chapter 8

Daydreaming and the Stream of Consciousness

William James coined the metaphor "stream of thought" (1890/1983) or "stream of consciousness" (1892) to convey two of the fundamental facts of consciousness: that within each personal consciousness the contents are always changing, and yet personal consciousness is continuous.

You know from your own experience how the contents of consciousness—perceptions, thoughts, images, feelings—are constantly changing.[1] Thoughts change in response to changing external stimuli and the changing demands of the "task at hand" (such as reading, driving, conversation). Daydream thoughts can roam widely from one topic to another, often being set off by something we have seen or heard, and then continuing in their own autonomous string of associations until we end up thinking about something quite different from what we started out with, as in the following example:

> O.K. I'm looking at that piece of wood down there in the corner. I'm thinking that this is a really, very interesting stream of consciousness. I'm looking at my coat now. I got it from uhm Hadassah. And there's this great Jewish lady there that was uh, oh, I'm thinking about this tie that I had. Oh, now I'm thinking of a tie of my grandfather's. I'm thinking about the day that my grandfather died. I was at junior high school and [name] walked into the office. I was in the office and I was crying and I didn't really care if he, if he cared that I was crying, uhm. I walked outside. I remember walking down by the football field. It was a long, curvy driveway sort of and I remember looking over through my tears at them playing football. Now I'm thinking about my coach in uh junior high school. He was [name] and he used to beat up all of, all of these, these kids uhm, but he

> liked me. I'm thinking of his big nose and bald head. . . . I'm looking at this piece of cellophane from a cigarette package . . . and I'm thinking that I'm smoking too many cigarettes. I should quit because I'm worried that I'm going to wind up just like my father . . . (Excerpt from tape-recorded stream of consciousness report by participant in thinking-out-loud study; Pope 1978, p. 288).

The stream of consciousness is much like the flow of conversation at a party, with successive topics being connected by associations having to do with factors such as similarity of relationship (child, spouse, parent), location (school, city, country), activity (work, sports, travel), emotional reaction (joy, anger, depression), life events (birth, marriage, divorce, death), or news events (politics, economy, war). An ever-changing stream of consciousness is a fundamental human characteristic, and it is normal to engage frequently in daydream thoughts—thoughts, either fantastic or mundane, that have nothing to do with the task at hand. A realistic representation of human conscious experience has been attempted by a number of writers using the "stream of consciousness" style, most notably James Joyce's *Ulysses*. Of course, one limitation of this literary technique is that it cannot show the visual mental images that are an important part of the waking thoughts of many people.

Psychologists are interested in trying to understand the factors that influence the stream of thought, that is, the factors that determine the selection of topics and their sequence. Cognitive psychologists are beginning to realize that a complete understanding of the human mind cannot be developed by studying only thinking during rational decision-making, memory, and problem-solving tasks. It is necessary also to study the spontaneous flow of thoughts that occurs in daydreaming (and also night dreaming). In studying the stream of consciousness the psychologist faces serious practical difficulties due to the limitations of verbal introspective reports, as I discussed in Chapter 3. But the topic is so interesting and important that, rather than abandon it, we must face the difficulties. Clinical psychologists want to know about the stream of thoughts so that they can understand their clients and help them with their personal problems. One of the tenets of cognitive approaches to psychotherapy is that our feelings and actions are influenced by our conscious thoughts, and we can change our maladaptive feelings and actions if we adopt strategies to change our conscious thoughts.

In this chapter I will first discuss a system for classifying the ever-changing thoughts in the stream of consciousness. Then I will discuss research on daydreaming, including personality correlates of daydreaming, experiments on task variables that influence daydreaming frequency, and physiological correlates of daydreaming. Next I will discuss the effects of sensory deprivation on conscious experience. Finally, I will present some conclusions and hypotheses about factors that influence daydreaming and the stream of consciousness.

DIMENSIONS OF THOUGHT IN NORMAL WAKING STATES

The first stage of studying a natural phenomenon is to develop a system to describe and classify various instances of the topic under study. In order to

study the stream of consciousness, we need a descriptive system that classifies moment-to-moment changes in conscious experiences according to abstract categories that cut across the variety of specific contents and that are likely to be meaningfully related to various personal and environmental variables (including experimental independent variables). In Chapter 2, I described various aspects of conscious experience—percepts, verbal thoughts, mental images, feelings, and so forth—that can vary in the stream of consciousness. But for a more detailed analysis we need to describe dimensions on which these aspects of experience can vary.

Several writers have tried to describe conscious thoughts in terms of two broad categories. For example, Freud (1900/1965) distinguished between secondary and primary process thinking: *secondary process thinking* is more controlled, verbal, rational, and oriented to reality, whereas *primary process thinking* is more spontaneous, imaginative, visual, and oriented to gratification of instinctive needs. Both night dreams and vivid wish-fulfilling daydreams and reveries involve primary process thinking.[2] Berlyne (1965) made a similar distinction between directed versus autistic thinking, whereas Hilgard (1962) distinguished realistic versus impulsive thinking.

All of these dichotomies are intended to capture the distinction between the more realistic, task-oriented type of waking thought (such as making a practical decision, solving a problem, reading a technical book) and the more imaginative, spontaneous type of thinking that occurs commonly in daydreaming and reverie. For purposes of experimental research on daydreaming, Singer (1975a, 1978) defined daydreaming in terms of *stimulus independent mentation* (SIM), on the assumption that thinking about a task at hand (such as driving a car or listening to a lecture) involves attention to external stimuli, whereas daydreams are thoughts that are unrelated to the task at hand and hence independent of current environmental stimuli.

Eric Klinger (1978, 1978–79) argued, however, that simple dichotomies do not capture the richness and variety of waking thoughts and images. For example, some thoughts classified as daydreams because they are not about the current task at hand are nonetheless quite realistic and rational thoughts about solving practical problems in one's life, rather than with wish-fulfilling fantasies. In other cases a train of spontaneous thoughts, either realistic or fantastic, may be elicited by current environmental stimuli, though the thoughts are not directly related to the task at hand. (For example, something you read in a textbook might remind you of a personal event in your life, and so you would start reminiscing.)

In order to describe more fully the variety of waking thoughts, Klinger proposed that they can be classified on each of several different dimensions. Each dimension is a continuum, ranging from high to low, or from one pole to another. The dimensions are independent (or semi-independent) of each other, so two thoughts on two different topics might be rated as similar on some dimensions but different on other dimensions. Though the dimensions are continua, I will describe them as if they are dichotomies, since the continua are best understood by describing their extreme ends.

Operant versus respondent thoughts. Klinger (1971) distinguished between operant and respondent thoughts, by analogy to Skinner's (1953) dis-

tinction between operant (emitted) and respondent (elicited) responses. Operant thoughts are thoughts directed toward accomplishing a task that requires controlled attention, rather than mere automatic, habitual performance.

> In very general terms, operant thinking [differs] from respondent thinking in that it is accompanied by a sense of volition, is checked against feedback concerning its effects, is evaluated according to its effectiveness in advancing [toward] particular goals, and is protected from drift and distraction by the thinker's deliberately controlling his or her attention (Klinger 1978, p. 235).

Conversely, respondent thoughts are elicited either by stimuli or by other thoughts, and they flow without any voluntary control over their direction. Respondent thinking is not concerned with accomplishing any task at hand, and so it is not evaluated according to its effectiveness in accomplishing particular goals, nor is it deliberately protected from attentional drift. Working on a calculus problem would involve operant thought, whereas daydreaming about a sexual fantasy or about winning a million-dollar lottery would involve respondent thought.

In general, operant thought is voluntarily directed, whereas respondent thought is undirected. This is not to say that respondent thought is necessarily "directionless." An elaborate but spontaneous fantasy may lead to some conclusion, but it does so in an automatic fashion, without foreknowledge of the conclusion or voluntarily leading it to the conclusion. The direction of the fantasy is apparent only in retrospect. Fantasies that involve some degree of voluntary control fall somewhere nearer the middle of the operant-respondent continuum. Aimless mindwandering is respondent thought.

Stimulus-bound versus stimulus-independent thoughts. Stimulus-bound thoughts are related to the current setting or task at hand, whereas stimulus-independent thoughts are unrelated to the current setting or task at hand. Stimulus-independence is the criterion that Singer (1978) and Antrobus (1968) used to identify daydreams in their experimental studies (to be described in a later section), in which they defined stimulus-independent mentation (SIM) as any thought that was not related to the task at hand. Klinger (1978) argued that stimulus-independence alone is too crude a criterion for classifying daydreams, since some stimulus-independent thoughts are rational and related to practical concerns (other than the task at hand), rather than being pure fantansy or recollection. Though most task-related thoughts may be operant thoughts, the two dimensions (operant/respondent and stimulus-bound/independent thoughts) are defined as independent dimensions. Table 8.1 shows examples of how thoughts can be either related or unrelated to the stimulus setting or task, and either operant or respondent.

