Available online at www.sciencedirect.com
SCIENCE DIRECT®
Consciousness and Cognition 12 (2003) 298–308
Consciousness and Cognition
www.elsevier.com/locate/concog

Continuity between waking activities and dream activities

Michael Schredl* and Friedrich Hofmann

Sleep Laboratory, Central Institute of Mental Health, P.O. Box 12 21 20, Mannheim, 68072, Germany

Received 22 July 2002

Abstract

Empirical studies largely support the continuity hypothesis of dreaming. Despite of previous research efforts, the exact formulation of the continuity hypothesis remains vague. The present paper focuses on two aspects: (1) the differential incorporation rate of different waking-life activities and (2) the magnitude of which interindividual differences in waking-life activities are reflected in corresponding differences in dream content. Using a correlational design, a positive, non-zero correlation coefficient will support the continuity hypothesis. Although many researchers stress the importance of emotional involvement on the incorporation rate of waking-life experiences into dreams, Hartmann (2000) formulated the hypothesis that highly focused cognitive processes such as reading, writing, etc. are rarely found in dreams due to the cholinergic activation of the brain during dreaming. The present findings based on dream diaries and the exact measurement of waking activities replicated two recent questionnaire studies. These findings indicate that it will be necessary to specify the continuity hypothesis more fully and include factors (e.g., type of waking-life experience, emotional involvement) which modulate the incorporation rate of waking-life experiences into dreams. Whether the cholinergic state of the brain during REM sleep or other alterations of brain physiology (e.g., downregulation of the dorsolateral prefrontal cortex) are the underlying factors of the rare occurrence of highly focused cognitive processes in dreaming remains an open question. Although continuity between waking life and dreaming has been

* Corresponding author. Fax: +49-621-23429.
E-mail address: Schredl@as200.zi-mannheim.de (M. Schredl).

doi:10.1016/S1053-8100(02)00072-7

demonstrated, i.e., interindividual differences in the amount of time spent with specific waking-life activities are reflected in dream content, methodological issues (averaging over a two-week period, small number of dreams) have limited the capacity for detecting substantial relationships in all areas. Nevertheless, it might be concluded that the continuity hypothesis in its present general form is not valid and should be elaborated and tested in a more specific way.

Keywords: Dream content; Continuity hypothesis

1. Introduction

The empirical literature in the field of dream research largely supports the so-called continuity hypothesis of dreaming which states that dreams reflect waking-life experiences (overviews: Domhoff, 1996; Strauch & Meier, 1996; Schredl, 1999). For example, significant elements of the pre-sleep situation (e.g., Goodenough, Witkin, Koulack, & Cohen, 1975; De Koninck & Brunette, 1991), life events such as divorce (Cartwright, Lloyd, Knight, & Trenholm, 1984; Cartwright & Lamberg, 1992; Proksch & Schredl, 1999) and stress (Breger, Hunter, & Lane, 1971) have been demonstrated to affect dream content. In addition, personality dimensions such as extroversion (Bernstein & Roberts, 1995) or thin boundaries (Hartmann, Elkin, & Garg, 1991; Schredl, Schäfer, Hofmann, & Jacob, 1999) are related to similar traits of the dream ego. Psychopathological symptoms of the waking state, e.g., depressive mood or psychotic symptoms, seem to be correlated with corresponding dream contents such as negative emotions or bizarre elements (Schredl & Engelhardt, 2001).

Although the continuity hypothesis is often cited as the basis of a particular study, the exact content of the hypothesis remains vague. The studies cited above mainly used two different approaches for testing the hypothesis: firstly, by looking at intraindividual differences in dream content, for example, as a result of experimental manipulation of the pre-sleep situation (e.g., stressful film vs. neutral film; Lauer, Riemann, Lund, & Berger, 1987), or, secondly, by correlating interindividual waking-life differences with corresponding dream characteristics (e.g., extraversion; Bernstein & Roberts, 1995). Within this context, the continuity hypothesis predicts that intra- and interindividual differences regarding waking-life experiences are reflected in comparable differences in dream content. The dreams after stressful films, for example, should be more negatively toned than dreams after a neutral film (cf. Lauer et al., 1987). When the relationship between waking-life and dream elements is studied by correlational techniques (interindividual differences), a positive coefficient will support the continuity hypothesis, whereas a null correlation indicate no direct relationship between waking life and dreaming and a negative correlation coefficient would reflect a complementary relationship, e.g., persons with negative daytime mood would report more positively toned dreams than persons with positive daytime mood. Thus, a correlation coefficient equal or below zero will not support the continuity hypothesis.

