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Absorption, psychological boundaries and attitude towards dreams as correlates of dream recall: two decades of research seen through a meta-analysis

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SUMMARY Many studies have reported positive correlations between dream recall frequency (DRF) and measures of absorption, psychological boundaries and attitude towards dreams. A majority of these studies, however, have relied exclusively on retrospective measures of DRF even though daily dream logs are generally considered to be more direct and valid measures of DRF. The first goal of the present meta-analysis was to evaluate the effect sizes of three variables (absorption, psychological boundaries and attitude towards dreams) as correlates of DRF. The second goal was to evaluate if these effect sizes varied as a function of how DRF was operationalized (i.e. retrospective measure versus dream log). Data from 24 studies were included in the analyses. For each of the three variables investigated, correlations with retrospective measures of DRF were of greater magnitude than those obtained with daily logs. These results indicate that scores on measures of absorption and psychological boundaries are not related to DRF *per se*, but rather to people's tendency to retrospectively underestimate or overestimate their DRF, while attitude towards dreams is related both to DRF *per se* and to people's retrospective estimation bias. Implications of these findings for dream research are discussed.

KEYWORDS absorption, attitude towards dreams, dream log, dream recall frequency, psychological boundaries, retrospective measure

INTRODUCTION

For over 40 years, numerous studies have investigated the relationship between dream recall frequency (DRF) and various personality dimensions such as neuroticism, extraversion, trait anxiety and repression. Although these research efforts initially gave rise to promising data, many studies yielded negative results. Overall, none of these dimensions showed robust and consistent correlations with measures of DRF. As discussed in an exhaustive literature review (Schredl and Montasser, 1996–97a) the influence of these personality variables on DRF is, at best, minimal. As an example, Schonbar (1959) found a correlation between a scale of repression sensitization and DRF ($r = 0.59$) and proposed that a repressive life style inhibits dream recall. As these results could be seen as a validation of a psychodynamic view of dreaming, many replication studies followed. However, most of these studies produced low to moderate correlations, which dampened whatever enthusiasm existed for the hypothesis (Cohen, 1979).

In light of this failure to relate DRF to classic personality variables, researchers sought more promising personality dimensions to correlate with DRF. Absorption and psychological boundaries were two such candidates. Absorption can be defined as an 'openness to absorbing and self-altering experiences' (Tellegen and Atkinson, 1974). For example, high absorbers are generally moved by artistic creations, able to vividly recollect past experiences and tend to experience episodes of missing time. The concept of psychological boundaries, originally developed by Hartmann (1984, 1989) to better understand the psychological characteristics of people with life-long nightmares, can be defined as the level of connection between the mind's different functions, processes and structures. In essence, 'boundary permeability' refers to

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overlap ('thinness') or separation ('thickness') between mental states, and the dimension covers many aspects of a person's functioning (e.g. degree of structure the person imposes on time and environment, organization of early and recent memories, rigidity of emotional defences). This broad personality dimension overlaps with a number of other personality or cognitive styles including fantasy-proneness, tendency to experience synesthesia, hypnotizability, openness and aspects of creativity (Hartmann *et al*., 1991). Not surprisingly, the dimensions of absorption and boundary thinness are conceptually and statistically related to one another ($r = 0.56$: Zamore and Barrett, 1989) and both are related to openness to experience, one of the 'Big five' traits of personality measured by the NEO Personality Inventory (Glisky *et al*., 1991; McCrae, 1994). Most studies having evaluated the relationship of these two personality dimensions to DRF found a significant correlation (see Schredl and Montasser, 1996–97a, for a review). The positive correlation between absorption and DRF is usually accounted for by the idea that high absorbers experience their dreams more vividly and thus remember them more easily than low absorbers. A similar explanation has been put forth for boundary thinness (Belicki, 1986; Hartmann, 1989).

In another line of research, Schonbar's (1965) life style hypothesis postulated that people who recall many dreams are generally interested in dreams, in trying to understand them, in increasing their DRF and tend to have an overall positive attitude towards dreams. Over the four decades that ensued, almost every study having evaluated the relationship between people's attitude towards dreams and DRF has found a positive correlation (e.g. Belicki, 1986; Cernovsky, 1984; Schredl and Doll, 2001). Consequently, it is now generally accepted that DRF is related to attitude towards dreams, although the direction of the causality remains unclear.

