

Experimental studies of ongoing conscious experience

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Abstract. A research programme designed to find ways of applying a variety of methods in psychological science to studying the seemingly ephemeral phenomena of the human stream of consciousness and its manifestations in daydreams, interior monologues, imagery and related private experiences is described. Approaches include psychometric studies to establish normative information on daydreaming and experimental studies using signal-detection paradigms to capture the ongoing stream of thought. Recent experiments involve thought-sampling methods for identifying the determinants of the content of the stream of thought in adolescents or the ways in which self-beliefs and emotions are manifested in a group of cocaine and heroin abusers. Children's pretend play is studied as a possible forerunner of adult consciousness. It is proposed that the human condition involves a continuing tension between processing information generated from the physical and social milieu and the continuous operation of centrally generated material from long-term memory in the form of reminiscences, wishes, current concerns, expectancies and fantasies. This concept has implications for personality variation, affective arousal and adaptive behaviour.

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William James' (1890) introduction of the concept of a stream of consciousness, so stimulating to several generations of writers, from his own student Gertrude Stein to James Joyce, Virginia Woolf, William Faulkner and Saul Bellow, was largely ignored by psychologists for almost 60 years of the 20th century. More recently, however, as personality researchers and specialists in social cognition attempt to examine the major characteristics of the individual that account for beliefs about self or others and for attitudes that may govern overt behaviour, they find increasing renewed interest in introspection and reports of consciousness (Sabini & Silver 1981, Singer & Kolligian 1987). Brain researchers, students of artificial intelligence, psychophysicologists and investigators of the neural and autonomic concomitants of sleep are intrigued by the opportunity for studying personal 'scripts', ongoing images, fantasies and interior

monologues (Ellmann & Antrobus 1991, Kreitler & Kreitler 1976, McGuire 1984, Schank & Abelson 1977, Singer & Bonanno 1990, Sperry 1976).

Although one must always keep in mind the limitations of using introspective reports for ascertaining causality sequences, the analyses of Natsoulas (1984), Baars (1987) and Singer & Bonanno (1990) all point to the rich range of information about beliefs and attitudes that emerges from introspective accounts, even from relatively less articulate subjects (Hurlburt 1990, Pekala 1991, Pope 1978).

In this paper, I shall focus on the study of ongoing consciousness through a variety of methods and experimental procedures. I propose we need such a basis for understanding at least one phase of the human condition, our 'private personality'. Experiences of interior monologue, mental glosses on one's social and physical surround, daydreams, fantasies, anticipations, recurring memories, all of which may interrupt or co-occur with our necessary processing of information, form a consensually agreed upon or physically measurable 'external world'. My personal strategy for 'navigating' the stream of consciousness over forty years of research has involved sets of convergent empirical methods with the hope that groups of new operations can yield reliable methods of measurement. These may lead to identification of the relevant phenomena and perhaps to formulation of theories and testable hypotheses about the determinants of ongoing sequences of thought and their implications for emotional reactions, information processing, the formation of interpersonal attitudes, beliefs about self and possibly even the roots of creativity, on the one hand, or to linkages to physical and mental health, on the other.

Psychometric approaches to the study of daydreams and ongoing consciousness

Rorschach inkblots

As a clinical psychologist, I began my effort to study imagination, daydreams and consciousness through some of the first empirical studies of correlates of responses to the Rorschach inkblots. Hermann Rorschach (1942) had proposed that persons who were inclined to 'see' human figures as associations to the blots, especially associations involving humans in action, were also more likely to show a rich fantasy life and engage in much daydreaming. Rorschach also reported that the persons who provided more of such human movement responses (the so-called M score) were more susceptible to inhibition in their movements or were more capable of controlling physical activity or behavioural motion. Research attention has focused chiefly upon linking the M response frequency to measures of fantasy, motor control, creativity, self-awareness and 'planfulness' (Moise et al 1988–1989, Singer & Brown 1977). Dozens of individual difference and factor-analytic studies consistently show that persons who give more M associations to inkblots (especially responses that are

reasonably congruent with the blot shapes) are also more likely to tell rich and varied stories in response to thematic apperception test pictures, to score more highly on questionnaire measures of daydreaming frequency, and to provide more varied and cognitively complex free associations and person descriptions in other tests and in psychoanalytic sessions. They are also more likely to sit quietly in waiting rooms, to be able to slow down writing speed voluntarily, to resist laughing if so instructed when listening to a 'laughing' record, to show fewer impulsive responses in problem-solving tasks, to be more accurate in time estimates and to manifest less open aggression (Singer & Brown 1977). Clinically, percipients with a low M score respond better to support-expressive or direct therapies, whereas those scoring a higher M value do better in more psychoanalytic types of therapy where imaginative productivity and free associations are critical (Blatt 1990).

Questionnaires and self-report procedures

It soon occurred to me that more direct inquiries about people's daydreams and ongoing thought might provide useful normative data on the phenomena of private experience. Singer & Antrobus (1972) developed a series of 22 scales of 12 items, each designed to measure a wide range of patterns of self-reported inner experience and types of daydreams. This imaginal processes inventory (IPI) has been factor-analysed in several studies with subjects of all ages. An extensive new analysis of the IPI with a large sample of college students has led to a shortened version, the SIPI (Huba et al 1982, Segal et al 1980). From the varied uses of the IPI, some generalizations about the normative role of daydreams are possible.

Briefly, many studies indicate that most people report being aware of at least some daydreaming every day, and that their daydreams vary from obvious wishful thinking to elaborate and complex visions of frightening or guilty encounters. Cultural differences in frequency and patterning of daydreaming also emerge. Comprehensive factor analysis of the scales of the IPI indicates that the data yield three major factors that characterize ongoing thought: a positive-constructive daydreaming style, a guilty-dysphoric daydreaming style, and a poor attentional control pattern that is generally characterized by fleeting thoughts and an inability to focus on extended fantasy (Singer & Kolligian 1987, Singer & Bonanno 1990). Giambra (1977a,b) found evidence for factor patterns similar to those reported in our studies and tracked these across an extensive age range; in addition, he checked the test-retest reliability of daydreaming reports in response to this set of scales and found it to be surprisingly high.

