

# *A Behaviorological Analysis of Adjunctive Behavior<sup>1\*</sup>*

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Adjunctive behavior is operant behavior that appears intermittently in the midst of other on-going behavior. It often appears to be an accidental intrusion that has little if any relevance to more important behavior that is already in progress and which it appears to interrupt, at least briefly. Adjunctive behavior is a *schedule effect*—that is, a pattern of behaving that occurs only if the prevailing schedules of reinforcement permit it to happen.

## ***Review of Relevant Conceptual Foundations for the Analysis of Adjunctive Behavior***

Adjunctive behavior is one of those real and frequently encountered behavioral phenomena that, although it manifests as common or at least familiar kinds of behavior, may nevertheless seem strange, because it often occurs amidst circumstances in which it seems irrelevant. The scientific recognition and explication of adjunctive behavior provide us with new and important analytical powers. Following John Falk's early work calling attention to this phenomenon (Falk, 1961), Stadden (1997) published a comprehensive review of the flurry of experimental activity that had been spurred by Falk's early work. Certain basic concepts within behaviorology, listed below, are relevant to the analysis of adjunctive behavior.

1. The behavior-controlling environment is defined by the antecedent stimuli that can effect control over behavior. At any given time, those stimuli can be ranked in their capacity to elicit or evoke a specific behavior.<sup>2</sup> Those rankings can and do change—in some cases over long periods of time, and in other cases momentarily.

2. Behaviorally functional units (or parts) of the body can be defined in terms of their independent capacities to come under antecedent stimulus control of behavior-controlling environmental events, and under that control, to exhibit behavior.

Such a functional part of the body, operating as a unit, can exhibit only one behavior at a time, but different behaviorally functional units of the body can behave con-

currently, and differently, under respective independent stimulus controls.

Consider for example, a piano player who is playing from printed music. The left hand and arm behave under stimulus control of the bass clef; the right hand and arm behave under stimulus control of the treble clef; the printed lines of music control the lateral back and forth tracking of the player's eyes and perhaps related slight turnings of the head, but with respect to the side-to-side head and eye movements, the base clef and treble clef function together as a single stimulus stream. Concurrently, the player's upper torso and head, as a unit, may "keep time" by bobbing rhythmically backward and forward under stimulus control of the rhythmic sound sequence being produced by the piano. If the person is also singing words to the song (not printed on the musical score), those vocal behaviors occur mainly under intraverbal stimulus control, an aspect of which involves each sung word evoking the next one.

Note that a body part that sometimes functions under independent antecedent controls can combine functionally with other body parts under a shared stimulus control. To cite another example, an arm and hand can work together to exhibit what is construed to be one behavior (e.g., a proffered handshake). An ultimate combination of this kind involves the entire body acting more or less as a unit, which may be approximated by the leap of a jumper over a small obstacle while maintaining balance, an action that we may then count as a single response (i.e., a "jump"). The same body parts that, acting together, respond to a single stimulus by executing a unitary handshake may also come simultaneously and independently under the respective control of different stimuli. An example of such independently controlled behaviors occurs when the fingers of a hand continue a sequence of finger presses on the keys of a small keypad while the elbow of the arm to which that hand is attached is lowered to tack down a fluttering piece of paper that is about to be blown off the desk top.

3. The behavioral interactions of organisms with the behavior-controlling environment occur in a continuous manner, at least across the range of the state connoted by the phrase "being conscious." Except in the organismic disorganization called death, or to a less extreme degree during coma or sleep—the operant behavior of an organism simply keeps occurring in one form or another. Even during coma or sleep the respondent behaviors that maintain bodily integrity continue in unbroken sequences. The antecedent controls on behavior can change, and with those changes in the antecedent controls, the form of the controlled behavior can change. However, those changes in control of the behavior, as well as any resulting changes in its form, occur without discontinuity in the general phenomenon called behavior.

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\* You will find the footnotes at the end of the paper, after the references, starting on page 28.

4. An important postulate, sometimes called the *postulate of behavior passivity*, prevails with respect to all behavior. Behavior happens only as an inevitable reaction. An organism has no capacity to behave initiatively or proactively. It does not *initiate* a behavior, nor can it *do* a behavior, nor does it even *choose* a behavior. At best, the organism only mediates behavioral effects that are determined both by the structure of the behaving body and by the environment. The environment of an organism consists of the universe of variables each of which can or does serve as an independent variable in the functions that control the behavior of that organism.<sup>3</sup>

Those aspects of “life” for which behavior is the evidence imply nothing more than the structural capacity of the body to perform that behavior–mediating function. At any instant, given both (a) the nature of the behavior–controlling environment and (b) the momentary structure of the body, the response that occurs is the only response that can occur. (B.F. Skinner included this observation in *Science and Human Behavior*, pp. 111–112. [Skinner, 1953]) The response that occurs is totally determined by the precise circumstances and relations prevailing at that moment, including the state of both the behaving body and its behavior–controlling environment. The *control* of a response, to the extent that that term means anything, resides with the environmental events that serve as the independent variables in the behavior–determining relations.

During analyses of operant behavior, the conceptual scheme afforded by the sciences of probability and chaos are conceptual devices for managing our ignorance about some of the controlling relations that share in determining the observed behavior. Those sciences do not impugn the basic assumption of determinism (Fraley, 1994).

5. Shifts in the capacity of antecedent stimuli to control behavior, both respondently and operantly, occur for many reasons. In cases of incompatible alternative behaviors, the inevitable appearance of the behavior controlled by the functionally strongest of those antecedents is called “prepotency” (Skinner, 1953, p. 220). The strength of such a functional relation, in which the dependent variable consists of behavior, depends on the conditioning history by which that relation was established. Only one of a set of incompatible responses can occur, and the stronger response occurs. It is said to be the *prepotent* response. In the adverbial expression, that response may be said to emerge *prepotently*.

One important principle holds that when the antecedent control on an occurring behavior weakens relative to other available events in the environment, one (or a set) of those other antecedent events will displace the former set in the behavior–controlling relation. Such a shift can be produced by any process that weakens the prevailing behavior–controlling relation. As soon as the

on–going controlling relation is weakened beyond a threshold defined by the capacity of another stimulus array to acquire control over behavior, the body of the organism will come under the behavioral control of that alternative array.

Observers of such a shift in the antecedent controls usually notice a corresponding shift in the behavior being exhibited by the organism, although in some cases the transfer can seemingly pertain only to the environmental antecedents and not to the behavioral manifestations (as when an actor’s recitation transitions smoothly from control by printed text on a cue card to intraverbal control).<sup>4</sup>

Behaviorologists have routinely studied procedures for effecting changes in stimulus controls: The term “conditioning” has long been applied to two major classes of such procedures. They are respondent conditioning, which operates through a pairing process, and operant conditioning, which operates through consequence processes. Through operant and respondent conditioning, elements of the environment have gained or lost the capacity to evoke or elicit behavior. For purposes of this section, the important aspect is that when an antecedent control on a behavior weakens, another antecedent will supersede it, that is, will take its place as a behavior–controlling stimulus. Furthermore, the new antecedent stimulus will usually produce its own kind of new behavior (which is sometimes said to “emerge” prepotently, although it does not really *emerge* from a latent existence elsewhere, but merely begins occurring).

Consider, for example, what happens operantly during an episode of gradual interference with the access to a currently functional antecedent stimulus. Suppose, at the sea shore, a volleyball game, in progress far down the beach, is evoking the visual attention behaviors of a person (who is said to be watching the game, although it is the game that is evoking the watching). Two kinds of behaviors are involved: First is attending, in which the body, and especially its eye–related parts, move under stimulus control of the distant players so that the eyes remain oriented toward the remote game. The second behavior is the private behavior of visual awareness (or visual comprehension), often described as “actually recognizing what one is looking at.” The former looking–behavior, which consists of the physical orientation of certain body parts, facilitates the latter private behavior of conscious seeing.