Fanciful versus realistic thoughts. Realistic thoughts are thoughts about things that have happened or are currently happening, or things that might plausibly happen given the thinker's current life situation or the world situation. Fanciful thoughts are imaginative thoughts about things that are either impossible or extremely unlikely to happen given the

TABLE 8.1 Examples of Thoughts to Illustrate Different Combinations of Stimulus Relatedness and Operant/Respondent Dimensions

TYPE OF THOUGHT	SETTING AND ACTIVITY	THOUGHT CONTENT
Stimulus-bound (related to task or setting):		
Operant	1. Driving home from work	Thinking about best route to avoid road repair work on way home.
	2. Reading *Abnormal Psychology* text book in library	Trying to recall and paraphrase the main points of the chapter section that I just finished reading.
Respondent	1. Driving home	Thoughts/images of traffic accident that I saw on this stretch of road last month.
	2. Reading textbook (chapter on depression)	Recalling a friend's suicide attempt, and how I felt about it.
Stimulus-independent (unrelated to task or setting):		
Operant	1. Driving home	Thinking about gathering the information I need to compute my income tax.
	2. Reading textbook	Trying to estimate the best time to leave the library in order to run two errands and get home in time for supper.
Respondent	1. Driving home	Images of kayaking last weekend, and the feel of cold water on my face.
	2. Reading textbook	Wondering whether Xxx was really flirting with me, or whether it was my imagination.

thinker's current life situation or the world situation. Note that realistic and fanciful are relative terms. For example, my fantasies about sailing an expensive sailboat might be similar to my dentist's realistic memories of last weekend's adventures. Many people daydream about what they would do if they were president, but such thoughts are realistic for only a few people. Fanciful thoughts are usually respondent and unrelated to the task at hand, but they can be operant and related to the task at hand, such as when you think of a very imaginative but impossible solution to a practical problem. (For example, I could end the threat of nuclear war if I were Superman and I could gather up all of the nuclear weapons and hurl them into the Sun.)

Well-integrated versus degenerated thoughts. This dimension distinguishes relatively orderly, connected, coherent trains of thought from those that are relatively disorderly, disconnected, and incoherent.

> Ordinary waking thought more often than not has about it a certain quality of intactness that sets it off from dreamlike thought: Particular thoughts tend to have a coherent quality, things that are separate topics retain their separateness, and images of different things retain their individual character; whereas dream images often flow without respect to beginnings or endings, shift gears drastically in the middle, interweave different concerns with one another, and offer images that seem to be the fused representatives of different basic ideas or forms (Klinger 1978, p. 241).

Klinger argued that the degenerateness dimension is functionally independent of the other dimensions, though not necessarily statistically independent. For example, most operant thought is well-integrated, but it may become degenerated if we are especially drowsy or in a drugged state. Most degenerate thoughts are respondent and fanciful, for example, the bizarre hypnagogic images that occur when you are drowsy and falling asleep. But some fanciful thoughts are well-integrated, with consistent characters and images, as in a good fantasy novel.

Vivid versus nonvivid mental images. Mental images are quasi-perceptual experiences of people, objects, and so forth, that occur in the absence of their real perceptual counterparts. Mental images can vary on a dimension of vividness, from high to low. Most people's night dreams involve vivid or life-like visual mental images. People differ widely in the vividness of their waking mental images. Mental images (visual, tactile, auditory) are common in fanciful, respondent daydreams, and they tend to be more vivid under relaxed or drowsy conditions. But images can occur in operant thought, too, such as when you visualize how you want to arrange your furniture, or how to build a brick-and-board bookcase. Auditory images often occur (musical melodies, animal sounds), but purely verbal thoughts are counted as a separate category, even though we may "hear" our own voice in our verbal thoughts.

Evidence for Klinger's Dimensions of Thought

Klinger's analysis of the abstract dimensions of thought makes sense in relation to his own introspections—and mine, too. But the dimensions of thought that you discover through introspection depend to some extent on your prior theoretical notions and the aspects of thought that you attend to during introspection. In order to find out whether his dimensions of thought were applicable to the thoughts of other people, Klinger (1978, 1978–79) analyzed the introspective reports of a dozen college students. The reports were collected in a systematic manner, but under uncontrolled, real-life circumstances. As they went about their daily activities the subjects carried an electronic gadget that beeped at random intervals averaging forty minutes between beeps. Whenever the gadget beeped, the subjects stopped

what they were doing and answered questions about their most recent thought segment (thoughts on one topic) on a thought-sampling questionnaire. First, they wrote a brief narrative description of the thought and the situation in which it occurred. Then they answered a series of fifteen questions about the thought segment, concerning its duration, directedness, specificity, visualness of imagery, detail in imagery, controllability of imagery, attentiveness to environmental events, and familiarity or strangeness of the thought. Afterward, Klinger had independent judges rate each thought segment according to its degree of relationship to the setting or task at hand.

Some 285 analyzable thought samples were collected in a wide variety of situations, ranging from resting or doing homework to driving or feeding cows, and they covered a wide range of topics, ranging from homework and death to travel and sexual seduction. The median duration of the thought segments was only five seconds; most thoughts were very brief, though some lasted nearly a minute. Correlational analysis of the data supported the notion that the first two dimensions, operant/respondent thought and stimulus dependent/independent thought, are largely independent of each other ($r = 0.20$); they are not simply two different ways of measuring the same thing. Of the 285 analyzable thought samples, 69% were judged to be clearly setting-related; of these, 65% were rated as wholly or mainly operant, and 27% as wholly or mainly respondent. Some 21% of the thought samples were judged to be clearly independent of the setting; of these, 37% were rated as wholly or mainly operant, whereas 25% were rated as wholly or mainly respondent. Thus, the correspondence between operantness and setting-relatedness is far from perfect ($r = 0.18$); the two dimensions are largely independent of each other. A factor analysis of the data (Klinger 1978–79) revealed three relatively independent factors corresponding to the dimensions of operant versus respondent thought, external versus internal attention, and fanciful versus realistic thought.[3] Also, thought samples varied on a vividness of imagery dimension.

The main results of the earlier study were replicated in a follow-up study using a larger sample size ($n = 29$; 1425 thought samples; Klinger & Cox 1987–88). In addition, the more recent study showed that most thought samples (73%) contained some degree of *interior monologue* (talking to oneself) and also most (67%) had some degree of *visual-spatial mental imagery*. As for the integrated versus degenerated thought dimension, in most thought samples (78%) the thoughts/images were well connected or organized, though 22% of the samples showed disconnected or disorganized thoughts. Only 3% of the thoughts/images were highly distorted, but another 22% contained some degree of dream-like distortion. In most cases (76%) the subjects had good confidence in their memory for their most recent thought. (Bear in mind that these are average results for twenty-nine subjects; there was considerable variability between subjects.)

Klinger's thought-sampling research is noteworthy for showing that waking thoughts can be reliably classified on several relatively independent dimensions, having to do with operantness, setting-relatedness, fancifulness, integration, and imagery vividness. His work shows that whereas the prototype daydream (stimulus-independent) thought might be respondent, fanciful, and vivid, some daydreams may be operant, realistic, and nonvivid, or

any other combination of the different dimensions. Klinger's studies (1978; Klinger & Cox 1987–88) can be criticized for their failure to include questions about affective dimensions of the stream of consciousness. In informal reports of their stream of consciousness, people often refer to the pleasant or unpleasant nature of their experiences, or to more specific emotions such as anxiety and joy. The task that remains is to discover the personal and situational variables that affect the characteristics of thoughts and feelings in the stream of consciousness—what Singer (1984) called the "private personality."[4]

RESEARCH ON DAYDREAMING

If you take a moment for retrospection of your thoughts over the last several minutes you will probably find that you have not focused your attention continuously on this textbook. Rather, from time to time your thoughts have shifted briefly to other things, including external stimuli, such as music or voices from the next room, and daydreams, such as thoughts about someone you hope to see later tonight. Perhaps your thoughts about that person produce emotional feelings, such as joy or anger. And perhaps these reactions have gotten you off on a train of associations that leads to still other daydreams, keeping your attention away from this text for minutes at a time. [SNAP OUT OF IT! This stuff is important! Study now, daydream later!]

Singer (1975a, 1975b) argued that daydreams differ so widely that they cannot be defined simply in terms of their content or quality. Rather, daydreams are defined as thoughts that are not directly related to the task at hand or to the setting (social or physical environment):

> Probably the single most common connotation is that daydreaming represents a shift of attention *away* from some primary physical or mental task we have set for ourselves, or *away* from directly looking at or listening to something in the external environment, *toward* an unfolding sequence of private responses made to some internal stimulus. The inner processes usually considered are "pictures in the mind's eye," the unrolling of a sequence of events, memories or creatively constructed images of future events which have varying degrees of probability of taking place. Also included as objects of daydreaming are our awareness of our bodily sensations, our emotions and our [interior monologues], those little inner voices we hear talking to us somewhere in our heads (Singer 1975b, pp. 3–4).

Daydream thoughts may arise directly from memory, or they may be elicited by distracting physical stimuli or even by stimuli from the task at hand. Whatever their initial stimulus, once irrelevant thoughts get started they often continue for several seconds or minutes, one thought leading to another in what could be termed a stream of thoughts or associations, or a stream of consciousness.

Here I will describe research on several factors related to daydreaming, including personality differences, ongoing tasks, and physiological correlates of daydreaming.

Individual Differences in Daydreaming

Jerome Singer and John Antrobus (1972; Singer 1975a, 1975b, 1978) developed an elaborate questionnaire, The Imaginal Processes Inventory (IPI), for studying individual differences in daydreaming. The IPI consists of twenty-nine scales (of twelve items each), covering topics such as frequency of daydreaming, positive reactions in daydreams, acceptance of one's daydreams, fear of failure in daydreams, sexual daydreams, heroic daydreams, hostile-aggressive daydreams, guilty daydreams, visual imagery in daydreams, problem solving in daydreams, and mindwandering. Singer and Antrobus (1972) did a factor analysis the IPI answers of some 579 college freshmen from two universities. Three factors emerged, suggesting three different daydreaming styles: a positive-vivid daydreaming style (PV), a guilty-dysphoric style (GD), and an anxious-distractible style (AD). Table 8.2 shows some examples of IPI items.[5]

TABLE 8.2 Examples of Items from the Imaginal Processes Inventory

Subjects check each item on a 1 to 5 scale according to how much they think it applies to themselves. The label before each item shows the IPI scale to which it belongs. The initials after each item (PV, GD, AD) show the IPI daydreaming style factor to which the scale relates most strongly.