Methodological issues concerning DRF

An important methodological point not considered in the literature is that a majority of the aforementioned studies relied exclusively on a retrospective estimate of DRF as the measure of DRF. Even though daily dream logs are generally considered as more direct and valid measures of DRF than retrospective measures, logs are used in very few studies. There are two principal reasons for this methodological choice. First, retrospective measures can be obtained with a single question and thus are less time-consuming than daily logs and more easily implemented in large-scale studies. Secondly, until recently, the manner in which DRF was operationalized (e.g. retrospective measure or log-based measure) was not viewed as a relevant factor. As both types of measures were considered to be sufficiently reliable (Cohen, 1979), correlates of one operationalization were implicitly assumed to be correlates of the other. Indeed, there is no doubt that retrospective measures and log measures of DRF are correlated (correlations usually range between 0.40 and 0.60: e.g. Beaulieu-Prévost and Zadra, 2005a; Cohen, 1979; Cohen and Wolfe, 1973). However, recent studies have shown that correlates of retrospective measures of DRF and of specific types of dreams (e.g. nightmares) are not necessarily correlates of daily log measures of such variables (e.g. Beaulieu-Prévost and Zadra, 2005a; Wood and Bootzin, 1990; Zadra and Donderi, 2000).

Although retrospective measures and log measures of DRF are correlated, retrospective measures are largely based on long-term memories and cognitive representations of one's dream life, contrary to log measures of DRF. As such, correlates of retrospective measures of DRF could be related to DRF but they could also simply reflect an estimation bias (Beaulieu-Prévost and Zadra, 2005a; Schredl, 2002). For example, it is possible that instead of having more vivid dreams, high absorbers tend to retrospectively overestimate their DRF because the dreams they recall are remembered with a high degree of intensity. This hypothesis is consistent with the finding that when compared with low absorbers, high absorbers tend to rate as more salient both their dreams and stories they listen to (Belicki, 1986). In essence, retrospective measures of dream recall face the same methodological problems as eyewitness testimonies, including the possibility of memory distortions (Beaulieu-Prévost, 2005).

Because of their prospective nature, logs minimize the possibility of incorrect or inaccurate estimation of DRF. However, logs are more intrusive than retrospective questionnaires and keeping a dream log could potentially affect DRF. Indeed, some studies showed that people's mean DRF as assessed with a dream log is higher than their previously measured retrospective DRF (e.g. Cartwright, 1977; Cohen, 1969; Zadra and Donderi, 2000) although at least one study found no difference (Schredl, 2002). As the difference between the log and retrospective measures was often more pronounced for low recallers than for high recallers, a common explanation of the phenomenon is that keeping a log increases DRF in low recallers because it makes them focus more on their dreams, whereas a similar augmentation is not possible for high recallers due to a ceiling effect (Cohen, 1969; Cory *et al*., 1975; Schredl, 2002).

However, concluding that daily logs tend to increase DRF is problematic as it is a circular argument based on the unsubstantiated premise that retrospective questions yield a valid and unbiased measure of DRF. Moreover, if the log data are used instead of the retrospective measure as the key reference point, it is equally justified to simply conclude that low recallers tend to retrospectively underestimate their DRF. It therefore becomes difficult to determine whether the difference between retrospective and log measures of DRF represents an increase in DRF due to the use of a diary or simply a retrospective underestimation of actual DRF. An additional support to the underestimation hypothesis is also provided by studies showing that biases can occur in low recallers in respect to retrospective dream questionnaires (Beaulieu-Prévost and Zadra, 2005b; Schredl, 2002). In conclusion, dream logs are less affected than retrospective measures of DRF by memory distortions and cognitive

representations of one's dream life although they could potentially increase DRF for low recallers.

The first goal of the present study was to conduct a meta-analysis to estimate, separately for retrospective versus log-based measures of DRF, the effect sizes of absorption, boundary thinness and attitude towards dreams as correlates of DRF. The second goal was to investigate if the effect sizes varied as a function of how DRF was assessed.

METHODS

The meta-analysis gathered the quantitative research on attitude towards dreams, absorption and psychological boundaries as correlates of DRF in adults while taking into account the manner in which DRF was measured.