Even with reliable and psychometrically well-constructed questionnaires, we are still left with the issue of whether individual respondents can really summarize accurately their ongoing experiences, the frequency of particular daydreams, etc. We must turn to other estimates of ongoing thought or other forms of

self-report to ascertain the validity of the questionnaire responses. Reviewing such data, one finds that the self-reports of frequent or vivid daydreaming on questionnaires are correlated with:

- (1) daydream-like thoughts obtained during signal-detection tasks, with imagery so vivid that the participants don't notice that a faint picture has been projected at the point they are fixating while imagining an object;
- (2) with particular patterns of eye shifts during reflective thought;
- (3) with particular emphasis on analogy usage when the structure of the language used in transcripts of regularly sampled thought reports is analysed;
- (4) with particular forms of drug and alcohol use;
- (5) with reported fantasies during sexual behaviour;
- (6) with daily records of dreams recalled;
- (7) with measures of hypnotic susceptibility;
- (8) with measures of hallucinations of mental patients or flashbacks of traumatized war veterans, etc (Singer & Bonanno 1990).

The evidence from our own and related questionnaires suggests that the psychometric approach has considerable value in identifying individual stylistic variations in awareness of, and assignment of priorities to, processing centrally generated information.

More direct thought-sampling procedures

Laboratory studies of signal detection

My colleague John Antrobus and I developed a particular paradigm for attempting to estimate some parameters of ongoing thought. An approach that affords maximum 'control' over extraneous stimulation (at the cost of some artificiality or possibly reduced 'ecological validity') is the use of prolonged (45–60 minute) signal-detection sessions by participants seated in sound-proof, reduced-stimulation booths. Because the amount of external stimulation can be controlled, it remains to be determined to what extent individuals will shift their attention away from processing external cues (by which they earn money for accurate signal detection) toward the processing of material that is generated by the presumably ongoing activity of their own brains. Can we ascertain the conditions under which participants, even with high motivation for external signal processing, will show that they are experiencing task-unrelated images and thoughts (TUITs)?

Thus, if an individual detecting auditory signals is interrupted every 15 seconds and questioned about whether any stimulus-independent thoughts occurred, a 'Yes' response is scored as a TUIT. The participant and experimenter agree in advance on a common definition of what constitutes a task-unrelated thought, so that the experimenter has some reasonable assurance that reports conform

to an established operational definition. A thought such as 'Is that tone more highly-pitched than the one before it?' is considered task-related and elicits a 'No' response. A thought such as 'I've got to pick up the car keys for my Saturday night date' is scored as a TUIT.

In this research paradigm, keeping the subjects in booths for a fairly long time and obtaining reports of the occurrence of task-unrelated thoughts after each 15 seconds of signal detection (with tones presented at rates of about one per second) have made it possible to accumulate extensive information on the frequency of occurrence of TUITs, as well as their relationship to the speed of signal presentation, the complexity of the task and other characteristics of the subjects' psychological states.

In addition to generalizations about the nature of cognitive processing (Singer 1988), the signal-detection model permits the study of individual differences. Antrobus et al (1967) showed that participants known by self-report to be frequent daydreamers were more likely as time went on to report TUITs than individuals who had said on a questionnaire that they were little given to daydreaming. Initially, the frequent daydreamers reported a considerable number of TUITs, but the same level of errors as the infrequent daydreamers. As time went on, however, the frequent daydreamers seemed to be preferring to respond to task-unrelated mentation: their error rate increased significantly, compared with the relatively stable rate of errors for the subjects who showed fewer TUITs.

Controlled studies of ongoing thought during signal detection afford a rich opportunity for investigating the determinants of the thought stream. The introduction of unusual or alarming information prior to entry into the detection booth (overhearing a broadcast of war news) can increase the frequency of TUITs, even though accuracy of detection may not be greatly affected (Antrobus et al 1966). Mardi Horowitz (1978) has demonstrated that intense emotional experiences prior to engaging in signal detection lead to increased ideation, as measured by thought sampling during the detection period. Such findings have suggested a basis for understanding clinical phenomena such as 'unbidden images' (Horowitz 1978) or 'peremptory ideation'.

Studies using auditory and visual signal detection or vigilance models with interruptions for reports have also shown that TUITs occur more than half of the time, even when subjects are achieving very high detection rates, when signals come as frequently as every 0.5 seconds or when the density (i.e. chords versus single tones) of signal information is increased. Indeed, there was evidence for parallel processing of the TUITs and the external signals. When external signals were visual, the visual content of TUITs was reduced relative to their verbal content and vice versa when the external signals were auditory. This suggests that our daydream processes in particular sensory imagery modalities (visual or auditory) use the same brain pathways as are needed for processing external cues. Studies of continuous talk in these laboratory settings point to the

moderately arousing, vigilance-maintaining quality of ongoing thought and also to the dependence of such thought on physical posture, the social setting, etc. For example, when experimenters and participants are of the opposite sex there is a significant increase in TUIT reports during signal detections (Singer 1988, Singer & Bonanno 1990).

Thought sampling in more 'natural' circumstances

Some methods that sacrifice the rigid controls of the signal-detection booth for greater ecological relevance have been increasingly employed in the development of an approach to determining the characteristics and determinants of waking conscious thought. These involve (1) asking participants to talk out loud while in a controlled environment, with such verbalization being scored according to empirically or theoretically derived categories; (2) allowing the respondent to sit, recline, or stand quietly and interrupting them periodically for reports of thought or perceptual activity; or (3) requiring the person to signal by a button press whenever a new chain of thought begins, and then to report verbally in retrospect or to fill out a prepared rating form characterizing various possible features of ongoing thought.