Within the context of the present study, the nature of the cognitive processes during dreaming and in the waking state are not the focus but the incorporation of waking-life experiences into the dream. In addition to the problem of null hypothesis testing (cf. Meehl, 1978), the generality of the continuity hypothesis is not clear. The question arises whether one can identify factors which might affect the closeness of the relationship between waking life and dreaming, i.e., whether specific waking-life experiences tend to be incorporated more often (or less often) into dreams than other waking-life experiences. Although many authors (e.g., Domhoff, 1996; Hall, 1947; Hartmann, 1998) emphasized that especially personal concerns and emotional preoccupations are reflected in dreams, systematic studies, for example, operationalizing the emotional involvement of daytime experiences and correlating this variable with the incorporation rate have not been carried out. The findings from trauma research would support the hypothesis of such an effect since extremely negative experiences can occur years later in the person's dreams (e.g., Cuddy & Belicki, 1992; Kaup, Ruskin, & Nyman, 1994).

Hartmann (2000) has formulated another hypothesis about factors which might affect the magnitude of continuity between waking and dreaming. He postulates that activities involving a convergent mode of thinking, such as reading, writing, calculating, and typing, occur very rarely in dreams compared with other activities such as talking and walking because the brain is in a state of cholinergic activation during REM sleep (e.g., Hobson, Stickgold, & Pace-Schott, 1998) and this brain state impairs highly focused thinking processes compared to the aminergic waking state. The findings of a questionnaire study carried out by Hartmann (2000) supports this hypothesis. As opposed to waking-life activities such as talking with friends, walking, and sexuality were more prominent in dreams than reading, writing, and typing. The lack of difference between activities such as walking vs. sexuality was interpreted by Hartmann (2000) to mean that emotionality may not be the only factor explaining continuity.

Interestingly, the idea of Hartmann (2000) was already formulated in 1909 by Meumann (1909); a predecessor which was very likely not known to Hartmann. Meumann (1909) observed that reading and writing occur very rarely in his dreams although he was engaged in these activities up to 6 h/day. In addition to the hypothesis that daily routine activities are seldom incorporated into dreams, he suggested that specific, narrowly defined perceptual processes and skills are impaired during dreaming. This anticipated Hartmann's formulations about the effects of the cholinergic–aminergic mechanisms which regulate REM sleep on thinking modes.

Hartmann's (2000) findings have been replicated (Schredl, 2000). In addition, it was found that using a computer also occurs rarely in dreams, despite the fact that computers play a major role in modern waking life, especially in the sample of students which was investigated. In contrast to Hartmann, Schredl (2000) formulated the hypothesis that dreaming is "archaic," i.e., achievements of modern civilization are infrequent in dreams.

The methodological problem of both studies is the fact that questionnaires were administered in order to measure dream content, i.e., participants were asked to estimate the relative prominence of specific activities as opposed to waking life on five-point scales (Hartmann, 2000). These global estimates might be biased due to

erroneous recall (all dreams have to be in the person's mind) or due to different sampling strategies of the participants (cf. Schredl, 2002a). The present study was designed to elicit a broader spectrum of waking activities as precisely as possible and to compare the amount of time spent with these activities in waking life to the occurrence of the same or analogous activities in dream reports. The exact hypothesis is that activities involving a convergent mode of thinking are incorporated into dreams less often than other activities such as talking with friends, i.e., the null hypothesis states that the kind of waking-life experience did not affect the incorporation rate.

2. Method

2.1. Participants

The sample population was comprised of 133 persons who are psychology students (75.2%) and employees (24.8%). The mean age of the 104 women and 29 men was 25.5 years ($SD = 10.9$).

2.2. Research instruments

2.2.1. Dream questionnaire

In addition to demographic data, actual dream recall frequency was elicited by a seven-point scale (0 = never, 1 = less than once a month, 2 = about once a month, 3 = two or three times a month, 4 = about once a week, 5 = several times a week, 6 = almost every morning). The retest reliability of this scale for an averaged interval of 70 days is high ($r = .83$; Schredl, 2002b).

2.2.2. Dream diary

Each participant kept a structured dream diary over a two-week period. In addition to a checklist measuring dream recall, participants were instructed to record their dream(s) as completely as possible. Up to five dreams were to be recorded.