Study selection

A search for studies was conducted by examining journal abstracts available through 1 May 2005 in the PsycInfo and Dissertation abstract databases. Three review studies (Belicki, 1986; Goodenough, 1991; Schredl and Montasser, 1996–97a) were also used as source material.

The search identified 33 studies, 10 of which were excluded from the analysis. One study (Hartmann, 1989) was excluded because the same data were presented in greater detail in a subsequent report (Hartmann *et al.*, 1991) included in the meta-analysis. Another study (Schredl *et al.*, 2003b) was similarly excluded as the data were contained in a second article by the same group (Schredl *et al.*, 2003a). To ensure a certain level of comparability and homogeneity across subjects, studies that sampled clinical (Schredl and Engelhardt, 2001), adolescent (Cowen and Levin, 1995) or elderly populations (Funkhouser *et al.*, 2001) were also excluded. Three studies (Belicki *et al.*, 1978; Moffitt *et al.*, 1990; Violani *et al.*, 1990) were excluded because the data presented were incomplete (e.g. missing statistical parameters). A fourth study for which information was missing (Wolcott and Strapp, 2002) was included after the first author provided the missing data. One study was excluded because it relied on a single item to measure attitude towards dreams (Schredl, 2002–03) and another because it measured attitude towards dreams with a new instrument that eliminated many items traditionally found in scales of attitude towards dreams (Schredl *et al.*, 2002). However, the relative merits and implications of the findings obtained with this instrument are presented in the Discussion. This resulted in a total of 23 published reports. To these were added unpublished data associated with two recent studies from our laboratory (Beaulieu-Prévost and Zadra, 2005a,b). In both studies, participants completed a battery of questionnaires (including measures of attitude towards dreams, absorption and psychological boundaries) and kept a daily dream log for 2–5 weeks. The short version of the Boundary questionnaire (Kunzendorf *et al.*, 1997) was included in both studies. The sample size associated with the Beaulieu-Prévost and Zadra's (2005b) study is larger than in the published report as a second sample was subsequently tested with an identical protocol.

Meta-analytical procedure

The first goal of the meta-analysis was to calculate the parametric estimations of the correlations between DRF, obtained either through retrospective measures or dream logs, and each one of the three correlates under consideration (i.e. attitude towards dreams, absorption and psychological boundaries). The meta-analytical procedure was conducted on effect size (i.e. Pearson correlations). and the choice of a method to conduct the meta-analysis was determined as follows.

Three methods of meta-analysis have remained popular over the last decades, namely, the method designed by Hedges and Vevea (1998), Rosenthal (1991) and Hunter and Schmidt (1990). Rosenthal's (1991) method uses a fixed-effect model while the two other methods use a random-effect model. Basically, unlike the random-effect model, a fixed-effect model does not take into account the possibility that population effect sizes can vary across studies. Although fixed-effect models were once the norm (National Research Council, 1992), recent studies have shown that fixed-effect models are generally too liberal for real-world data (Field, 2003; Osburn and Callendar, 1992). The two remaining methods were compared in two Monte Carlo studies. In a study by Hall and Brannick (2002), both methods yielded similar results although the Hunter and Schmidt (2001) method tended to be more accurate. A second study (Field, 2001) showed that the Hunter and Schmidt (2001) method tended to provide the most accurate estimates of the mean population effect size when effect sizes are heterogeneous, as is frequently the case with real-world data sets. For these reasons, the Hunter and Schmidt (2001) method was chosen to guide our analyses.

Information on the number of participants and the size of the correlations was obtained for each sample. In five studies (Herman and Shows, 1984; Robbins and Tanck, 1988; Schredl and Montasser, 1996–97b; Schredl *et al.*, 2003a; Wolcott and Strapp, 2002), the variable attitude towards dreams was divided into subscales and only the correlations between each subscale and DRF presented. For each of these studies, an average correlation was computed across these subscales. The number of items in each subscale was used as a weight in the averaging process to ensure that the resulting score approximated as accurately as possible the correlation that would have resulted from a global score on the scale. As suggested by Hunter and Schmidt (1990), correlations were not transformed into Fisher's z before the averaging process. The parametric estimations were then calculated for each correlation by using the formulae presented by Hunter and Schmidt (1990).