Now, further suppose that a fog slowly but steadily drifts ashore with increasing thickness. Slowly, the observer’s view of the distant game is progressively obscured. Seeing the volleyball players becomes more difficult in the sense that the distant players are rendered less and less capable of generating reinforcing visions (interpretive seeing responses) in the observer. As the fog continues to stretch the variable reinforcement ratio on

the person's attending behavior, the attending behavior is gradually being put on extinction. The functional shift, though gradual in its transition, is from a nearly continuous reinforcement schedule (when the air is clear) to a much more intermittent schedule (when the fog largely obscures the view). The reinforcement ratio can soon stretch to the absolute extinction mode in which no looking response can again be reinforced.

As the stimulus control on the on-going looking behavior that is being exerted by the volleyball players continues to weaken due to insufficient reinforcement and the resultant visions progressively disorganize, the reinforcing capacity of the ill-defined responses of visual awareness continues to diminish. Even when glimpses of the vaguely distinguished players do occur, some other features in the more proximal environment will, at some point, abruptly gain control of the attending behavior and, in turn, of the private visual awareness behaviors occurring to the observer. It may later be said that something else (more easily seen) captured the person's attention.<sup>5</sup>

Thus, the change in these looking and seeing behaviors is not something that the person *does*, but rather is something that *happens to* that organism. The body at all times remains only the passive mediator of its own behavioral manifestations. In this context, a body is merely a device that renders the remainder of the environment capable of producing a behavior, and a *person*, distinguished from the body, is nothing more than the abstracted concept of the behavioral repertoire that accumulates over time. However, note that a behavioral *repertoire* connotes the potential to exhibit behavior but lacks ontological status and thus is not an existing entity. Thus, a *person* reduces to a transient sequence of behavioral manifestations that are controlled exclusively by the environment. It may be said that a person is a natural phenomenon in the class denoted by the term *function*.

### ***Intra-schedule Adjunctive Behavior***

We have seen how the prevailing antecedent controls over behavior can weaken, as in the preceding fog-at-beach example, which allows a new antecedent stimulus abruptly to gain control of the body or of a subset of the body's functioning parts. One behavior stops and another begins. This occurs on the occasion of a change in the relative evocative capacities of the competing stimuli. The weaker stimulus may intensify, or the stronger stimulus may weaken. In the current example at the beach, the stimulus that is said to "take over" was originally weaker in its behavior-controlling capacity than the stimuli controlling the initial behavior and could only gain control after the initial controlling relation was sufficiently weakened.

This can happen briefly *within* each cycle of behavior produced by a prevailing schedule of reinforcement. That

is, if a behavior is occurring in repeated cycles according to some schedule of reinforcement, a new and different behavior can begin to appear briefly *within each cycle* of the primary behavior. The new behavior that suddenly appears there and briefly preempts the primary behavior has been called *adjunctive behavior*. This new behavior, appearing briefly within each cycle of the primary behavior and therefore intermittently across many cycles, is said to be "schedule-induced."<sup>6</sup>

However, the manner in which adjunctive behavior occurs can be discriminated from a process in which one schedule of reinforcement completely replaces another for an indefinite time. We have such a complete replacement, for example, when a person, who has been playing a slot machine, completely stops playing and instead proceeds to read a long series of printed messages scrolling on a nearby television monitor. That person does not necessarily resume play on the slot machine. The total and potentially permanent shift in behavior follows from a total and potentially permanent change in the evocative stimuli that are controlling the behavior of the person.

On the contrary, adjunctive behavior of the kind being discussed here instead appears as a temporary but re-occurring *intra-schedule* effect—starting and stopping within each cycle of a different behavior that is occurring on its own schedule of reinforcement. This intruding adjunctive behavior arises primarily in connection with interval schedules and fixed ratio schedules. The new *adjunctive* behavior can intrude into the on-going behavior during a part of each cycle when the rate of the primary behavior is low.

For example, suppose that you have gone blind and are reduced to begging on a street that is frequented by tourists. To beg, you extend your hand, palm up, and move it slowly back and forth. People walking past your location often put coins in your hand, but people pass by your location only in small tour groups that are spaced about five minutes apart. Continuous loud vehicular noise prevents your hearing when people are approaching, but immediately following the passage of each small group there is a short interval during which begging behavior cannot be reinforced, because no one is there who could put money in your hand.

After sufficient exposure to these conditions, you are said to have *adapted* to them. Following that preparatory conditioning, during those brief intervals in the early part of each cycle following the passage of a tour group, you may shuffle a deck of cards. Your behavior of shuffling those cards is an adjunctive behavior that appears briefly *within each cycle of your hand-extension behavior*. With the imminent arrival of the next tour group the card shuffling stops, and the begging behavior resumes. The extension and waving of your hand to beg is said to be the *primary behavior*, and the card shuffling is the *adjunctive behavior*.

It may seem that adjunctive behavior could have been predicted through a conceptual analysis, but that did not happen. An experimentalist, John L. Falk, working with lab rats, serendipitously discovered the effect, which he first reported in 1961. Falk (1961) found that under certain schedule conditions in which rats were acquiring reinforcing food pellets, the rats drank water excessively during the intervals between reinforcements. The food pellets were made important by depriving the rats of food until the rats lost twenty percent of their body weight. The food was made available on an intermittent (interval) schedule, and eating the food pellets according to their availability on that schedule had no planned or anticipated relation to water or to the behavior of drinking water. The water had simply remained available in the setting.

With adjustments in the schedule on which the rats acquired their food pellets, amounts of water far in excess of normal ranges were consumed along with the pellets. After each reinforcer (food pellet) was contacted on an interval schedule,<sup>7</sup> food would not again be available for a brief period (a requirement of the interval schedule). During that brief interval when food-producing responses would not be reinforced, a rat would drink water. That drinking behavior, occurring within each cycle, resulted in the cumulative consumption of far more water than would normally be drunk.<sup>8</sup> At that time, a ready explanation for that kind of drinking pattern seemed lacking, and that mystery led to a long sequence of investigations of the phenomenon that continued over many years.

The schedule-induced (or adjunctive) behavior was drinking water (to excess), and the rats became waterlogged. The critical aspects of the arrangement were (a) that the pellet-eating responses were spaced apart over time (which is precisely how responding occurs under certain interval schedules) and (b) that pellet-eating was a strong response. In this case, food deprivation effectively strengthened food pellets as reinforcers, which kept the rats "on task" to acquire food under whatever prevailing schedule food became available. A decade after his seminal article on adjunctive behavior, Falk (1971) summarized his interpretation of that phenomenon.

A number of additional studies soon appeared in which different kinds of adjunctive behavior were observed in rats. These included attack, pica, air licking, and running in an exercise wheel (Falk, 1981, 1984, 1986). In other early studies, human experimental subjects were reported to exhibit various adjunctive behaviors including extraneous movements of body parts, excessive smoking, and game playing (see the extensive survey of such studies that are cited in Falk, 1984; see also Falk, 1993). Falk also suggested that some of the frenetic social behavior characteristic of business lunches and cocktail parties is schedule-induced adjunctive behavior (Falk, 1981). In 1995 Falk, during a talk to The International Be-

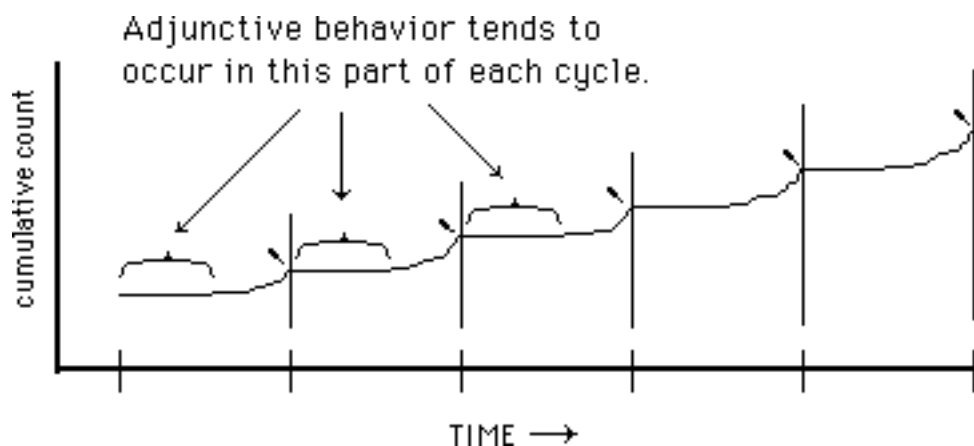
haviorology Association, (Falk, 1995), summarized the work on adjunctive behavior, to which a multitude of researchers had contributed over the past three decades.