2.2.3. Waking activities questionnaire

The waking activities questionnaire comprises items measuring the amount of time spent for a variety of daily activities such as using a computer for working, playing computer games, making telephone calls, spending time with the spouse, reading (divided into leisure time and occupational/studying), driving a car, watching TV, riding a bus/tramway, walking, doing a job, calculating, talking with friends, writing, and being in nature. Participants were asked to estimate the average time spent for these activities during the last two weeks. Each of these variables were transformed in units of hours per week since some variables, e.g., making telephone calls, reading, driving a car, were elicited in units of minutes per day.

2.2.4. Dream content analysis

With reference to the items of the waking activities questionnaire, several rating scales were developed in order to measure the occurrence of specific activities within

the dream. Whether a spouse is present in the dream or whether activities such as working with a computer, playing computer games, making phone calls etc. (see above) occur within the dream was measured. Solely the presence of an activity was coded as 1; otherwise zero was entered.

2.3. Procedure

Participants were recruited on the campus or from the second author's work setting. Participation was voluntary and unpaid. First, participants completed the dream questionnaire. Second, the dream diary was kept over a two-week period without any further contact with the experimenter. Third, participants retrospectively estimated the time periods spent with selected activities by filling in the waking activities questionnaire. This procedure was chosen in order to avoid a possible bias if activities were recorded daily before bedtime (effect on dream content). Dream reports were typed, randomly arranged, and scored on the dream rating scales by a judge blind to the identity of the dreamers. One hundred dreams were rated independently by a second judge in order to compute interrater reliability coefficients. For comparing waking activities and dream activities percentages were computed. Differences between percentages were transformed into effect sizes and tested against the null hypothesis ($d = 0$) (e.g., Domhoff, 1996). To obtain individual dream content measures (for correlational analysis), 1 was coded if a specific theme was present in at least one dream; otherwise zero was coded. Statistical analyses were carried out using the SAS for Windows 6.12 software package. The degrees of freedom for the comparison of waking-life activities and dream activities was computed as geometric mean (square root of the product). For correlational analyses, number of subjects is the basis for deriving the degrees of freedom. Sample

Table 1
Percentages for waking activities and dream activities

Variable	Waking life (68.1 h/week)	Dreaming (274 activities within 442 dreams)	Difference between waking and dreaming effect size (p value)	
Computer (work and games)	9.7%	4.0%	0.23	.015
Telephone	8.0%	7.3%	0.03	ns
Watching TV	12.4%	8.2%	0.14	ns
Reading	22.6%	7.3%	0.44	.001
Driving a car	5.7%	14.6%	−0.30	.005
Riding a bus/tramway	9.6%	10.6%	−0.03	ns
Calculating	5.0%	4.0%	0.05	ns
Talking with friends	15.2%	27.7%	−0.31	.002
Writing	4.3%	3.3%	0.05	ns
Being in nature	7.9%	11.3%	−0.12	ns

Statistical test ($d = 0$) was two-tailed, except for computer, reading, writing, and calculating.

sizes varied due to missing values and analyzing subsamples (e.g., persons with a partner).

3. Results

3.1. General findings

The mean dream recall frequency (questionnaire) was 4.11 ± 1.21. On average, 3.74 ± 2.62 dreams were recorded by each participant. The elicited waking activities (see Table 1) amounted to 68.1 h/week (averaged for all participants), i.e., it was not a complete measurement of all activities (168 h). The most common activities were reading and talking with friends. Overall, 442 dreams were reported. Mean dream length was 124.7 ± 105.4 words. Within these dreams, the activities of Table 1 occurred in 274 cases. For all scales, interrater reliability (exact agreement) ranged between 89 and 99%. Talking with friends and being in nature were the most prominent activities in the dreams.

3.2. Comparison between waking activities and dream activities

For the accumulated cognitive activities (reading, writing, computer, calculating), the difference between waking life (41.6%) and dreaming (18.6%) was significant ($d = 0.51$; $p < .001$; see Fig. 1). The comparison of the different activities yielded the following results. Using a computer and reading occurred less often in dreams as opposed to waking life, whereas driving a car and talking with friends were more prominent (see Table 1). No differences were found for the other activities.