Positive reactions: "My daydreams often leave me with a warm, happy feeling." PV
Frightened reactions: "My daydreams have such an emotional effect on me that I often react with fear" GD
Visual imagery: "The pictures in my mind seem as clear as photographs." PV
Auditory imagery: "In a daydream I can hear a tune almost as clearly as if I were actually listening to it." PV
Problem-solving: "Sometimes an answer to a very difficult problem comes to me during a daydream." PV
Future-oriented: "I picture myself as I will be several years from now." PV
Bizarre-improbable content: "I daydream about utterly impossible situations." GD
Fear of failure: "I imagine myself failing those I love." GD
Hostile-aggressive: "I imagine myself getting even with those I dislike." GD
Sexual: "While reading I often slip into daydreams about sex or making love to someone." PV
Heroic: "I picture myself risking my life to save someone I love." GD
Guilt: "In my daydreams I am always afraid of being caught doing something wrong." GD
Absorption in daydreams: "Some of my daydreams are so powerful that I just can't take my attention away from them." AD, PV
Hallucinatory vividness: "Voices in my daydreams are so distinct and clear that I'm tempted to answer them." GD
Mindwandering: "No matter how much I try to concentrate, thoughts unrelated to my work always creep in." AD
Distractibility: "I find it hard to read when someone is on the telephone in another room." AD

Source: Singer, J. L., & Antrobus, J. S. (1972). Daydreaming, imaginal processes, and personality: A normative study. In P. Sheehan (Ed.), *The Function and Nature of Imagery* (pp. 175–202). New York: Academic Press .

Daydreaming styles. People with a *positive-vivid* daydreaming style could be called "happy daydreamers." Positive-vivid daydreamers tend to daydream frequently, have positive reactions to their daydreams, have vivid visual and auditory images in their daydreams, and use daydreams to help solve personal problems. Such people may develop fairly elaborate fantasies and show a lot of interest in their inner experience.

The *guilty-dysphoric* daydreaming style is characterized by daydreams showing guilt, hostility, fear of failure, heroism, achievement-orientation, hallucinatory vividness, and frightened reactions. Guilty-dysphoric daydreamers "seem to be people who are given to a great deal of tortured self-examination, driven toward achievement and heroic accomplishment, and characterized by a generally negatively toned fantasy life" (Singer 1975a).

The *anxious-distractible* style (also termed "mindwandering-distractible style") is associated with mindwandering through daydreaming, worrying, boredom, and distractibility. Paradoxically, such people may become very absorbed in daydreams without being able to maintain concentration on a single daydream topic; their daydreams jump around a lot, so they rarely develop extended fantasies. Such people tend to be extremely anxious, self-doubting, and fearful, with relatively low achievement motivation.

In extreme cases of people who score high on one factor and low on other factors, we could say that positive-vivid daydreamers are generally well-adjusted; guilty-dysphoric daydreamers are obsessive-compulsive neurotics; and anxious- distractible daydreamers are anxiety neurotics (Singer & Antrobus 1972). However, it is important to note that most people fall in between the extremes, perhaps being mostly of one daydreaming-personality type but also having some elements of the other types. For example, you might commonly have visually vivid, pleasurable fantasies characteristic of the positive-vivid daydreamer, but also sometimes have heroic or aggressive daydreams that are more characteristic of the guilty-dysphoric type.

Research using the IPI with college students and other people of various ages shows that nearly everyone daydreams fairly often, though some people daydream more than others. A high frequency of daydreaming is not, in itself, a sign of psychopathology. Older people show the same daydreaming styles as college students, though with advancing age there tends to be a decrease in daydreams about the future, sexual daydreams, and daydreams showing guilt or anxiety (Giambra 1974).

Correlates of daydreaming styles. Several studies have shown relationships between IPI daydreaming types and other measures of fantasy, thought, or behavior. Starker (1974, 1978) found a correspondence between IPI daydreaming styles and night dreaming styles. He administered the IPI to college students and also asked them to keep dream diaries for two weeks. For each IPI daydreaming type, three subjects were selected who were the most clear-cut examples of that type, and their dreams were analyzed in detail. Judges who were "blind" to the subjects' IPI daydreaming style scored the dream reports on several dimensions. The night dreams of positive-vivid daydreamers showed more positive emotionality, and less bizarreness, than did either guilty-dysphoric or anxious-distractible daydreamer types. Of the three groups, night dreams of the anxious-distractible types showed the most

emotionality, the most bizarreness, and the greatest number of different idea units per dream. (The latter result suggests that the anxious-distractible types tended to have dreams that were more fragmented—jumping around from one scene to another—than did the other types.) Nightmares—defined as anxious dreams that awakened the subject—never occurred among the positive-vivid daydreamers; they were most frequent among the anxious-distractible types. In another study, Starker (1978, 1982) asked college students to make up dreams, describing their "best possible" and their "worst possible" fantasies. Interestingly, guilty-dysphoric types tended to include negative affect even in their best possible fantasies, whereas positive-vivid types minimized negative affect in their worst fantasies. Starker's research shows a continuity between waking fantasy and dream fantasy: your positive or negative temperament shows up in both your daydreams and your night dreams.

Antrobus, Coleman, and Singer (1967) studied daydreaming during a *vigilance task*, in which brief auditory signals occurred at irregular intervals, and subjects were supposed to press buttons whenever they detected the signals. The subjects who scored highest on the positive-vivid daydreaming factor reported the most daydreams during the vigilance task; as the boring task wore on, their daydream frequency increased, while their signal-detection performance deteriorated more rapidly than did the performance of low-frequency daydreamers.

Isaacs (1975) examined the language used to describe daydreams that occurred during a vigilance task. Positive-vivid daydreamer types described more elaborate daydreams, and used more metaphoric ("this is like that") language in describing them, compared to other subjects. Fusella (1973) found that positive-vivid daydreamers can generate visual mental images that are so vivid that they can interfere with the detection of dim visual signals, more so than people who score low on the PV factor.

Daydreams may reveal your desires or fears more than they reveal what you actually do in your life. For example, people of all three daydreaming styles, both male and female, daydream fairly often about sex, though the specific nature of sexual daydreams tends to differ for the different daydreaming-personality types, showing themes characterized more by either pleasure, guilt, or anxiety. But elaborate and exciting sexual daydreams, for most of us, reveal what we would like to do rather than what we have actually done. Males tend to have heroic daydreams more often than females, though people with heroic daydreams may never have done anything heroic in their lives. And some people have highly aggressive daydreams in which they may brutally destroy real or imagined enemies, though their actual behavior toward other people may not be particularly aggressive. Only when someone is obsessed with aggressive fantasies, and has little realization of the consequences of aggression, is there likely to be a relationship between aggressive daydreams and actual behavior (Singer 1978).

To say that your daydreams do not necessarily reveal your actual behavior is not to say that your daydreams are unrelated to your life experiences. Our life experiences give us a variety of desires, successes, failures, and personal concerns that can become the source of daydream fantasies involving

either pleasurable recollection, imaginative compensation, or practical planning for the future.

Experimental Studies of Factors that Affect Daydreaming

As you know from your own experience, you are most likely to daydream at times when you do not have to respond to information from the environment—that is, when there is no external "task at hand"—or when the environmental input is so redundant or boring that you stop attending to it. Antrobus and Singer did several experiments on the influence of various task variables (such as task difficulty, and payoffs for good performance) on daydreaming frequency.

Daydreaming and information load. Antrobus (1968) examined the relationship between daydreaming frequency and the rate of information presentation, or *information load*, in a vigilance task. Vigilance tasks were originally devised by psychologists after World War II to study factors that affect human performance in monitoring radar screens, an activity in which observers must spend long periods of time looking for new blips—possibly indicating enemy warplanes—to appear on the screen. In Antrobus's study a series of brief tone signals was presented to the subjects, and they were required to press a telegraph key each time they heard a tone. Under some conditions tones of two or three different pitches (high, medium, or low) were used, and subjects had to press one of two or three different keys, depending on which pitch they heard. The difficulty of the vigilance task was manipulated by varying both the signal presentation rate (from 2.0 tones per second to 0.2 per second [that is, one every five seconds]) and the number of different tones that might occur (1, 2, or 3). When two or three different tones were used, tones of different pitches were presented in a random sequence. Table 8.3 shows how the different signal presentation rates and number of possible tones were systematically combined, on different trials, to produce nine different information presentation rates (information load) measured in *bits per second.*[6] Over the course of a 2-hour session each subject

TABLE 8.3 Information Load in Bits per Second under Nine Test Conditions in Antrobus's (1968) Experiment: Three Signal Presentation Rates Crossed with Three Tone Conditions (Multiplicative Rule)

	SIGNAL PRESENTATION RATE: SIGNALS PER SECOND		
NUMBER OF DIFFERENT TONES	2/sec.	1/sec.	0.2/sec.
1	2	1	0.2
2	4	2	0.4
3	6	3	0.6

From Antrobus, J. S. (1968). Information theory and stimulus-independent thought. *British Journal of Psychology*, *59*, 423–30.

was tested with each of the nine different information loads on 20 different trials, in a randomized sequence. As an incentive for good performance the subjects were paid a small monetary bonus based on the number of correct keypress responses (correct signal detections). In order to minimize extraneous distracting stimuli, the subjects were tested in a soundproof chamber, with a masking noise and with the lights turned off (partial sensory deprivation conditions).

The frequency of daydreaming was measured by a thought-sampling method. Daydreaming was strictly defined as *stimulus-independent mentation* (SIM), that is, a thought or image that was not directly concerned with performing the vigilance task. Prior to the experiment, subjects were given extensive training in classifying their thoughts as either task-relevant thoughts or "outside thoughts." During the vigilance task, at the end of each fifteen-second trial the subjects reported whether they had had any outside thoughts during the trial. They merely reported whether they had had any outside thoughts (daydreams); they did not have to report the content of the daydream. (This simple yes-no reporting procedure was designed to minimize interference with the natural flow of the stream of consciousness.) The next trial started immediately after the thought report.