Our second goal was to calculate, separately for each of the three correlates of DRF, the parametric estimations of the difference between the correlation with a retrospective measure of DRF and the correlation with a log measure of DRF. The parametric estimations previously calculated where used to

estimate the difference between the related correlations and the standard error of each difference.

To obtain a more precise estimate of the impact of the type of DRF measure on the correlations with absorption, psychological boundaries and attitude towards dreams, confidence intervals were calculated for the difference between the correlations with a retrospective measure when compared with a log-based measure of DRF. One problem with observed differences between correlations is that they cannot be easily interpreted as they do not automatically translate into a specific amount of explained variance. Consequently, to transform the confidence intervals of differences between correlations into confidence intervals of differences in explained variance, an adaptation of Tryon's (2001) inferential confidence intervals was used. Inferential confidence intervals are mathematically equivalent to tests of statistical significance. However, they represent the statistical significance of a difference as confidence intervals around each effect size. The difference is said to be statistically significant (excluding zero) when the confidence intervals are not overlapping and non-significant when do overlap. Technically, to obtain the difference in explained variance for each limit of a confidence interval in the differences between correlations, the two corresponding inferential confidence intervals must first be calculated and the limits of each confidence interval transformed into explained variance by squaring them. When the inferential confidence intervals are not overlapping, the smallest difference in explained variance is then calculated by subtracting the upper limit (UL) of the smallest effect from the lower limit (LL) of the largest effect while the largest difference is calculated by subtracting the lowest limit of the smallest effect from the UL of the largest effect. A negative result is interpreted as an effect in the direction opposed to the difference.

RESULTS

Table 1 presents descriptive information for each variable as well as effect sizes obtained for each study included in the meta-analysis. Table 2 presents, separately for each operationalization of DRF, the parametric estimations of the correlations with measures of absorption, psychological boundaries, and attitude towards dreams. As can be seen in Table 2, measures of absorption and of psychological boundaries appear to explain a similar proportion of the variance in DRF while attitude towards dreams appears to explain more variance than either absorption or psychological boundaries. However, the most striking difference observed lies between retrospective versus log measures of DRF. Specifically, while a moderate amount of variance (between 6% and 13%) is explained when a retrospective measure of DRF is employed, the amount of variance explained is markedly reduced (to between 1% and 6%) when DRF is based on a prospective log measure. These results indicate that the use of a retrospective measure of DRF instead of a dream log measure increases by approximately 5–6% the amount of explained variance by the personality measures of absorption, psychological boundaries and attitude towards dreams.

As previously mentioned, Tryon's (2001) inferential confidence intervals were used to calculate the difference in explained variance between retrospective measures and daily logs. To help readers understand the calculations involved, a 5-step procedure is presented below, using the absorption variable as an example [reader interested in greater details are directed to Tryon's (2001) original article].

Step 1

Obtain the correlation and the standard error of the two effects involved in the comparison. These statistics were calculated using the Hunter and Schmidt's (1990) procedure (see Table 2).

Step 2

Calculate Tryon's equivalent of the critical z value necessary for determining the inferential confidence intervals using the following formula:

$$z_T = z \times \frac{\sqrt{\mathrm{se}_1^2 + \mathrm{se}_2^2}}{\mathrm{se}_1 + \mathrm{se}_2}$$

In the case of absorption:

$$z_T = 1.96 \times \frac{\sqrt{0.041^2 + 0.046^2}}{0.041 + 0.046} = 1.39,$$

where z_T is Tryon's equivalent of the critical value; z is the critical z-value associated with the specified alpha level; and se_1 and se_2 are the standard errors of each correlation.

Step 3

Calculate Tryon's inferential confidence interval for each correlation with the following formula:

$$\mathrm{CI}_{Inf} = r \pm z_T \times \mathrm{se},$$

where $\mathrm{CI}_{\mathrm{Inf}}$ is the inferential confidence interval; r is the correlation; se is the corresponding standard error and z_T is Tryon's equivalent of the z-value. In the case of absorption, the inferential confidence intervals are between $r = 0.189$ and $r = 0.303$ for the retrospective measures and between $r = 0.023$ and $r = 0.150$ for the prospective logs.

Step 4

Transform the resulting inferential confidence intervals in explained variance by squaring each value. In the case of absorption, the resulting r^2 is between 0.036 and 0.092 for the retrospective measures and between 0.001 and 0.023 for the logs.

