by the threat of guilt, and indecisiveness — are not explained by the presence of these defense mechanisms.

It is hard to imagine how *undoing* could ever be of any practical help in forestalling impulses, although it may well be inspired by a "defensive purpose" (Freud, 1926, pp. 119-120, p. 164). Going through the motions of avoiding or undoing an impulse that has already been followed might be a favorite kind of self-punishment to make the impulse less likely in the future (White and Gilliland, 1975, pp. 65-68), but should not be more effective than any other mild self-punishment. It might be just an attempt to imagine that the impulsive behavior did not take place, which, insofar as it succeeded, would *decrease* the effectiveness of the relevant private side bet like any other way of ignoring lapses. Here seems to be an example of one "defensive" motive — the avoidance of unpleasant perceptions — contradicting the other defensive motive — the avoidance of impulsive behavior.

Reaction formation, which operates by cultivating an emotional process that reduces the motivation for an impulse, would not be expected to lead to the compulsive person's timid, legalistic style. In fact, Freud did not say that reaction formation was specific to compulsive neurosis, but only that it took on a "universal", generalizing quality when used by a compulsive person (1926, pp. 157-158).

Isolation of affect, another emotion-controlling device, would not in itself lead to a legalistic style. However, a person who controlled himself largely by private rules should prefer isolation to repression as a supplement to his defensive strategy. Repression, the avoidance of information itself rather than of the affect associated with it, might interfere with the person's policing of his rules, while avoidance of affect would not.

Regression, as I have just argued, is not an impulse-controlling device but a modification of another device: a retreat to more elementary private rules from private rules that have proved untenable.

Although undoing, reaction formation, isolation of affect and regression may often be found together with compulsive characteristics, the use of private rules must be a defensive operation in its own right and central to the "compulsive defenses". We recognize this when we say that a relatively healthy patient has "good compulsive defenses". Certainly no one would be pleased to see a defensive style that was simply a combination of undoing, reaction formation, isolation of affect, and regression. The operation that gives compulsive defenses both their power and their symptomatic side effects seems to be the making of private side bets.

Private side bets are not made only in compulsive neurosis. However, it may be that only compulsive people exaggerate the process to the point where it becomes obvious to the observer. As Sandler and Joffe have reminded us, compulsiveness is "a distinction or exaggeration of the ego's normal activities and functions, in particular those processes of control and mastery which are the essential ingredients of secondary process thinking" (1965). Many elements of private side betting have been included in historical descriptions of normal will power (Ainslie, 1975), in behavior therapy techniques such as "beta control" (Kanfer and Karoly, 1972), and in the cognitive social learning concept, "self-reward" (Mischel, 1973).

Other complex defenses

Several other defense mechanisms seem to describe particular cases of private side betting and/or their side effects. They can only be outlined here.

Identification and *introjection* involve the use of other people's behavior as a criterion for the person's own private rules, as in a rule to do nothing his father does not or did not do (cf. Ainslie, 1980).

Displacement and *sublimation* describe the redefinition of private rules that are initially inadequate to counteract a category of specious reward, leading to a compromise that permits the

reward under circumstances that reduce or eliminate its harmfulness. For instance, anger that was directed at family members and could not be wholly prevented becomes permissible, but only when directed at a scapegoat, or when expressed through the effective performance of the person's duty as a policeman. Simple abandonment, rather than modification, of a rule would be called regression, but it is not hard to think of examples where the distinction between the displacement-type defenses and regression is academic.

The only major defense that remains to be discussed is *projection*. It may be that this mechanism is mostly a way of avoiding an unpleasant perception of the person's own motives, as White and Gilliland's examples suggest (1975, pp. 83-85). This view would make a projection just an auxiliary form of repression. However, private side bets themselves represent a subtle motivating force that a person might come to perceive as external to his present self. The person's description of this "external" motivation would be apt to be labelled as projection. The topic of how motives are perceived as native or foreign to the self has been developed in a separate article (Ainslie, 1980).