Figure 8.1A shows the proportion of trials with daydreams ("stimulus-independent responses") as a function of the information-presentation rate. The frequency of stimulus-independent thoughts decreased as a direct linear function of the information-presentation rate, from about 60% at the lowest information rate to about 35% at the highest rate. Figure 8.1B shows the bits/second encoded by the subjects (correct responses) as a function of the bits/second presented (information load). The fact that the bits encoded are less than the bits presented indicates that vigilance performance was far from perfect, especially at higher information presentation rates. Figure 8.1C shows the relationship between frequency of stimulus-independent thoughts and actual task performance in bits/second encoded. Daydreaming occurs less frequently, the greater the amount of external information that is being encoded.

Besides showing, as expected, that daydreaming decreases as an information-processing task becomes more difficult, Antrobus's (1968) study revealed a rather surprising result: Even under the most difficult vigilance task conditions, in which signal detection performance was only about 50% correct (about 3 bits encoded out of 6 bits presented), the subjects still daydreamed on 35% of the trials. You might think that people could resist daydreaming in order to perform well on a difficult task. But it appears as if there is a strong internal need or pressure to daydream, and so daydreaming will occur even during a difficult task, particularly when the task is as boring as a laboratory vigilance task.

Incentives for task performance. One day I was discussing Antrobus's (1968) experiment in an undergraduate course when a student spoke up and suggested that Antrobus's subjects daydreamed so much because they were not sufficiently motivated to do well on the task. At best they could only earn a few dollars by good performance. The student then described one of his own experiences. He said that he was a Viet Nam war veteran, and that dur-

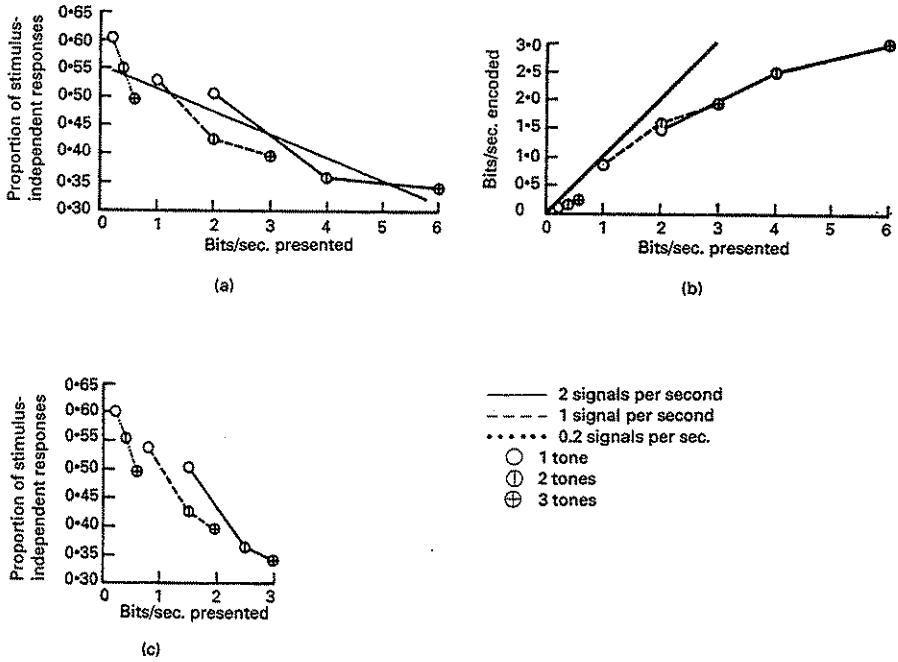


FIGURE 8.1. Relationship between stimulus-independent thought (daydreaming) and information load in a signal detection task. (A) Relative frequency of stimulus-independent thought reports as a function of information-presentation rate. (B) Rate of information encoding as a function of the rate of information presentation. If task performance was perfect then the data points would fall on the diagonal line (for example, 3 bits presented would correspond to 3 bits encoded). (C) Relative frequency of stimulus-independent thought reports as a function of the rate of information encoding. [From Antrobus, J. S. (1968). Information theory and stimulus-independent thought. *British Journal of Psychology, 59*, 423–30. By permission of the British Psychological Society.]

ing the war he had been the radar man on a bomber that flew bombing missions over Hanoi and other targets. It was his job to operate equipment designed to jam the enemy's radar so they couldn't shoot down the bomber. It was a real-life vigilance task, requiring rapid processing and responding to a variety of external stimuli. His life, and the lives of the other crew members, depended upon his doing his job correctly. He said: "Under those conditions, when we were being fired upon, I did not daydream. It was like I was part of the machine."

Of course, nobody asked the radar man about his daydreams *during* the bombing runs, before he had had a chance to forget any daydreams that he might have had. But the radar man's report is consistent with other real-world observations. Perhaps you have had similar experiences in which your daydreaming was reduced to zero or near-zero for several seconds or minutes while you were engaged in some dangerous task that required your full

attention, such as skiing down the expert slope or kayaking through treacherous rapids.

Undoubtedly motivation to perform the task at hand is an important factor influencing daydream frequency. Antrobus, Singer, and Greenberg (1966) manipulated incentives in a signal detection task (2 bits/second presented) by varying the size of a monetary penalty for errors. The error penalty amounts were to be subtracted from the subjects' earnings for participating in the experiment. The frequency of stimulus-independent thoughts decreased from 65% with no penalty to about 32% with the highest penalty. Thus, daydreaming frequency was affected by incentives, but even under the best conditions daydreaming frequency remained relatively high. Of course, the total amount of money to be earned for perfect performance was only a few dollars.[7] But even under the best of laboratory conditions, with a difficult task and a monetary incentive for good performance, it is doubtful whether daydreaming could be reduced to a really low level. The vigilance task is probably a good laboratory analogy to a real-world task such as listening to a boring lecture, but it may not be a very good analogy to real-world tasks in which life or limbs are at stake.

Incentives for daydreaming. Daydreaming is influenced not only by the task at hand, but also by recent events that are personally significant to you. For example, if you were to receive bad news, such as news that a close friend had been in a serious automobile accident, just before you entered a classroom, then you would probably be less attentive to the lecture than usual because you would be thinking about your friend. Antrobus et al. (1966) modeled this situation after the vigilance signal detection task. Subjects had to wait for fifteen minutes in a waiting room before doing the vigilance task. During that time a music radio program was played through a loudspeaker. For subjects in the experimental group, the music program was interrupted by a special (phony) news bulletin that said that China had entered the Viet Nam war and had sunk two U.S. aircraft carriers, and that local draft boards should "call in for physical examinations, as soon as possible, all unemployed youths over 18 and all eligible college graduates" (p. 411). (This experiment was done in mid-1965, during the first major escalation of the Viet Nam war, when college-age people were especially concerned about being drafted into the army.) During the vigilance task the experimental subjects reported daydreams (SIMs) twice as often as control subjects, and their signal detection performance was three times as variable as that of the controls. On a follow-up questionnaire most of the subjects reported that the "news bulletin" had caused them to feel anxiety and to have thoughts about the implications of the news for their future. They reported that, during the signal-detection task, they had had thoughts about things such as the possibility of themselves or friends being drafted, the effect of the draft on school plans, moving to Canada to escape the draft, "being tied to a tree in Vietnam and being tortured by Chinese," and so forth. Also there were some general thoughts about such topics as war, people being killed, and atomic explosions. This study shows how personally significant news can increase the in-

centive (payoff) value of pertinent daydream thoughts, so that daydreaming increases, even though daydreaming interferes with performing the task at hand.

The processing requirements of daydreams. In the multistore model of the human information processing system, working (short-term) memory is a limited capacity, general-purpose information processing system. Researchers have shown an inverse relationship between daydream frequency and external task difficulty or task performance (Antrobus 1968; Antrobus et al. 1970). That is, daydreaming and performing an external task mutually interfere with each other. The implication is that both sorts of mental activity—daydreaming and doing tasks with external stimuli—require working memory.

While people are doing external tasks, some daydreaming occurs concurrently with responding to task stimuli (parallel processing). But most daydreaming occurs during the time gaps between responses to task stimuli. In a vigilance signal-detection task with signals presented at regular time intervals, the greater the interval between signals, the more subjects daydreamed (Antrobus et al. 1970). When the signals occurred at variable intervals, daydreaming occurred less often than when signals occurred at regular intervals (where the regular interval was the same [e.g. 5 seconds] as the mean interval under the variable interval condition). Thus, when we do not know exactly when to expect critical external events (variable intervals), we must be vigilant and prepared to respond at any moment, so we daydream less often. But when the critical events are predictable, we can relax and daydream during the intervals between them. In other words, we alternate attention between internal events (daydreams) and external events. Alternating between two external tasks, or between an external task and internal processing, is called *multiplexing.* Concurrent (parallel) daydreaming and task performance should be more common when you are doing a relatively simple or highly practiced, automated task, such as driving under easy conditions, whereas multiplexing should be more common with a more difficult or less automated task.