Table 1 Descriptive information extracted from studies and presented separately for absorption, psychological boundaries and attitude towards dreams (ATD)

Variable	*Type of DRF*	n	r	*Source of information*
Absorption	Retrospective	81	0.106	Beaulieu-Prévost and Zadra (2005a)‡
Absorption	Retrospective	142	0.009	Beaulieu-Prévost and Zadra (2005b)‡
Absorption	Retrospective	100	0.42	Belicki (1986)‡
Absorption	Retrospective	72	0.23	Glicksohn (1991)¶
Absorption	Retrospective	336	0.32	Hill *et al.* (1997)‡
Absorption	Retrospective	288	0.30	Levin and Young (2001–02)§
Absorption	Retrospective	238	0.088	Schredl *et al.* (2003a)§
Absorption	Retrospective	51	0.41	Schredl *et al.* (1997)§
Absorption	Retrospective	48	0.51	Spanos *et al.* (1980)‡
Absorption	Retrospective	42	0.28	Spanos *et al.* (1980)‡
Absorption	Retrospective	36	0.35	Zamore and Barrett (1989)¶
Absorption	Dream log	81	−0.148	Beaulieu-Prévost and Zadra (2005a)
Absorption	Dream log	142	0.088	Beaulieu-Prévost and Zadra (2005b)
Absorption	Dream log	336	0.32	Hill *et al.* (1997)
Absorption	Dream log	115	0.18	Levin *et al.* (2003)
Boundaries	Retrospective	81	0.119	Beaulieu-Prévost and Zadra (2005a)‡
Boundaries	Retrospective	142	0.002	Beaulieu-Prévost and Zadra (2005b)‡
Boundaries	Retrospective	757	0.40	Hartmann *et al.* (1991)§
Boundaries	Retrospective	238	0.177	Schredl *et al.* (2003a)§
Boundaries	Retrospective	50	0.26	Schredl *et al.* (1996a)§
Boundaries	Dream log	81	−0.072	Beaulieu-Prévost and Zadra (2005a)
Boundaries	Dream log	142	0.128	Beaulieu-Prévost and Zadra (2005b)
Boundaries	Dream log	50	0.29	Schredl *et al.* (1996a)
ATD	Retrospective	82	0.35	Beaulieu-Prévost and Zadra (2005a)‡
ATD	Retrospective	142	0.286	Beaulieu-Prévost and Zadra (2005b)‡
ATD	Retrospective	100	0.29	Belicki (1986)‡
ATD	Retrospective	46	0.31	Cernovsky (1984)§
ATD	Retrospective	295	0.46*	Herman and Shows (1984)§
ATD	Retrospective	336	0.41	Hill *et al.* (1997)‡
ATD	Retrospective	123	0.292*	Robbins and Tanck (1988)§
ATD	Retrospective	40	0.34	Rochlen *et al.* (1999)‡
ATD	Retrospective	238	0.291*	Schredl *et al.* (2003a)§
ATD	Retrospective	89	0.62	Schredl and Doll (2001)§
ATD	Retrospective	47	0.292*	Schredl and Montasser (1996–97b)‡
ATD	Retrospective	57	0.412	Schredl *et al.* (1996b)§
ATD	Retrospective	80	−0.01	Stickel and Hall (1963)§
ATD	Retrospective	87	0.56	Tonay (1993)§
ATD	Retrospective	173	0.213†	Wolcott and Strapp (2002)§
ATD	Retrospective	149	0.41	Bartnicki (1997)§
ATD	Dream log	82	0.00	Beaulieu-Prévost and Zadra (2005a)
ATD	Dream log	142	0.272	Beaulieu-Prévost and Zadra (2005b)
ATD	Dream log	336	0.32	Hill *et al.* (1997)
ATD	Dream log	98	0.204*	Robbins and Tanck (1988)

*Weighted mean correlation calculated from the original data.
†Results communicated directly by the corresponding author.
‡Study using a small-ranged retrospective measure of dream recall frequency (DRF).
§Study using a large-ranged retrospective measure of DRF.
¶Study using a relative retrospective measure of DRF