The nature and relationships of the defense mechanisms

At the beginning of this article mention was made of several unanswered questions about the nature of the defense mechanisms. The hypothesis that impulses arise from the disproportionate effectiveness of imminent rewards, and the predictions which follow from this hypothesis, suggest some answers.

Membership

If impulse control and not simple pain avoidance is made the defining characteristic of defense mechanisms, the question of what constitutes a defense mechanism can be answered largely in favor of existing proposals, e.g., the definitions suggested by Fenichel (1945, pp. 141-167) and Anna Freud (1966, p. 44). However, undoing, although it may be a response to perceived impulsiveness, seems to be useless as a device to forestall impulses; and an addi-

tional mechanism should be recognized — the formation of interdependent sets of choices, “private side bets” — which seems to be central to the compulsive style of defense. Regression, introjection, identification, displacement, sublimation, and projection do not seem to name defensive processes in their own right, but rather phenomena that sometimes arise in the course of using private side bets to forestall impulses.

*The use of defense mechanisms
for purposes other than impulse control*

The four groups of devices defined in this article may not always be used in the service of forestalling impulses. They may bring reward in their own right, and sometimes may not forestall impulses or may forestall them only as a by-product. The reward they bring may even be specious with respect to some other rewards, so that these devices themselves become impulsive. Rapaport may have been referring to this possibility when he said that the defenses were sometimes controlled by the id (1967, p. 695).

(a) For instance, it may be hard to ascertain whether an impulsive delinquent has caused trouble mainly for the pleasure of causing trouble for its own sake, or mainly to “ask for controls” that will help him avoid more threatening impulses — an extra-psycho device.

(b) Similarly, a person may keep his attention away from a stimulus not because it signals the availability of a specious reward but because the stimulus is unpleasant — the other motive commonly detectable in defensive operations. It may be particularly unpleasant if it conveys information that the person has lost a private side bet. For instance, a person pledged to diet may repress, or just not read, information on the high caloric content of food he has just eaten or is about to eat. Keeping attention away from this information may then serve an impulsive purpose. Most of the classical defenses can be made to serve impulsive motives; undoing and denial may have little or no other use.

(c₁) Affects may certainly be sought or avoided for their own value, rather than for their influence on other motives in the near future.

(c₂) Private side bets may come into being for no deliberate purpose, but may arise spontaneously as a consequence of the way a

person predicts future reward. Insofar as this prediction is realistic, private side bets can have only an anti-impulsive effect, since they will only increase the relative effectiveness of delayed incentives. However, distorted perceptions of causality may modify these bets in a way that taxes their power to forestall impulses: if private side bets permit the "willing" of behavior that a person is otherwise unable to perform, it may occur to him that these bets could also bring about events whose causality he does not understand. For instance, if a primitive farmer ensures seed grain for the next planting by making a personal rule against using it to satisfy his immediate hunger, he may think of trying to assure rain for the harvest by performing other kinds of sacrifice. That is, he may try to influence events that are actually outside of his control by including them in private side bets. Conversely, he may try to increase the stake of his private side bets against impulses by interpreting as consequences of impulses events that are actually unaffected by them. For instance, he may bolster his resolve against sin by interpreting crop failure as the consequence of sin. ("The whole universe is harnessed to men's attempts to force one another into good citizenship", Douglas, 1966, p. 3...and to force themselves as well!) In either case, he will actually win or lose this additional stake at random. But if the evidence is ambiguous, he may prefer to interpret the outcomes as impulse-related rather than as random, finding flaws in this sacrifice or thinking of some way he has violated his rules to account for the loss of a stake.

It may be impossible for an observer to tell whether a person is making externally-caused events the stake of a private side bet mainly in order to feel that he controls these events or mainly in order to increase the force of the bet; and there is no reason these motives could not coexist. But since this practice makes a person's perception of winning or losing his bet depend more on his arbitrary interpretation than on the ostensibly external criterion, it must ultimately interfere with the effectiveness of his bet. The practice is associated with primitive peoples ("sorcery") and with psychopathological states ("grandiosity"). However, the frequency with which ordinary people respond to disease as if it were punishment suggests that these over-extended bets are also fairly normal in western society.