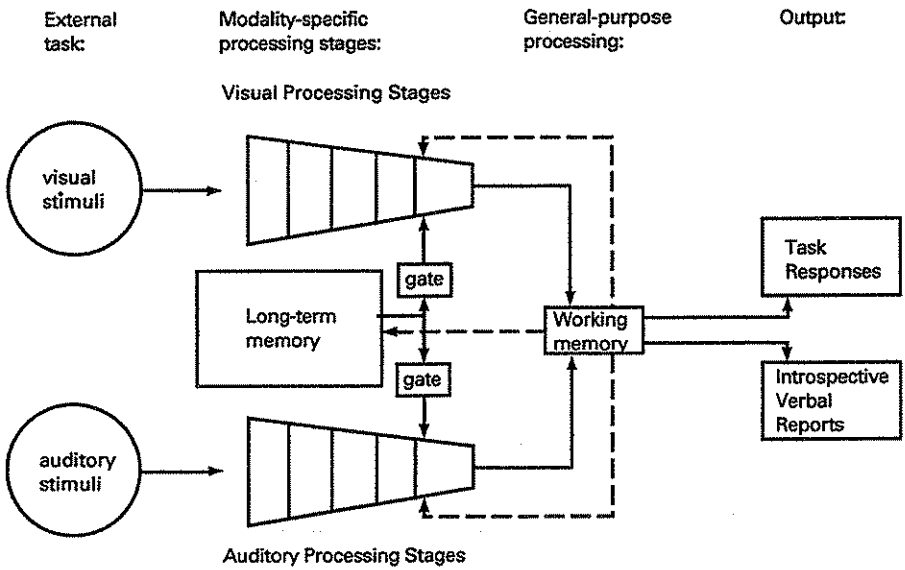
When daydreaming involves vivid visual or auditory mental images, specialized visual or auditory information-processing mechanisms are required, in addition to general-purpose working memory. This conclusion was suggested by an experiment in which one group of subjects did a signal-detection task with visual signals, whereas another group detected auditory signals. Within each group, half of the subjects were asked to make thought-sampling reports of daydreams involving visual mental images, whereas the other subjects reported daydreams involving auditory mental images. The critical finding was that, as the information load increased in the visual signal-detection task, the frequency of visual daydream images decreased more than the frequency of auditory images. And vice versa for auditory signals: auditory imagery decreased more than visual imagery. In other words, looking/listening for signals interferes with daydream images more for images in the same modality as the signal than for images in the other modality

(Antrobus et al. 1970). A complementary result was obtained in an experiment in which subjects were required to generate visual or auditory mental images while doing visual and auditory signal-detection tasks: visual images interfered with visual signal detection more than with auditory signal detection, and vice versa for auditory images (Segal & Fusella 1970).

Based on the rationale that when two tasks interfere with each other they must be competing for the same information processing mechanism, these studies suggest that visual and auditory mental images use some of the same mechanisms that are involved in later stages of visual and auditory perception, respectively. As a practical example, since driving a car is a visual task, we would expect more mutual interference between driving and visual mental imagery than between driving and auditory imagery. Thus, in principle, while you drive it should be safer to imagine singing or carrying on an imaginary conversation than it would be to visualize the action in a complicated ballet or baseball game.

Figure 8.2 shows how interference between daydreaming and task performance can be explained in terms of the multistore theory (Antrobus et al. 1970). Visual and auditory stimuli from external tasks (such as driving a car) are processed first through a series of modality-specific visual and auditory

FIGURE 8.2. Multistore theory explanation of interference between external tasks and daydreaming. Task performance and daydream imagery may interfere with each other at either (a) the working memory stage, or (b) the later stages of modality-specific processing, or both. Under some conditions (such as a difficult task with large task incentives) daydream images can be blocked (gate) from interfering with task performance. The return arrows (dashed lines) indicate the interaction between working memory and earlier processing stages. [Adapted from Antrobus, J. S., Singer, J. L., Goldstein, S., & Fortgang, M. (1970). Mindwandering and cognitive structure. *Transactions of the New York Academy of Sciences*, *32*, 242–52. By permission of the N.Y.A.S.]



processing stages, then through a general-purpose processor (working memory) that makes the task decisions and initiates the task responses. Daydream imagery and task performance may interfere with each other at either (a) the working memory stage, or (b) the later stages of modality-specific processing, both of which are limited in information-processing capacity. Visual and auditory daydream images come initially from long-term memory. They are actively transformed through interactions between their respective modality-specific processing stages and working memory. Interference is greatest when external stimuli and daydream images are in the same modality (both visual or both auditory), since interference occurs in both the modality-specific stages and in working memory. When task stimuli and daydream images are in different modalities (such as visual stimuli and auditory daydream images) then interference occurs only in working memory. The more complex the task or the daydream, the more of the limited working memory processing resources they require, so the more they interfere with each other.

Physiological Correlates of Daydreaming and Imagery

In laboratory studies of night dreaming, sleeping subjects are awakened periodically and asked to report what was going through their mind just before they were awakened. Visually vivid, story-like dreams are reported more often when subjects are awakened during REM sleep (rapid eye movements, fast low-amplitude brain waves) than when they are awakened during non-REM sleep (slow eye movements, slow high-amplitude brain waves).

Antrobus, Antrobus, and Singer (1964) examined physiological correlates of daydreaming under conditions similar to those used in laboratory studies of night dreaming. Subjects lay awake, with their eyes open, on a bed in a dimly illuminated room while their eye movements and brain waves were recorded by psychophysiological devices. Thought reports were collected via a thought-sampling procedure, where subjects were told that whenever they heard a signal they were to report what was going through their mind just before the signal. Signals were presented ten times, at irregular intervals, during a two-hour session. Half of the signals occurred immediately after four-second intervals of ocular quiescence (no eye movements or eye blinks), and half after intervals of ocular movement, in a mixed sequence. Blind judges rated the thought reports on dimensions of external visual perception and internal mental imagery. As one might expect, ratings of external perception were higher during periods of ocular movement than during ocular quiescence. But ratings of internal imagery were higher during periods of ocular quiescence. Also, alpha brain waves were more abundant during ocular quiescence than during ocular movement. (Alpha waves, 8–13 Hz [cycles per second], are an indicator of relaxed wakefulness. They are the slowest brain waves that commonly occur during wakefulness. Faster brain waves occur during alert wakefulness and REM sleep; slower waves occur during non-REM sleep.)

The results are opposite what one would expect if daydreaming were

physiologically analogous to night dreaming: that is, night-dream imagery is greatest during fast eye movements and fast brain waves, but daydream imagery is greatest during ocular quiescence and relatively slow brain waves.

Why is vivid daydreaming associated with reduced eye movements? Antrobus et al. (1964; Singer & Antrobus 1965) found that the frequency of eye movements is related to the frequency of *changes* in thought contents. For example, in one experiment subjects were asked to engage in either relaxed thinking ("let your thoughts drift lazily") or active thinking ("make your thoughts race"), for one-minute intervals. Both eye movements and eye blinks were greater during active thinking than during relaxed thinking. The implication is that a low frequency of eye movements during spontaneous, vivid daydreaming may be related to a low frequency of thought content changes at such times.

During instructed mental imagery, when subjects generate images specified by the experimenter, both eye movements and eye blinks occur more often when subjects generate images involving movement (such as a tennis match) than when they generate static images (an orange on a table). The responses are the same with eyes open or closed (Antrobus et al. 1964). Also, subjects rate instructed mental images involving movement as more vivid than static images (eyes closed; Farthing et al. 1983). Undoubtedly a number of factors affect the frequency of eye movements during spontaneous daydreaming, night dreaming, and instructed mental imagery, and the factors may not be the same in all three situations. A correlation between eye movements and thought or imagery dimensions may not be a cause-and-effect relationship; the relationship may be mediated by other factors, such as the person's physiological state.

A temporal cycle in waking fantasy. When people are asleep, the REM sleep stage and vivid, story-like dreams tend to occur on a regular cycle averaging about 90 minutes (80–100 minutes). The REM sleep cycle is regulated by a biological clock (see Chapter 10). Kripke and Sonnenschein (1978) asked whether there is a cyclic pattern to waking fantasy. In two studies using a thought-sampling method, subjects reported their thoughts whenever a tone sounded, at five- to ten-minute intervals over a ten- to twelve-hour period. In one study the subjects were isolated in laboratory room; in the other they went about their daily business, carrying an electronic beeper and portable tape recorder for making their thought reports. The thought samples were later rated on a five-point scale that ranged from (1) "present-time perceptual scanning" to (5) "vivid dreamlike fantasy."

Dreamlike waking fantasies occurred less often during ordinary daily activities than they did in the laboratory. But in both studies, a computerized "autocorrelation" analysis showed that the best fit for the fantasy ratings was a cycle averaging about 90 minutes (range: 72–120 minutes per cycle). In other words, thoughts tended to become more dreamlike, and less oriented to the immediate environment, about every 90 minutes. Also, in the laboratory study, eye movements and brain waves changed in a 90-minute cycle, with periods of slowest eye movements and maximum alpha waves tending to occur at the same time as periods with the most fantastic thoughts.

If waking fantasies tend to occur on about a 90-minute cycle, why don't

we notice it? One reason is that the cycle length is variable; it averages about 90 minutes, but ranges from 72 to 120 minutes. Sometimes we might skip a cycle, when we are intensely involved in a demanding task. Also important is the fact that our daydream fantasies are so common and repetitive that we usually do not remember specific instances of fantasy, or when they occurred, so we cannot compare them and notice their cyclic nature. Unfortunately, a later study failed to replicate the earlier findings of a 90-minute waking fantasy cycle (Kripke, Mullaney, & Fleck 1985). Thus, at this time it is uncertain whether waking fantasy cycles are a common but subtle phenomenon, or one limited to some people under some conditions, or, perhaps, an artifact of certain experimental procedures.

You have probably noticed that there are moments during the day when it is exceptionally hard to resist letting your thoughts wander away from your work to vivid fantasy daydreams. Perhaps these times correspond to peaks in a daydream cycle. In any case, since it is so hard to resist daydreaming at such times, and since the daydreams interfere with your work anyway, perhaps it is just as well to indulge yourself, if possible, and spend a few minutes enjoying your daydream fantasy. Then hopefully you can get back to work with renewed vigor.