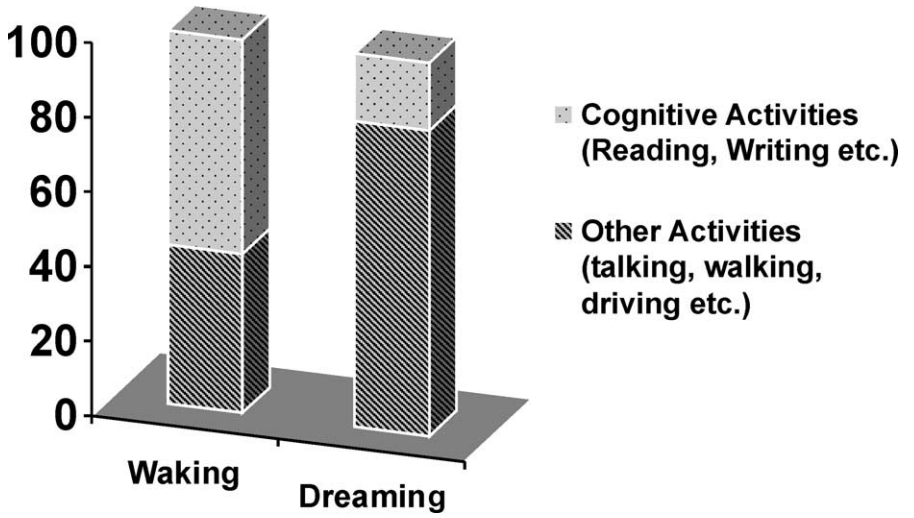

Fig. 1. Waking activities and dream activities (percentages based on the total amount of elicited activities).

Table 2
Correlations between time spent with waking-life activities and occurrence of dream activities

Variable	Correlation $r = (p$ value)	
Computer (work and games)	−.101	ns
Telephone	−.040	ns
Watching TV	−.004	ns
Reading	.149	.06
Driving a car	.321	.001
Riding a bus/tramway	.029	ns
Calculating	−.038	ns
Talking with friends	.001	ns
Writing	−.037	ns
Being in nature	.081	ns

Statistical test were one-tailed ($r > 0$).

3.3. Correlation between waking activities and dream activities

The analyses depicted in Table 2 revealed that only two dream activities (reading and driving a car) were substantially related to the amount of time spent with this activity during waking. The correlation to reading within dreams became more pronounced if one differentiates between reading as leisure time activity ($r = -.166$, ns) and reading for the job or studying ($r = .257$, $p = .003$). Similarly, the differentiation into playing computer games and using a computer for work yielded a marginal significant relationship. Whereas playing computer games was related to dream content ($r = .152$, $p = .06$), using a computer for work was not ($r = -.079$, ns). In addition, the amount of time spent with the spouse was significantly related with the occurrence of the partner in the dreams ($r = .349$, $p = .002$, $N = 64$). As expected, persons with partners dreamed more often about a partner than singles (57.0 vs. 8.6% persons with at least one dream featuring a partner as dream character; $\chi^2 = 23.8$, $p < .001$). Similarly, persons dreamt more often about occupational themes if they had spent more time working ($r = .305$, $p < .01$, $N = 62$). This was also valid for the subgroup of students who earned extra money ($r = .460$, $p = .003$; $N = 44$).

4. Discussion

The discussion will focus on three topics: (1) comparison of the incorporation rate of cognitive activities compared to other activities, (2) methodological issues, and (3) the magnitude of the correlation between time spent with a specific waking-life activity and the occurrence within a dream.

The findings of the present study indicate that highly focused cognitive activities occur less frequently in dreams in comparison to other activities. Marked differences were found for reading and using a computer. Thus, the questionnaire studies of Hartmann (2000) and Schredl (2000) have been replicated using data stemming from

dream content analyses. If one computes the percentages of cognitive activities with respect to the total amount of activities published by Schredl (2000), the figures are comparable to those of the present study: cognitive activities represent 42.4% of the elicited waking activities and 18.6% of the dream activities.

Before interpreting the results, methodological issues must be taken into consideration. First, the diary method permits only the measurement of a small portion of the total dream activity. On the other hand, laboratory awakenings substantially affect the sleep/wake cycle of the participants as well as the dream contents (e.g., Strauch & Meier, 1996). Second, dream activities were measured roughly (occurrence vs. absence) in contrast to the more sophisticated measurement of the waking activities. With the assistance of the dreamer (carrying out a structured interview immediately upon awaking), it may be possible to elicit the time spent for a particular dream activity more precisely. Research has shown that subjective estimates of time intervals are related to REM duration (e.g., Dement & Kleitman, 1957) indicating that subjective time estimates are of value.

Despite the methodological issues, the present finding and the results of the previous studies clearly demonstrate that the continuity hypothesis in its general form is not valid, i.e., the type of waking-life experience (reading, working with a computer vs. other activities such as talking with friends) affect the probability of incorporation into subsequent dreams. It should be kept in mind that the present study did not focus on the nature of the cognitive processes but on the occurrence of waking-life activities within the dream.

