Normal Adult Human Sleep as a Problem-Solving Process

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The article "The Role of Sleep in Psychological Development: Introduction" (this website) sketched a view of normal adult sleep cycling in which the progression through sleep stages is interpreted as being largely expressive of a continuous learning process in which adaptations are honed over several non-REM (NREM)-REM sleep epochs. NREM sleep is seen as ever contributing preparatory effort for REM sleep, with the most fundamental distinction between the two modes of sleep being that mental content is literally experienced during REM sleep while during NREM sleep it is not. The elements of this position will be summarized here, and then their logical consequences will be pursued in interpreting normal adult human sleep cycling in unprecedented detail.

According to this viewpoint, experiencing trial adaptations during REM sleep accomplishes two things. The first involves a form of reality testing. By experiencing a set of adaptations in the real world of a person's memory, the person becomes better able to judge the full range of possibilities the adaptations need to address. Thus, one developmental purpose of the testing is to broaden the experiential base of the adaptations to achieve increased flexibility, since the events of the preceding day being adapted to will probably never again occur in exactly the same way. This diagnostic process operates, in part, by activating related long-term memories that should have been included in the adaptations. Memories that have been activated in a particular REM period are not integrated into the adaptations during that REM period to any great extent. Rather, they are mostly made ready for use as new ingredients in the more inclusive adaptations to be formed during the next interval of NREM sleep.

The second thing that REM presentation accomplishes is a form of positive reinforcement with regard to those portions of the adaptations that are supported in compromise fashion by both the person's forward-seeking goals and his internal concept of reality. Positive reinforcement is a progressive achievement as the adaptations are honed over several NREM-REM sleep epochs. This reinforcement is seen as giving the perceptual, motor, and motivational adaptations temporary prominence as the structural underpinning of a person's waking behavior.

Upon going to sleep, a person assesses the outcomes of the behaviors employed during the preceding day in relation to his developmental goals initially during slow-wave sleep, at which time all aspects of the person's life that were impacted during the day are considered concurrently, in a manner that may be likened to parallel distributed processing, but which is actually superior to it, because of the possibility for emergent conclusions arising from the application of various separate lines of thought to one another. It is through such emergent processing that diverse aspects of a person's life are knitted together in an integrated fashion.

During the initial descent to slow-wave sleep, a person attempts to form a set of adaptations based on the events of the previous day, taken as a whole. When this adaptive "solution" has been reached, a move is made toward REM presentation. The first slow-wave adaptations, being reactions to the events of the previous day, are tailored to the specifics of those events. As REM presentation continues, related but not included

memories are continually evoked, whose growing presence helps point up inadequacies in the ongoing simulation of experience, possibly through the agency of the anterior cingulate cortex. Since the first slow-wave adaptations are too closely tied to previous-day events, the inadequacies of these adaptations become evident relatively quickly, with the recognition of these inadequacies bringing this REM period to a quick end.

The second slow-wave period is concerned with arriving at adaptations that are based on both the memories of the events of the previous day and the related activated memories from the first REM period. This leads to a second REM presentation, which generally evokes more excluded memories, whose activation again points up inadequacies in the adaptations. Because there are generally fewer of these memories and the second NREM integration is better organized, the second REM period generally lasts longer. The activation of more memories leads to a NREM period that contains some SWS sleep and a subsequent REM period that is longer yet. During this REM period, generally no more excluded memories turn up, so organizational problems alone bring this REM period to an end, leading to cycling between stage 2 and REM sleep, as the effort to hone the set of adaptations continues as an organizational activity. Organizational changes are seen as being made within REM periods as well.

The psychological honing that takes place over sleep is largely involved with finding ways of looking at reality that support developmental initiatives while conflicting minimally with a person's longstanding reality concept. As a result, psychological development remains a struggle for a person saddled with pathogenic beliefs, because the beliefs ever seek interpretative inroads as a person sleeps. The progressive integration of long-term memories into new adaptations over several sleep epochs thus may be seen as providing a mechanism whereby childhood memories persist as a shaping influence in a person's adult behavior.