THE FUNCTIONS OF DAYDREAMING

Daydreaming may sometimes interfere with doing an important task, but often daydreaming serves valuable functions and it is far from being a waste of time. Insofar as daydreams are about current concerns they can have practical value, particularly if the emphasis is on planning rather than on worrying. Through daydreams we plan how to achieve our intermediate and long-term goals, and assess our progress toward our goals. Daydreams refresh our memory of what our goals are, and they can give us the opportunity to reevaluate and make changes in them. Imagining personal actions and their outcome can help us evaluate the likelihood of our actions being successful. It can also generate emotional states that either reinforce our goal strivings or suggest that we should change our goals (as when the anticipated outcome is unpleasant).

But daydreams that involve fantasies, rather than practical planning, also have their value. Daydreams that are pure wish-fulfilling fantasies may express our needs and desires without making any progress toward satisfying them. Such fantasy daydreams may be mere entertainment. They break the monotony of routine tasks, and so they make routine tasks more endurable. For the artist or writer, daydream fantasies may be a source of creative inspiration. Also, daydream fantasies may be important for mental health. As Freud hypothesized, when wish-fulfilling daydreams (or night dreams) are the only way to express our emotional needs and wishes, such imaginary expression may be better than no emotional expression at all. Finally, guided daydreams have been incorporated in cognitive psychotherapy to aid in the modification of goals, attitudes, self-concept, anxiety, and behavior (Singer 1975b; Singer & Pope 1978; Starker 1982). For practical sugges-

tions, see Eric Klinger's book *Daydreaming: Using Waking Fantasy and Imagery for Self-knowledge and Creativity* (1990).

SENSORY DEPRIVATION AND CONSCIOUSNESS

We have seen that the frequency of daydreaming increases as the information presentation rate decreases in vigilance signal-detection tasks (Antrobus 1968). Normally, though we daydream frequently, the necessity of responding to external stimuli tends to direct our thoughts and put some restrictions on the flow of conscious experience. What would happen to the waking stream of consciousness if external stimulation was minimized or eliminated, and there was no external task to perform? This question was asked in research on *sensory deprivation*, which began at McGill University in the 1950s.

The McGill studies used a *monotonous stimulation technique*, in which subjects spent several days lying in bed in a lighted isolation chamber. Patterned sensory input was eliminated by translucent goggles, white noise, and cardboard-tube cuffs over the subjects' hands. Early sensory deprivation studies made several dramatic findings, including hallucinations, reduced cognitive efficiency, increased susceptibility to persuasive messages heard during isolation, and stress reactions (many subjects quit after only one or two days in sessions planned for six days or more) (Heron 1957; P. Solomon et al. 1961). These findings produced concern that sensory deprivation procedures might be dangerous and that they could be misused for political "brainwashing." However, more recent research, with different procedures and better controls, has generally failed to replicate the undesirable effects of sensory deprivation and has led to useful applications in psychotherapy (Suedfeld 1980; Suedfeld & Coren 1989; Zubec 1969, 1973).

Nowadays researchers use the term *Restricted Environmental Stimulation Technique* (REST), since such research does not really involve total sensory deprivation, and because researchers want to avoid the negative connotations associated with the older "sensory deprivation" research. Two different procedures are used in modern REST research (Suedfeld 1980). In *isolation chamber REST*, subjects lie in a bed in a dark, soundproof room. They are instructed to avoid unnecessary movement (no calisthenics), though no restraints or touch-preventing cuffs are used. Sessions typically last twenty-four hours, though some subjects have gone for six days without adverse effects. In *flotation REST*, subjects float on their back in a shallow water tank. The water is approximately body temperature and it is saturated with Epsom salt, which makes the body float high, so with the help of a floating pillow subjects can easily keep their face above water. The tank is in a dark, soundproof enclosure, with internal sounds masked by a fan. Sessions typically last forty to sixty minutes, rarely more than two hours. Now let us review some of the findings of REST research.

Research on Effects of Restricted Environmental Stimulation

Hallucinations and visual anomalies. One of the most dramatic findings of the McGill studies was reports of hallucinations—usually visual,

though sometimes auditory or tactile. Some subjects reported visual hallucinations similar to those reported following ingestion of hallucinogenic drugs, including simple geometric patterns and, at later stages, complex meaningful scenes (see Chapter 19). However, later systematic research showed that true hallucinations—where subjects have vivid mental images that they confuse with external reality—are in fact rare during REST (Zubek 1973; Zuckerman 1969b). In a large majority of cases subjects realized that their reported visual experiences were merely their imagination; only 2 percent were true hallucinations, in a three-day isolation-chamber REST study (Schulman, Richlin, & Weinstein 1967). Thus, vivid daydreams, but not true hallucinations, are common in REST.

Reports of hallucinations and visual anomalies (unusual visual percepts or images) during REST are influenced by subjects' expectations and experimental demands (Suedfeld 1980). Hunt and Chefurka (1976) suggested that some REST effects are cases of *introspective sensitization*—reports of unusual subjective experiences that occur simply as a result of sitting quietly and paying close attention to the bare features of one's immediate subjective experience. For example, Hunt and Chefurka instructed one group of subjects to attend closely to their immediate subjective experiences; a control group was told to just relax. After only ten minutes in an isolation chamber, attention group subjects reported visual anomalies and other altered-state-like experiences—such as uncanny emotion, cognitive disorientation, and feelings of interpersonal detachment and loneliness—more often than control subjects. Hunt and Chefurka and suggested that some apparent differences between REST and control procedures may result from the heightened set to attend to subjective experiences during REST. Introspective sensitization may also influence subjective reports in other situations, such as meditation, hypnosis, and biofeedback, and in experiments on effects of psychedelic drugs.

Daydreaming. Suedfeld et al. (1986) administered the Imaginal Processes Inventory (IPI) to 15 healthy college students both before REST, and immediately after 24 hours of isolation-chamber REST. Somewhat surprisingly, IPI scale scores did not change across this interval. The subjects reported fairly high daydreaming levels (with visual, auditory, and kinesthetic imagery) before REST, and these levels were not increased by 24 hours of sensory reduction. There were no reports of hallucinations or particularly bizarre ideation. The most frequently reported activities during REST included trying to determine the time, thinking about the future, sleeping, planning ahead, identifying sounds, recalling books, starring into space, and mental exercises. Thought sampling reports indicated that subjects daydreamed mostly about real personal events, usually involving their friends. During REST the subjects were usually wide awake, calm, and alert, and had no feelings of anxiety or stress.

Stress. The benign nature of REST subjects' experiences in recent research contrasts with the dramatic reports of hallucinations and stress in the McGill studies. In fact, the frequency and severity of stress reactions in the early research was exaggerated by popular reports. In fact, only 5 to 10 per-

cent of subjects quit early due to discomfort, and almost all of the quitters were in research with the monotonous stimulation technique (Suedfeld 1980). Negative expectations about sensory deprivation's effects appears to have been a major factor in producing stress reactions in some subjects (Orne & Scheibe 1964). With current methods involving reduced stimulation (rather than monotonous stimulation) and instructions to eliminate negative expectations, stress reactions are rare even after six days of isolation chamber REST, and when they occur, stress reactions are mild (Suedfeld 1975, 1980). Flotation REST, pioneered by John Lilly (1977), is becoming increasingly accepted as a means of relaxation and inner exploration, and is being used therapeutically for stress reduction (Fine & Turner 1985; Suedfeld, Turner, & Fine, 1990; Turner et al. 1989). Commercial flotation tanks are available in some cities.

Reduced cognitive efficiency. Reductions in cognitive efficiency have been found in some tests administered during prolonged REST. Peter Suedfeld (1980) reviewed over eighty published studies on cognitive effects, and classified the tasks used according to their complexity. He found that when subjects were tested during REST, impaired performance was more likely on relatively complex tasks ("open-ended" tasks such as story telling and creative problem solving) than on relatively simple tasks (such as rote memorization or mental arithmetic). Cognitive efficiency quickly returns to normal after the REST session is terminated.

Stimulus hunger. In early REST research it was noted that subjects often had a craving for sensory stimulation. For example, they would attend closely to extraneous sounds or body stimuli. This need for stimulation was termed *stimulus hunger*. Several studies demonstrated *stimulus seeking behavior*, in which subjects would perform an operant response (pushing a button) in order to produce visual or auditory stimuli (A. Jones 1969). They would respond repeatedly to hear messages normally considered boring, such as out-of-date stock market reports or soap commercials. Responding increased with time during REST, and was greater for stimuli that varied each time than for stimuli that were repeated unchanged.

It is noteworthy that stimulus hunger rarely occurs during flotation REST. "This may have to do with the relatively short duration of such studies [usually forty to sixty minutes], but . . . almost all participants are quite happy in exploring the inner world during that period rather than seeking external stimuli. In fact, many are quite annoyed when their stimulus reduction is violated through external inputs required by the experimenter" (Suedfeld, 1989, personal communication).

Attitude change and suggestibility. Early REST research showed that subjects are more likely to change their attitudes in response to persuasive messages heard during REST (Suedfeld 1969). For example, Bexton (reported in Scott et al. 1959) presented students who were mildly skeptical about psychic phenomena (ghosts, poltergeists, ESP) with a series of messages designed to convince them of the reality of such phenomena. Subjects who heard the messages during several days of monotonous-stimulation

REST showed greater increases in belief in and interest in psychic phenomena, compared to control subjects who heard the same messages under non-deprivation conditions. Similar results have been found with sensory-reduction isolation-chamber REST.

Suedfeld (1980) explained enhanced attitude change during REST in terms of two factors. First, stimulus hunger during REST increases attention to persuasive messages. Second, reduced cognitive efficiency during REST interferes with the usual process of carefully evaluating an argument and formulating counterarguments. Thus, REST can help "unfreeze" prior belief/opinion systems and allow restructuring of beliefs in response to persuasive messages.