Adjunctive behavior is an apparently independent class of often irrelevant behavior that can emerge within the cycles of a different primary behavior that is occurring under an intermittent schedule (Falk, 1969). The initial schedule is called the *primary* schedule; it is often said to govern the *primary* behavior (pellet eating, in the case of Falk's rats). The intruding adjunctive behavior is sometimes called the *secondary* behavior. Adjunctive behavior was found to arise within interval schedules featuring either contingent responding or non-contingent responding. That is, whether the reinforcer is delivered non-contingently on an interval *time* schedule or on a *behavior-contingent* interval schedule is not important. Within any schedule that spaces out important (primary) responding, adjunctive behavior typically occurs in the immediate post-reinforcement period when the primary behavior is temporarily at frequencies as low as zero (Falk, 1971, p. 582).

In explaining the appearance of adjunctive behavior, one principle seems to have special relevance: When a principal antecedent stimulus that is controlling an ongoing behavior weakens sufficiently, another antecedent will supersede it. That is, a weaker stimulus that has been present in the environment but behaviorally non-functional will preemptively gain control of the body and thus establish a new behavior-controlling relation. Furthermore, that new antecedent event will probably evoke its own kind of new behavior.

We have only to take note of the fact that intermittent schedules are characterized by a temporarily weakening of the evocative capacity of the primary antecedent stimuli within each cycle. That repeated weakening occurs in the intra-cycle time zone immediately following the delivery of a reinforcer (see Figure 1). This temporary reduction in the evocative capacity of the antecedent stimuli occurs reliably within each cycle just after the reinforcer is contacted, and in *fixed* interval schedules (or in *fixed* time schedules) the effect is not only reliable but occurs with a uniform periodicity as well.

Any weakening of the evocative capacity of a currently functional antecedent is precisely the prescription for inducing a prepotency shift—one in which we would expect to see the behavior change. If any current but behaviorally non-functional feature of the environment is available potentially to capture functional control of the body, its greatest likelihood of doing that as a schedule-effect comes in that intra-cycle interval immediately following the reinforcer. Those are intervals when, strong as the primary scheduled reinforcer may be, another contact with it is not going to occur for awhile, and the evocative stimulus for the primary behavior is temporarily less effective than during other parts of the cycle.<sup>9</sup>



**Figure 1.** The repeated appearances of an adjunctive behavior during an interval schedule.

When organisms are said to be “adapting” to an interval schedule, the evidence for adaptation is the intra-cycle redistribution of responding that results in the scalloped cumulative curve when the cumulative responses are plotted graphically. Figure 1 illustrates where adjunctive behavior may appear. It tends to happen whenever behavior on the primary schedule is weakly evoked and infrequently occurring, and the immediate post-reinforcement period in each cycle represents such an opportunity.

Because, during the early part of each cycle, little or no further responding of the primary kind occurs even though its evocative stimuli remain present, people tend to say that during those early parts of each cycle, the antecedent stimuli have lost, temporarily, all or much of their evocative strength. When later in each cycle the rate of primary responding increases, we can say that the antecedent stimuli are temporarily reacquiring their evocative strength. It is as if contact with the primary reinforcer at the end of each cycle temporarily changes the  $S^D$  into an  $S^A$  for the primary behavior. This waxing and waning in functional evocative strength is a schedule-induced effect.

If adjunctive behavior appears, we account for its occurrence by assuming that contingencies are in place to support it, proceeding to discover such contingencies, and describing them in satisfying detail. Those contingencies may be entirely independent of those that govern the primary behavior.

The evocative stimuli for both the primary behavior and the adjunctive behavior remain available in the environment at all times. While the reinforcer of the adjunctive behavior is, in general, relatively weak compared with the reinforcer of the primary behavior, an interval schedule results in the stronger primary reinforcer being unavailable during a part of each cycle. If the waning in

evocative capacity of the  $S^D$ s for the primary behavior carries below the evocative capacity of an available alternative stimulus, that alternative stimulus will temporarily acquire control of the body, stimulating its own, and usually different, kind of behavior (i.e., the adjunctive behavior). The adjunctive behavior, when it happens, results in contact with its own kind of reinforcer (weak though that reinforcer may be relative to the temporarily unavailable reinforcer of the primary behavior). Thus, during the early part of each cycle, an adjunctive behavior may temporarily attain prepotency. That adjunctive behavior briefly intrudes, preempting the primary behavior. However, in the latter part of each cycle the behavior controlled by the primary interval schedule regains prepotency. That is, any on-going adjunctive behavior stops, and the primary behavior resumes.

Regardless of contact with the relatively weak reinforcers that result directly from the adjunctive behavior, an instance or sequence of adjunctive behavior is always followed first by the primary behavior and then by contact with the stronger reinforcer that is contingent on the primary behavior. The primary reinforcer not only reinforces the primary behavioral response, but also, to a progressively lesser degree, it reinforces the respective preliminary behaviors that led to that primary kind of response. In the case of interval schedules, those preliminary behaviors are the adjunctive behaviors that precede each instance of the primary behavior. Thus, the ultimate primary reinforcer has an additional reinforcing effect on the adjunctive behavior in addition to any secondary reinforcers that are produced directly by the adjunctive behavior per se.

To those human subjects that interpret their own behavior in agential terms, it may seem to them like “they must engage in the adjunctive behavior to insure contact with the primary reinforcer” for which a full account can

actually be completed with consideration only of the primary behavior. Such subjects may come to think that they are hastening the next contact with the primary reinforcer by deliberately and necessarily engaging in the adjunctive behavior. In such cases, observers tend to classify that adjunctive behavior as *superstitious*, because it is mistakenly being assigned a functional role that it does not actually play.

Consider organisms that are nearing perfect adaptation to a fixed interval schedule, and recall that only one response per cycle is necessary for maximal contact with the primary reinforcer. This leaves most of each cycle free for the intrusion of an adjunctive behavior. The result can be lots of adjunctive behavior interrupted at regular intervals for a single instance of the primary behavior (which is sufficient to maintain maximized contact with the primary reinforcer across any number of cycles).

For example, suppose that you are standing along the sideline at the 50-yard marker of a football field. A person marching at a steady cadence is carrying the national flag back and forth across the length of the field between the goal posts. You salute the flag each time that it passes directly in front of you. (Assume that these saluting responses are strongly reinforced by the admiring reactions of an audience, provided that the flag is in front of you when you salute). Following each salute, the flag will not again be in front of you until it has been carried 100 yards.

Now consider a second behavior that may intrude when salutes will not be reinforced, namely, a hand wave. Assume that you have been conditioned to wave at people who are looking at you from a remote vantage point. Suppose, in this case, that some of the passengers in the many vehicles that are streaming continuously past on a nearby highway will return your hand wave. Assume that those returned hand waving responses are relatively weak reinforcers. While the flag is away from the area directly in front of you, the passengers in those passing vehicles evoke your adjunctive hand-wave behavior.