The Psychology of Problem Solving

The above discussion may seem to be a set of ad hoc rules designed with a person's progression through sleep stages during a normal night of sleep in mind. This is not at all the case. I began with an understanding of daytime problem solving, which I gradually realized could be applied to an understanding of sleep. To great extent, in my view, sleep is a type of problem-solving activity. It should not be surprising, therefore, that it proceed in an analogous fashion to daytime problem solving. After all, we do not become a different kind of being when we sleep. Because it will be helpful in interpreting sleep research data and in removing any onus of the theory being a set of ad hoc rules, I would like to preface this discussion of the sleep cycling data with my understanding of daytime problem solving and of the analogies I drew in relating this to sleep.

I was trained as a theoretical physicist, which means that I was trained in a particular area of applied mathematics. This training provided me with many mathematical problems to solve. There is of course no inherent difference between mathematical problem solving and any other kind of problem solving, but one does generally try to solve such problems in one sitting, whereas with other instances of problem solving, one may work in a less intensive fashion. With mathematical problem solving, therefore, one is led to witness problem solving as a continuous activity from start to finish. In relating to the discussion that follows, therefore, I ask the reader to recall the last time he or she solved a

mathematical problem, which may have been the last time one struggled to help a child solve a mathematical word problem assigned as homework.

In analyzing problem solving, I was initially struck by the fact that it is a mostly conscious activity only for easy problems. That is, it is only when we find a problem easy that we confront the problem, consciously hit upon an approach to solving it, and then consciously work out the details of the solution.

When a problem is hard, we usually start considering the problem consciously, but quickly become dissatisfied with our approach. At that point, our minds go consciously blank for a time, until an "idea" pops into our heads, which reveals itself as being an organized approach to solving the problem that is different from the one initially tried. While it may be possible to suppose that problem solving had ceased during the time when our mind was consciously blank, one would then have no explanation for the new approach that eventually emerged. A better supposition would be that problem-solving activities had switched to an unconscious mode, which ceased when a new general approach to solving the problem had been worked out.

If a problem is truly difficult, the first thought-out approach that consciously comes to mind will eventually also lead to a dead end after a certain amount of conscious work, causing problem-solving effort to again revert to the unconscious mode until a different idea can be offered to one's conscious faculties. This switching between conscious and unconscious work could involve five or more unconscious-conscious epochs before an entirely valid approach to solution is finally hit upon.

Examining these cycles more closely, one finds three characteristics. First, when one examines the mental contents used to solve the problem, one finds that the mix of ingredients in working memory changes from one conscious period to the next. Not only do new memories participate in subsequent conscious efforts, but changes in perspective based on past experience may also be found. While it may be supposed that these new ingredients were put in place during the unconscious mode of problem solving alone, that supposition would leave no explanation for the second characteristic, which is the sense of dissatisfaction that arises during conscious problem solving.

Our conscious activities are monitored by a critical faculty that judges how well we are doing in real time while we consciously work on the problem, and which apparently participates in bringing conscious activities to an end. Without the activation of something not yet participating in the conscious solution, this critical faculty would have no basis for dissatisfaction until the bout of conscious problem solving obviously came to a dead end. It seems more logical to suppose that the dissatisfaction is based on memories that have been activated during the course of conscious problem solving but not included in the conscious approach being worked out.

Generally a person reacts to a growing sense of dissatisfaction by making relatively minor adjustments in the conscious approach being taken, with the altered approaches making some use of the activated memories. These adjustments may seem to work for a while but then peter out, leading to another growing sense of dissatisfaction, which prompts another shift in one's mode of attack. There is then a waxing and waning of satisfaction during an interval of conscious work. There are moments when everything seems to be working fine, and moments of dissatisfaction during which a person searches

for a new approach, with the waxing and waning of seemingly successful effort finally coming to an end with the recognition that a different tact must be taken that more fully uses what has been learned during the bout of conscious problem solving. At that point, work begins at the unconscious level to develop that significantly different approach.

The first two characteristics of problem solving provide evidence for the third, namely, that we solve problems through a honing process, one in which successive conscious bouts at problem solving get better with each iteration. To understand why succeeding bouts of conscious problem solving progressively better as we home in on a solution, it is necessary to suppose that we learn something from each bout and that these lessons participate in the formation of each subsequent unconscious conceptual framework that serves as the basis for the next "good idea."