Barabasz (1982) found that responsiveness to hypnotic suggestions was markedly increased following six hours of isolation-chamber REST. REST also increased pain tolerance. He speculated that increased imaginative involvement during REST could account for its effects on responsiveness to suggestions and pain tolerance.

Applications in psychotherapy. The effects of REST on attitude change, imagination, and suggestibility suggests that REST might be a useful adjunct to psychotherapy. This is indeed the case. Isolation-chamber REST has been found to enhance the effectiveness of therapeutic messages concerning smoking cessation (Suedfeld 1990; Suedfeld & Ikard 1974), weight reduction (Borrie & Suedfeld 1980), alcohol addiction, and phobias (Suedfeld 1980; Suedfeld & Kristeller 1982). Suedfeld pointed out that several psychotherapeutic techniques have a sensory restriction component, such as hypnosis, meditation, and progressive relaxation training.

Implications of Restricted Stimulation Effects for Consciousness

Sensory deprivation or REST has sometimes been characterized as a technique for producing an altered state of consciousness. Although conscious experience may be altered during REST, the variety of experiences varies so widely—depending upon the specific deprivation technique and its duration, experimental instructions and implicit demands, and subjects' personal characteristics and expectations—that it is not possible to describe a typical altered conscious state during REST (Zuckerman 1969a). With modern procedures, REST typically produces a pleasant, restful experience with plenty of daydreaming, rather than a dramatically altered state of consciousness.

Research on restricted environmental stimulation has some general implications for consciousness. The mind/brain system is continuously active, whether the brain is awake or asleep. The system is motivated to maintain varied conscious experience. During prolonged periods of sensory restriction, the occurrence of stimulus hunger and operant responding for varied sensory input shows that people are motivated to maintain varied conscious experience. The most satisfying input is that which is difficult or impossible to predict, since such input presents an intellectual challenge and combats boredom (Suedfeld 1980). When varied external input is not

available, people vary their conscious experience through daydreaming. During the most extreme condition of sensory deprivation—when people are asleep—the mind/brain system maintains varied conscious experience through dreaming. Thus, varied mental activity does not depend upon external stimulation; it is self-generated. The mind/brain system both interprets the stimulation that it receives and seeks out or generates varied stimulation to interpret.

TOWARD A THEORY OF THE STREAM OF CONSCIOUSNESS

A comprehensive theory explaining and predicting moment-to-moment changes in the content of consciousness has not been developed. However, we can list several factors that affect the stream of consciousness and which are pertinent to developing such a theory (Pope & Singer 1978, 1980; Klinger 1978, 1987).

General Considerations

The mind/brain system is continuously active. The mind/brain system is not a mere passive reactor to external stimuli, nor is it a mere storehouse of memories. Rather, the mind/brain system is continuously active. The system is motivated to maintain varied conscious experience. When people are awake they seek varied sensory inputs to process, and they experience stimulus hunger during prolonged periods of restricted stimulation. During periods of restricted or boring stimulation, people maintain varied conscious experience by daydreaming.

However, people do not daydream merely by default because there is nothing better to do. There is a positive motivation to daydream, such that people often daydream even during difficult tasks when it interferes with their performance. The implication is that the human mind/brain system is motivated to maintain a degree of *balance* between two types of conscious activity: outer-directed consciousness, which involves seeking out and responding to varied and challenging sensory inputs, and inner-directed consciousness, which involves recollection, daydreaming, and fantasizing.

A continuum of awareness. The contents of consciousness can be described as falling on a continuum of awareness that ranges from the public to the private (Pope & Singer 1978). We can identify several points on the continuum: (1) *public events*, those external physical stimuli (objects and events) that can also be perceived by other people; (2) *interoceptive stimuli*, such as pains and tummy rumbles, that are directly sensed only by the individual (although electrophysiological instruments may be able to objectively measure the physiological events that produce these internal sensations); (3) *private conscious mental events*, such as verbal thoughts, mental images, and feelings, that cannot be known by other people except indirectly, through our introspective reports; and (4) *nonconscious mental events*, those mental processes, stimuli, memories, and desires of which we are not directly aware

but which nonetheless may have an influence on the ongoing stream of thought.

Overview of factors that affect the contents of the stream of consciousness. Given that the mind/brain system is continuously active and that there is a continuum of awareness, the contents of the waking stream of consciousness are influenced by four types of factors: (1) factors that influence the direction of attention, particularly, whether attention is directed to external stimuli or internally to thoughts and images (daydreams); (2) factors that influence which external stimuli are selected for attention; (3) factors that influence the contents of daydreams; and (4) factors that influence the specific sequences of thoughts and images, and their transformations and combinations.

For each of these types of factors we can consider both general principles (psychological processes that operate in everyone and that determine the most general characteristics of the stream of consciousness) and individual difference factors (aspects of personality and personal past experiences that give each individual's stream of consciousness its unique features). Whereas cognitive psychologists tend to be more interested in general principles, personality and clinical psychologists are especially interested in the uniqueness of individuals.

Factors Affecting Attention to External Events versus Daydreams

Priority of external stimuli. External stimuli compete with daydream thoughts for the brain's limited information-processing resources. External events are likely to be critically important for our safety, nourishment, and well-being. Therefore, there is adaptive value in having the selective attention process give preference to external stimuli, particularly those that are novel, loud, or meaningful. Also, strong internal sensory stimuli, such as pain, have priority in selective attention. The bias favoring sensory stimuli is particularly strong when we must make some overt response to them.

Shift to daydreaming in predictable, dull, or barren environments. Both personal experience and laboratory studies show that daydreaming occurs virtually continuously when external stimuli are eliminated or held constant, and we do not have to respond to them. Also, during an ongoing task there is a shift to daydreaming when the rate of information input or responding is low, when the task is boring or our motivation to perform is low, or when the task is well practiced and our response to it is semi-automatic (Pope & Singer 1978). However, daydreaming is not limited to dull or barren environments. It may occur during performance of difficult tasks, particularly when the individual has pressing personal concerns that generate emotional reactions.

Level of arousal. Level of arousal refers to the degree to which you are feeling alert and energetic. Level of arousal is a continuum ranging from hyper-aroused emotional or activity states, through normal wakefulness, to

drowsiness, sleep, and coma. In the waking state, in general, at higher levels of arousal you are more ready to respond to external stimuli whereas at lower levels of arousal your attention is more likely to be directed inwardly to daydreams. However, there is a reciprocal relationship between arousal and external task demands, such that more difficult tasks tend to increase arousal, whereas arousal decreases in the absence of demanding tasks (Eysenck 1982; Kahneman 1973). There are exceptions to these generalizations; for example, high arousal in the absence of a demanding task may produce inner-directed attention and anxiety.

Individual differences. Individual differences in preferences for external attention versus daydreaming have been characterized in terms of personality measures of extraversion versus introversion, or Field-dependence versus Field-independence (Singer 1984). A bias for daydreaming may stem from positive temperamental factors such as acceptance of and taking pleasure in inner fantasies (positive-vivid daydreaming style), or from negative factors such as a tendency to worry and ruminate about personal concerns or imagined problems (guilty-dysphoric daydreaming style).

Factors Affecting the Direction of External Attention

We can attend to only a limited number of the objects and events in our environment. Which ones we select depends upon a combination of factors: (1) *Voluntary attention.* We voluntarily search for and attend to stimuli that are relevant to the task at hand (such as learning from a lecture or locating a friend on a crowded dance floor). (2) *Automatic (nonvoluntary) attention switching.* (a) Attention is automatically shifted to external stimuli that are novel (such as a peculiar noise from the car engine) or intense, or which have enduring personal meaning (such as your own name, or conditioned emotional stimuli). (b) Attention is also shifted automatically to certain stimuli that are related to personal current concerns and interests, even though the stimuli are not relevant to the task at hand. For example, at the moment my main task is writing this chapter, but I find my attention being distracted by birds singing outside my office window, since I am interested in birdwatching and learning to identify birds by their songs.

Factors Affecting the Contents of Daydreams

Daydreams may arise directly from memory or they may occur as an associative response to some external stimulus. In either case, there is a bias toward daydreaming about current concerns, such as unfinished business or unresolved stress.

Current concerns. Klinger (1975, 1978, 1987) has developed the concept of current concerns in some detail. He defines *current concern* as "the state of an organism between the time it becomes committed to pursuing a goal and the time it either gains the goal or abandons the pursuit" (1978, p. 249). At any moment each individual has a wide variety of personal concerns, relating to short, intermediate, and long-term goals. For example, you might have long-term goals of graduating from college, finding a good job,

and marrying a desirable mate, while at the same time having intermediate goals of finishing a term paper and planning a vacation, and short-term goals of buying a pizza and meeting your lover later tonight. A current concern need not be present in consciousness. At this moment you are not thinking about most of your current concerns. But as long as a concern is current it has the potential to affect your actions, your daydreams, your attention to external events, and your memory of your experiences.

Klinger (1978) demonstrated that current concerns can affect automatic attention switching. He first questioned subjects to determine their most pressing current concerns. Then he had them listen to dichotic tapes, where different fictional stories were presented concurrently to each ear through stereo headphones. The subjects did not have to listen to either story, but they indicated which message (left or right) they were listening to, if any, by pushing a toggle switch left or right. Brief segments related to the subject's personal current concerns (health, love, money, and so on) occurred periodically in either the left or right message. The data showed that subjects were more likely to shift attention to a passage that was relevant to a personal concern than to an irrelevant passage, and also that they spent more time attending to relevant passages, and subsequently recalled relevant passages better than irrelevant passages.