Whether the rare occurrence of focused cognitive activities is explained by the cholinergic state of the brain (cf. Hobson, Pace-Schott, & Stickgold, 2000), the down-regulation of the dorsolateral prefrontal cortex (cf. Maquet et al., 1996; Braun et al., 1997), the alteration of the hypothalamic regulation (Morrison & Sanford, 2000) or other factors such as emotional involvement is on open question for future research. The increased percentage of the 'talking to friends' activity suggest that emotional involvement attached to the waking-life experience is of importance. In order to test this hypothesis properly, one has to correlate activities with different emotional involvement (within-subject design) with the occurrence of these activities within the subsequent dreams. Also of interest will be an experimental stimulation of the cholinergic system (e.g., Schredl, Weber, Leins, & Heuser, 2001), because the cholinergic hypothesis would predict a further reduction of focused cognitive activities in dreams.

The frequent occurrences of driving a car do not support the hypothesis of Schredl (2000) that dreams are 'archaic'. In addition, other 'modern' activities such as watching TV, making phone calls, riding a bus/tramway are quite common in the present sample of dreams.

Regarding the correlations between waking activities and dream contents, the areas of partner, reading (job/studying), occupation, and driving a car showed clear relationships between waking and dreaming. That is the continuity hypothesis predicting that interindividual differences are reflected in dreams is supported. None of the correlations were negative and non-significant correlations are due to methodological issues not easy to interpret, i.e., it must be noticed that averaging the duration of daily waking activities across the two-week period (done by the

participants) and the small number of dreams per participant (3–4 dreams on average) increase error variance and detection of substantial correlations is thus impeded. This is especially valid for activities which occur very seldom in dreams and which show large day-to-day fluctuations in waking life. Within this context, longitudinal studies will be appropriate. However, one has to keep in mind the above mentioned methodological issue that dreams are easily influenced by the measurement method (cf. Stern, Saayman, & Touyz, 1978), i.e., daily recording of waking activities prior to sleep may alter dream content systematically.

The marked relationships for partner, occupation, reading, and playing computer games indicate that emotional involvement increases the incorporation rate of waking activities. The finding regarding driving a car may also fit in this line of thinking since it seems plausible that driving a car is an exciting activity for young persons (student sample) or may be associated with anxiety due to a lack of driving experience. In order to test this hypothesis, a study with persons who are being trained for their driving license is currently being carried out. As mentioned above, it will be necessary to include a measure of emotional involvement for the waking-life activities.

To summarize, a continuity between waking life and dreaming has been demonstrated, although methodological issues (averaging over a two-week period, small number of dreams) have limited the capacity of detecting substantial relationships in all areas. Waking activities involving a convergent mode of thinking such as reading and using a computer are found in dreams less often than other activities such as talking with friends etc. The findings support the notion of continuity between waking and dreaming but the study also clearly demonstrated that an unspecific, global formulation of this hypothesis is not valid. Future research should aim at a more precise formulation of the continuity hypothesis, e.g., a mathematical model predicting the magnitude of correlation coefficients (if correlational designs investigating interindividual differences are applied) which includes factors (e.g., emotional involvement, state of the brain) which might modulate the incorporation of waking-life experiences into dream content.

References

Bernstein, D. M., & Roberts, B. (1995). Assessing dreams through self-report questionnaires: Relations with past research and personality. *Dreaming, 5*, 13–27.

Braun, A. R., Balkin, T., Wesensten, J., Carson, R., Varga, M., Baldwin, P., Selbie, S., Beleaky, G., & Herscovitch, P. (1997). Regional cerebral blood flow throughout the sleep–wake cycle. *Brain, 120*, 1173–1197.

Breger, L., Hunter, I., & Lane, R. W. (1971). *The effect of stress on dreams*. New York: International Universities Press.

Cartwright, R. D., & Lamberg, L. (1992). *Crisis dreaming: Using your dreams to solve your problems*. New York: Harper Collins.

Cartwright, R. D., Lloyd, S., Knight, S., & Trenholm, I. (1984). Broken dreams: A study of the effects of divorce and depression on dream content. *Psychiatry, 47*, 251–259.

Cuddy, M. A., & Belicki, K. (1992). Nightmare frequency and related sleep disturbance as indicators of a history of sexual abuse. *Dreaming, 2*, 15–22.

De Koninck, J., & Brunette, R. (1991). Presleep suggestion related to a phobic object: Successful manipulation of reported dream affect. *Journal of General Psychology, 118*, 185–200.