The unconscious-conscious problem-solving cycles initially consist of long periods of unconscious work, with the periods of conscious activity initially being quite short. During the first conscious period following a long unconscious interval, thought is generally fragmentary, and a person has difficulty bringing thoughts to mind. When this first conscious period ends, another long period of unconscious work follows, which leads to a generally longer conscious period in which thoughts flow more readily. With each progressive unconscious-conscious epoch, one generally finds that successive conscious bouts lengthen and become more engaging, while the previous unconscious portions shorten. That is, as problem solving continues, the "good ideas" that pop into our mind get better, meaning that more conscious activity is required before discovering inadequacies in the ideas, and it generally takes less unconscious time for us to come up with the ideas.

I trust that it is now obvious how the concept of normal adult sleep cycling I have presented makes use of a comparison between unconscious problem solving and NREM sleep, on the one hand, and conscious problem solving and REM sleep, on the other. A notable difference between the unconscious-conscious epochs of daytime problem solving and the NREM-REM epochs of sleep is that the former do not adhere to a 100-minute timeframe. There is apparently no explaining this species-specific regularity in terms of problem-solving concepts, but then it was never claimed that adaptive problem solving is the only thing going on during sleep.

Dreaming and Problem Solving

As an example of one kind of problem we solve during sleep, I would like to focus on an aspect of my analysis of Freud's botanical monograph dream ("A New Look at Freud's Botanical Monograph Dream," this website), which was the last dream Freud dreamt during the night of March 9, 1898. One thematic plane of this dream concerns the situation Freud had created by "forgetting" to buy his wife cyclamens, the type of flowers she most liked. The question I would like to pursue is how this thematic plane was generated in response to the events of the preceding day. Everything said of course is pure speculation. My aim, however, is not to accurately peer into Freud's mind as it operated over 100 years ago, but merely to illustrate the concept of sleep under discussion.

Adaptations formed in the furtherance of human relationships are often based on guesses founded on inadequate evidence. Freud apparently went to sleep that night quite satisfied

with his behavior with respect to his wife. As he indicated in his analysis of the dream, he neglected to buy his wife flowers out of spite. This forgetfulness did not cause any problems in the marriage so far as Freud could see, even though his wife Martha must have noticed that he regularly remembered to purchase flowers for his mother. That he didn't give this aspect of his relationship any thought the previous day is indicated by his continual claim during his analysis of the dream that cyclamens represented an indifferent stimulus he had received. This word presented itself in the title of a book in a bookstore window he had passed by during the day. The book was a treatise on the flowers.

A much more important instigator of the dream, as far as Freud was concerned, was a conversation with his old friend Dr. Leopold Königstein, who had berated Freud for being too absorbed with his hobbies, to the detriment of his professional medical practice. During the course of that conversation, a woman named Frau L. was discussed briefly. Apparently also during the previous day, Martha had made an innocent remark, perhaps to the effect that artichokes, Freud's "favorite flower," were too expensive to purchase at the market. By the end of the night of sleep, all of these separate details had become woven into a fabric of thoughts that included a guess that Martha was becoming upset because of Freud's neglectfulness and a plan for dealing with the situation. Our speculation centers on how the weaving took place.

In Freud's conversation with Königstein, the hobbies that were criticized represented Freud's get-rich-quick schemes, which included the book on dreams he was writing and a paper he was working on concerning the theory that unconscious motives were often behind forgetting. It seems reasonable to suppose that during the first episode of slow wave sleep, Freud spent most time trying to find ways of dealing with Königstein's criticisms and with justifying his own approach to success. The impressions relating to cyclamens, Frau L., and artichokes probably remained unconnected in Freud's mind, with his perception being that Martha had merely commented on market conditions at the grocery store. This perceptual stance was part of what was experienced during the first REM dream, at which time alarm bells started going off, which helped to bring that first REM dream to an end.

During the second episode of slow wave sleep, Freud possibly began to consider the possibility that Martha's remark was not as innocent as it had seemed, that she may have been putting him on notice that she was not going to buy him his favorite flowers anymore until she sees cyclamens coming her way. Another possible implication of the remark was a commentary on their sorry financial condition brought about by a lack of patients. So instead of having merely Königstein attacking him, it now may have seemed to Freud that Königstein and Martha were ganging up on him.