Klinger (1990) has employed thought sampling in the ways described above to test a series of hypotheses about ongoing thought. He has made a useful distinction between 'operant' and 'respondent' thought processes. The former category includes thoughts that have a conscious instrumental property—the solution of a specific problem, analysis of a particular issue presently confronting one, examination of the implications of a specific situation in which one finds oneself at the moment. Operant thought is active and directed, and has the characteristics of what Freud called 'secondary-process' thinking. As Klinger (1978) has noted, it is volitional; it is checked against new information concerning its effectiveness in moving toward a solution or the consequences of a particular attempted solution; and there are continuing efforts to protect such a line of thought from drifting off target or from being distracted by external cues or by extraneous, irrelevant thought. Operant thought seems to involve a greater sense of mental and physical effort; it is a human capacity especially likely to suffer from fatigue or brain damage.

Respondent thought, in Klinger's terminology, involves all other thought processes. These are non-volitional in the sense of conscious direction of a sequence and most are relatively effortless. Most of what we consider daydreams are instances of respondent thought.

The use of thought sampling in a reasonably controlled environment also permits evaluation of a variety of conditions that may influence or characterize ongoing consciousness. One can score the participants' verbalizations on dimensions such as (1) organized, sequential thought versus degenerative, confused thought; (2) use of imagery, related episodes or event memory material

versus logical, semantic structures; (3) reference to current concerns and unfulfilled intentions; (4) reminiscence of past events versus orientation toward the future; and (5) realistic versus improbable content. Two studies of my students may be cited here. Pope (1978) demonstrated that longer sequences of thought more remote from the participants' immediate circumstances were obtained when the respondents were reclining rather than walking freely and when they were alone rather than in company. Zachary (1983) evaluated the relative role of positive and negative emotional experiences just before a thought-sampling period. He found that intensity of experience rather than its emotional quality and, to a lesser extent, the relative ambiguity of the material, determined the frequency of recurrence in the thought stream.

Klinger's own research points to the relative importance of current concerns as determinants of the material that emerges in thought sampling. Current concerns are defined as those that occur between the time one becomes committed to pursuing a particular goal and when one either consummates or abandons this objective (Klinger 1990). Such concerns, as measured psychometrically, make up a useful operational definition of the Freudian wish in its early form as an unfulfilled intention or aspiration that is not necessarily libidinal or sexual (Holt 1976). They may range from unfulfilled intentions (e.g. to pick up a container of milk on the way home) to long-standing unresolved desires (e.g. to please a parent). One can evaluate current concerns before the thought-sampling sessions and estimate the relative importance of goals, the person's perception of the reality of goal achievement, and so on. Only after we have explored the range and influence of such current conscious concerns in sampling of the individual's thoughts, emotions and behavioural responses can we move to infer the influence of unconscious wishes or intentions.

In the 1980s there has been a considerable interest in thought-sampling studies outside the laboratory—research now involves accumulation of data over as long as two weeks, from participants who carry paging devices and report on their thoughts, emotions and current activities when signalled several times a day (Csikszentmihalyi & Larson 1984, Hurlburt 1990, Klinger 1990). The results suggest this method is feasible and suitable for hypothesis testing as well as for accumulating basic descriptive data (as in the Csikszentmihalyi & Larson study of teenagers).

In one such study, participants whose prior measured fantasies pointed to greater longing for closer association with others, reported more thoughts of other people and more positive emotional responses in social situations than did other participants, on the basis of a week-long accumulation of eight daily reports (McAdams & Constantian 1983). The relationship between similarly obtained frequent daily reports of thought and the same participants' scores on a daydreaming questionnaire, our IPI (Singer & Antrobus 1972), was evaluated by Hurlburt (1980). He reported significant correlations between the questionnaire scales of frequent daydreaming and acceptance of daydreaming

and the accumulated daily reports of daydreaming, based on two days of dozens of interruptions.

The accumulation of thought samples has also proven useful in studies of clinical groups, such as bulimiacs or patients with panic disorder, where the time, locale and contingent circumstances associated with recurrent thoughts have yielded meaningful data (Singer & Bonanno 1990). I have found that samples of ongoing conscious thought of normal individuals include many of the metaphors or symbols that are also reported by them in recounting subsequent night dreams, i.e. the ongoing consciousness is already laying the groundwork for what seem to be the strange or creative settings of the night dream (Singer 1988).

Children's imaginative play as a forerunner of the thought stream

With Dorothy Singer, I have carried out a series of observational studies and experiments that involve recording the spontaneous play and language of preschool children, especially between the ages of 2½ and 5 years, when make-believe or pretend play is most prevalent (D. Singer & J. Singer 1990). In this work, we rely on pairs of trained observers who independently record samples of children's behaviour during 'free play' periods in the day care centre (or, occasionally, at home). These samples can be obtained on several occasions in a week and, in some studies, recurrently over a year. We must, of course, rely on the spontaneous verbalizations of the child in scoring the degree to which play introduces elements of fantasy and transcends the concrete description of objects or the child's motor actions. One can then look at variables such as affective responses, cooperation with others, leadership and aggression, and also examine the kinds of language forms used.

A detailed review of findings from this approach would take us far afield, but one can assert that, as Jean Piaget (1962) suggested, symbolic play emerging by the third year is a key factor in leading towards more advanced cognitive processes. Yet contrary to Piaget, make-believe does not fade once concrete operational thought appears. It never goes away and seems to be a welcome, if concealed, feature of middle childhood. As we have tried to show (D. Singer & J. Singer 1990), pretending and make-believe either as private experiences of daydreaming or in the form of adult play, e.g. carnival dressing-up, persist throughout life.