Klinger, Barta, and Maxeiner (1980) validated a *Concerns Dimensions Questionnaire* by showing a good correspondence between current concerns reported on the questionnaire and thoughts reported in a thought-sampling procedure as the subjects went about their usual daily activities during the next twenty-four hours. Thought-sampling data showed that subjects spent more time thinking about (a) goals that were particularly important to them (those that generated more pleasant emotional reaction by their achievement, or unpleasant reaction by their abandonment), (b) goals that were more likely to be attained, and (c) goals that were most likely to be attained very soon. Also (d) they thought more about goals in the pursuit of which they were meeting special challenges or unexpected difficulties (such as threatened personal relationships). Subjects spent relatively little time thinking about routine things in their lives, except for the minimal thinking that is necessary to accomplish routine tasks, even though the tasks may be important (such as grocery shopping, routine tasks at work).

Stress. Unresolved personal stresses produce a particularly compelling tendency to daydream. For example, impending divorce, the death of a loved one, or being fired from a job, create stresses that make it hard to concentrate on attention-demanding external tasks and increase our tendency to daydream. In such cases goals formerly met have been wrenched from us, so that new goals, and hence new current concerns, are created.

Emotions. Klinger (1975, 1987) argued that the success or failure of our goal strivings—our personal concerns—is a particularly important determinant of our emotional state: success brings joy, failure brings feelings of anger or depression. During daydreaming, we can imagine the emotional reactions that we will feel upon the future success or failure of our goal strivings. Such imagined emotional reactions—and actual emotional reactions in-

duced by daydreams—are responsible for giving current concerns the power to motivate our behavior and influence the contents of our daydreams.

Individual differences. Individual differences in daydream content are related not only to individual personal concerns, but also to long-term personality/temperamental differences. Research with the Imaginal Processes Inventory (Singer 1978; Starker 1982) revealed three daydreaming personality types: the positive-vivid type, with an emphasis on pleasant fantasies and daydreaming to solve personal problems; the guilty-dysphoric type, with an emphasis on themes related to achievement, guilt, and anger; and the anxious-distractible type, characterized by anxiety themes and easy distractibility from ongoing fantasies.

The Sequencing of Thoughts

Studies using the thinking-out-loud method indicate that when people are engaged in a complex problem-solving task, the sequence of task-related thoughts is related to the stage of progress in the task and the decision that has to be made in order to complete the next step. It is more complicated to explain the sequence of thoughts in situations where there is no task at hand, or where the task is so easy that people can daydream a lot. Klinger's observations led him to formulate the *induction principle* as a first step toward understanding the sequencing of thoughts in relatively nonstructured situations:

> At any given moment, the next thematic content of thought is induced by the combination of a current concern and a cue related to that concern. The "cue" is either a cognitively meaningful stimulus in the external environment or a symbolic event in the stream of the individual's own consciousness. This "induction principle" is still very general, in that it says nothing about the properties of current concerns that make them more or less influential in sensitizing people to cues, about the specific properties of a cue that make a person see it as concern-related, or about the properties of concern-related cues that affect their potency in influencing thought. Nevertheless, this principle is a starting point... (Klinger 1978, p. 250).

The induction principle implies that the sequence of daydream thoughts is not entirely random; there are causal or associative connections, at least of a probabilistic nature, between successive thoughts. But the task of explaining and predicting specific thought sequences in detail is enormously complex. The difficulty in developing a comprehensive theory of the stream of consciousness is that, while we have a pretty good idea about the different factors that influence the stream of thought, we do not know much about how the various factors interact with each other.

Subjective experiences in the normal waking stream of consciousness are highly varied, ranging, for example, from alert attention to external tasks to relaxed daydream fantasies. However, under some conditions our subjective experiences seem to go beyond the normal range of waking consciousness. If the overall pattern of subjective experiences seems to differ markedly from normal, we may conclude that we are in an altered state of

consciousness, where our mind seems to be functioning differently from normal. The following chapters will be concerned with altered states of consciousness.

SUMMARY

Individual thoughts in the stream of consciousness may be classified on several abstract dimensions. Several thought dimensions proposed by Klinger were described: (1) operant versus respondent; (2) stimulus-bound versus stimulus-independent; (3) fanciful versus realistic; (4) well-integrated versus degenerated; and (5) vivid versus nonvivid mental images. Klinger's thought-sampling research showed the first two dimensions to be relatively independent of each other, and he found that most thought samples had either inner verbal monologue, visual-spatial mental imagery, or both.

Singer and Antrobus defined daydreaming in terms of stimulus-independent thought, that is, thoughts that are unrelated to the task at hand. Their research with the Imaginal Processes Inventory revealed three daydreaming styles, which are related to other aspects of personality and behavior: (1) positive-vivid daydream style (the well-adjusted, happy daydreamer); (2) guilty-dysphoric style (the obsessive-compulsive neurotic, plagued by hostility, fear of failure, and guilt); and (3) anxious-distractible style (anxiety neurotics, characterized by worrying and mindwandering). Most people are a blend of two or three types, rather than being purely one type.

In laboratory experiments Antrobus and Singer studied the conditions that affect the frequency of daydreaming. While subjects did a vigilance signal-detection task they were interrupted periodically for thought-sampling reports. Daydreaming frequency decreased, the greater the information load in the signal detection task. Daydreaming decreased with increased incentives for good task performance; daydreaming increased with increased incentives for daydreaming (as with increased need to think about important personal concerns). There is an inverse relationship between daydream frequency and task performance. Two factors determine the degree of mutual interference between daydreaming and performing external tasks: (1) the complexity of the task and the daydream thoughts (competition for limited-capacity working memory); and (2) whether the task stimuli and daydream images are in the same or different sensory modalities (competition for limited modality-specific processing resources). Studies of physiological correlates of daydreaming show that during periods when daydream imagery is most vivid, eye movements decrease and alpha brain waves increase, compared to periods without vivid daydream images.

Research on sensory deprivation, or the restricted environmental stimulation technique (REST), shows that it can produce vivid daydreams, though true hallucinations are rare. Prolonged REST results in stimulus hunger, in which subjects seek varied sensory inputs. Susceptibility to persuasive messages and hypnotic suggestions increase during REST; these effects have applications in psychotherapy.

Several factors that must be considered in developing a theory of the stream of consciousness were discussed, including factors that influence (1)

the bias toward either external attention or daydreaming, (2) the direction of external attention, (3) the content of daydreams, and (4) the sequencing of thoughts. Klinger's research shows that personal current concerns (goals being pursued) and stresses are major factors affecting daydream contents. Daydreaming serves important functions including choice of goals, planning to achieve goals, entertainment, and wish-fulfilling fantasy.

ENDNOTES

[1]In *The Principles of Psychology* James discussed the nomenclature problem, to find a single generic class word to cover the various types of contents of consciousness, including thoughts, feelings, sensations, images, and ideas. Though he sometimes used "state of consciousness," he felt that it was cumbersome, and he wanted a noun that had a corresponding verb. He finally settled on "thought" as the generic noun for conscious contents (1890/1983, pp. 185–86). (At that time he did not have to worry about the confusion that might be caused when some modern psychologists talk about the possibility of nonconscious thinking, hence nonconscious thoughts.) Here I will follow James in using "thought" as the generic term (as did Klinger 1978), and I will use other words when I need to refer more specifically to sensations, images, feelings, and so forth.

[2]Freud called it "primary" process thinking because he thought that it was characteristic of infants and occurred before the development of secondary process thinking. Primary process thinking is sometimes called "regressive" thinking, because it is presumably more primitive or childlike than rational thought.

[3]Factor-analysis is a statistical procedure for discovering underlying factors (such as personality or cognitive factors) that can account for the pattern of responses in a set of questionnaire data. In simplified terms, the method of factor analysis is as follows: After the questionnaire has been filled out by a large number of people, the numerical values (such as ratings on 1–5 scales) of the responses to each of the questions are correlated with each other, for all possible pairs of questions. Questions that correlate highly with each other are grouped together as one factor; other questions that correlate highly with each other, but not with those in the first group, are grouped together to form a second factor, and so on. Then the researcher examines the content of the questions in each factor and gives the factor a name that suits his/her interpretation of the factor. The types of factors that can be discovered is limited by, but not strictly dictated by, the nature of the questions in the questionnaire.

[4]In response to my comment about his omission of affective dimensions, Klinger replied: "The reason I have not included affect in my thought-sampling work is that I initially focused on properties of ideation, rather than of consciousness as a whole, and I labored under the impress of the Wundtian distinction between cognition and affect. . . . You are no doubt right that in omitting affect from my factor-analytic studies I have excluded perhaps the most prominent feature of consciousness. The next investigation, a dissertation just getting underway, will remedy that lapse" (Klinger, personal communication, December 1988).

[5]Note that in Table 8.2 the first twelve items include six each for the positive-vivid (PV) and the guilty-dysphoric (GD) factors. As a rough measure of how you rate on those two factors, you may answer each of the questions on a five-point scale (1 = applies to me not at all; 5 = applies to me very much). If you do not have normative data from your own class, compare your total scores (six items) on each dimension to these data from two of my classes ($n = 57$): PV mean = 20.2 (standard deviation 3.5); GD mean = 13.3 (sd = 2.9). If your score is more than one standard deviation above or below the mean on either factor, then you are notably different from average (approximately the top or bottom 16 percent of the range of scores). Bear in mind that this is a crude measure; the full IPI, with many more items, is needed for a more reliable measure.

[6]A *bit* is a technical measure of information quantity, where one bit is the information contained in a single yes/no response. Thus, when only one tone pitch could occur, and it was presented at a rate of one per second, the information presentation rate was one bit per second.

With three possible tones presented at the rate of two tones per second the information presentation rate was six bits per second (3 tones × 2 per second).

[7]When Antrobus tried to decrease daydreaming still further by offering subjects $50 (in today's dollars) for good signal-detection performance, the manipulation backfired. "No one believed we'd actually pay them!" (Antrobus, personal communication, December 1989).