Adaptiveness

To the question of whether the defense mechanisms are always maladaptive, the answer must be no. Because of the disproportionate effectiveness of imminent rewards, a person will not maximize his reward in the long run simply by gaining an accurate perception of what rewards are available to him, i.e., simply by forming an undistorted picture of reality. He must use precommitting devices to forestall the temporary dominance of inferior rewards. The difference between pathological defense mechanisms and adaptive "coping mechanisms" does not seem to be a qualitative one, but rather describes the skill of the user in forestalling a given impulse at the least possible cost in harmless reward. Efficiency in doing this is the mark of maturity; excessive costs are the appropriate target of psychotherapy.

It has sometimes been proposed that defensive strategies form a hierarchy of adaptiveness, which might correspond to the order in which a child learns them (A. Freud, 1966, pp. 30-35; Gedo and Goldberg, 1973; Menninger, 1963, pp. 153-270; Vaillant, 1971). If we look at the functional classification of defense mechanisms proposed above, we might indeed guess that some are learned earlier than others. Certainly, reliance on external constraint (a) must come first, probably followed by the child's discovery that he can avert his attention from temptation (b) or build psychological momentum by the early avoidance or cultivation of certain emotions (c₁). The perception of one's own current behavior as a precedent predicting future choices in similar situations (c₂) must be the subtlest possibility to discover; however, its prominence in "anal" issues suggests that the discovery is probably not delayed beyond infancy. Thus most of a person's skill in using defense mechanisms is probably acquired in years when all the basic types are already known to him.

In the only hierarchy of adaptiveness which is backed by systematic research (Semrad et al., 1973; Vaillant, 1971), the categories of defense described above seem to develop in parallel. For instance, Vaillant's table (1971) assigns fifteen defensive strategies to four levels of adaptiveness, ranging from "mature" through "neurotic" and "immature" to the least adaptive "narcissistic" level. External constraint (a) is not considered, unless it is the purpose of *acting out* (an "immature" defense). But the attention-controlling defenses (b) are represented on every level:

suppression (mature), *repression* (neurotic), *schizoid fantasy* or *denial through fantasy* (immature) and *psychotic denial* (narcissistic).

Mature emotion control (c_1) is called altruism ("benign and constructive reaction formation"). Reaction formation, the archetype of the emotion controlling defenses, is listed as neurotic in Vaillant's table, as are the *reversal* and *counterphobia* he groups with dissociation and the *isolation of affect* he groups with intellectualization. Emotion-control is represented at the immature level by *passive-aggressive behavior* to the extent that such behavior results from the inhibition of overt rage, and at the narcissistic level by *distortion*, in which "unpleasant feelings are replaced with their opposites."

Insofar as Vaillant's *anticipation* represents a defense mechanism, it probably uses rule formation (c_2); he groups it among the mature defenses with *control through thinking* and *conscious control*. At the neurotic level, rule formation is approximated by *intellectualization*. If, as has been elsewhere hypothesized (Ainslie, 1980), *projection* is sometimes a way of perceiving commitment by private rules, then rule formation occurs at the immature and narcissistic (*delusional projection*) levels. Redefinitions of private rules are present at two levels at least: as *sublimation* (mature) and *displacement* (neurotic).

It seems that there can be an efficient way to use all four tactics of defense, and none is inconsistent with a mature defensive style. Haan has reached a similar conclusion, stating that for each of ten defense mechanisms there is a corresponding coping mechanism (1963).

Vaillant has added that there is one defense mechanism, *suppression*, which is associated with prosperity and signs of emotional maturity in normal adult males (Vaillant, 1976). This might be an example of an attention-controlling defense, since he defines it as "the conscious or semi-conscious decision to postpone paying attention to a conscious impulse or conflict". However, the illustrations of it he lists include "employing a stiff upper lip", and "deliberately postponing but not avoiding", which suggest willpower, i.e., private side bets. Thus we cannot be sure whether his "repression" represents a single precommitting tactic or combines attention-control and private side bets.