Table 2 Parametric estimations for each effect size

Type of dream recall frequency	*Variable*	r	*SE*	*Explained variance (%)*
Retrospective	Absorption	0.246	0.041	6.1
Retrospective	Boundaries	0.290	0.065	8.4
Retrospective	ATD	0.357	0.031	12.7
Dream log	Absorption	0.086	0.046	0.7
Dream log	Boundaries	0.098	0.065	1.0
Dream log	ATD	0.252	0.052	6.4

Step 5

Calculate the LL of the CI for the difference in explained variance by subtracting the UL for the logs from the LL for the retrospective measures and calculate the UL of the CI for the difference by subtracting the LL for the logs from the UL for the retrospective measures.
In the case of absorption,

$$\mathrm{LL} = 0.036 - 0.023 = 0.013 = 1.3\%$$

$$UL = 0.092 - 0.001 = 0.091 = 9.1\%$$

Table 3 presents the parametric estimations of the difference between correlations for each of the three personality variables with a retrospective versus log-based measures of DRF. As can be seen in this table, the parametric estimations of the probable ranges for the differences in explained variance between correlates of dream log measures of DRF and correlates of retrospective measures of DRF begin between 0% and 1% and end between 9% and 14%, depending on the correlate. These differences are statistically significant ($P < 0.05$) for absorption and psychological boundaries and approach statistical significance ($0.05 < P < 0.10$) for attitude towards dreams. These results are illustrated in Fig. 1.

Making sense of the measurement effect

The results of the meta-analysis indicate that although people's scores on measures of absorption or psychological boundaries can be used to partially predict their retrospectively measured levels of dream recall, they cannot be used to predict their level of dream recall as measured prospectively by a daily log. The dimension of attitude towards dreams appears useful in predicting both one's retrospectively measured level of DRF and the actual number of dreams reported in a daily log. That said, questionnaires assessing attitude towards dreams appear to be much more effective in predicting someone's retrospectively estimated average number of dreams recalled than the actual number of dreams reported prospectively in a dream log.

Why do retrospective measures appear to be stronger correlates of personality variables than prospective measures? One potential explanation is that daily logs are less sensitive to low DRF because they generally only cover a period of time between 2 and 4 weeks while retrospective measures often cover up to 1 year. In fact, daily logs might group together people who recall dreams once in every month, once in every 6 months, once per year, and those who report no dream recall whatsoever, whereas retrospective measures will often distinguish between these categories. If this is true, it follows that retrospective measures covering a longer time-span should produce larger correlations than retrospective measures using a more limited time-span similar to that of prospective logs (e.g. 2 weeks). To evaluate this hypothesis, the data obtained with retrospective measures were reanalysed. In these analyses, studies in which the smallest frequency unit of the DRF scale (excluding *zero* or *I never recall my dreams*) was either *once per 2 weeks* or *once per week* (called *small-range* DRF scales) were compared with studies in which the smallest frequency unit of the DRF scale was less than *once per 2 weeks* (called *large-range* DRF scales). Two studies (Glicksohn, 1991; Zamore and Barrett, 1989) were excluded as they used a relative DRF scale (i.e. never, sometimes, often, always). The specific category attributed to each study (i.e. large range, small range or relative) is indicated in Table 1.

Table 4 presents, separately for each personality variable, the parametric estimations of the correlations with both large-range and small-range retrospective measures of DRF and the confidence interval of the difference between the two correlations (in explained variance). A global measure of the difference was also obtained by (i) weighting the inferential confidence intervals of each difference by the number of participants and (ii) calculating a weighted average. As can be seen in Table 4, the prediction of a significantly larger correlation for large-range versus small-range retrospective measures of DRF does not hold for any of the three personality dimensions nor for the global weighted average.

Table 3 Parametric estimations, for each of the personality correlates, of the difference between correlations with a retrospective versus log measure of dream recall frequency

Variable	*Mean difference*	*95% CI*	*CI in difference of explained variance (%)*
Absorption	0.160	0.040–0.280	1.3–9.1
Boundaries	0.192	0.001–0.382	0.0–14.4
ATD	0.104	−0.014 to 0.222	−0.0 to 12.9