If, over a period of time spanning many saluting cycles, we compare counts of the primary and adjunctive behaviors, we find that far more adjunctive responses (waves) have occurred than primary responses (salutes). Note, too, that the primary behavior (saluting) occurred on a fixed interval schedule, while the adjunctive behavior (waving), while it was occurring, occurred on a variable ratio schedule.<sup>10</sup>

The adjunctive behavior that appears prepotently during the early part of a cycle is under its own kind of stimulus control by one or more features of the ambient environment that can be, and usually are, unrelated to the events governing the primary intermittent schedule and its featured behavior. The adjunctive behavior is typically a new and different behavior. It occurs preemptively and under its own natural contingencies. Although usu-

ally of brief duration (because it is occurring within one cycle of another prevailing interval schedule), while it lasts, *it is under its own schedule of reinforcement* (often called the secondary schedule), and that schedule is usually unrelated to, and different from, the primary schedule within which this adjunctive behavior has arisen prepotently (as in the previous example that featured salutes and hand waves).

For the intruding behavior to occur adjunctively, the reinforcer acquired under the primary schedule must generally be stronger (in isolated direct comparisons) than that acquired following the adjunctive behavior. If the primary reinforcer did not have the greater evocative capacity in general, the adjunctive behavior, once it began, would not stop (in which case, we would not describe it as *adjunctive*). That is, if the intruding behavior were at *all times* more strongly reinforced than the primary behavior, including those intervals when the primary schedule allowed that secondary behavior to occur, the antecedent stimuli in the primary schedule could not again re-acquire control and thus evoke the primary behavior. The organism would just continue to exhibit the intruding behavior, because that behavior would always produce contacts with the stronger kind of reinforcer. In that case, observers may say simply that the exhibition of one behavior had superseded the exhibition of another behavior.

While adjunctive behavior is in progress (however briefly), an organism's behavior will adjust to maximize contact with the reinforcers that are available under the secondary schedule. For example, suppose that during the intervals between the occasional arrival of paying customers who purchase tickets to my show, I drum my fingers on the ticket counter (an adjunctive behavior). My fingers may come under stimulus control of the rhythmic sounds that they are producing, and as more reinforcing rhythms are selected by this prevailing natural shaping procedure, the finger-drumming becomes more strongly reinforced and accordingly will intensify and evolve in form.

If the sounds from this adjunctive drumming were to become more reinforcing than a ticket sale, the next customer arriving to buy a ticket would fail to acquire control of my behaving while the drumming proceeded. (In agential language, the prospective customer would be ignored.) However, if making a ticket sale remains a stronger reinforcer, even than the improved rhythmic sounds shaped adjunctively under the secondary schedule, the arriving customer will re-acquire behavioral control of my body, and ticket selling behavior will reappear as the primary schedule re-establishes.

The literature commonly refers to intra-schedule adjunctive behavior as *schedule-induced behavior*, but it is perhaps more correct to call it *schedule permitted behavior*. That is because the adjunctive behavior will occur naturally or automatically under its own operant potentiation

if the controlling relation governing the primary behavior weakens sufficiently for whatever reason. A weakening of the controlling relation between an environmental antecedent and the primary behavior during the early part of each cycle of an interval schedule is just an unusual way for that to occur. Thus, although the appearance of this kind of adjunctive behavior represents a behavior change occurring because of a common kind of event (a reversal in the relative evocative strengths of two stimuli), it initially attracted attention because it was happening repeatedly under unusual circumstances (i.e., as an intra-schedule phenomenon within each cycle of an interval schedule).

We can safely infer that during the “dead intervals” within intermittent schedules, adjunctive behavior of some unnoticed and undescribed kind has in all cases always been occurring. That conclusion rests on the assumption that some operant behavior will always be occurring while an organism is in a generally responsive mode, and within the cycles of any schedule, if the primary behavior is not occurring, an adjunctive behavior will be in progress. We need only look carefully for what is often the mundane, trivial, or unimportant behavior occurring during intervals when the primary behavior is not happening (during the flat part of each scallop, if we are plotting the primary behavior counts on cumulative count graphs). Only occasionally has that adjunctive behavior been so unusual or interesting that it has captured the attention of observers who are usually preoccupied with monitoring the primary behavior and therefore tend to ignore the uninteresting adjunctive behavior.

For example, the excessive drinking behavior in Falk's rats was easily noticed. The rats were on an interval schedule that produced reliable “dead times” at the start of each cycle of the primary schedule. At the same time, the rats were in the continuous presence of a strongly compelling antecedent stimulus (a drinking tube) with respect to which a lot of reinforcement history had taken place. After eating the pellet, the reinforcing moment on the primary schedule was past, and the rat came at once under stimulus control of the salient drinking tube. A brief episode of drinking behavior was evoked. When this sequence repeated within each cycle of the primary schedule, the result was excessive total water consumption. If, at first, that excess drinking goes unnoticed, the increasingly water-logged condition of the rats would eventually tend to attract attention, and in Falk's case it did so.

Note that even when seemingly satiated, most mammals can take yet another sip of liquid without that event resulting in an excessively aversive consequence. If such an adjunctive response can be evoked without an immediate and acutely aversive consequence, even though the drinking response may not be repeated at that time (because the net reinforcing effect is insufficient and the primary schedule is re-establishing its alternative control),

the cyclic nature of the primary schedule will shortly provide yet another compelling opportunity—and will continue to do so periodically.

A mere single adjunctive response during each such cyclic opportunity will, over time, produce cumulative totals that can be excessive in various ways. As we have seen, water accumulating from the adjunctive drinking behavior may waterlog a body. In other examples, a repeatedly used body part may become sore from excess use, as when finger tips, adjunctively drummed repeatedly if intermittently on a sandstone surface, become painfully abraded.

People often do something similar with a big glass of a preferred beverage when sitting in front of the television. The primary schedule of reinforcing visual and aural events that are presented by the television controls a person's attending behaviors on a modified variable interval schedule. That schedule features a variable dead time following each reinforcing event (i.e., some variable time interval is required for the “stage to be set” for the next humorous or thematically interestingly moment).

The nearby glass full of beverage is often a strongly conditioned discriminative stimulus, and it can effectively evoke the behavior of picking it up and taking a sip. However, the here adjunctive behavior of sipping the beverage is *less* strongly evoked by the drinking glass than is attending to the television set evoked during the latter part of each cycle on the primary TV-watching schedule.

While the person is held in the limited environment by the primary schedule, the glass remains a salient feature of that environment where it can become evocatively effective at any time that antecedent events evoking the primary behavior temporarily lose their relative evocative advantage. Every time the program hits a “dry” post-reinforcement stretch, the beverage evokes a sip or two by the drinker. Over a few hours under those circumstances (with the glass being continually refilled) the drinker will consume substantially more beverage than would be drunk were the television set absent and the drinking behavior was primary instead of adjunctive.

In pubs and other kinds of drinking establishments, where conversations with drinking companions often take the place of a television set, a person will sometimes be found sitting before an array of many empty bottles or mugs. How anyone could sit down and drink that much of any beverage may seem perplexing, because those “empties” represent more liquid than even a thirsty heavy drinker would consume if given the opportunity to sit down alone and drink his or her fill. However, under the primary schedule arrangements featuring the social stimuli that prevail in such establishments, the person will take an adjunctive swig from the current mug or bottle each time there is a momentary lag in the conversation. Excessive adjunctive drinking can sustain a whole

beverage industry. Schedule-permitted adjunctive drinking behavior has also been linked to the social problem of alcoholism (Falk & Tang, 1988).

Similarly, individuals who spend long hours in coffee houses may suffer the adverse effects of excessive caffeine ingestion. That outcome is facilitated if they adjunctively engage in more coffee drinking than the taste and aroma of the coffee could otherwise sustain.

