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The Chronobiological Theory of Therapeutic Suggestion: Towards a Mathematical Model of Erickson's Naturalistic Approach

Ernest Lawrence Rossi

■ *Erickson's naturalist approach to therapeutic suggestion emphasizes that the classical phenomena of hypnosis can be experienced as spontaneous manifestations of the "common everyday trance" without being directly suggested by a therapist. The chronobiological theory of therapeutic suggestion proposes a mechanism for this aspect of Erickson's naturalistic approach: the classical phenomena of hypnosis are expressions of the normal range of cybrenetic homeostatic psychobiological behaviors that are manifest in ultradian and circadian rhythms. Hypnotherapeutic suggestion is the psychosocial "entrainment" of this natural range of rhythmic chronobiological behavior for therapeutic purposes. This association between chronobiology and hypnosis integrates many of the classical historical phenomena of hypnosis with recent research unifying life processes from the psychosocial and behavioral levels to the neuroendocrinal, psychoimmunological and cellular-genetic-molecular levels.*

Since it is exactly ten years since the publication of the first paper proposing an association between Milton Erickson's naturalistic approach to therapeutic hypnosis and the psychobiological rhythms of chronobiology (Rossi, 1982), it is appropriate to examine the research generated by this hypothesis. The chronobiological hypothesis proposes that the „basic stuff" of hypnotherapeutic suggestion is the accessing and utilization of the normal range of cybrenetic, homeostatic psychobiological parameters that are manifest in ultradian (many cycles every 24 hours) and circadian rhythms (one cycle every 24 hours) throughout the day. Hypnotherapeutic suggestion is regarded as the psychosocial „entrainment" of this natural range of chronobiological behavior for therapeutic purposes. Since it is now believed that biological rhythms are a fundamental expression of organization and information processing in all living systems (Lloyd and Rossi, 1992), this theoretical integration may infuse hypnosis with a variety of new approaches to therapeutic suggestion that can operate with a greater degree of specificity on all levels from the

psychosocial and behavioral to the neuroendocrinological, psychoimmunological and cellular-genetic-molecular levels.

This review will begin with the initial clinical observations that led to the first intuitive recognition of the apparent identity between the classical phenomena of hypnosis and the typical range of behaviors found in the 90-120 minute Basic Rest-Activity Cycle (Kleitman, 1970, 1982). We will then summarize the results of about a dozen experimental studies designed to assess some of the unique predictions of this chronobiological view of hypnotherapeutic suggestion. We will conclude with suggestions for mathematical modeling of hypnotic phenomena and the new experimental studies that are needed for the further exploration of the chronobiological parameters of therapeutic suggestion.

The initial clinical observations of and association between Erickson's naturalistic approach and the biology of time

An important but little appreciated aspect of Milton H. Erickson's teaching of the „naturalistic approach" to hypnotherapy was to emphasize how often a variety of the classical phenomena of hypnosis became manifest „spontaneously" or „autonomously" in the patient's behavior without direct suggestion during a therapeutically oriented session (Erickson and Rossi, 1979, 1981; Erickson, Rossi and Rossi, 1976). This was particularly true in the area of psychosomatic medicine where the spontaneous appearance of many varieties of hypnotic phenomena were carefully documented in a series of four papers (Erickson, 1943a,b,c,d) that Erickson called the „psycho-neuro-physiological" foundation of hypnosis.

This recognition of the spontaneous manifestation of hypnotic and psychophysiological phenomena extended to the normal patterns of living wherein, Erickson believed, everyone experienced mild, transient states of altered consciousness at various times throughout the day when they felt „tired" and needed to take a little rest. He called these natural rest periods „the common everyday trance" (Erickson and Rossi, 1981). Erickson taught his students to enhance their observational skills in recognizing these natural minimal manifestations of hypnotic phenomena in daily life as well as in the consulting room. In his later years Erickson taught the subtle indirect approach to utilizing the patient's naturalistic trance experience as the essence of hypnotherapy. This permissive approach to the utilization of naturalistic hypnotic phenomena is in striking contrast to the traditional authoritarian view that hypnosis is usually the outcome of a special ritualized encounter wherein a hypnotist puts a subject into an altered state called „trance" and directly suggests what is to be experienced.

The hypothesis that Erickson's naturalistic approach to therapeutic suggestion may be

conceptualized as a means of accessing and utilizing the normal variations of psychobiological processes that take place during ultradian and circadian rhythms originally arose from my clinical observations of the way he used a variety of subtle behavioral signs to determine when his patients were ready to enter therapeutic hypnosis (Erickson & Rossi, 1976, 1979). Rossi (1982) reported that Erickson's „trance readiness indicators" appeared to be identical with many of the „rest phase behaviors" of ultradian rhythms that were carefully recorded by chronobiologists. In keeping with these observations, it was intriguing to note that Erickson's hypnotherapeutic sessions, in sharp contrast to the conventional 50-minute hour of most psychotherapists, usually lasted between 90 to 120 minutes - the same periodicity as Kleitman's REM dream cycle during sleep and the homologous Basic Rest-Activity Cycle (BRAC) during the awake state in the daytime. When this author brought the similarity between Erickson's „trance readiness indicators" and the „rest phase behaviors" of ultradian rhythms to his attention, the 78-year-old Erickson admitted he had never heard of ultradian rhythms. It was an immediate speculation by both of us, however, that Erickson's reputation for having an uncanny knack for facilitating deep hypnosis and his therapeutic effectiveness with psychosomatic problems could be due, at least in part, to his unwitting utilization of the natural psychobiological variations of behavior that are observed in ultradian rhythms. I named this the ultradian, or more generally „the chronobiological hypothesis of therapeutic suggestion" (Rossi, 1982, 1986a, b & c; Rossi and Cheek, 1988).