Frau L. was related to all of this because of a story she had told Freud long ago about her husband forgetting to buy her her favorite flowers on her birthday. She immediately became upset because she interpreted her husband's forgetfulness as evidence that she no longer held the same place in his heart and thoughts. It is possible that this memory also became activated during the first REM period and participated in the subsequent slow-wave thought. Clearly, if Frau L. could become upset at her husband's forgetfulness, so could Martha. This memory then would seem to increase the probability that Freud had a problem on his hands that he had to deal with. Increasing the probability even more was a memory that was possibly activated during the next REM dream. This was the memory

that Frau L. had spoken to Martha only a couple days previously. It was quite possible that the subject of flowers came up and that Frau L. told Martha of the husband-forgetting-flowers incident and of her interpretation of it.

Freud spent the rest of his night planning his strategy for dealing with the situation. His ultimate solution, which was indicated in the botanical monograph dream, was ingenious. He would not forgo retribution; rather, he would continue taking revenge, but do it in a way that Martha would never notice. Martha would get her flowers the next day, and Freud would analyze the dream he dreamt and write up the analysis in his dream book in such a way that it clear that he "forgot" to buy his wife flowers because of spite. Thus Freud would publicly declare his resentment toward his wife. Martha, however, would not learn of this, because he knew she would never read the book. Martha's indifference to Freud's intellectual life was one of the main factors sustaining Freud's commitment to revenge.

Night-to-Night Variability of the EEG Record

I will now turn to the task of applying the problem-solving concepts presented so far to an interpretation of normal adult human sleep cycling. I will interpret the data as a physicist would. That is, I will not chop up the data into sleep stage segments for the purposes of statistical analysis, as is standard sleep-research practice. Rather, I will interpret the data as it unfolds naturally during nights of sleep. This interpretation will include lending meaning to confluences of separate data streams.

My method will be to pursue the numerous logical implications of the notions presented so far, which turn out to provide myriad empirical windows through which to test the theory. I will begin discussing these implications in terms of a figure from Dement and Kleitman's (1957) seminal paper, which is reproduced below (Figure 1) and depicts sleep cycling for three nights of normal adult human sleep. Rapid eye movements during REM periods are indicated by black bars, and the vertical hash marks under each diagram indicate body movements, with the larger marks representing larger movements.

The authors do not say whether the three EEG tracings came from the same person. Nevertheless, they could have. A person's progression through EEG stages is not exactly the same night after night. Considerable variability exists from one night to the next. This I see as being consistent with the adaptive activity postulated by the problem-solving model. The experiences of each day leave us with a somewhat new adaptive problem to solve during sleep, which leads to some variability in our march through sleep stages. The existence of night-to-night variability of course doesn't prove anything in itself.

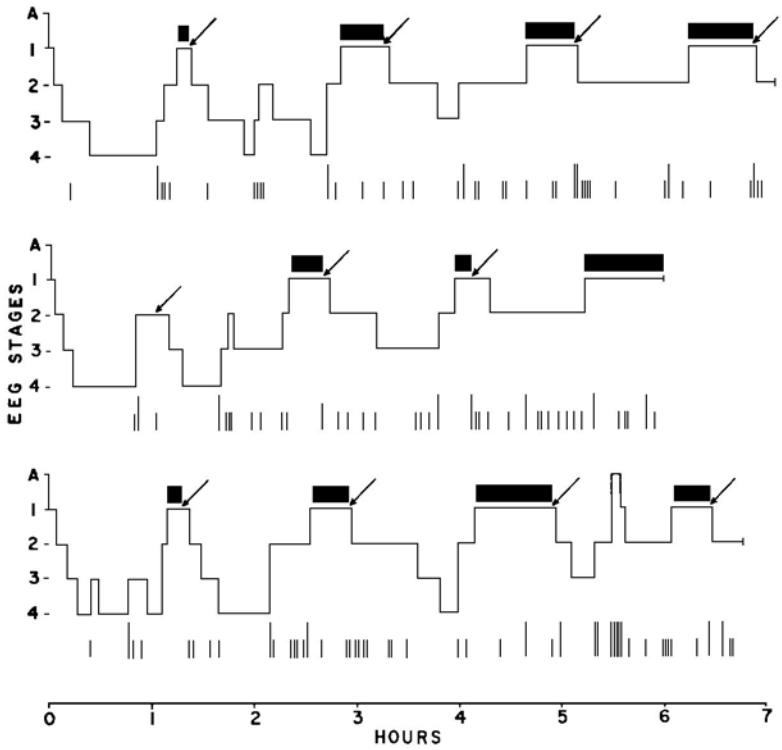

Figure 1. Three normal nights of sleep. The hash marks at the bottom of each diagram represent body movements, with the larger marks representing larger movements. Diagram from Dement and Kleitman (1957).