### ***Explanation versus Description***

In its most common expression *schedule* is a concept of *procedure* and pertains to the behavior of those who arrange the conditions under which another organism is to behave (although we can speak of *natural* schedules if the behavior-controlling circumstances have occurred naturally and were never contrived). The behavior of the organism in question, occurring under those special conditions, whether natural or arranged, may exhibit behavior patterns that observers *interpret* as alternating adjunctive and primary behaviors.

However, an organism, from its private perspective, simply behaves in accordance with its bodily behavior-producing capacities in response to events in its immediate environment. Bodies work behaviorally only with respect to the here and now, and do not exhibit the behavior patterns called schedule effects because they find themselves behaving under certain schedule arrangements. What we may identify as the schedule-induced effects simply manifest as sequential accumulations of responses that have occurred individually for much simpler reasons. The on-going behavior is indiscriminate with respect to historical motives that might have influenced both the present configuration of the environment in which that behavior is occurring and any contemporary variance in that environment.

Thus, when adjunctive behavior appears, it does not occur "because the organism finds itself in a particular intracycle period on some procedurally or naturally defined primary schedule." As far as the behaving organism is concerned, what a schedule-aware observer calls "adjunctive behavior" occurs simply because circumstances have arisen under which one behavior stops and another starts. And that is equally true of the reversal back to the primary behavior. The start and cessation of an adjunctive behavior is shrouded in no more mystery than is implicit in that simple circumstance. Change of the behavior that is currently exhibiting prepotency depends on current stimulus conditions (i.e., opportunities for change) and the relative strength of the reinforcers that are contacted following each of the behavioral alternatives.

The body of an organism is not really schedule-sensitive. Rather, the body is only *stimulus*-sensitive. Behaviors simply start and stop as a function of changes either in the environment or in the body, or both. That simple

behavioral start-and-stop is what bodies and environments together can do, and that is about all that together they can do.

We may recognize or arrange the circumstances that we call schedules of reinforcement, but the patterns of behavior that are then exhibited consist of responses that have accumulated so as to define those patterns. However, each individual response has occurred because, at the instant of its occurrence, that response was the inevitable outcome of the momentary relation of the behaving body to its environment.

Put another way, bodies do not know anything about schedules, nor is that necessary for the occurrence of responses that comport with schedules and cumulatively define the patterns of behaving that we call schedule effects. When an adjunctive behavior occurs in the early part of a cycle on an interval or ratio schedule, the body is functionally oblivious to that schedule and is at that instant merely exhibiting whatever behavior the immediate body-environment circumstances will inevitably produce.

The complexity of the verbal behavior in the analytical conceptual devices by which we explain behavior often exceeds the complexity of the elemental functions that lead to the phenomenon that is being studied. In such cases, that verbal complexity tends to serve the procedural operations through which we may exert a precise control over the behavior, while the behavior-related manifestation per se is an accumulation of responses that, individually, occur in accordance with the less elaborate behavior-producing mechanism.

By analogy, if 100,000 people stand close together on a hillside, and each of them simultaneously raises a single hand-held card, a viewer standing a mile away may see a relatively high resolution image of the Mona Lisa. The arrangements that are necessary to produce that pictorial effect are quite complex, as are descriptions of the elaborate procedure by which it can be made to happen, but each person merely raised a colored card. The manifestation of the Mona Lisa is the product of simultaneous responses by many individuals, while schedule effects represent the accumulating sequence of responses by one individual. However, in both cases an account of an elemental response is far simpler than an account of their combined effects.

### ***Sequential Adjunctive Behaviors***

More than one kind of adjunctive behavior can occur within each cycle of the primary schedule. For example, two adjunctive behaviors, appearing in a fixed sequence within each primary cycle, can be produced within a primary fixed-time schedule. In one such demonstration, food-deprived rats are given food as the primary reinforcer. Suppose that we also place a conveniently accessible drinking tube and a running wheel in the chamber so that they are continuously available as salient features

of the proximal environment. When this has been arranged, the rats typically adapt to a primary FT-30 sec. schedule by engaging in “food anticipation” behaviors toward the end of each 30-second cycle. That is, as the end of each 30-second interval approaches, the rats draw near to the food dispenser where they can quickly grab the bits of food that it regularly expels.

Within each cycle of that primary schedule, after a rat had gotten its food (which then remained unavailable through the next 30 seconds), the rat typically then drinks some water, after which it may run briefly on the wheel before returning to hover near the food dispenser. In each cycle of the FT-30 sec. schedule the adjunctive drinking and wheel running will ordinarily be repeated in the same order.

As in the previous paragraph, the schedule that is arranged in this demonstration is often described as a fixed-time schedule (here an FT-30 sec. schedule), because the behavior of hovering near the dispenser does not functionally produce the dispensing of food. Note however, that the schedule designator by which we classify a set of circumstances depends, in part, on the behavior of scientific interest.

For example, with respect to the hovering behavior (called, in general, “food anticipation behavior”), the schedule is an FT-30 sec. schedule. However, note that with respect to the actual food-eating behavior, the same arrangements, or circumstances, closely approximate the definition of an FI-30 sec. schedule. Note that with respect to the eating behavior (getting the food into the mouth and in contact with taste and odor receptors) the gustatory reinforcer is not contacted until that eating response has occurred. Contact with the gustatory reinforcer is obviously contingent on that eating behavior. With this interpretation, the drinking and wheel running would be classed as *adjunctive*, the hovering near the food dispenser would be classed as *enabling*, and the eating would be classed as the *primary* behavior.

In this kind of demonstration, the requirements for the adjunctive behavior to occur are that (a) the primary schedule feature intervals of sufficient length for more than one adjunctive behavior to occur (here, 30 sec.), (b) antecedent controls (evocatives) for the two adjunctive behaviors remain present in the environment, (c) the reinforcers acquired through both kinds of adjunctive behavior always remain weaker than the reinforcer (food) acquired under the primary schedule, and (d) the evocative strengths of the antecedent controls on the two adjunctive behaviors (drinking and running) begin each cycle with the same relative magnitudes, which then reverse in mid cycle before all adjunctive behavior is again preempted as the primary behavior re-establishes.

We can speculate about why drinking was evoked first. Normal drinking tends to follow eating, and we

may expect that sequence to be maintained in the case of this adjunctive drinking. Also, in the past, drinking has often been strongly reinforced (negatively) at the conclusion of episodes of water deprivation. The drinking tube has thus had many opportunities to become a somewhat strongly conditioned evocative stimulus.

However, in general, adjunctive drinking tends to water-log a body, and although a drinking response may be evoked on each cyclic occasion, it will be less and less reinforced as the cycles pass. For similar reasons in the demonstration being discussed here, a drinking response, although adjunctively evoked by the salient drinking tube, is also less and less likely to be *repeated* in any given cycle of the primary schedule. If time remained within a cycle for some additional adjunctive behavior, and the drinking tube was quickly losing its initial evocative capacity (rapid satiation), the salient running wheel, with its initially weaker evocative capacity, would then gain control of the rat’s behavior. However, while rapid running is reinforced (perhaps in various ways), it is also punished with increasing intensity by aversive fatigue. This behavior-suppressing punishment results in a net weakening of the evocative capacity of the antecedents that evoke the running. This facilitates a return to the primary behavior. As the 30-second interval draws to an end, the rat again comes under the control of the features of the feeding area. That is, the wheel is abandoned as the food dispenser once again evokes the rat’s behavior of hovering near it.

Why the rat would stop running and move to the food dispenser as the interval nears its end has been the object of much theoretical speculation. The following two paragraphs provide an example differing somewhat from the explanation proffered in the preceding paragraph (though perhaps supplementing it more than displacing it).