Task-unrelated images and thoughts during eleven days of signal detection

With John Antrobus, I studied a group of participants who returned to the laboratory on eleven consecutive days for a one-hour session of detecting auditory signals at a frequency of one per second. They were interrupted every 15 seconds and pressed buttons indicating if they had experienced (1) No TUIT;

(2) a TUIT that involved a perceptual response, e.g. to an extraneous noise, physical discomfort or other sensory-derived reaction not specific to the listening to and discriminating of the auditory signals, the task for which they were paid; (3) a TUIT that involved specific thoughts about the experimental situation, e.g. 'How much longer?'; (4) a TUIT that involved experimentally remote responses, e.g. 'I'm picturing myself canoeing with Sadie this weekend'. The participants had been accustomed, before the experiment, to common definitions and we asked them, during training, to verbalize actual thoughts. They were in relatively sound- and light-proof booths and wore earphones through which the signals (randomly presented high or low pure tones, one class of which was the one demanding a button press) were presented.

Fig. 1 shows the average findings for the group across eleven days of one-hour sessions of reports every 15 seconds. The subjects sustained an overall accuracy, as in most of our studies, of 80 to 100%. The percentage of reports other than 'No', that is, the task-unrelated thoughts, remains steady across eleven days at 52–58%. On the first few days, either the perceptual or experiment-related responses represent as much as 40% of the TUITs. By the second or third session most of the TUITs are quite remote from the immediate experience of the signal-detection booth. The participants have accustomed themselves to the setting and, while merrily continuing to process signals, almost all of their reported TUITs represent memories, wishes, fantasies or other thoughts far removed from the immediate setting.

We might conclude that even in an environment that makes a continuing demand on us for external signal detection, our brain may be continually active in generating information from long-term memory. We seem to orient ourselves to new settings, then our brain's channel capacity soon allows us to perform accurately our main task of environmental attention while also becoming aware of our centrally generated, long-term memory stimuli.

Determinants of the content of ongoing thought

For a more natural thought-sampling procedure, we set up a hierarchy of possible conditions that might lead to recurrence of material from an experimental situation during later thoughts sampled after experimental intervention from a group of adolescents (Klos & Singer 1981). The thought reports were rated by trained judges for their similarity to the particular experimental scenarios experienced by our subjects. The judges were provided with samples of all the different possible experimental scenarios, but were ignorant of the actual experimental conditions. We could then estimate the probability that the exposure of a participant to a particular experimental condition matched up with its recurrences in the person's later stream of thought.

It was proposed that even for first-year college students, parental involvements were likely to prove especially provocative of further thought. We chose to

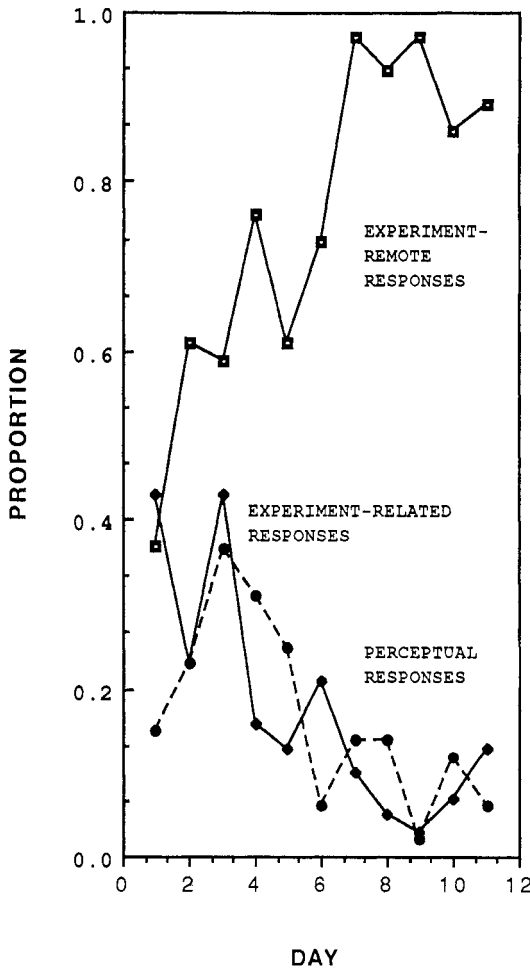


FIG. 1. The average proportion of the different kinds of task-unrelated images and thoughts (TUITs) in the total TUITs reported during a 45 minute signal-detection period on each of eleven days of participation by five subjects. All types of TUITs reported during each session made up, on average, 55% of the responses obtained after each 15 second period of detecting signals; thus about 45% of the time subjects answered 'No' to the query 'Were your thoughts unrelated to those specifically about detection of the signals?' Perceptual or experiment-related TUITs drop off sharply as the participants gain more experience in the experimental situation and experimentally remote TUITs become more prominent.

evaluate the relative recurrence in later thought of (1) generally resolved versus unresolved situations (the old Zeigarnik effect); (2) a mutual non-conflictive parental interaction; (3) a confrontation with a parent that involved a collaborative stance by the adult; and (4) a comparable confrontation in which the parent's attitude was clearly coercive. It was proposed that exposure (through a simulated interaction) to each of these conditions would yield differences in the later recurrence of simulation-relevant thoughts in the participants' consciousness.

More specifically, we predicted that unresolved situations would have a greater impact on later thought than resolved situations, that conflict situations would recur more in later thought than non-conflictive simulated interactions with a parent, and that the confrontation with a coercive parent would cause more later thought than one with a collaborative parent. Finally, we proposed that a history of long-standing stress with one's actual parents would amplify all of these conflict effects. Our experimenters and judges were unfamiliar with participants' scores on the long-standing parent stress measure. In summary, we predicted that while an unresolved, non-conflictive situation might recur more often in later thoughts than a resolved, non-conflictive simulation, more powerful effects on recurrence would emerge for the parent conflict situations and especially for those with a coercive parent, particularly if the subject had a history of parental stress.