Characteristics of the First REM Period

I have interpreted the fact that the first REM period of an evening of sleep is relatively short in length as being indicative of an unusually sharp "critical" reaction brought upon by the circumstance that the adaptation being presented excludes the implications of many related memories held in long-term storage. These memories become activated as REM presentation proceeds, undermining a person's commitment to the adequacy of the presentation. I would now like to bring some evidence to bear on these interpretations.

In discussing the characteristics of the various REM episodes, Dement and Kleitman mention an indication that can possibly be interpreted as evidence of an unusually sharp critical reaction with regard to the first REM period. While discussing the persistence of the stage 1 EEG during eye movement periods, they mention that "rare exceptions to this occurred when the EEG changed briefly to stage 2 in the middle of an eye movement period." They go on to state "this 'slipping' down to stage 2, when seen, usually happened during the first eye movement period and almost never occurred later in the night." If we interpret these movements to stage 2 as brief reintegration attempts, we can see them as patchwork efforts to restart the REM presentation despite great resistance, resistance coming possibly from an overly sharp ongoing critical reaction.

I have drawn an analogy between NREM-REM sleep cycling and daytime problem solving and have pointed to the fact that we initially have difficulty bringing thoughts to consciousness, presumably due to what I have characterized as a sharp critical reaction.

On the basis of this analogy, one would expect to find a similar circumstance with respect to the first REM period, which could take the form of an inhibited simulation of experience. Herman et al. (1968) found some evidence of this. They report that 75% of first REM presentations are in black and white, while about 75% of our dreams from the 2nd through the 5th are in color.

Shown in the middle diagram of Figure 1 is another occurrence that could be related to the inadequate integrations that generally support first REM period attempts. Shown here is an apparent instance of a REM attempt that was aborted in stage 2.

Implicit in the assumption that stage 2 is primarily concerned with making final preparations for REM dreaming is the contention that this stage represents a physiological mode of processing information in which critical responses to REM presentation can be anticipated much more accurately than in either stage 3 or stage 4. Thus occurrences as shown in Figure 1, occurrences which, incidentally, take place about 20% of the time, can be interpreted as the result of stage 2 judgments regarding the inadequacy of NREM thought for REM presentation.

REM Sleep and Body Movements

Figure 2 shows that body movements tend to cluster at the beginning and termination of REM periods. This tendency is suggested by Figure 1 data, as well. The model postulates that a movement toward REM sleep is initiated when a NREM "solution" has been reached and that a REM period ends when the credibility of that solution has become undermined. A similar situation occurs during our waking problem-solving efforts when we get an "idea" as to how the solution may be worked out and subsequently find that the idea has problems with it. Interestingly, body movements are generally made at both times.

We generally become animated when an idea pops into our head, making an excited body movement at that time. We also generally make a body movement when our conscious work arrives at a dead end—we may sit back in our chair or turn to look out the window or shift our position so that we can put our feet up. The point is that we generally do something at each juncture, with the body movements associated with the arrival of an idea being more animated than those associated with the end of conscious work.

Taking the correspondence with daytime problem solving seriously means that the body movements at the start of a REM period should be more animated than those at the end of a period, since the former would be associated with an "I got it!" response, while the latter would represent a settling back to begin developing a new solution. Unfortunately, I know of no evidence that bears on this point.

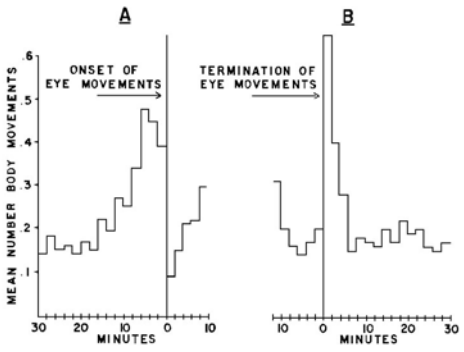

Figure 2. Body movements increase with the onset and termination of REM periods. Diagram from Dement and Kleitman (1957).