We cannot entertain an explanatory reliance on the next portion of food that has not yet arrived (a teleological fallacy). Nor can we indulge in assumptions about mystical internal agents that develop “anticipations” and keep time with magical internal clocks. However, there is a natural kind of clock at work to which we can appeal.

Remember that (a) time is defined only by the events that are said to fill it and (b) an organism is always behaving in *some* way. Each 30-second cycle of the schedule begins with some adjunctive behavior (of whatever kinds), and those adjunctive behaviors define somewhat consistent time intervals. Although the adjunctive behaviors were reinforced immediately in their own ways on their respective adjunctive schedules, those behaviors were not immediately reinforced in the stronger primary way (in the present example, by food). However, like the moving hands of a clock, they were reliably reoccurring periodic events of relatively consistent duration.

We could speculate that the passage of a somewhat fixed amount of any kind of behavior that fails directly to

yield the primary reinforcer can nevertheless function as a conditioned composite stimulus that, like shifted clock hands, re-capacitates the food dispenser as an evocative stimulus for the behaviors characteristic of the primary schedule (food anticipation behaviors, in the present case). After all, organisms can be conditioned to discriminate events of longer and shorter duration, regardless of the nature of those events. Following the cyclic and relatively consistent bout of adjunctive behavior, "it is time for another contact with the food," as we may say.

Put another way, an adjunctive behavior, occurring on its own schedule with respect to the secondary reinforcer, can always be said to be on extinction with respect to the primary reinforcer, which it cannot produce. While it does yield the relatively weak secondary reinforcer, it does not produce the stronger primary reinforcer, even during the part of a cycle when the primary reinforcer is available. As we know in general, ineffective behavior tends to stop occurring. In this curious twist on the extinction procedure, the adjunctive behavior, while yielding a weak reinforcer, always fails to yield a stronger one although it is available intermittently in the setting. That is, while the adjunctive behavior is occurring, the primary behavior is precluded, and the organism is thus prevented from contacting the strong reinforcer that the primary behavior would yield during latter part of each primary cycle. During each cycle of the primary schedule, when the strong primary reinforcer again becomes available, it is the on-going adjunctive behavior that is then precluding access to that stronger reinforcer by competitively pre-empting the primary behavior that would produce it. (This observation may contribute to a theoretical conceptualization of prepotency.<sup>11</sup>)

### ***Adjunctive Behavior under Conflicting Contingencies***

Having examined how adjunctive behavior can arise within a single primary schedule, we can also look for similar shifts in prepotency, not within the cycles of an intermittent schedule, but on occasions when the net antecedent control of a behavior that is occurring under *opposing* contingencies becomes sufficiently weak. For instance consider a behavior that is both punished and reinforced. Such situations are often described as *conflict*. Suppose that that behavior has continued to occur because the contingent reinforcers are stronger than the contingent punishers. However, if the relative strengths of those consequences reverse, that behavior will decrease in frequency under what is then a net suppression.

However, if a person withdraws from a conflict situation, any chance for ultimate contact with potentially big reinforcers is forfeited. If strong reinforcers are potentially available, one may behave to remain in the conflict situation while acting to protect oneself against potential

harm inherent in that conflict. From common lore comes the old advice: *Stay involved but keep a low profile, or hang in there, but watch your back.*

Conflict represents circumstances perhaps more recognizable as typical punishment episodes. The organism enters the episode under one or more reinforcing contingencies that strengthen a behavior of interest and render it frequent. At some point, while those reinforcing contingencies remain in effect, one or more punishing contingencies are imposed on that same behavior. The net effect on the rate of that behavior is a reduction in its frequency. The behavior, perhaps stabilizing at a new lower frequency level (i.e., it may re-equilibrate), is said to be "suppressed" to that new lower frequency. That new level of equilibrium is a net effect of the reinforcing and punishing contingencies both of which remain in effect. A behavior can re-equilibrate near or at a rate of zero if the stringency of the punishment is sufficiently increased relative to the strength of the reinforcers.

Here, again, is precisely the kind of circumstance during which a previously uncompetitive feature of the ambient environment may capture functional control of the body in a way that yields new and different behavior. Although that intruding behavior produces a relatively weak reinforcer, its evocative stimuli can gain control of the body during an interval in which the primary contingency of reinforcement is largely or entirely neutralized by the imposed punishment. When that happens, a new behavior is exhibited. It is often incompatible with the primary behavior and hence precludes the primary behavior, which must cease if the new behavior is to occur.<sup>12</sup> The new intruding behavior occurs on its own schedule of reinforcement.

That intruding secondary behavior, like its intra-schedule counterpart (discussed previously), if it exhibits a pattern of intermittent occurrences, can be classed as adjunctive behavior. Once the adjunctive behavior has intruded and has temporarily displaced the excessively punished primary behavior, the neutralizing balance between the reinforcing and punishing contingencies on the primary behavior may be destabilized by changing circumstances in the situational background, perhaps (and hopefully) by a weakening of the punishing contingencies. It may also be that a stronger reinforcer of the primary behavior becomes available. Should such a destabilization happen while the primary behavior is being precluded by the intruding adjunctive behavior, a reoccurrence of the primary behavior, if it were to happen, would then be more strongly reinforced than punished.<sup>13</sup> The primary behavior would then tend increasingly to be repeated. That is, a relaxation of the punitive contingency, or an increase in the capacity of the reinforcing contingency would allow the equilibrium to shift to a higher rate level for the primary behavior if it were to reoccur and thus be

susceptible to the new and more favorable mix of consequences. The *relatively* stronger reinforcers featured in the primary contingencies of reinforcement would then continue to facilitate the recovery of that primary behavior, any occurrence of which marks the termination of the temporarily intruded adjunctive behavior.

In this process, the more strongly reinforced primary behavior returns to displace the adjunctive behavior. That is, the adjunctive behavior (of little *prima facie* importance although perhaps serving a socially important function) stops, and the behavior of interest resumes under its own schedule of relatively stronger and now relatively less punishment-counteracted reinforcement.

Consider, for example, a person who is engaged in an important conversation with an attractive stranger at a social event. Suppose that the speaker is under strong contingencies to maintain reinforcing social relations with the attractive party, but the only line of conversation that occurs to the vocalizer appears to offend the listener, whose responds punitively. The speaker's potential contact with strong reinforcers would be protected if the offending speech stopped until it could resume with the theme continuing in a less offensive form. However, if during that interval, contact with the listener is broken, that contact may not be restorable when the speaker is prepared to resume the conversation in a less offensive way. Given the currently opposing contingencies of reinforcement and punishment, the controls on the on-going line of offending talk are weakened. When that control becomes weaker than the antecedent control on some potential irrelevant small-talk, the small-talk will tend to displace the on-going line of conversation.

That kind of shift in prepotency is so common and familiar that it can sustain a clichéd mimic as humor—for instance, this classic self-interruption: "*How 'bout them Celtics?!!*" Celtics is the name of a professional basketball team. The italicized rhetorical question pertains to a familiar topic with which all parties are presumably familiar. Such a common kind of adjunctive interjection temporarily replaces conversation that has been suppressed by social punishment. A resort to popular local sports, as featured in this example, is typical. Comedians whose humor of the moment requires making conspicuous the plight of their character in finding it necessary to engage in such a ploy, will render the ploy conspicuous through the careful mistiming and exaggeration of the injection of the new topic. It is a contrived simulation of a naturally arising kind of adjunctive behavior, carefully adjusted to exploit its comedic potential.

This kind of intruding adjunctive behavior in real conflict situations can be reinforced both positively and negatively. The adjunctive behavior usually produces mild positive reinforcers such as the social reinforcers implicit in the above episode of small talk.