The practical significance of the chronobiological hypothesis is that therapeutic suggestion conducted during the rest-rejuvination phase of ultradian rhythms may more easily access many naturally occuring parasympathetic processes of mind-body healing that are most active at this time. The rest-rejuvination phase of ultradian rhythms may be a „window of opportunity" for observing and facilitating many periodic patterns of mind-body communication and behavior in health and illness. We know, however, that hypnosis is not sleep or merely rest or relaxation; hypnotic suggestion can be use to optimize high level performance where hyperalertness is required. The more general chronobiological hypothesis proposes that these „high end behaviors" are the hypnotherapeutic entrainment of the peak performance phase of ultradian and circadian rhythms. In this regard it is significant to recall that Erickson's most original and favorite method of hypnotic induction was „hand levitation" which required a state of arousal, heightened tension and focused attention rather than relaxation. Indeed, Erickson rarely if ever used the word relaxation in hypnotic induction. A state of relaxation developed naturally within a patient as an appropriate response only after having done a significant bit of psychotherapeutic work. That is, Erickson's typical hypnotherapeutic session involved an initial phase of activation, a midd-

le phase where significant inner therapeutic work was done and a final phase of relaxation and ratification (Erickson & Rossi, 1979). This rhythmic pattern is evident in Figure one which outlines some of the more important parameters chronobiological rhythms that can help us understand the dynamics of hypnotherapeutic suggestion.

The value of a new theory in science may be assessed by (1) its ability of account for all the previous emperical data of the past in a more comprehensive and economical manner, (2) the unique predictions the new theory can generate about new phenomena that previous theories never even recognized as relevant and (3) the mathematical models generated by the new theory that can formulate relationships in the precise manner required for further, more quantitative hypothesis testing. In this paper these three criteria will be used to assess the value of the new chronobiological theory of hypnosis in general and therapeutic suggestion in particular.

I. Integrating hypnotherapeutic suggestion with chronobiology

Figure one is a summary of the parameters of chronobiological behavior that may be operative in the domain of traditional hypnotherapeutic suggestion. The high or peak phase behaviors of chronoiological rhythms (Brown & Graeber, 1982; Schulz & Lavie, 1985) that are responsive to hypnotic suggestion such as the optimization of performance in memory, learning and a variety of behaviors (eg. athletics) have been listed elsewhere (Rossi, 1986; Rossi & Lippincott, 1992). Likewise the low or trough phase behaviors of chronobiological rhythms (Dinges & Broughton, 1989; Kleitman, 1970, 1982; Kupfer, Monk, & Barchas, 1988) that are found responsive to hypnotherapeutic suggestion for facilitating psychophysiological healing (Gorton, 1957, 1958) are listed in the same places (Rossi, 1986; Rossi & Lippincott, 1992) .

One outstanding value of recognizing these associations is that the facts of chronobiological can now provide a means of vastly extending of the domain of therapeutic suggestion from the psychosocial and behavioral levels of traditional hypnosis to the psychobiological on all levels from mind to gene (Rossi,1986, 1987, 1989, 1990a, b, c & d). This expanded domain must be regarded as the ultimate goal of any truely complete theory of mind-body relationships in hypnosis (Tinterow and Rossi, 1992). To fully appreciate the explanatory power of this expanded domain, however, it will be necessary to understand the adaptive significance of chronobiological rhythms in their role of facilitating the organization and informational processing of all cybrenetic life systems in general.

Adaptive psychobiological rhythms as organization and information

Two common characteristics of most circadian (one cycle every 24 hours) and ultradian (many cycles every 24 hours) rhythms that have important implications for health and psy-

chosomatic medicine are their highly adaptive nature and their responsiveness to psychosocial cues. Our circadian rhythm of sleeping and waking, for example, is flexible within certain limits; most people can adapt fairly well to a one or two hour shift in their sleep-waking rhythm (Coleman, 1986) in response to many psychosocial cues (alarm clocks, expectations, stressors etc).

Ultradian rhythms are even more flexible in their temporal expression. Most of the well researched 90-120 minute cognitive-behavioral ultradian rhythms such as activity level, psychomotor efficiency, appetite, sexual fantasy, sensory-perceptual acuity, alertness, memory, mood and social behavior are highly adaptive in their responsiveness to psychosocial cues (Brown and Graeber, 1982; Kupfer, Monk & Barchas, 1988; Schultz and Lavie, 1985). This means that these 90-120 minute rhythms are not rigid or fixed in their periodicity. In fact, they are so variable in response to the ever changing contingencies of everyday life that some investigators have questioned whether they really exist and just how significant can they be if they are so sensitive to all forms of psychosocial stimuli (Kripke, 1982). More recent and thorough evaluations of the literature, however, have introduced the idea that the highly variable nature of these rhythms is actually an expression of their role in the „frequency encoding of information" to enhance the overall efficiency of life processes (Rapp, 1979, 1987; Lloyd and Rossi, 1992). Since these ultradian behaviors are also responsive to the special class of psychosocial cues we call „therapeutic suggestion" it seemed worthwhile to undertake a research program to determine whether there is an natural periodic component to what we traditionally call „hypnosis".

II. Unique predictions of the chronobiological theory of hypnosis

Einstein is reported to have said, „It is the theory which decides what can be observed." (Heisenberg, 1983). With this perspective the author asked a series of questions and made a number of predictions about hypnotic behavior from the chronobiological point of view (Rossi, 1982, Rossi, 1986; Rossi and Cheek, 1988). Some of the pilot studies and the major experimental results generated by these questions are summarized here.

1. Does hypnotic susceptibility evidence a natural periodicity or chronobiological rhythm during circadian (daily) or ultradian (hourly) time periods?