Interrelationships

There is clinical lore, but little research, suggesting that some defenses tend to occur together, while some tend to be alternative to each other. This lore is compatible with predictions that might be made about the broad functional categories of defenses described above: (a) external constraint, (b) attention control, which is often described as central to a hysterical defensive style, and (c) intrapsychic alteration of incentives. I will speak of category c loosely as compulsiveness, since emotion-control (c_1 reaction formation, and isolation and reversal of affects) tends to be observed in conjunction with rule formation (c_2).

Attention control and compulsiveness are widely thought of as alternatives, and analysis of interview transcripts to detect subjects' habits of ego defense has in fact found a negative correlation between the use of compulsive and hysterical defenses (Vaillant, 1976). It has already been mentioned that a defensive strategy based on ignoring information from the environment is apt to interfere with the maintenance of private rules, because these rules depend on the person's receiving accurate information about whether they are being followed. Conversely, the strict private rules that would defend this testing of reality must forbid the ignoring of any important information, and would thus interfere with a hysterical defensive strategy. It might be that inattention can buffer rules that are formulated too rigidly, but it would be hard to keep this process within limits. Thus the precommitment model of defenses predicts that the relationship between hysterical and compulsive defenses will be antagonistic.

Extrapsychic controls seem to be incompatible with compulsive defenses, and the use of external constraints where private rules might have served could directly undermine the maintenance of private rules. For instance, children who are largely restrained by parental pressure may grow up to use fewer internal controls (Aronfreed, 1968, pp. 308-309; Freedman, 1965). The force of a private rule is proportional to the number of delayed rewards which are perceived to be part of the interdependent set. Choices which are externally forced cannot form part of an interdependent set, since they will be made according to the external force and without regard to how other, unforced choices are made. Since this is the case, the person's choice does not provide evidence about how he will respond in unforced choices and thus does not contribute to the

personal credibility he can stake on private rules. A manipulated child or other prisoner simply depends less on his will than does a free person, and for that reason will has less force. Furthermore, a person who often places himself under external constraints is apt to find that he is sometimes forced by these constraints to disobey private rules. Therefore, strong, externally regulated motives certainly should reduce the potential scope of the will.

The remaining pair of categories — extrapsychic constraints and attentional control — could well be found together. There is no reason to predict that they will undermine each other, and each one is apt to be limited in its applicability — extrapsychic constraint by the availability of appropriate external forces, and attention control by its interference with reality testing. Since both are relatively incompatible with the compulsive defenses, they might sometimes wind up supplementing each other. Hysterical traits have often been attributed to people who experience unusual amounts of coercion, such as slaves, impoverished men, and women who have adopted a subordinate role (Smith-Rosenberg, 1972), but there is little evidence on the point.

Choice of defenses

It is easy to assume that reliance on extrapsychic controls is inferior to compulsiveness, perhaps because examples of dependent and delinquent people who have little apparent “self” control come readily to mind. Kohlberg seems to make this assumption, ranking even the most sophisticated form of external constraint, social influence, third from the bottom on his six-level hierarchy of moral decision-making (1963), while giving highest place to the epitome of private rule-making, the categorical imperative. It should then be disturbing that the girls Kohlberg has studied have tended to remain at the third level of thinking, while the boys have “advanced” beyond it. But this research seems to confound a plausible observation, that a difference between female and male roles has been the use of extrapsychic and compulsive defenses respectively (see, e.g., the choice of self-descriptive adjectives in Block [1973], with an unfounded approbation of the use of compulsive defenses [Vaillant, 1971, discussed above]). In a highly interdependent society it is far from obvious that a person who leaves himself open to social influence is less well adapted than a person who acts on unassailable

personal principles. The association between moral development on Kohlberg's scale and actual moral behavior has been doubtful, and deviations from his supposedly universal sequence of maturation have been frequent (Kurtines and Greif, 1974). It seems more likely that compulsive defenses have an advantage in an environment that rewards independent work and punishes influenceability, while reliance on social constraint has the advantage where cooperative work is rewarded and aloofness is punished.