The data provided clear support for the major hypotheses. The frequency of thoughts' recurrences occurred in the predicted order (Fig. 2). The effects were clearly amplified by a history of long-standing interpersonal stress with a parent. The 'pure incompleteness effect' was a modest one, observed mainly in the non-conflictive situation. It was overridden by the increasing coerciveness of the imaginary conflict situations. Of special interest is the fact that, once exposed to a simulated parental conflict, young people with a history of stress reflected this brief, artificial incident in as many as 50% of their later sampled thoughts. If we tentatively generalize from these results, the thought world of adolescents who have had long-standing parental difficulties may be a most unpleasant domain, since many conflictive chance encounters or even film or television plots may lead to a considerable degree of associative thought recurrence. The implications of a method of this kind (combined with estimates of personality variables or of other current concerns) for studying various groups (e.g. patients after surgery) are intriguing.

Self-belief discrepancies in cocaine abusers

In some studies recently completed with S. Kelly Avants and Arthur Margolin, we sought to test hypotheses derived from the work of Tory Higgins on the linkage between self-belief discrepancies and specific affective states. Higgins (1987) had proposed that we all formulate, consciously or otherwise, a series

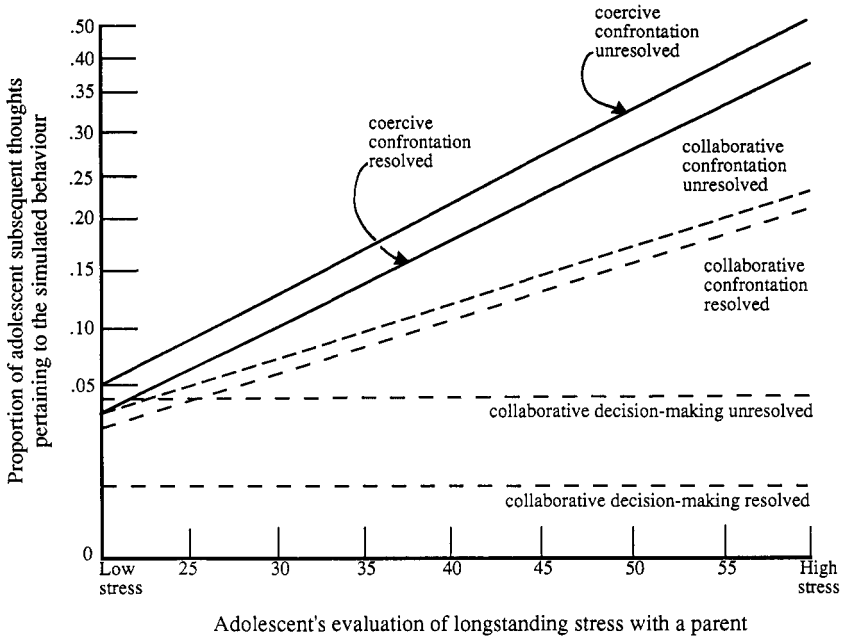


FIG. 2. Adolescent stress and simulated parental confrontation. Adolescents' thoughts during a 20 minute post-experimental period were rated by judges as bearing a clear similarity to the scenarios of the simulated (1) resolved or unresolved, (2) collaborative or confrontational, or (3) coercive or collaborative conflict situations that subjects had undergone earlier. The abscissa reflects previously obtained measures of the subjects' degree of reported stress with their actual parents. Thus, while unresolved simulations recur in later thought more than resolved ones, and confrontational or conflictual episodes more than collaborative decision-making simulations, the simulated coercive parental conflict is much more likely to recur in later thought. All the conflictual effect recurrences are greatly affected by the degree of individuals' experience of long-standing stress with parents. From Klos & Singer (1981), reproduced with permission of the American Psychological Association.

of beliefs about ourselves in various manifestations. These can be about our Actual Self, our Ideal Self, our Ought Self (what we think our parents might have wanted us to be), or other representations such as Past, Future or Dreaded Self. The Actual Self, as reported by a participant's listing of traits or tendencies, reflects how one describes one's self as accurately as possible. One's Ideal Self represents the aspirations one holds for the best one might be, e.g. 'star athlete, popular, deeply respected . . .' The Ought Self might reflect more early family or social group expectations, e.g. 'scholarly, obedient, religious . . .' A Dreaded Self might yield terms like 'sexually impotent, unmarried, friendless . . .'.

Higgins had shown that individuals found to have large measured discrepancies between Actual Self and Ideal Self were also likely to suffer from

depression or sadness, while those with discrepancies between Actual Self and Ought Self were more likely to experience agitation, anxiety and fear. Indeed, experimental priming of Actual-Ideal or Actual-Ought Self discrepancies generated sadness or agitated emotional reactions, respectively. Discrepancy scores, which could be calculated by counting non-recurring trait words listed for Actual Self, Ideal Self or Ought Self, proved predictive in differentiating depressed (Actual-Ideal) versus socially fearful (Actual-Ought) clinical groups.

We hypothesized, on the premise that cocaine abusers may be self-medicating a depressive mood by using an 'up-lifting' drug, that this class of abusers should show more evidence of an Actual Self-Ideal Self discrepancy than either a group of heroin users or a non-abusing control group. Our results clearly support this hypothesis (Fig. 3). We also obtained thought samples of the participants and we could show how cravings for cocaine emerged along with reports of greater Actual-Ideal discrepancies on a day-to-day basis. We then asked these patients to keep logs of their moods and of their thoughts of self (as 'Addict', 'Ideal', 'Craving', etc), while a cognitive-behavioural therapy intervention sought to help them identify and practise more adaptive self-representations. Follow-up thought samples revealed correlations between each of: less craving, fewer Actual-Ideal discrepancies, more positive Future Selves and physiologically measured abstinence.