When Hilgard (1982) reported that hypnotic susceptibility is a stable trait in longitudinal studies over ten years, there were as yet no studies for circadian and ultradian parameters of hypnosis as predicted by chronobiological theory. This first unique prediction of chronobiological theory received its initial experimental verification from Aldrich and Bernstein (1987) who found „time of day" was a statistically significant factor in hypnotic susceptibility. They reported a bimodal distribution of scores on The Harvard Group Scale of

Hypnotic Susceptibility (HGSHS) in college students with a sharp major peak at 12 noon and a secondary, broader plateau around 5 to 6 P.M. Because they assessed their subjects in a large groups they acknowledged the limitations of their study as follows: „Research with individuals would also be a better test of Rossi's (1982) contention that an ultradian rhythm exists in hypnotizability. These rhythms would have been cancelled out when the individual rhythms were averaged together when analyzing the data in the present study." (p. 144)

The author therefore designed a pilot study whereby individual subjects could keep diaries that might identify periodicity in their daily patterns of self-hypnosis (Rossi, 1992 a). A Hypnosis Diary Group made up of individuals with an interest in learning self-hypnosis and were trained with one classical hypnotic induction involving eye fixation, imagery and relaxation to facilitate „mind-body healing." They were instructed to keep a „Self-Hypnosis Diary" for two weeks in which they daily recorded three items: (1) The time of day when they did self-hypnosis, (2) How much time they remained in self-hypnosis and (3) a few sentences describing their healing experience of self-hypnosis.

A second group of subjects were encouraged to keep an ultradian diary. This Ultradian Diary Group consisted of people who attended one of the author's lectures on „The Ultradian Healing Response" as an approach to optimizing mind-body healing (Rossi & Nimmons, 1991). To facilitate this new approach to mind-body healing they were to record the same items as the self-hypnosis group. Both groups were encouraged to do their „inner healing work" and diary recording as many times a day as they felt a need to.

Figure two is an overview of the data for the total group of 16 subjects in this pilot study. The jagged line with dark filled circles represents the original data of 292 diary reports by the total group. The symmetrical curve of hollow circles is the results of the analysis on the original data with the computer technique of Multiple Complex Demodulation (MCD) carried out blind by Helen Sing, Chief Statistician of the Behavioral Biology Department of Walter Reed Army Institute of Research (Sing et al., 1985). This symmetrical curve represents a very prominent circadian rhythm with a peak between noon and 1 pm in the „number of incidents" of self-hypnosis and the ultradian healing response in the total group . This result is consistent with Aldrich and Berstein's finding of a peak in hypnotic susceptibility at noon. The contrast between the smooth computer generated circadian curve and the jagged original data which is more suggestive of an ultradian periodicity (with peaks at 9 a.m., noon, and perhaps at 2, 4 and 6 p.m.) suggested that more detailed analysis on an hourly level was required.

While chrobiological theory (Kleitman, 1970) suggests there would be a 90-120 Basic Activity Rest Rhythm (BRAC) in the data, figures 4a & 4b illustrate a 180 minute component that was identified by the MCD analysis as the most prominent ultradian rhythm both groups of this pilot study. How can we account for the prominance of this longer ultradian rhythm in the „self-hypnosis" and „ultradian healing response" groups? A careful study of the chronobiological literature reveals that the 90-120 BRAC is most clearly evident only under carefully standardized „bed rest" conditions. We must recall that ultradian rhythms are highly adaptive and responsive to enviromental demands, particularly psychosocial cues. Since this pilot study was carried out during normal everyday pattern of activity rather than bed rest, it is reasonable to speculate that the ultradian rhythms our subjects were a bit longer because the typical workday they were experiencing did not usually permit them to take-a-break or rest period for self-hypnosis or an ultradian healing response whenever they really felt a need to.

2. Is there a natural or typical trance time when subjects are premitted to stay in therapeutic hypnosis for as long as they need to for resolving problems?

A significance observation in figures 3a and 3b is that both groups remained in self-hypnosis or ultradian healing for about 15 or 20 minutes with a range between 5 and 30 minutes. This is consistent with chronobiological observations where Kleitman (1969, p. 37) reports on „The relief obtained by some individuals from brief 10 to 15 minute cat naps perhaps representing a 'tiding over' the low phase of a BRAC..." This apparent correspondence in the natural ultradian rest periods and self-hypnosis suggested further studies to determine whether there was a natural or typical length of time when subjects would remain in therapeutic trance.

Accordingly, a group of 30 successive patients were seen by their regular therapist (the author) for 90-120 minute therapy sessions so there would be sufficient time for their natural hypnotherapeutic trance period (Erickson's „Common Everyday Trance") to become manifest without being concerned about the possible time limitations of the more typical 50 minute therapy hour. Trance induction usually required one to three minutes for eyes to close. Eye closure was taken as the beginning of the recorded trance time. The induction always ended with a permissive suggestion in the form of an implied directive (Erickson & Rossi, 1976; Rossi & Ryan, 1992) phrased as follows: „You will remain in trance as long as is necessary for you to resolve the issue you have been dealing with in as satisfactory a manner as is possible at this time. Your unconscious (or „inner mind") will then allow you to awaken entirely on your own feeling refreshed and alert." This suggestion made trance length and awakening contingent on some natural endogenous psychobiological process within the patient rather than trance length being controlled externally by the therapist as is typical of traditional hypnotherapy.

The results of this study were consistent with the prediction of chronobiological theo-

ry: patients remained in a naturalistic therapeutic trance for about twenty minutes. This naturalistic trance time is reliable in the sense that there was a correlation of 0.49 (significant at the .02 level, df=28) between time spent in the this type of permissive trance on two occasions. There were large standard deviations and wide range of times spent in these naturalistic trance periods (between 2 and 67 minutes), however, so it is easy to understand why this has not been a generally recogized variable in the traditional hypnotherapeutic literature where the therapist controls trance length.