REM Attempts Aborted in Stage 3

The first and second EEG diagrams in Figure 1 show instances of upward movements to stage 2 that ultimately give way to downward movements without intervening REM episodes. As has been indicated, the model views those as aborted REM attempts, as NREM "judgments" that REM presentation would be premature. The bottom diagram, however, shows occurrences that seem to conflict with this picture. Here, upward movements stop at stage 3 before turning back to stage 4.

I have, for the sake of simplicity, lumped stage 3 and stage 4 together as slow-wave sleep. Stage 3, however, is defined in a way that distinguishes transitions from it to stage 2 in a rather arbitrary way. The sleep model presented here would predict that instances in which downward movements in the EEG, such as those shown in the first NREM-REM epoch of the last diagram, are movements from stage 3 records that are borderline for stage 2.

NREM Sleep and Body Movements

The claim that NREM sleep is ever a preparation for REM sleep creates the implication that *every* upward movement in the EEG record is a movement toward REM dreaming, whether or not that stage was reached. To bring some evidence on this point, let us consider the vertical hash marks at the bottom of each EEG tracing, indicating body movements. Seen here are the body movements at the beginning and end of each REM period, and even during REM periods, which Dement and Wolpert (1958) have found to be associated with stoppages of the dream display. Body movements are seen at other times, too. We will turn our attention to these now.

If every upward movement in the EEG is a REM attempt, and if REM attempts are generally accompanied by body movements, then upward movements in the EEG should be generally be accompanied by body movements, whether or not the REM stage was reached. Downward movements in the EEG from one NREM stage to another, however, should not, since they lack any connection to REM state psychology. This is what the model predicts and what may be seen to occur in each of the three diagrams Dement and Kleitman offer.

Seen in the record, however, are also a few body movements coincident with downward shifts and others correlated with no shift in NREM EEG stage. There are two factors that should be considered in any future study. An effort should be made to determine whether the body movements at the onset of REM periods can be classified as being of a similar type, as the model suggests. If a consistent similarity can be found, then my prediction would be that most upward swings in the NREM EEG should be accompanied by body movements of this kind and that body movements during downward NREM shifts should possess a different character.

The second consideration has to do with the circumstance that lighter and deeper moments exist within many NREM EEG stages. It is possible, therefore, that at least some of the body movements that took place during an apparently unchanging NREM stage were correlated with a temporary lightening of stage that did not persist long enough to be counted as a stage change.

'Paradoxical' GSR Data

Spontaneous galvanic skin responses (GSRs) have been linked to "arousal" and "emotionality." It has struck sleep researchers as being paradoxical, therefore, that highest GSR activity is usually associated with the deepest sleep stage of all, stage 4, while the most aroused and emotional stage, the REM state, is often characterized by minimal GSR values (Johnson and Lubin, 1966) (see Figure 3).

Interestingly, something similar happens during daytime problem solving. When we are completely stumped by a problem, and our minds remain stubbornly blank, we find that we are extremely uncomfortable, because we are anxious as to our ability to solve the problem, because every moment we sit apparently with no ideas in our head is a moment of judged failure. All of this discomfort vanishes, however, when an idea pops into our minds. Suddenly we are excited and confident and having fun.

I do not know that our blank intervals during waking problem solving efforts are actually associated with relatively high GSR activity, relative, that is, to our periods of conscious work. Nevertheless, I believe that the high GSR values of delta sleep are related to a person experiencing difficulty in arriving at a suitable solution and that the REM state's minimal GSR readings are expressive of the renewed confidence that comes upon achieving and applying an organized approach.

Initially, we presumably have no idea as to how the events of the previous day can be organized. It is plausible to assume that we are concerned about this and that we are relieved to finally arrive at a solution that can be worked out during the REM state. In a general way, therefore, the problem-solving model has no trouble with the appearance of high GSR values during stage 4—because it sees them as being related to frustration—and to low values during REM sleep—because it sees them as being related to a senses of relief and excitement.

When we work on a difficult daytime problem, the anxiety we feel during our blank intervals is most intense at first and then lessens after a period or two of active work, due to the sense of progress these generate. This implies that there should be a decrease in GSR activity in each NREM stage as a period of sleep continues. Another prediction this analogy makes is that if a person is put under stress during sleep, by, say, being forced to

sleep in a strange laboratory setting for the first time, there should be an across-the-board increase in the number of GSR responses. Figure 3 shows that both predictions are verified.