Dement, W. C., & Kleitman, N. (1957). The relation of eye movements during sleep to dream activity: An objective method for the study of dreaming. *Journal of Experimental Psychology, 53*, 339–346.

Domhoff, G. W. (1996). *Finding meaning in dreams: A quantitative approach*. New York: Plenum Press.

Goodenough, D. R., Witkin, H. A., Koulack, D., & Cohen, H. (1975). The effects of stress films on dream affect and on respiration and eye movement activity during rapid-eye-movement sleep. *Psychophysiology, 12*, 313–320.

Hall, C. S. (1947). Diagnosing personality by the analysis of dreams. *Journal of Abnormal and Social Psychology, 42*, 68–79.

Hartmann, E. (1998). *Dreams and nightmares: The new theory on the origin and the meaning of dreams*. New York: Plenum Press.

Hartmann, E. (2000). We do not dream of the 3 R's: Implications for the nature of dream mentation. *Dreaming, 10*, 103–110.

Hartmann, E., Elkin, R., & Garg, M. (1991). Personality and dreaming: The dreams of people with very thick and very thin boundaries. *Dreaming, 1*, 311–324.

Hobson, J. A., Pace-Schott, E. F., & Stickgold, R. (2000). Dreaming and the brain: toward a cognitive neuroscience of conscious states. *Behavioral and Brain Sciences, 23*, 749–842.

Hobson, J. A., Stickgold, R., & Pace-Schott, E. F. (1998). The neuropsychology of REM sleep dreaming. *NeuroReport, 9*, R1–R14.

Kaup, B. A., Ruskin, P. E., & Nyman, G. (1994). Significant life events and PTSD in elderly world war II veterans. *American Journal of Geriatric Psychiatry, 2*, 239–243.

Lauer, C., Riemann, D., Lund, R., & Berger, M. (1987). Shortened REM latency: a consequence of psychological strain? *Psychophysiology, 24*, 263–271.

Maquet, P., Peters, J. M., Aerts, J., Delfiore, G., Deguelde, C., Luxen, A., & Franck, G. (1996). Functional neuroanatomy of human rapid-eye-movement sleep and dreaming. *Nature, 383*, 163–166.

Meehl, P. E. (1978). Theoretical risks and tabular asteriks: Sir Karl, Sir Ronald, and the slow progress of soft psychology. *Journal of Consulting and Clinical Psychology, 16*, 806–834.

Meumann, E. (1909). Über Lesen und Schreiben im Träume. *Archiv für die Gesamte Psychologie, 15*, 380–400.

Morrison, A. R., & Sanford, L. D. (2000). Critical brain characteristics to consider in developing dream and memory theories. *Behavioral and Brain Sciences, 16*, 806–834.

Proksch, K., & Schredl, M. (1999). Impact of parental divorce on children's dreams. *Journal of Divorce and Remarriage, 30*, 71–82.

Schredl, M. (1999). *Die nächtliche Traumwelt: Eine Einführung in die psychologische Traumforschung*. Stuttgart: Kohlhammer.

Schredl, M. (2000). Continuity between waking life and dreaming: Are all waking activities reflected equally often in dreams. *Perceptual and Motor Skills, 90*, 844–846.

Schredl, M. (2002a). Questionnaires and diaries as research instruments in dream research: Methodological issues. *Dreaming, 12*, 17–26.

Schredl, M. (2002b). Messung der Traumerinnerung: Skala und Daten gesunder Personen. *Somnologie, 6*, 34–38.

Schredl, M., & Engelhardt, H. (2001). Dreaming and psychopathology: Dream recall and dream content of psychiatric inpatients. *Sleep and Hypnosis, 3*, 44–54.

Schredl, M., Schäfer, G., Hofmann, F., & Jacob, S. (1999). Dream content and personality: Thick vs. thin boundaries. *Dreaming, 9*, 257–263.

Schredl, M., Weber, B., Leins, M.-L., & Heuser, I. (2001). Donepezil-induced REM sleep augmentation enhances memory performance in elderly, healthy persons. *Experimental Gerontology, 36*, 353–361.

Strauch, I., & Meier, B. (1996). *In search of dreams: Results of experimental dream research*. Albany: State University of New York Press.

Stern, D. A., Saayman, G. S., & Touyz, S. W. (1978). A methodological study of the effect of experimentally induced demand characteristics in research of nocturnal dreams. *Journal of Abnormal Psychology, 87*, 459–462.