Because of the significance of the existence of naturalistic therapeutic trance time for understanding the psychobiology of therapeutic hypnosis, three other independent efforts were made to verify these research results. Brian Lippincott (1990), Carol Sommer (1992, 1993) and Shirley Sanders (1991a & b) each reported independent replications of the above study with (1) significant modifications of procedure, (2) subjects assessed in different age ranges and parts of the country and (3) scales for measuring hypnotic susceptibility. All three found essentially similar results. Lippincott reported a mean naturalistic trance time of 18.55 minutes (standard deviation, 14.11) when using the Spiegel Hypnotic Induction Profile with college students. Sommer reported the mean naturalistic trance time with the Wilson Creative Imagination Scale for 32 subjects to be 18.02 minutes (standard deviation, 9.62) when she controlled for a variety of variables such as sex (half her subjects were male and half were female) and amount of previous trance experience.

In a clinically oriented survey Sanders (1991 a & b, In press) mailed a self-hypnosis questionnaire to 1000 members of the American Society of Clinical Hypnosis. In the 233 responses she received it was found that a 15-20 minute period was most typical in the use of self-hypnosis. In a more recent study Sanders and Mann (1992) found an interesting relationship between naturalistic trance time and subjective reports of trance depth. Ninety five subjects from the University of North Carolina Department of Psychology were administered the Stanford Clinical Scale of Hypnotic Susceptibility individually. Following this induction subjects were given the non-directive suggestion to „allow themselves to explore the trance state and go as deeply as their unconscious mind would like to go." As illustrated in figure four the subjective reports of trance depth increased with a monotonic curve that appeared to reach an asymptote at 20 minutes when the experiment was terminated. In another study Lippincott (1990) tested a unique hypothesis derived from ultradian theory: If the 20 minute naturalistic trance is, in fact, an important psychobiological period („marker") for some endogenous psychobiological rhythm, one would expect that after subjects have experienced it, they would no longer have a need to remain in a second naturalistic trance for another 20 minutes within the same 90-120 BRAC ultradian period. This leads to the prediction that subjects (N=30) will remain in a permissive naturalistic

trance for much shorter periods if they are asked to experience a second, third and fourth trance in rapid succession immediately after they have awakened from their first 20-minute naturalistic trance. This prediction was well supported by the results illustrated in the „Successive Trances in 90 Minutes" of figure 5 where the first trance had a mean length of 18.55 minutes while the second, third and fourth experienced in rapid succession were 4.03, 1.96 and 0.98 minutes respectively.

A perceptive peer reviewer of these results noticed that figure six looked like the typical extinction curve of classical learning theory and therefore expressed the view that ultradian dynamics might not be required as an explanatory principle. But this is an important area of study where traditional learning theory may be ignoring the facts of chronobiology. A chronobiological factor of „spontaneous recovery" is usually associated with every learning and extrinction process. The typical learning experiment does, in fact, produce an extinction curve like figure 5. This is a temporarily result, however; after an hour or two and the learned response can be evoked once again by an appropriate stimulus (usually in a weakened form). This recovery of the learned response is itself an ultradian phenomenon; it is a chronobiological factor in the classical learning and extinction process that has not been recognized as yet by experimental psychologists.

Our peer reviewer's observation is still an excellent one, however. Further research is now needed to substantiate the chronobiological factor by repeating Lippincott's experiment over the course of an entire day and repeatedly assessing hypnotizability over short intervals in much the same manner as Lavie (1992) has for assessing sleep tendency. If the classical extinction hypothesis of learning theory is valid hypnotizability will go down consistently throughout the day and finally be extinguished altogether by the end of the day. The chronobiological hypothesis would predict, to the contrary, that hypnotizability will recover every 90-180 minutes throughout the day so that the data will follow a sinsoidal pattern similar to figures 4a and 4b.

Since the original presentation of this paper at the 12th International Congress of Hypnosis in 1992, Wallace (1993) independently carried out a study exactly as proposed above by assessing hypnotizability throughout the day on an hourly basis from 7 a.m. to 10 p.m.. As will be reported in more detail below (when dealing with the question 5 on the differences in hypnotizability of owls and larks) he found an ultradian periodicity of hypnotic susceptibility throughout the day that supports the prediction of chronobiological theory and refutes the prediction of classical learning theory that hypnotizability would be extinguished by the end of the day. This is a striking and entirely unexpected example of how chronobiological theory is making „unique predictions...that previous theories never even recognized as relevant" (the second criteria for the value of a new theory as described

above). Chronobiological theory therefore provides a greatly expanded framework that can encompass an enhanced general learning theory and the psychobiology of hypnosis.

The existence of a naturalistic 20 minute trance is consistent with a number of earlier reports by clinicians and researchers that documented a twenty minute natural trance time in an incidental manner without recognizing its theoretical significance for chronobiological theory. Erickson, for example, mentions 20 minutes as a typical unit of trance time in a number of his clinical papers and workshops (Erickson 1943b/1980). In one early research report he outlines how he used approximately 20 minutes for „the development of a deep trance state"; approximately another 20 minutes for „the development of a stuporous trance state"; and yet another 15 minutes for „the development of a somnambulistic state" (Erickson, 1954/1980, p. 53).

A review of the literature of experimental hypnosis turned up a number of studies that could be interpreted as providing further support for a natural 15-20 minute trance time. In an early methodological study Dorcus, Britnall and Case (1941) compared the amount of time a group of 20 deeply hypnotizable subjects remained in trance after the hypnotist left the room with a control group who were told to simply lay down and relax. In both groups the majority of the subjects got up and left the room within 20 minutes. In two studies using control groups subjects simulating hypnosis it was found that highly hypnotizable subjects remained in trance when they believed they were left unobserved for 10.7 and 16.5 minutes (Orne and Evans, 1966; Evans and Orne, 1971) while the simulating low hypnotizable subjects acted as if they were in trance for 25.2 minutes.