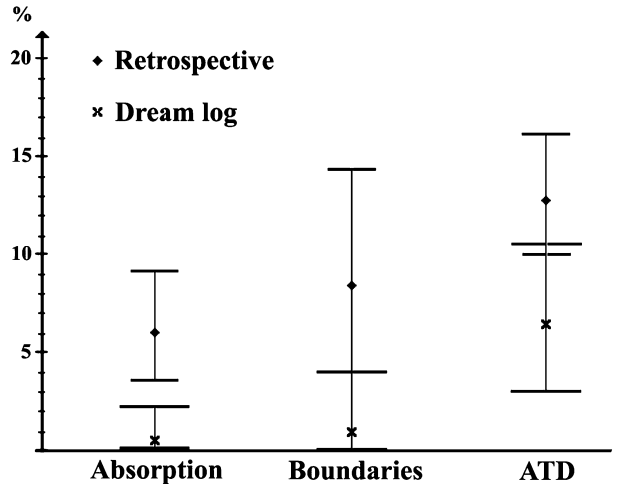

Figure 1. Parametric estimations in percentage of explained variance for each correlate of dream recall frequency represented with Tryon's (2001) inferential confidence intervals (95%).

Table 4 Parametric estimations, for each of the personality correlates, of the correlation (and standard error) with large-range versus small-range retrospective measures of dream recall frequency (DRF) and the confidence interval in explained variance of the difference between the two correlations

Variable	*Large-range DRF, r* (SE)	*Small-range DRF, r* (SE)	*CI in difference of explained variance (%)*
Absorption	0.222 (0.067)	0.261 (0.063)	−10.4 to 6.9
Boundaries	0.191 (0.022)	0.319 (0.087)	−18.7 to 2.0
ATD	0.359 (0.047)	0.353 (0.023)	−6.5 to 8.1
Global			−11.3 to 5.9

DISCUSSION

Our literature review indicated that correlates of retrospective measures of DRF could be related to DRF, but they could also simply be a reflection of an estimation bias. As the difference in effect sizes between correlates of retrospective versus log measures of DRF cannot be attributed to a lack of sensitivity in prospective logs, the 'estimation bias hypothesis' is most likely correct. Hence, scores on measures of absorption and psychological boundaries do not appear to be related to DRF *per se* (i.e. the elusive trait that researchers try to capture through both retrospective questions and daily logs), but rather to people's tendency to retrospectively underestimate or overestimate their DRF, whereas people's attitude towards dreams appears to be related both to DRF *per se* and to their retrospective estimation bias.

The findings from two recent studies suggest that these differential relations may be more complex than originally believed. Consistent with the aforementioned results, one study (Beaulieu-Prévost and Zadra, 2005a) found that people's scores on a questionnaire of attitude towards dreams and their diary DRF were independently related to retrospectively measured DRF. In addition, retrospective measures of DRF were largely inaccurate when used to predict diary DRF, with individuals presenting a negative attitude towards dreams being more likely to retrospectively underestimate their diary DRF. The second study (Beaulieu-Prévost and Zadra, 2005b) showed that (i) when memories of past dreams are readily available (i.e. when DRF is high), people's beliefs about their general dream content are closely related to their actual dream experiences and (ii) when such memories are not easily available (i.e. when DRF is low), people's beliefs about their dream content is influenced by their current affective state. Taken together, these data suggest that people's level of dream recall can be an important variable to take into account in such studies.

While the present study examined attitude towards dreams as a global trait, a study by Schredl *et al.* (2003a) who investigated different aspects of the construct suggests that various facets show differential relations to people's dream life. As discussed by these authors, some items usually included in conventional scales of attitude towards dreams are indirect measures of DRF. For example, high dream recallers can be expected to score generally higher than low recallers on a question about the frequency with which they talk about their dreams. In fact, Schredl *et al.* (2003a) found that their attitude towards dreams scale included two factors. While the global scale was correlated with a retrospective measure of DRF, the association disappeared when the factor including items conceptually related to DRF was excluded from the analysis. These results suggest that the correlations between traditional scales of attitude towards dreams and measures of DRF are at least partially due to a methodological constraint. These findings also suggest that the different factors related to measures of attitude towards dreams should be investigated and taken into account in future studies.