Overview

Freud's theoretical requirement that impulses must have been created by censorship is rendered unnecessary by the discovery that the effectiveness of rewards declines in a hyperbolic curve as a function of delay. Even if later research fails to confirm a precisely hyperbolic shape of this curve, any highly concave delay-of-reward curve predicts that a choice-maker will regularly change his choice from better, later rewards to poorer, earlier ones as the earlier ones become imminently available. It also implies that at certain times he will be motivated to forestall this change of choice.

A definition of the defense mechanism as a device to forestall temporary preferences for poorer alternatives is narrower than the common understanding of this term. It excludes devices which function merely to avoid pain or seek reward and which sometimes work in direct antagonism to defense mechanisms as defined in this narrower sense. In return for this restriction of view we are enabled to make a systematic classification of defense mechanisms, and form hypotheses about their interactions and about the advantages and disadvantages of each kind.

The ways by which a person can forestall the temporary attractiveness ("speciousness") of inferior alternatives fall into four groups, two of which go together:

(a) Devices that require the cooperation of people or objects in the environment. These produce external constraints, by changing the contingencies of reward, and include among other methods the physical destruction of tempting substances, taking drugs that alter appetites, submitting to someone else's control, or making *public* side bets. They are sometimes described as *asking for controls*.

(b) Devices that keep attention away from specious alternatives, called *suppression, repression, or denial*.

(c) Devices that change the future contingencies of reward using intrapsychic means. There seem to be two basic types of devices within the latter category:

- (c₁) the cultivation or early avoidance of those affects that have some intrinsic psychological momentum (*reaction formation, reversal and isolation of affect*); and
- (c₂) the formation of interdependent sets of incentives (private side bets, i.e. *compulsiveness*), various facets of which may be called *identification, introjection, displacement, sublimation and projection*.

This article has dealt most extensively with category c₂, which is the most complex of the predictions that can be based on the delay-of-reward curves, the most difficult to fit into our clinical intuition, and probably the most important. The hypothesis that has been developed here is that insofar as a person's current choice supplies him with evidence about how he will make future choices, he is apt to perceive these choices as part of an interdependent set, with the effect that moment to moment choice-making will become governed by the whole series of incentives summed together. That is, he will make each choice while seeing it as a precedent for future choices in the same set. When there are many possible boundaries to such a set, the choice-maker will tend to settle on those that stand out from the others by some unique feature (*bright lines*), since he would otherwise expect to shift boundaries repeatedly in order to make exceptions for imminent rewards. The process by which a person's incentives interact to determine the boundaries of such sets will obey some of the logic of interpersonal bargaining; but the conflict among successively dominant rewards will be more limited than conflicts among individual people, since it arises entirely because of a simple, regular diminution in the effectiveness of delayed rewards.

Basic research in motivation has not refuted Freud's theory of motivational conflict. On the contrary, the implications of a hyperbolic drop in the effectiveness of rewards as a function of delay resemble many of the dynamic processes that he described. The parametric study of motivation in a laboratory can be a means of developing the economic approach to behavior that he began long ago (Freud, 1916-1917, pp. 356-357).

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References

Ainslie, G.

- 1974 "Impulse control in pigeons", *Journal of the Experimental Analysis of Behavior* 21: 485-489.
- 1975 "Specious reward: A behavioral theory of impulsiveness and impulse control", *Psychological Bulletin* 82: 463-496.
- 1980 "Impulse and compulsion: A behavioral, economic approach to involuntary behavior". (Unpublished manuscript.)

Ainslie, G.; Haendel, V.

- 1982 "The motives of the will", in: E. Gottheil; A.T. McLellan; K. Druley (eds). *Etiologies of alcoholism and drug addiction: Implications for research and treatment*. Springfield, NJ, Thomas.

Ainslie, G.; Herrnstein, R.

- 1981 "Preference reversal and delayed reinforcement", *Animal Learning and Behavior* 9(4): 476-482.

Aaronfreed, J.

- 1968 *Conduct and conscience*. New York, Academic.

Baum, W.

- 1977 "Time allocation in human vigilance", *Journal of the Experimental Analysis of Behavior* 27: 453-467.