It is interesting that while none of these researchers set out to test the ultradian prediction that there is a natural 15-30 minute trance time, all their data supports it. Since there is no other theory of hypnosis that would make such a prediction, the consistent observation of a 15-20 minute natural trance time in a great variety of clinical and experimental situations by many researchers working independently of each other with different theoretical perspectives provides considerable support for a chronobiological theory of hypnosis that may have important implications for therapeutic suggestion.

3. Is There an Inverse Relationship Between Hypnotizability and Naturalistic Trance Length during problem solving?

While Rossi (1990d) initially hypothesized that there would be no relationship between hypnotizability and naturalistic trance length, both he and Sommer (1993) noticed that there was a tendency for their highly suggestible patients, as measured by the Barber-Wilson Creative Imagination Scale, to experience somewhat shorter naturalistic trance when they were engaged in personal problem solving. This inverse relationship between suggestibility and naturalistic trance length was not statistically significant in either of these clinically oriented studies, however. In what was a better controlled experimental study with college subjects, however, Lippincott (1990, 1992a) found a statistically significant inverse relationship between hypnotizability as measured by the Hypnotic Induction Profile and naturalistic trance length (Pearson product moment correlation coefficient of $r = -0.602$ ($p < 0.001$).

One way of interpreting these results is to say that whatever the psychobiological basis of the naturalistic trance length may be, the more highly susceptible hypnotic subjects are more efficient in their experience of it for personal problem solving since they require less time to do it. Presumably highly hypnotizable subjects are more highly focused and therefore more efficient in their personal therapeutic inner work. Verification of these findings with a broader range of subjects, tasks and measures of hypnotic suggestibility are required before we can accept their implications for a chronobiological theory of hypnotherapeutic suggestion.

4. Are the classical phemomena of hypnosis entrained manifestations of natural patterns of chronobiological behavior that are characteristic of certain phases of circadian and ultradian rhythms?

As mentioned previously, Erickson believed that all the classical phenomena of hypnosis were manifestations of naural human behvior during the „common everyday trance" (Erickson & Rossi, 1979; Rossi & Ryan, 1992). While there has been a great deal of controversy about the nature of hypnotic phenomena, most modern theorists agree that the „feats of hypnosis" are all within the normal range of human behavior (Wagstaff, 1986). These researchers openly acknowledge, however, that they have no adequate theory about the source and parameters of hypnotic performance. Naish, for example, has recently summarized the situation as follows: „As [hypnotic] susceptibility is normally assessed, a high scorer is one who produces the behavior, the reason for its production remains unknown ... the claim was frequently made that cognitive processes are involved in the production of 'hypnotic' effects. However, the exact nature of these processes generally remained obscure." (Naish, 1986, 165-166).

The chronobiological hypothesis is consistent with Erickson's clinical findings as well as those experimental conclusions summarized by Wagstaff and Naish above: the source and parameters of hypnotherapeutic responsiveness may be found in that class of circadian (daily) and ultradian (more than once a day) psychobiological rhythms that are modulated by psychosocial cues (Brown, 1991a & b; Rossi, 1982, 1986a & b; Rossi and Cheek, 1988). This hypothesis was assessed intially in a qualitative manner by carefully examining the written diary reports of the subjects and patients in the author's two studies reported above (Rossi, 1992a & b) and was replicated by Lippincott (1990), Sommer (1992,

1993) and Sanders (1991a). These authors all determined that while there were the typically wide variations in the nature of what their subjects reported about the subjective aspects of their naturalistic trances, virtually all the classical phenomena of hypnosis were experienced even though they were not directly suggested.

While the contingencies of the ongoing therapeutic situations limited most of these studies to the qualitative level, Sanders (1991a) took the first step toward quantifying these findings by simply counting the frequencies of commonly reported hypnotic phenomena in naturalistic trance. She found, for example, the following frequencies of a few classical hypnotic phenomena in her group of 95 college age subjects: 69, relaxation; 39, dissociation; 18, imagery, dream and fantasy; 12, amnesia. Erickson's basic premise that patients in therapeutic trance tend to experience many of the classical phenomena of hypnosis spontaneously even when they are not suggested in any way, is supported by these studies as well as the more specific test of the predictions of chronobiological theory about age regression and analgesia to be reported in the next section on owls and larks.

5. Are there differences in the hypnotic susceptibility of Owls and Larks throughout the day?

Aldrich and Bernstein (1987) finding of bimodal peaks in hypnotic susceptibility in the morning and evening led Rossi to hypothesize that from a chronobiological perspective such results could be a reflection of the different optimal periods of hypnotic susceptibility in a mixed population of larks (people who claim to be more alert in the morning) and owls (people who claim to be more alert in the evening). Accordingly, Lippincott (1992 a & b) designed an experiment to test the hypothesis that (1) larks would have higher hypnotic susceptibility in the late afternoon (4 p.m. to 6 p.m.), (2) owls would have a higher susceptibility in the morning (8 a.m. to 10 a.m).and (3) there would be no difference in hypnotizability between midnight and 2 am when both groups would normally be asleep.

Colman's „Owl and Lark Questionnaire“ was used to select 42 subjects that could be identified as owls (N=21) and larks (N=21) using a median split within a larger group of college students who had taken the Harvard Group Scale of Hypnotic Susceptibility, Form A (HGSHS:A). It was found that owls have significantly higher scores the morning (mean=6, SD=2.22) than larks (mean=2.76, SD=2.20; $p<0.0001$). Larks, on the other hand, have significantly higher scores in the late afternoon (mean= 5.52, SD=2.68) than owls (mean=3.52, SD=2.11; $p<0.01$). There was no significant difference between owls (mean= 4, SD=1.17) and larks (mean=4.71, SD=2.49; $p< 1.19$) between midnight and two in the morning.