These results have other implications for dream research in general and within specific subfields such as the relationship between nightmares and psychopathology. The retrospective assessment of overall dream frequency can be performed in different ways. For instance, questionnaire items can inquire about the subject's average dream recall with open-ended questions (e.g. How many dreams do you usually recall per week?), present nominal choices to questions such as 'How often to you remember your dreams?' (e.g. never, rarely, sometimes, often), offer ordinal choices (e.g. 0 times per week, 1–3 times per week, 4–5 times per week, 7 or more times per week), etc. The relative merits, comparability and validity of these different options remain unknown and have attracted little attention. Similarly, log measures can take many forms ranging from having participants actually write out the narrative of their dreams on a daily basis to simply indicating with a checkmark if one or more dreams were recalled on a given night. Although the results of the present meta-analysis indicate that strong correlates of retrospective measures of DRF can show poor relations to log-based indices of DRF, the exact type of retrospective and log DRF measure may represent another variable which could be specified and taken into account in order to better understand these questions.

Within the field of nightmare research, dozens of studies have reported a positive relationship between nightmare frequency and scores on various measures of psychopathology. However, it was only in 1990 that researchers first used daily logs in addition to retrospective measures to assess nightmare frequency (Wood and Bootzin, 1990). In other words, nightmare frequency has almost always been assessed by retrospective self-report (e.g. number of nightmares in the previous week, month or year). But then, only a handful of other studies have used log-based data to assess nightmare frequency. One of the consistent findings from these investigations is that when compared with results from daily home logs, retrospective self-reports underestimate current nightmare frequency by a factor of 2.5 in young adults (Wood and Bootzin, 1990; Zadra and Donderi, 2000) to a factor of over 10 in the healthy elderly (Salvio *et al.*, 1992). Moreover, the study of Zadra and Donderi (2000) showed that the retrospective underestimation of nightmare and bad dream frequencies was not simply the result of an increase in recalled dreams caused by keeping a dream log. For instance, whereas DRF from a 4-week log was only about 15% higher than a retrospective measure, the dream log frequency of nightmares and bad dreams was considerably higher (between 53% and 162%) than the retrospective measure. Although such systematic retrospective underestimations do not imply that correlates of retrospective measures of nightmare frequency are not correlates of log-based measures of nightmare frequency, they point to the fact that estimation biases can occur for retrospective measures of dream content. As for the relation between nightmare frequency and measures of psychopathology, Wood and Bootzin (1990) found that the magnitude of the association between trait anxiety and nightmare frequency decreased from 0.13 to 0.04 when daily logs were used to measure nightmare

frequency instead of 12-month retrospective self-reports. This led the authors to suggest that anxious individuals do not necessarily have more nightmares, but rather that they are more likely to remember and report nightmares retrospectively. Although results from a subsequent study (Zadra and Donderi, 2000) provided mixed support for this idea, these kinds of results clearly illustrate the importance of taking into account the method used to assess the frequency of dream experiences before concluding that they are reliably associated with measures of personality or well-being.

One methodological limit of our meta-analysis is the small number of studies used to evaluate some parameters (e.g. three studies for the correlation between boundaries and log indices of DRF). However, this is clearly superior to any of the individual studies included in the analysis, and as such provides the most valid estimations that can be computed from the existing literature. Furthermore, although the number of studies is sometimes small, the number of participants included in each estimation was at least 273 (and was >2000 in the case of attitude towards dreams and retrospective DRF). Finally, the fact that the same global correlational pattern was found for each of the three personality variables (i.e. correlations with retrospective measures being larger than those with log values) suggests that the findings can be generalized to other personality correlates of DRF.

Some important conclusions can be inferred from this meta-analytical review. First, correlates of retrospective measures of DRF should not be automatically assumed to be correlates of log measures of DRF, especially for questionnaire-type variables. It is probably safer to consider retrospective indices of DRF as measures of peoples' cognitive representations of their dream recall instead of accurate indicators of their habitual levels of morning dream recall. More generally, peoples' cognitive representations of their general dream life and their daily levels of self-reported dream recall should be recognized as two different, albeit-related, objects of study. Finally, the personality dimensions of absorption, psychological boundaries and attitude towards dreams appear to affect peoples' cognitive representation of their dream recall but not their everyday levels of dream recall as measured by a dream log. However, the possibility that peoples' attitude towards dreams is also minimally related to their DRF cannot be excluded based on the present state of the literature. Additional research is clearly required to elucidate these questions. To this end, often neglected variables such as the specific methods employed to assess retrospective and log DRF, and the relation between questionnaire and prospectively obtained DRF data need to be critically investigated instead of being viewed as unimportant or taken for granted.

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