The punishment of the primary verbal behavior in a conflict situation is often increasingly aversive and can become relatively severe. Escape from those aversive stimuli is effected through the onset of an adjunctive behavior. Thus, such adjunctive behavior, while it may yield its own kind of relatively weak positive reinforcers, can also occur as a negatively reinforced escape behavior resulting in the avoidance of further contact with the punishers contingent on the primary behavior. In that case, to put it agentially, the person may care little about the nature of the small talk; it just defuses the threatening situation.

As John Falk, who first described adjunctive behavior in the literature, observed many years ago, one is usually in a conflict situation because a strong reinforcer is potentially available. However, one must prevail or at least survive during the conflict, or the potential to contact that primary reinforcer can be lost. That is especially true if the primary behavior is reinforced only intermittently, as in the case of stretched ratio schedules or long-interval schedules.

The adjunctive behavior serves in a protective way, because it maintains the status quo for a time both by temporarily preventing (a) what may be either an inappropriate continuance of an otherwise generally useful primary behavior or (b) an inappropriate withdrawal from the primary situation. In such cases the adjunctive behavior holds the person in the general setting until the normal situational dynamics can reduce or resolve the conflict. Thus, this kind of adjunctive behavior represents a diversification of behavior in a tense or dangerous situation, which can allow the organism to remain uncommitted in the predicament and give unstable situational vectors time to reach what may prove to be an advantageous resolution. That is, the intruding of the adjunctive behavior maintains the kind of contact that is necessary to the reoccurrence of the primary behavior while allowing time for natural shifts in some of the prevailing contingencies that have been determining the ineffective forms of the primary behavior.

### ***Predicting Adjunctive Behavior***

Once adjunctive behavior and the essential features surrounding its occurrences can be described accurately, we can test the adequacy of our analyses by predicting adjunctive behavior in new kinds of situations. For example, suppose that an organism is put in continuous contact with a reinforcing food. The taste and aroma of the food reinforces the behavior of putting pieces of that food into the mouth and chewing it. Under these conditions, and prior to the onset of satiation effects, that eating behavior would tend to increase and/or stabilize in rate as is characteristic of the process of positive reinforcement, which these facts define.

Assume that we are talking about a person eating a big and very delicious apple. The apple is held in the

hand and is periodically moved to the mouth where a bite of the crisp apple flesh is taken. However, when eating a crisp food of this kind, a bite cannot be swallowed whole. First it must be thoroughly chewed, and it is precisely that chewing behavior that results in contact with the principal reinforcing stimuli (the taste and aroma).

Let us also note that, in the case of eating an apple, the reinforcing flavor and aroma diminish substantially with the first several chewing motions, but the crisp flesh of the apple is typically not ready to be swallowed until many more chewing motions take place. During the latter part of that extended interval of pre-swallow chewing, the primary reinforcers (flavor, and aroma) are increasingly reduced in strength from their peak initial level during the first few chewing responses following a bite from the apple.

We predict the appearance of adjunctive behavior, in this case *during the latter part of each bite-chew-swallow cycle*. Let us assume that the person is supposed to be practicing the piano, which is not much fun, and that the person is eating the ripe and delicious apple while seated before the piano. Given the relative strengths of the reinforcers respectively contacted by those two behaviors, apple eating is primary and piano playing is secondary. Taking a bite from the apple can be construed as an enabling operation with respect to the primary chewing behavior.

As a bite of apple pulp becomes increasingly insipid during the prolonged interval of necessary mastication, the person puts down the apple and starts to play some practice music. The sounds of the piano are reinforcing, but less so than the flavor, aroma, and texture of the freshly bitten apple. During the next intra-cycle interval, the continuing chewing behavior yields a much weakened gustatory reinforcer, while, concurrently, the piano playing behavior yields a relatively stronger auditory reinforcer. When the swallow occurs, thus freeing the mouth parts to take another bite of fresh apple, the piano playing stops, and the apple is again brought to the mouth for a bite. If we define a cycle from bite to bite, then across repeating cycles, at first blush we observe a sequence of primary chewing behaviors being periodically *accompanied* by some adjunctive piano playing.

In this example, we recognize the piano playing as a kind of intra-schedule adjunctive behavior. The primary schedule appears to be some sort of modified ratio schedule in which an approximate number of chewing motions are required following each bite, the latter instances of which are progressively less reinforced. There are two adjunctive behaviors, which occur as a sequential pair: (a) putting down the apple and (b) playing the piano. Putting down the apple occurs under the secondary schedule as an enabling operation that makes possible the second adjunctive behavior (piano playing) by freeing an otherwise preoccupied hand.<sup>14</sup>

The independent schedule of reinforcement under which the adjunctive piano playing then occurs is actually a complex combination of several schedules operating at the same time. Every press of a key yields a reinforcing audible tone (a CR schedule). Every several key presses results in a reinforcing musical phrase (either a FR or a VR schedule modified by musical pacing requirements). Combinations of such phrases yield the reinforcing strains of the melody (apparently another modified FR or VR schedule, but with a larger ratio). The cyclic repetition of similar short sequences of these key presses yields a reinforcing rhythmic pattern (in many cases, respecting an FR schedule modified by certain musical pacing requirements). . . . And this analysis could probably continue.

Note, in this example of adjunctive behavior, unlike earlier examples, the primary behavior actually continues through almost all of each cycle, while the adjunctive behavior arises, continues, and abates *concurrently* rather than alternatively. That is possible because different independently controlled body parts respectively execute the primary and adjunctive behaviors, and the primary behavior (chewing) does not have to stop to free the body parts that are necessary for execution of the adjunctive behaviors. (When discussed in the general scientific literature, concurrent and independently controlled operant behaviors are often categorized as *multiple operants*.)

The primary behavior is chewing, but its positive reinforcement becomes progressively less strong during each cycle. Although a partially chewed bit of apple will soon have lost most of its flavor and aroma, the chewing must continue until its texture has been refined sufficiently for swallowing. An increasingly flavorless and unaromatic wad of coarse apple flesh progressively can become a mild aversive stimulus, the escape from which is effected by continued chewing until the next swallow can occur. Thus, the chewing continues unabated through each cycle, but the controls on that chewing may change from positive to negative reinforcement. In that case, the associated concurrent adjunctive behavior arises during the latter part of each cycle when the control of the primary chewing behavior has shifted from mostly-strong-positive to mostly-mild-negative reinforcement.

In such a case, the concurrent adjunctive behavior occurs during an interval when the strong primary reinforcer is not available, although the behavior by which that primary reinforcer is accessed continues under a different contingency (i.e., for a different reason). The primary behavior and the intermittent adjunctive behavior occur concurrently during the part of each cycle in which the adjunctive behavior occurs. Thus, the attempt to predict adjunctive behavior in this new kind of situation has brought out attention to a new class of adjunctive behavior—namely, *concurrent adjunctive behavior*. The adjunctive piano playing did not displace the apple chewing.

Instead, its reinforcing effect was added to the temporarily diminished reinforcing effect of the primary chewing.

### ***The Selection of Adjunctive Behavior***

Notice has been taken of the potentially advantageous “holding” function of adjunctive behavior in conflict situations. That has implied to some people that those situations afford some sort of selection mechanism that may be responsible for the biological capacity for shifts to an adjunctive behavior on such occasions. Organisms that could more readily do that would presumably enjoy a survival advantage. The emergence of a relatively harmless adjunctive behavior displaces any impending retreat from the perhaps temporary conflict, and keeps the organism positioned in the situation where potentially important benefits may subsequently be realized when eventually the conflict subsides or is resolved. If the avoided implications are lethal, a contingency of survival is defined, and the kind of selection required for biological evolution is implicit.

However, adjunctive behavior, discovered as an intra-schedule effect and subsequently pursued to conflicts and other kinds of situations, represents a common kind of behavior change that is occurring under previously unrecognized circumstances. The biological selection responsible for the *capacity* to exhibit such changes in behavior traces back to the ancient history of organisms. It is the same evolutionary history that produced the capacity for operant behavior in general and for shifts in the prepotency of a specific operant behavior.