What is most significant about these results is the realization that if the owls and larks had not been separated there apparently would have be no significant differences in hypnotic susceptibility over time because the inverse periodic patterns of owls and larks would have canceled each other out. If future studies confirm such ultradian and circadian performance shifts in owls and larks it will require a profound reevaluation of many previous studies on psychobiological variables in general as well as hypnosis in particular. These results challenge previous conceptions of hypnotic susceptibility as a relatively fixed, unvarying trait of the individual (Hilgard, 1982).

A careful comparison of the hypnotic and chronobiological literature revealed that all but two of the classical phenomenon hypnosis, age regression and analgesia, were reported as characteristic of the low or near sleep or napping phases of our natural rest periods (Rossi, 1986, 1990; Rossi and Lippincott, 1992). This allowed the author to make the prediction that age regression and analgesia would be found as a natural behavioral manifestation of biological rhythms; the confirmation of this unique prediction (that would not be made by any other theory of hypnotic phenomena) could be regarded as further evidence for an association between chronobiology and hypnosis. Lippincott (1992c) accordingly tested this prediction by administering the Stanford Hypnotic Susceptibility Scale, Form C age regression subset and the Cold Pressor test of hypnotic analgesia to 60 graduate students at 8:00-10:00 A.M. and 8:00-10:00 P.M. in a rolling Latin square format. Colman's Owl and Lark Questionnaire as well as oral temperature (body temperature is one of the classical measures of the circadian rhythm in chronobiology) were used to identify the subjects using a median split. The predictions of chronobiological theory were confirmed when it was found that larks (identified by both questionnaire and body temperature) were significantly higher in age regression and analgesia in the evening. Subjects identified as owls, by contrast, had significantly higher age regression and analgesia scores in the morning.

In a more recent study to replicate Lippincott's original findings on owls and larks with a different population and set of controls, Sanders and Mann (1992) reported what initially seemed to be contradictory results. They found that owls reported a significantly greater subjective sense of trance depth in the afternoon and evening whereas the larks reported greater subjective depth in the morning. There were a number of important differences in the experimental procedures that could account for the differences between Lippincott and the Sanders & Mann study: (1) Lippincott used objective measures of hypnotic susceptibility (HGSHS:A) while Sanders\Mann used subjective measures of trance depth (which are positively correlated with the HGSHS:A, however); (2) Lippincott use of a longer hypnotic induction period with the HGSHS:A may have generated a more relaxed state in his owls in the morning and thus induced them to relapse more easily back into a passive state of hypnotic susceptibility in the morning when they are more vulnerable to rela-

xation and sleep than the larks. The Sanders\Man study, by contrast used the shorted and more challenging induction from the Stanford Clinical Scale which may have generated a more cognitively focused alert state in Larks in the morning and thus accounted for their superior performance relative to the owls.

Since the above analysis of hypnotic susceptibility in owls and larks was made, a third paper has been published in this area by Wallace (1993) apparently without knowledge of the Lippincott and Sanders & Mann papers. Wallace abstracts his paper as follows: „Day persons (those most alert during daytime hours) and night persons participated in two experiments to examine within - subject variability of scores over time on the Harvard Group Scale of Hypnotic Susceptibility, Form A, and the Stanford Hypnotic Susceptibility Scale, Form C. Regardless of scale used, day persons exhibited peak susceptibility at 10 a.m. and 2 p.m.; for night persons, peak susceptibly was found at 1 p.m. and between 6 p.m. and 9 p.m. Furthermore, two peaks of temperature increase (1 p.m. and 6 p.m.) appeared to be associated with peaks in hypnotic susceptibility. However, such was shown to be associated with periods of food intake rather than with increases in hypnotic susceptibility. Results are examined with respect to methodological concerns and the potential existence of ultradian rhythms for hypnotic responsiveness."

Wallace's results thus brings the score of 2 studies to 1 in favor of hypnotic susceptibility being higher for larks in the morning and higher for owls in the afternoon and evening. Future research will be needed to resolve this important issue. Among the methodological differences to be considered will be (1) how owl-lark status is defined (Wallace used The Alertness Questionnaire while the Lippincott and Sanders-Mann studies used the Colman Owl and Lark Questionnaire), (2) how hypnosis is induced and assessed, (3) how temperature is assessed in relation to owl-lark status (Lippincott, 1993) as well as (4) other situational and human factors such as the variability in the vividness of imagery as a function of time-of-administration (another chronobiological rhythm reported earlier by Wallace, Turosky and Kokoszka, 1992).

The significance of all these psychosocial and experimental variables in assessing hypnotic susceptibility with owls and larks reminds us of the subtlety of hypnosis research and how easy it is to be misled. Failing to take the owl-lark variable into account, for example, could be responsible for many type 2 errors in hypnosis research - failing to reject the null hypothesis when it should be. When the responses of owls and larks are averaged together, as they have been in all previous research in hypnosis, they may cancel each other out so that the researcher reports that the null hypothesis has been accepted when it should be rejected. This means that many previous research reports that reject hypnosis as a significant variable may be in error. At the very least, ignoring the owl-lark variable

could account for many inconsistent findings in the clinical and experimental literature in hypnosis.

6. Is there an ultradian association between the nasal brain-breath rhythm and hypnosis?

One of the most intriguing areas of recent research exploring the association between hypnosis and psychobiological rhythms is the so-called nasal breath-brain connection. The German rhinologist, Kayser (1895) is credited with recognizing and measuring the widely varying ultradian shifts in the degree to which air is inhaled in the left or right chamber of the nose. In humans the left and right chambers of the nose alternate in their size and shape to change the degree of air flow through each every few hours. Recently Debra Werntz (1981) reported a contralateral relationship between cerebral hemispheric activity (EEG) and the ultradian rhythm of the nasal cycle. She found that relatively greater integrated EEG values in the right hemisphere are positively correlated with a predominant airflow in the left nostril and vica versa. In a wide-ranging series of studies Werntz et al (1982a & b) found that subjects could voluntary shift their nasal dominance by forced uninostril breathing through the closed nostril. Further, this shift in nasal dominance was associated with an accompanying shift in cerebral dominance to the contralateral hemisphere and autonomic nervous system balance throughout the body (Shannahoff-Khalsa, 1991). The ultradian nasal cycle is not only a marker for cerebral hemispheric activity, but it also could be used to voluntarily change the loci of activity in the highest centers of the brain and autonomic system that are involved in cybrenetic loops of communication with most organ systems, tissues and cells of the body. Some of these investigators hypothesize that this nasal-brain-mind link may be the essential path by which the ancient practice of breath regulation in yoga led to the voluntary control of many autonomic nervous system functions for which the Eastern adeps are noted (Brown, 1991; Rossi, 1990b, 1991).