We have extended the self-belief discrepancy study to a large sample of normal individuals. We have measured many personality variables, clinical attitudes such as depression, and various manifestations of Self (Actual, Ideal, Ought, Dreaded, Past, Future). Our participants are involved in experiments that seek

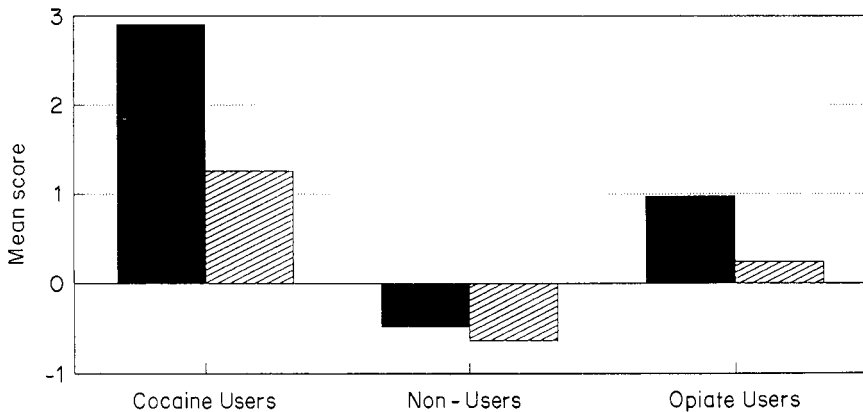


FIG. 3. Actual Self-Ideal Self and Actual Self-Ought Self discrepancies for cocaine users, opiate users and non-users. A high score (arbitrary units) indicates that subjects' descriptions of their Actual Self are considerably different from the way they describe either their Ideal Self or their Ought Self (for definitions, see text). ■, Actual-Ideal; ▨, Actual-Ought.

to prime particular self-discrepancies to determine whether these will increase recurrent thoughts about these concerns. The subjects carry paging devices for a week, which signal them randomly eight times a day so they can report on mood, specific thoughts and contingent events. We hope by this method to ascertain to what extent the conscious thoughts of the respondents show consistency with personality measures and cross-sectionally measured self-schemata, as well as reflecting priming of particular self-belief discrepancies.

A cognitive–affective perspective

I should like to close by summarizing my conclusions from years of applying these methods to the study of ongoing thought. I propose that human beings are best regarded as creatures who are biologically endowed with the necessary capacities and motivated from birth to explore their environments and to move gradually toward labelling and assigning meaning to their experiences. The human information-processing systems are closely tied to the separate, differentiated affective system, so that we are aroused, frightened, angered or depressed by sudden or persistent incongruity between our expectancies (plans, goals or wishes) and the information presented in a given situation. Likewise, we are moved to laughter and joy when incongruities are resolved, or to interest and to exploration when the novelty we confront is at a moderate level rather than an extreme one (Mandler 1984, Singer 1974, 1984, Tomkins 1962). If there is an overarching human motive from this perspective, it is to assign meaning, to make sense of the world. The theorizing and empirical research of the Kreitlers highlights the heuristic value of such an approach for the study of personality (Kreitler & Kreitler 1976).

If we are indeed ‘wired’ to make sense of our environment, to select, to identify, to label, to encode and to schematize new stimulation, what are the sources of this information? For human beings (as far as we can tell), the stimuli derive either from the ‘objective’ world, the consensually measurable physical and social stimuli in our milieu, or from the ‘subjective’ or private world of our memories and ongoing mental processes (Cartwright 1981, Pope & Singer 1978). At any given moment, a human being must assign a priority to responding either to those stimuli that come from external sources (sounds, light patterns, smells, touches or tastes) or to those that appear to be ‘internal’ (the recollections, associations, images, interior monologues, wishful fantasies or ruminative worries that characterize consciousness). Bodily sensations or signals of pain or malfunction from our organ systems represent a kind of intermediary source of stimulation, although such experiences often appear to us to have an ‘objective’ quality, despite their inherent embedment within our physical selves. We must generally give greater weight in our instantaneous assignments of priority to externally derived stimuli, or else we are likely to be hit by cars or to bump into poles. But human environments are characterized by sufficient

redundancy, and our motor skills and cognitive plans for specific situations generally are so overlearned and well differentiated, that we have ample opportunity to engage in elaborate memories, plans or fantasies, even while driving a car or participating in a business meeting.

Our human condition is such that we are forever in the situation of deciding how much attention to give to self-generated thought and how much to information from the external social or physical environment. This dilemma represents, I believe, a way of formulating the introversion–extroversion dimension of human experience. It may be seen as one manifestation of, or perhaps even as the prototype for, the major existential dilemma of the human being—the persisting dialectical struggle between autonomy and association (Singer & Bonanno 1990). Under the umbrella of the overarching motive for meaning, we humans are always seeking, on the one hand, to feel loved, admired or respected, to feel close to an individual or a group, and, on the other, to sustain a sense of autonomy and individuality, of self-direction, privacy in thought or uniqueness in competence and skill. Although the individual stream of consciousness may be seen as the human's last bastion of privacy and sense of uniqueness, our studies of ongoing consciousness suggest that a great majority of our thoughts are about affiliation and attachment to others!

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DISCUSSION

Kihlstrom: Jerry, can you talk a little about people's awareness of where these TUITs come from and where they go? For example, you might think that a task-unrelated thought could come from some unconscious source, or it might reflect some kind of day residue. To what extent are people able to reflect on the origins of the things that pass through their mind? Do they surprise them? If they did, you might think the thoughts were coming from some place that's unknown. Or can the subjects relate the thoughts to a particular event or circumstance?

Another point is that because these things flit through the person's mind, they can't be very deeply processed, which suggests that they would not be well remembered later on. You collect people's TUITs on-line, in the course of doing the tasks. Have you ever tested their memory for them later on?

Singer: We haven't tested the memory in a formal study. I believe that a huge percentage of our TUITs are simply forgotten, because of interference effects from the environment and social situation. If you did a little introspection, you might be able to retrieve a few of the TUITs you experienced while I was talking. But there are so many of them, that's the point we have tended to neglect. There are so many random thought processes that we tend to forget a great deal. People in these experiments and in other thought-sampling experiments that we have done are surprised at how much of the time they do spend daydreaming.