Baum, W.; Rachlin, H.

- 1969 "Choice as time allocation", *Journal of the Experimental Analysis of Behavior* 12: 861-874.

Becker, H.

- 1960 "Notes on the concept of commitment", *American Journal of Sociology* 66: 32-40.

Berlyne, D.

- 1960 *Conflict, arousal, and curiosity*. New York, McGraw-Hill.

- Bibring, G.; Dwyer, T.; Huntington, D.; Valenstein, A.
1961 "A study of the psychological processes in pregnancy and of the earliest mother-child relationship", *Psychoanalytic Study of the Child* 16: 9-72.
- Block, J.
1973 "Conceptions of sex-role: Some cross-cultural and longitudinal perspectives", *American Psychologist* 28: 512-526.
- Bradshaw, C.; Szabadi, E; Bevan, P.
1976 "Behavior of humans in variable-interval schedules of reinforcement", *Journal of the Experimental Analysis of Behavior* 26: 135-141.
1977 "Effect of punishment on human variable-interval performance", *Journal of the Experimental Analysis of Behavior* 27: 275-279.
- Carr, A.
1974 "Compulsive neurosis: A review of the literature", *Psychological Bulletin* 81: 311-318.
- Cautela, J.
1967 "Covert sensitization", *Psychological Reports* 20: 459-468.
- Conger, R.; Killeen, P.
1974 "Use of concurrent operants in small group research," *Pacific Sociological Review* 17: 399-416.
- deVilliers, P.
1977 "Choice in concurrent schedules and a quantitative formulation of the law of effect", pp. 233-287, in: W. Honig; J. Staddon (eds). *Handbook of operant behavior*. Englewood Cliffs, NJ, Prentice Hall.
- DiCara, L.
1970 "Learning in the automatic nervous system", *Scientific American* 222: 30-39.
- Douglas, M.
1966 *Purity and danger: An analysis of concepts of pollution and taboo*. London, Routledge and Kegan Paul.
- Dreyer, P.; Renner, K.
1971 "Self-punitive behavior — Masochism or confusion," *Psychological Review* 78: 332-337.
- Elster, J.
1979 *Ulysses and the Sirens: Studies in rationality and irrationality*. Cambridge, Cambridge University Press.
- Eysenck, H.; Wilson, G.
1973 *The experimental study of Freudian theories*. London, Methuen.

Fenichel, O.

1945 *The psychoanalytic theory of neuroses*. New York, Norton.

Freedman, J.

1965 "Long-term behavioral effects of cognitive dissonance", *Experimental Social Psychology* 1: 145-155.

Freud, A.

1966 *The Ego and the mechanisms of defense*. New York, International Universities Press.

*Freud, S.

1894 "The neuropsychosis of defense", pp. 45-61 in: vol. 3 of *The standard edition of the complete psychological works of Sigmund Freud*. London, Hogarth Press, 1959.

1895 "Project for a scientific psychology", pp. 295-341, in: vol. 1.

1911 "Formulations on the two principles of mental functioning", pp. 226-239, in: vol. 12.

1913 "Totem and taboo", pp. 1-100, in: vol. 13.

1915 "Instincts and their vicissitudes", pp. 117-140, in: vol. 14.

1916-17 "Introductory lectures on psychoanalysis", pp. 243-448, in: vol. 16.

1918 "From the history of an infantile neurosis", pp. 7-104, in: vol. 17.

1920 "Beyond the pleasure principle", pp. 7-66, in: vol. 18.

1923 "The ego and the id", pp. 13-48, in: vol. 19.

1924 "The economic problem of masochism", pp. 159-172, in: vol. 19.

1926 "Inhibitions, symptoms and anxiety", pp. 87-187, in: vol. 20.

1938 "An outline of psychoanalysis", pp. 144-205, in: vol. 23.

1964 "On the history of the psychoanalytic movement", pp. 7-66, in: vol. 14.

Gedo, J.; Goldbert, A.

1973 *Models of the mind: A psychoanalytic theory*. Chicago, Ill., University of Chicago Press.