These relationships inspired a recent Ph.D dissertation by Darlene Osowiec (1992) who assessed hypothesized associations between the nasal ultradian rhythm, anxiety, symptoms of stress and the personality process of self-actualization. She found that: „(1) there is a significant positive correlation between self-actualizing individuals having low-trait anxiety and stress-related symptoms and a regular nasal cycle... and (2) non-self-actualizing individuals with high levels of trait anxiety and stress-related symptoms exhibit significantly greater irregularity in the nasal cycle..." These results are reminiscent of the ancient texts that emphasize that an irregular nasal cycle, particularly one in which the person remains dominant in one nostril or the other for an excessively long period of time are associated with illness and mental disorder (Rama, Ballentine and Ajaya, 1976).

In a more recent 12-week follow up study Osowiec (personal communication) is finding

that highly hypnotizable subjects evidence more regularity in their ultradian nasal rhythms when they practice self-hypnosis but low hypnotizable subjects do not. Osowiec tentatively concludes that her findings with the ultradian nasal rhythm are similar to the general types of association that are found between stress, symptoms, personality and responsiveness to therapeutic hypnosis.

To further assess the hypothesis of an association between hypnosis and the nasal breath-brain link Lippincott (1992c) studied the effect of two forms of hypnotic induction: (1) a traditional form of hypnosis via the Harvard Group Scale of Hypnotic Susceptibility and (2) a naturalistic form of hypnosis via Rossi's Ultradian Accessing Formula (Rossi, 1986), on the nasal rhythm. He hypothesized that since hypnosis has been associated with shifts in cerebral hemispheric dominance (Erickson and Rossi, 1979) one would expect that hypnotic induction would be associated with a shift nasal dominance. He found that both groups of subjects experienced more nasal dominance shifts than a resting control group and, further, the group that experienced a naturalistic hypnotic induction exhibited significantly more nasal shifts than the traditional hypnotic induction group.

III Towards a mathematical model of naturalistic hypnosis

The Sanders and Mann study (1992) made an initial effort to examine the effects of two other important chronobiological variables, light and temperature on hypnotic susceptibility. The range over which they used light (room illumination of 60 versus 400 watts) and temperature (surface room temperature of 68 degrees versus 78 degrees Fahrenheit) in the morning and evening did not effect hypnotic susceptibility as they measured it. These negative results are readily explained by recent chronobiological research that reports how the effects of light on the endogenous circadian rhythms of core body temperature and cortisol are most evident when administered two or three hours before awakening when body temperature is at its daily minimum (Jewett, Kronauer and Czeisler, 1991) rather than the morning and evening hours of the Sanders/Mann study. The really crucial test of the chronobiological theory of hypnotic susceptibility therefore remains to be done. Researchers must administer an appropriate light stimulus (as defined by the experiments of Jewett et al. cited above) to subjects a few hours before awakening to determine if the time of optimal hypnotic susceptibility is shifted in owls and larks by the amount predicted by the shift induced in their circadian rhythm. The interpretation of the results of such experiments may be a bit more difficult than appears, however. As many researchers (Jewett et al., 1991; Winfree, 1991) have noted, this low point of core body temperature is at a „singularity point" in the circadian rhythm; that is, „the organizing center of the [circadian] pattern" (Winfree, 1991) at which the circadian rhythm may be reset in a non-linear manner

subsequent psychobiological rhythms. This means that the resetting of the human circadian pacemaker at the singularity point a few hours before awakening can lead to an apparent temporary loss of the regularity of the circadian rhythm and consequently quasiperiodic (non-linear) responses in hypnotic susceptibility in owls and larks. Research on owl-lark hypnotic susceptibility shifts by an appropriate light stimulus at the singularity point of the circadian cycle may be modeled appropriately only by the most sophisticated mathematical models of non-linear dynamics on the leading edge of current psychobiological studies (Glass & Mackey, 1988).

While such non-linear dynamic models of hypnosis and chronobiology are complex we can outline some of their basic parameters with simple harmonic (periodic or oscillatory) motion as illustrated in figure one. The four parameters of interest in this mathematical model are the amplitude, period, phase and entrainment of hypnotic behavior. A broad approach to the relationship between these parameters of our natural psychobiological rhythms and hypnosis leads to many basic questions. To what degree does hypnosis modulate (synchronize or entrain) the amplitude, phase or period and frequency of psychobiological rhythms? From figure one we can infer that the entrainment of the high and low phases of psychobiological rhythms is of paramount interest in hypnotherapy. The basic problem of hypnotherapy from this point of view may be stated as one basic question: How does hypnotherapeutic suggestion synchronize, entrain or „phase lock" the high and low phases of our natural psychobiogical rhythms for therapeutic purposes? Some specific research areas that are of pressing concern for the further assessment of the chronobiological theory of hypnotherapeutic suggestion are outlined below.