There is a kind of meta-attitude that people develop. Some people are particularly attentive to their memories and fleeting thoughts or associations. Because I study this all the time, I'm extremely self-conscious about it. As I'm giving a talk, I can catch myself having a fantasy right at that moment, and I would be able to narrate it to you if I had enough time. This is because I'm on the look out for these thoughts; most people are not. One of the differences between introverts and extroverts might be that introverts are the kinds of people who are aware of their TUITs a lot of the time, they really think they are worth something. Of course, writers like James Joyce and Saul Bellow are acutely sensitive to their association flow.

Carr: In your work on the visual signal-detection tasks, you are trying to measure ongoing rates of spontaneous thought. You have shown that when people are supposedly doing a signal-detection task, spontaneous unrelated thoughts occur. You have found some factors that influence the rate at which different sorts of thoughts arise, as if there were some spontaneous activity in these mechanisms that was sensitive to factors that would normally be expected to influence the rate of such activity, even though the person is not at the time overtly engaged in a task that requires this kind of activity. Spontaneous thoughts appear to depend on information processing mechanisms that exist and may even continue to operate independently of current task activity. What are those mechanisms like? An hypothesis can be found in the work of Dan Wegner.

Wegner has done his so-called 'White bear' experiments. He gets people to sit and describe their environment. In advance, he tells them, 'Don't ever think about a white bear. But if you should happen to think about one, raise your hand'. He records the number of 'illicit' white bear thoughts during this period. Then he allows the subject to continue with the description task afterwards, and says, 'Now you can think about a white bear any time you want, and if you do tell me.' Wegner finds that while people are fairly successful at suppressing white bear thoughts during the first part of the task, they do occasionally have them, even though they are told not to. But in the second part, there is a gigantic rebound effect—they think about white bears all the time.

Why is this story relevant? There have been various attempts to replicate the white bear phenomenon, including a failed one by Rose Zacks at Michigan State University (personal communication). If the phenomenon is real, it suggests that whatever mechanisms support endogenous generation of thoughts, they are sensitive to opponent-process rebound effects. These may be the same as similar, better understood opponent-process mechanisms in sensory perception, such as colour vision. This suggests, in turn, that the mechanisms involved in consciousness have properties that are shared with other physiologically well understood mechanisms and operate in similar kinds of ways. Do you agree with that kind of notion?

Singer: I would agree with the general notion; I'm not sure that I completely accept the specific interpretations of the white bear experiment. (For a full

discussion of issues related to Wegner's work and also some of our own earlier studies of mental control of conscious thought suppression, see Wegner & Pennebaker 1993, Antrobus et al 1964, Singer & Antrobus 1965, Bonanno & Singer 1993.) We did similar experiments many years before Wegner. We were interested particularly in what happens if you ask someone to imagine certain kinds of scenes, and how this is reflected in their eye movements. We made electrophysiological studies of the eye movements during those conditions. We used instructions such as: 'Imagine you have a secret wish that's very important. You allow that wish to come true mentally and imagine it as vividly as possible.' We found that under those circumstances a person's eyes tend to become relatively fixed. It is as if one wants to blot out extraneous stimulation and just focus on a private image of some kind.

Then we said, 'Now suppose we can read your mind and you want to suppress this image'. Under those conditions we found a great deal of eye movement, even if the eyes were covered. We did not at that point think of rebound, so we didn't test for that effect specifically. Our whole effort was to try to show what you said in your second point, that these processes are part of the general cognitive system. They are in no sense something peculiar or independent. The same processes that support external perception seem to operate for imaginal thought.

Carr: Do you think that that line of work and the conclusion you have drawn speak in any profound way to the mind-body issues that have been discussed here? For example, it seems quite consistent with John Searle's straightforward idea that conscious processes arise naturally from the ordinary operation of the nervous system.

Singer: I would say yes. Personally, I'm having great trouble sorting out my position on the various views. I accept the principle of Dr Searle's that all consciousness emerges from brain processes. At the same time, I want to stress that I do not feel such a position is incompatible with one aspect of Dr Velmans' position, namely that all our experience is, from the start, representational. I believe that we approach each new information processing situation using schemata from previous experience and then reshape the new combined schemata through our subsequent ongoing conscious thoughts about the material, thus reconstructing and reshaping memories.

Fenwick: I have a general question which relates to responsibility. More and more, psychiatrists are called into court to give their views as to whether people are responsible for their behaviour. Our knowledge of brain function has been significantly enhanced by the use of modern techniques, such as structural imaging by magnetic resonance imaging or functional imaging by positron emission tomography, and by our increasing knowledge of brain chemistry. For example, we know that 5HT is related to impulsivity and aggression. Is a person to be held morally responsible for behaviour, however reprehensible, caused by low levels of 5HT? The more we understand about disorders of brain

function, the more the question of personal responsibility seems to recede under the onslaught of reductionist science.

Now your studies have shown that if you put people into a boring situation, their intrusive thoughts start blocking out the signals they have to detect. Air-traffic controllers, for example, may miss a moving radar image as an intrusive thought interferes with cognition. Are they *responsible* for not seeing these signal blips, if the very mechanisms that they use to detect them let them down?

Another example is patients with epilepsy, who may have abnormal brain discharges which are very quick—less than 250 ms. But during that time the patient's cognition is disturbed in a major way. It has been shown in Holland, using a special car that senses the position of the car on the road, that if one of these discharges occurs, the car may deviate from the centre of the carriageway. If an accident was caused in that split second, could the person be held responsible, when it was abnormal activity in their brain (of which they had no knowledge) that caused the accident to occur? If consciousness is merely a brain function, does 'moral responsibility' have any meaning? My question is, what effect is your research having on our understanding of human responsibility?