Goldiamond, I.

1965 "Self-control procedures in personal behavior problems," *Psychological Reports*, 17: 851-868.

Haan, N.

1963 "Proposed model of ego functioning: Coping and defense mechanisms in relationship to IQ change", *Psychological Monographs* 77: 8 (whole no. 571).

Hendrick, I.

1958 *Facts and theories of psychoanalysis*. New York, Knopf.

Hirschman, A.

1977 *The passions and the interests*. Princeton, NJ, Princeton University Press.

*All S. Freud references are to *The standard edition* . . . , London, Hogarth Press, 1959.

Hollitscher, W.

- 1939 "The concept of rationalization", *International Journal of Psychoanalysis* 20: 330-332.

Homer

- 1946 *The Odyssey* (trans. E. Reiss). Baltimore, Md., Penguin.

Kagel, J.; Rachlin, H.; Green, L.; Battalio, R.; Basman, R.; Klemm, W.

- 1975 "Experimental study of consumer demand behavior using laboratory animals", *Economic Inquiry* 13: 22-38.

Kanfer, F.

- 1975 "Self-management methods", in: F. Kanfer; A. Goldstein (eds). *Helping people change*. Elmsford, NJ, Pergamon.

Kanfer, R.; Karoly, P.

- 1972 "Self-control. A behavioristic excursion into the lion's den", *Behavior Therapy* 3: 398-416.

Kimmel, H.

- 1974 "Instrumental conditioning of automatically mediated responses in human beings", *American Psychologist* 29: 325-335.

Klein, G.

- 1973 "Two theories or one?", *Bulletin of the Menninger Clinic* 37: 102-132.

Kohlberg, L.

- 1963 "The development of children's orientations toward a moral order: I. Sequence in the development of moral thought," *Vita Humana* 6: 11-33.

Kohut, H.

- 1977 *The restoration of the self*. New York, International Universities Press.

Koriat, A.; Milkman, R.; Averill, J.R.; Lazarus, R.S.

- 1972 "The self-control of emotional reactions to a stressful film," *Journal of Personality* 40: 601-619.

Kurtines, W.; Greif, E.

- 1974 "The development of moral thought: Review and evaluation of Kohlberg's approach," *Psychological Bulletin* 81: 453-470.

Lazarus, R.

- 1975a "A cognitively oriented psychologist looks at biofeedback," *American Psychologist* 30: 553-561.

- 1975b "The self-regulation of emotion," in: L. Levi (ed.), *Emotions, their parameters and measurement*. New York, Raven.

Liddell, H.

- 1956 *Emotional hazards in animals and man*. Springfield, Ill., Thomas.

Longstreth, L.

- 1971 "A cognitive interpretation of secondary reinforcement," *Nebraska Symposium on Motivation* 19: 33-80.

Lowenstein, R.

- 1967 "Defensive organization and autonomous ego functions," *Journal of the American Psychoanalytic Association* 15: 795-809.

Masserman, J.

- 1943 *Behavior and neurosis*. Chicago, Ill., University of Chicago Press.

McCarley, R.; Hobson, J.A.

- 1977 "The neurobiological origins of psychoanalytic dream theory," *American Journal of Psychiatry* 134: 1211-1221.

Menninger, K.

- 1963 *The vital balance*. New York, Viking.

Mischel, W.; Ebbeson, E.

- 1970 "Attention in delay of gratification," *Journal of Personality and Social Psychology* 16: 329-337.

Mischel, W.; Ebbeson, E.; Zeiss, A.

- 1972 "Cognitive and attentional mechanisms in delay of gratification", *Journal of Personality and Social Psychology* 21: 204-218.

Mischel, W.

- 1973 "Toward a cognitive social learning reconceptualization of personality," *Psychological Review* 80: 252-283.

Mischel, W.; Baker, N.

- 1975 "Cognitive appraisals and transformations in delay behavior", *Journal of Personality and Social Psychology* 31: 254-261.

Mowrer, O.; Ullman, A.