Research proposals assessing the chronobiology of hypnosis

1. Triple Blind Research: Our two hundred-year-history of hypnosis has taught us that the therapist's, experimenter's and patient's hopes and expectations can influence hypnotic responsiveness in many mysterious ways. Most of the studies assessing the chronobiological hypothesis of therapeutic suggestion reviewed above may be criticized on this basis. Most of these studies need to be replicated with a triple blind methodology: above all the theorist and/or the research director planning the research, who has hopes and expectations about the results, needs to be separated from the entire process of conducting the experiment and the analysis of its outcome. The subjects, experimenter and data analyst/interpreter must all be „blind" as to the theory and purpose of the study.

2. Some of the most interesting leading edge chronobiological research has developed a methodology for shifting the human circadian pacemaker and attenuating endogenous circadian amplitude (Jewett et al., 1991). Since about a dozen studies reviewed in this

paper found hypnotic susceptibility is a function of ultradian/circadian rhythms, we would expect that shifting and/or temporarily attenuating a subject's circadian amplitude would be a way of temporarily sifting the peak period and /or modifying the subject's hypnotic susceptibility. A triple blind study utilizing the well controlled Jewett methodology for modulating human biological rhythms would be the most direct and convincing documentation of an association between hypnosis and chronobiology.

3. Since a number of independent studies have reported that hypnotizability (Higard, 1965) and the parameters of biological rhythms (Moore-Ede et al., 1982; Wever, 1988) both change with age we would predict that a systematic studies would find a significant correlation between the changing parameters of biological rhythms and hypnotizability over a wide age range. Likewise we would predict that some diagnostic groups that have been found to have altered hypnotic susceptibility (Evans, 1991) would have corresponding changes in their biological rhythms. In general we would predict that any variable that modulates hypnotic susceptibility would also modify chronobiological rhythms (their amplitude, phase, period, frequency, entrainability etc.). These clinical associations would have obvious therapeutic as well as theoretical implications.

4. New scales of naturalistic hypnotic susceptibility need to be developed that would measure (a) the degree to which hypnotic phenomena can be experienced without direct suggestion (Rossi, 1986 d) and (b) the psychobiological and chronobiological correlates of such naturalistic hypnotic susceptibility. We would predict that naturalistic suggestibility on such a scale would be a better predictor of the psychoimmunological and psychoendocrinological responsivenss of human subjects to hypnotherapeutic suggestion than current scales that focus entirely on the psychosocial and behavioral level of hypnotic responsiveness. The use of non-invasive methods of measuring molecular and immunological variables associated with naturalist hypnotic responsiveness will greatly facilitate research in this area (Kirschbaum and Hellhammer, 1989).

5. Use the new nasal-hemispheric dominance methods to determine the relatedness of hypnosis to the ultradian shifts in cerebral dominance as reported by Lippincott and Osowiec in this review. Methodological issues and preliminary data on ultradian rhythms in consciousness (eg. vividness of visual imagery and self rating scale for states of consciousness) are currently under development by Kokoszka & Meus (In preperation).

6. Clinical experience and experimental research suggests that so-called „chronic pain" as well as the classical psychosomatic symptoms are actually experienced periodically throughout the day with an ultradian periodicity (Lloyd & Rossi, 1992; Kupfer et al., 1988; Reinberg & Smolensky, 1983). Research is now needed to confirm the chronobiological parameters of most medical and psychological symptomology on all levels from the cogni-

tive, emotional, behavioral and neuroendocrinological to the cellular-genetic (Rossi, 1986/1993). Studies will then be needed to assess the hypothesis that hypnotherapeutic suggestion is effective precisely to the degree that it is able to entrain the chronobiological parameters of pain and psychosomatic problems and shift them to facilitate healing. This implies that hypnotherapeutic healing involves the modulation of chronobiological and psychobiological parameters at the levels of molecular and genetic expression (Glaser et al., 1990, 1993) as well the psychosocial level.

7. Calculate the psychobiological constants and parameters of the mathematical model outlined in figure one for the various classical hypnotic and hypnotherapeutic phenomena. Are they the same or different from such parameters calculated for chronic pain and psychosomatic symptoms? How general is this chronobiological model of hypnotherapeutic suggestion and healing? Are chronobiological variables always involved in hypnosis and symptomatology or is there a class of hypnotic phenomena and symptoms that are not in any way related to the mathematical model introduced in this paper?

Summary

A careful consideration of Milton Erickson's naturalistic approach has led us to consider chronobiology as a new window into the psychobiology of hypnosis on all levels from the psychosocial to genetic expression. The traditional significance of time and rhythm in the dynamics of hypnotherapy finds a deep conceptual foundation in the ten years of research on the chronobiological theory of therapeutic suggestion reviewed in this paper. Most researchers currently believe that what seems to be an extension of the normal parameters of many mind-body performance skills via hypnosis is actually the optimization of the individual's natural range of abilities. The chronobiological hypothesis proposes that the source and parameters of hypnotherapeutic responsiveness may be found in that class of circadian (daily) and ultradian (more than once a day) psychobiological rhythms that are responsive to psychosocial cues. It now appears that all psychobiological processes on the cognitive-behavioral, neuroendocrinological, immunological and cellular-genetic levels that manifest a natural variability during ultradian and circadian rhythms are also modifiable by psychosocial cues such as hypnosis. This leads to the conjecture that what has been traditionally called „therapeutic suggestion" may be, in essence, the accessing, entrainment and utilization of the natural variability of ultradian and circadian processes that respond to psychosocial cues. Within this framework, the classical phenomena of hypnosis may be conceptualized as the entrainment or „phase-locking" of extreme manifestations (and/or perseverations) of time-dependent psychobiological processes that are responsive to psychosocial cues. The natural psychobiological rhythms associated with memory, lear-

ning, sensory-perceptual acuity, behavior, emotions, dissociation and psychopathology may be understood as mediating variables between the suggestions of the hypnotherapist and the psychophysiological processes that are the essence of mind-body communication and healing at the molecular level. A host of new research approaches for exploring a tentative mathematical model of the chronobiological theory of hypnotherapeutic suggestion are proposed.

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