Singer: I think we simply have to accept as a natural human process that the brain is constantly active and generating all kinds of alternative stimuli. Intellectuals like ourselves are particularly prone to this: we walk along the street thinking through some complex problem, and we are likely to bump into a pole or walk past our apartment door and then can't understand why our key won't open the next apartment door. I think part of our responsibility as adult human beings is to make some determination in particular situations as to how much priority we can give to long-term memory derived stimulation, which confronts us almost all the time, and how much we can give to the necessities of an immediate milieu. I would not be terribly sympathetic to the notion that even though we are confronted with the persistent dilemma of having to sort out our priorities, that is, whether to go on with mental reflection or to pay attention to the traffic, we bear no responsibility for an accident. I would say that part of being adult and a responsible human being is that we assign the priorities in relation to the social demands of the situation. A feature of human responsibility, even for the epileptic, is to recognize our characteristic styles and adjust to situations.

Van Gulick: Peter Fenwick said that in the signal-detection task, the subjects' thoughts intruded and interfered with their detection ability. I thought they were still very good at the task.

Singer: Yes. It is impressive that we have much more channel space than we often realize. When we greatly increase the information load on the subjects, there is certainly a reduction in the number of TUITs, but note that the 55% occurrence of TUITs corresponds with about a 90% detection rate. Even when we increase the frequency of TUITs by presenting upsetting information before the test, we still get good detection rates.

Carr: You showed modality-specific interference.

Singer: Yes. When auditory signals are being processed, the TUITs are more likely to involve visual memories or fantasies, and when visual signals are being presented the TUITs are more likely to involve verbal thought or inferior monologue. We also find interesting individual preference styles. There are people who just process their TUITs and don't care about the money.

Shevrin: There is an interesting dichotomy reflected in the discussion, namely that agency seems implicitly to be assigned solely to consciousness, while the brain is regarded as an automatically operating mechanism lacking agency. I think it's worth considering that agency is also present in unconscious operations. Or, brain operations unaccompanied by consciousness do not exclude agency. Therefore, one can raise the issue of responsibility for unconscious acts for the more conventional acts based on conscious volitions, although the former may be more difficult to determine. I think Ben Libet's work on the neurophysiological, pre-conscious origins of voluntary acts speaks to this issue as well. The implicit dichotomy between consciousness and agency, on the one hand, and unconscious and brain mechanisms, raises a serious question.

Gray: That must be right, but it addresses the wrong issue. Peter Fenwick made it clear that he was talking, not about a natural science concept, but about a socio-legal concept. The issue was how, as a society, we need to think about responsibility and the conditions under which one is to be treated as an agent.

Marcel: People vary in the extent to which they can control unwanted thoughts. In clinical depression and under certain anxiety situations, it's very hard to exclude unwanted thoughts. One of the only methods that works (and that is hardly at all) is to use a suppression task like articulatory suppression. Intrusive thoughts do impair hugely what you might think of as 'automatic' perceptual processes.

There are studies addressing this on people driving in traffic. The perceptual-motor linkage of braking due to the expanding visual flow field when you are approaching a truck in front has been thought to be quite automatic. But, it turns out that intrusive thoughts impair this. This is important and it relates to when you talk about responsibility. Forget about brain responsibility, it's just a practical question at a psychological level.

Singer: One of the characteristics of depressive thought is its somewhat contentless structure, or its repetitive structure of self-demeaning statements (Williams & Dritschel 1988).

To come to your point about driving, we have done experiments where we put someone in front of a screen across which stripes are moving, and they are encouraged to engage in different kinds of thought. The movement of stripes on the screen produces what's called the optokinetic nystagmus reflex (continuous following movements by the eyes). We measure the movement of

the eyes electrophysiologically when they are tracking these stripes. If the subject engages in very vivid fantasy, the eye tracking activity drops drastically. So we are capable, when preoccupied with elaborate thought processes usually of a visual nature, of blocking out the optokinetic nystagmus effects (Singer et al 1971).

Marcel: I was concerned about essentially our own ability to control the source of content. In states of depression, and certainly in anxiety, people sometimes can't control their dominant action patterns.

Velmans: That stresses the point made by Howard Shevrin that the locus of control is actually unconscious. It's a little like asking: who is in control when you are speaking? How much conscious control do you have over the words that are produced? In normal conversation, I am usually conscious of what I'm going to say only once I've said it. Who is in control of the next thought that comes into my mind? Whatever the locus, whatever the mechanism is, it's all in the unconscious processing (see Velmans 1991a).

Libet: When the subjects are having daydreams and doing the signal detection, are they aware of the signal? When they report having had a daydream in a certain period, do you ask whether they remember seeing or hearing a signal?

Singer: We haven't asked them that in the form you suggest. We know that they got the signal right because their button presses indicate recognition that the tone presented was the targeted one. We have also obtained verbal reports in some studies which indicate conscious thought specifically about the signals, e.g. 'Was that tone louder than the last one?' We do have systematic evidence of parallel, as well as sequential, processing of tones and TUITs (Antrobus et al 1970).

Libet: I think that they might not be aware of the signal, even though still detecting it and responding correctly.

Singer: You can drive quite safely, depending on the road conditions, while engaged in very elaborate thought processes or in conversation with someone else. In fact, we found in one study that talking to oneself may keep one awake and moderately alert during a prolonged signal-detection session (Antrobus & Singer 1964).

Gray: A boring methodological point: on 50% of occasions, the subject reports having a task-unrelated thought. That is the frequency I would have expected. Nonetheless, it is an estimate that one wants to be sure is correct. It seemed to me that the method of the first experiment could include an artifact. You sampled the TUITs every 15 seconds. If that was every fixed 15 seconds, could there have been a conditioning element, either classical or instrumental, involved in the method? So subjects would be expecting to be asked every 15 seconds whether they were having a task-unrelated thought. That would almost certainly influence the likelihood that one was or was not having such a thought.

Singer: That's certainly possible. We have also conducted studies changing the time intervals. There is still a high rate of TUITs. If there is a random

interruption rate, the number of TUITs is reduced substantially, so there is an element of anticipation involved. In daily life, I propose that we also anticipate situations that will allow us time to attend to our thoughts.

Harnad: Is there any evidence for cyclicity?

Singer: Kripke & Sonnenschein (1978) reported a study which seemed to suggest some support for that. We have never studied it.

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