- 1945 "Time as a determinant in integrative learning", *Psychological Review* 51: 61-90.

Navarick, D.; Fantino, E.

- 1976 "Self-control and general models of choice", *Journal of Experimental Psychology: Animal Behavior Processes* 2: 75-87.

Nevin, J.

- 1975 "Interval reinforcement of choice behavior in discrete trials", *Journal of the Experimental Analysis of Behavior* 23: 45-53.

Pribram, K.; Gill, M.

- 1976 *Freud's "project" re-assessed*. New York, Basic.

- Rachlin, H.; Green, L.
1972 "Commitment, choice, and self-control", *Journal of the Experimental Analysis of Behavior* 17: 15-22.
- Rangell, L.
1968 "The scope of intrapsychic conflict: Microscopic and macroscopic considerations," *Psychoanalytic Study of the Child* 18: 75-102.
- Rapaport, D.
1959 "A historical survey of psychoanalytic ego psychology," *Psychological Issues* 1(1): 5-17.
1960 *The structure of psychoanalytic theory*. New York, International Universities Press.
1967 "A theoretical analysis of the superego concept", in: *The collected papers of David Rapaport*. New York, Basic.
- Renner, K.
1964 "Delay of reinforcement: A historical review," *Psychological Bulletin* 61: 341-361.
- Sandler, J.; Joffe, W.
1965 "Notes on obsessional manifestations in children", *Psychoanalytic Study of the Child* 20: 425-438.
- Schelling, T.
1960 *The strategy of conflict*. Cambridge, Mass., Harvard University Press.
- Schroeder, S.; Holland, J.
1969 "Reinforcement of eye movement with concurrent schedules", *Journal of the Experimental Analysis of Behavior* 12: 897-903.
- Schwartz, G.
1975 "Biofeedback, self-regulation, and the patterning of physiological processes," *American Scientist* 63: 314-324.
- Semrad, E.; Grinspoon, L.; Feinberg, S.
1973 "Development of an ego profile scale," *Archives of General Psychiatry* 28: 70-77.
- Shefrin, H.; Thaler, R.
1978 *An economic theory of self-control*. Stanford, Calif., National Bureau of Economic Research. (Working Paper No. 208).
- Sjoberg, H.
1973 *The psychoanalytic theory of the defense processes*. London, Wiley.
- Skinner, B.
1953 *Science and human behavior*. New York, Macmillan.

Smith-Rosenberg, C.

- 1972 "The hysterical woman: Sex roles and role conflict in 19th century America," *Social Research* 39: 652-678.

Solnick, J.; Kannenberg, C.; Eckerman, D.; Waller, M.

- 1980 "An experimental analysis of impulsivity and impulse control in humans," *Learning and Motivation* 11: 61-77.

Solomon, R.; Wynne, L.

- 1954 "Traumatic avoidance learning: The principles of anxiety conservation and partial irreversibility," *Psychological Review* 61: 353-385.

Stuart, R., Davis, B.

- 1972 *Slim chance in a fat world*. Champaign, Ill., Research Press.

Taylor, M.

- 1975 *Anarchy and cooperation*. London, Wiley.

Teasdale, J.

- 1974 "Learning models of obsessional compulsive disorder", in: H. Beek (ed.). *Obsessional states*. London, Methuen.

Thoreson, C.; Mahoney, M.

- 1974 *Behavioral self-control*. New York, Holt, Rinehart and Winston.

Vaillant, G.

- 1971 "Theoretical hierarchy of adaptive ego mechanisms," *Archives of General Psychiatry* 24: 107-118.
1976 "Natural history of male psychological health V: The relationship of choice of ego mechanism of defense to adult adjustment," *Archives of General Psychiatry* 33: 535-545.

Waelder, R.

- 1960 *Basic theory of psychoanalysis*. New York, International Universities Press.

White, R.; Gilliland, R.

- 1975 *Elements of psychopathology: The mechanisms of defense*. New York, Grune & Stratton.

Wyckoff, L.

- 1959 "Toward a quantitative theory of secondary reinforcement", *Psychological Review* 66: 68-78.