The argument for a special selection, based on the subtle utility of the implications of adjunctive behavior in conflict situations, seems somewhat redundant. All operantly capable organisms enter into those kinds of conflict situations already endowed with the capacity for adjunctive behavior—beneficiaries of an evolutionary history that long ago put that in place during the original emergence of operant capabilities. It therefore seems unlikely that adjunctive behavior, which results from a simple shift in prepotency, is a product of the selection mechanism operating only within the limited range of circumstances that have brought just one class of prepotency manifestations, described as “adjunctive,” to the attention of the experimental community.

While the capacity for adjunctive behavior may be further selected through such contingencies of survival in conflict situations, it would seem that that selection would serve mainly as a maintenance function, because bodies already work that way for reasons more general than those prevailing only within interval schedules or in conflict situations. The adjunctive behavior is, in general, already going to occur, because when one operant behavior weakens, another becomes prepotent. The kind of selection that, in evolutionary antiquity, produced the

general phenomenon of behavior change in response to change in the behavior-controlling environment, has bestowed the capacity for prepotency as a major and universal aspect of the contemporary endowment of operant capacity. For the most part, operantly behaving organisms all work that way in general, and shifts in the prepotent behavior will occur on *any* kind of occasion that affects the relative evocative strengths of environmental elements—and certain behaviors are called “adjunctive” when they occur prepotently during a special subset of that more general family of occasions.

### ***Conclusions***

The nature and occurrences of adjunctive behavior do not endow it with the fundamental status of a separate behavioral category in parallel with operant and respondent behavior. Nevertheless, its recognition is scientifically useful. The phrase *adjunctive behavior* is a tact of operant behavior that is occurring under a particular set of circumstances that, in some cases, render it (or its products) strange in a contextual sort of way.

Recognizing and analyzing adjunctive behavior provides some welcome scientific relief. For example, we can now describe and explain with better scientific precision such events as (a) the often feeble efforts of a privately terrified person to defuse a threatening situation, (b) the nonsensical diversions of a momentarily bored companion, (c) certain apparently unconscious ingestive excesses portending adverse although oddly ignored implications, or (d) perfunctorily getting one’s uninteresting work done while under the distractions of a favored diversion. With adjunctive behavioral phenomena included in our science, we are generally better prepared to deal analytically with a variety of curious behavior-related obtrusions that used to tease us with peripheral threats to the adequacy of our understandings.✻

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## Footnotes

<sup>1</sup> A version of this article appears in Chapter 16 of *General Behaviorology: The Natural Science of Human Behavior*, a book now under development by the author.

<sup>2</sup> This ranking of the relative evocative capacities of environmental elements, if is not already available, can be discovered experimentally.

<sup>3</sup> Implicit in this statement is a theoretical question about how to define *environment*, which is either (a) all stimuli to which the organism *could* be conditioned to respond, (b) all stimuli to which the organism has *ever* responded, or (c) all stimuli to which the organism is *currently* responding. These three definitions denote different behaviorological concepts of *environment*.

<sup>4</sup> Some theorists argue that two such behaviors, similar in form but controlled by different antecedents, cannot be identical in form and may therefore be distinguished, one from another, by sufficiently sensitive comparisons. According to that view, even though, under casual observation, those differently evoked responses may appear to represent the *same* behavior, normal interresponse variance aside, they are just not examples of the same behavior, and instead can be separated into two response classes, each representing its own behavior.

<sup>5</sup> Note that the common phrase “captures the person’s attention” is behaviorologically valid, a rarity among common references to how behavior works.

<sup>6</sup> Note that adjunctive behaviors differ from those that result from what are called secondary contingencies that may arise within the cycles on an interval schedule. Such secondary contingencies pertain to the primary behavior and introduce changes in how it is being controlled across different parts of each cycle. Here, we are talking about the temporary intrusion of entirely different behaviors that are controlled by stimuli that do not directly affect the primary behavior.

<sup>7</sup> An interval schedule features an interval of time during which the reinforcer of the behavior of interest is not available, after which it becomes available and remains so until the next response occurs. That response is reinforced, and then a new cycle begins as the reinforcer again becomes unavailable for another interval of time. If those time intervals are fixed, the schedule is called a *fixed-interval schedule* (FI schedule). If those time intervals vary from cycle to cycle, the schedule is called a *variable-interval schedule*.

<sup>8</sup> The excessive consumption of water, often to the point of damage to the organism, has been called *polydipsia*, but that term has in some cases been used to suggest an unspecified internal cause for the excessive drinking behavior. That implicit internal cause may be a fictional construct (e.g., a psychological causal trait) or perhaps an implicit physiological defect of some kind. However, in this case, the excessive drinking, though it has been called polydipsia, is entirely schedule-induced, a fact recognized by John Falk in his early descriptions of the phenomenon.

<sup>9</sup> In operant conditioning, apparent changes in the evocative capacity of an antecedent stimulus, the intrinsic properties of which remain fixed, are actually due to changes that occur within the behaving body. That is, the evocative strength of the antecedent stimulus may appear to wax and wane although that stimulus has not been changed. The temporary weakening of the evocative capacity of the antecedent stimulus that is illustrated in Fig. 1 actually occurs as a result of changes that happen within the body of the behaving organism. Remember that the conditioned evocative capacity of a stimulus is not one of its intrinsic properties. The real variables that define that capacity actually inhere in the behaving organism.

<sup>10</sup> In a variable ratio schedule, every Nth response gets reinforced, while N varies from cycle to cycle around some mean. If every response gets reinforced, the schedule is called a *continuous schedule of reinforcement*.

<sup>11</sup> When these details were mentioned to a person who explains behavior as operations conducted by an ethereal body-managing self-agent, that person observed that only a fool would continue in a trivial activity that yields little gain while neglecting opportunities to behave in more important ways that would pay off

handsomely. Furthermore, that person had no difficulty applying that explanation to each cycle within a schedule when each cycle features initial adjunctive behavior along with later behavior that intermittently can produce the strong primary reinforcer.

<sup>12</sup>An alternative possibility is that the punished behavior continues while the intruding behavior, which in this case occurs concurrently, distracts the punitive agent (assuming that the aversive source is a distractible organism). The punishment then weakens or abates, and the primary behavior re-equilibrates at a new higher level that is determined by the strength of the primary reinforcer. An example occurs when a companion, who has been punitively reacting to your remarks to a third party, is distracted when you, while continuing to talk to that party, extend your arm and hand to point to an interesting event that is occurring nearby. If your companion looks away and begins to attend to those events and that companion's punitive remarks therefore stop, your remarks to the third party can then increase in frequency under the control of the social reinforcers being provided by that party.

<sup>13</sup>In cases where a strongly reinforced behavior is suppressed by punishment, a low net rate implies that at least an occasional response will occur. Even if the suppression has the rate stabilized at zero, most organisms are nevertheless separately conditioned to exhibit the behavior occasionally as a probe, because in the past such "probes" have occasionally revealed that the suppressive conditions have changed.

<sup>14</sup>In each cycle, at the time that the apple is put down, it has temporarily lost most of its capacity to evoke another biting response. Carefully putting the apple down to begin the piano playing would represent the first of the two kinds of adjunctive behavior in the adjunctive sequence within each cycle. The deposit of the apple would be a negatively reinforced adjunctive behavior, because a loaded (preoccupied) hand becomes a conditioned aversive stimulus to the extent that it precludes access to the reinforcers acquired by playing the piano. The negatively reinforced escape behavior is "putting the apple down." The second adjunctive behavior, piano playing, is then positively reinforced by the resulting musical sounds under a combination of schedules. These facts reveal how the temporarily intruding adjunctive behaviors occur under their own respective kind of reinforcement. ☪