If a person does actually experience difficulty in achieving his initial adaptive framework and if high GSR readings are actually expressive of the fear that a suitable integration may not be found, one would think that this fear could at times get out of control and manifest itself in terms of nightmares. Thus the interpretation I have presented implies that NREM nightmares should be most frequent during a person's first two NREM intervals, that these should occur during stage 4 sleep, and that they should be more frequent during the first NREM interval than during the second.

Fisher, Byrne, Edwards, and Kahn (1970) made a study of REM and NREM nightmares. While they did witness a few relatively mild stage 2 nightmares, they state that most NREM nightmares arise out of stage 4 sleep. These were characterized by "sudden cataclysmic breakthroughs of panic with intense vocalization or bloodcurdling screams" and were found to take place "mostly during the first two NREM periods, 70 percent occurring during the first NREM."

If sleep time GSR activity is related to a person's sense of confidence regarding his ability to achieve a suitable integration based on the events of the previous day, it follows that if those events cause a person mental stress during wakefulness, then sleep time integrative efforts should be attended by less self-confidence, which, in turn, should be evidenced by higher GSR readings.

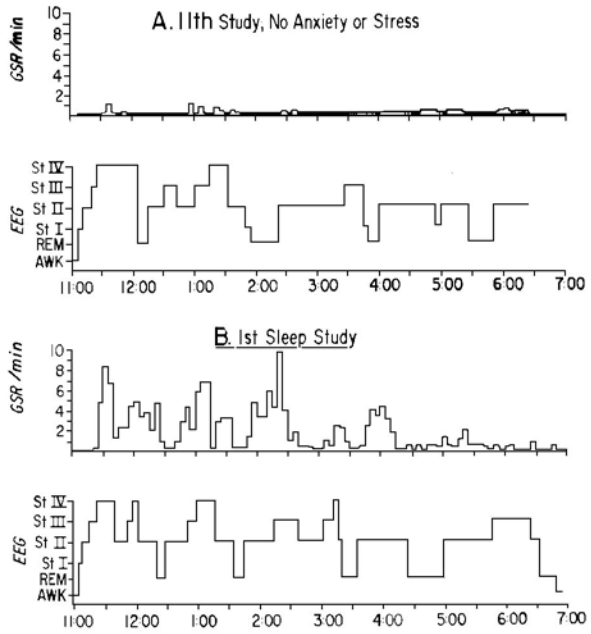

Figure 3. GSR activity as related to EEG stages of sleep for (A) low-stress and (B) stressed sleep caused by a subject's first night in a sleep laboratory. Diagram from Johnson and Lubin (1966).

Lester, Burch, and Dossett (1967) found this to be true in their study of the effect of presleep stress on nocturnal EEG/GSR profiles. They found that mean GSR frequency for each stage of sleep was significantly correlated with the existence of presleep stress and,

further, that higher mean GSR frequencies were generally associated with more stressful presleep conditions.

The authors, however, also mention a number of exceptions to this rule. As a part of their study, they monitored three medical students six times each before, during, and after a week of comprehensive final medical school exams and report that one subject showed highest GSR activity after, instead of during, these stressful exams.

The authors also say, however, that the subjects were kept in the dark as to the results of these crucial exams for about a week. Although they do not specifically state when after the exams they monitored the subjects, it seems likely that this occurred during the week before the subjects found out how well they had done. It is possible, therefore, that the subject who showed high GSR activity in the post-examination period did so because of extreme stress, stress caused by the fear that he had failed. The authors also discuss seven occasions when subjects experienced "near-panic" reactions related to severe personal problems. They state that on these occasions "there was very little nocturnal GSR activity, and EEG sleep profiles were greatly disturbed, with no identifiable stage 3 or stage 4 sleep."

The absence of slow-wave sleep leads me to believe that the implications of these presleep events were judged to be so disturbing that the individuals attempted to block all thought of them from their minds. One subject, for example, showed no slow-wave sleep for three consecutive nights after having his first homosexual experience. I believe this experience induced an intense identity crisis and that during the first three nights of sleep, an attempt was made to not consider the implications of what happened.

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