Dream-Enacting Behaviors in a Normal Population

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Study Objectives: Determine the prevalence and gender distributions of behaviors enacted during dreaming ("dream-enacting [DE] behaviors") in a normal population; the independence of such behaviors from other parasomnias; and the influence of different question wordings, socially desirable responding and personality on prevalence.
Design: 3-group questionnaire study
Setting: University classrooms
Participants: Three undergraduate samples (Ns = 443, 201, 496; mean ages = 19.9 ± 3.2 y; 20.1 ± 3.4 y; 19.1 ± 1.6 y)
Interventions: N/A
Measurements and Results: Subjects completed questionnaires about DE behaviors and Social Desirability. Study 1 employed a nonspecific question about the behaviors, Study 2 employed the same question with examples, and Study 3 employed 7 questions describing specific behavior subtypes (speaking, crying, smiling/laughing, fear, anger, movement, sexual arousal). Somnambulism, somniloquy, nightmares, dream recall, alexithymia, and absorption were also assessed. Factor analyses were conducted to determine relationships among DE behaviors and their independence from other parasomnias. Prevalence increased with increasing question specificity (35.9%, 76.7%, and 98.2% for the 3 samples). No gender difference obtained for the nonspecific question, but robust differences occurred for more specific questions. Females reported more speaking, crying, fear and smiling/laughing than did males; males reported more sexual arousal. When controlling other parasomnias and dream recall frequency, these differences persisted. Factor solutions revealed that DE behaviors were independent of other parasomnias and of dream recall frequency, except for an association between dream-talking and somniloquy. Sexual arousal was related only to age. Behaviors were independent of alexithymia but moderately related to absorption.
Conclusions: Dream-enacting behaviors are prevalent in healthy subjects and sensitive to question wording but not social desirability. Subtypes are related, differ with gender and occur independently of other parasomnias.
Keywords: Dream-related motor activity, parasomnias, REM sleep behavior disorder, somnambulism, somniloquy, nightmares, gender differences, social desirability, alexithymia, absorption, state dissociation
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DREAMING IS A SLEEP RELATED COGNITIVE ACTIVITY CHARACTERIZED BY MULTISENSORY IMAGERY, EMOTIONAL AROUSAL AND APPARENT SPEECH AND motor activity. For some REM sleep parasomnias, most notably REM sleep behavior disorder (RBD),[1–3] the emotional, verbal, or motor components of dreaming may be enacted behaviorally and form part of the disorder's clinical symptomatology. These behaviors are distinct from other behaviors observable during REM sleep that are not clearly linked with dream content, such as phasic muscle twitches, and from somnambulistic behaviors observable during NREM sleep that are not typically associated with vivid dreaming. Dream-enacting behaviors have also been reported for healthy individuals in autobiographical accounts[4] and by parents evaluating their children's sleep.[5] We recently demonstrated[6] that in the first 12 postpartum weeks, 63% of new mothers report some form of dream enactment, whether it be body or limb movement, emotional expression (e.g., weeping during a sad dream), or verbalization of dreamed speech; behaviors were also prevalent for pregnant women (56%) and nulligravid controls (40%). Such behaviors are most often reported for transitions from dreaming to wakefulness because the individual is able to recall enactment of the imagery immediately after it takes place. To illustrate, in a dream report of being pursued by a leopard and confronted by a looming masked figure, a dreamer describes his emotional reactions during the dream and in the transition to awakening:

> *. . . Panting for breath, I turned around to see the day turned to night, and a giant figure . . . I heard a thunderous voice saying only that it was time. And my entire body began to shake violently with the sound, as if I were breaking apart . . . I jerked up in a sweat, hitting my head against the wall lamp that stuck out above the bunk. In the darkness, my heart slowly evened itself, but I couldn't get back to sleep again.*[4]

This rather severe nightmare awakening underscores how the body movements and tachycardia on awakening mirror the vivid subjective emotions and movements of the dream—and are thus readily identifiable as transitional DE behaviors. Such behaviors are distinct from somnambulism or somniloquy, for which recalled dream imagery is absent or vague at best.

A more precise characterization of DE behaviors in different healthy and clinical populations may have relevance for the assessment of RBD and other parasomnias. For example, the frequency and prevalence of such behaviors among the elderly, who have the highest prevalence of RBD, is unknown. Further, it is not known whether different types of behaviors occur among healthy subjects in the same proportions as they do among RBD patients, nor whether there are gender differences (male predominance) among healthy subjects as there are with patients.

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Table 1—Age and Gender of the 3 Study Samples

	Total		Males		Females		Gender Unspecified		
	N	Mean *(SD)*	N	Mean *(SD)*	N	Mean *(SD)*	N	Mean *(SD)*	P
Sample 1	443	19.9 *(3.24)*	119	19.7 *(2.05)*	311	19.9 *(3.61)*	6[a]	18.8 *(1.07)*	0.598
Sample 2	201	20.1 *(3.43)*	56	20.4 *(3.51)*	128	20.0 *(3.40)*	0[b]	n/a	0.457
Sample 3	496	19.1 *(1.62)*	182	19.2 *(1.73)*	286	19.0 *(1.55)*	10[c]	19.1 *(0.99)*	0.402
Total	1140		357		725		16		

[a]7 subjects withheld age; [b]17 subjects withheld age; [c]18 subjects withheld age

Finally, RBD is a known prodrome of synucleopathic diseases such as Lewy body dementia and is itself often preceded by many years by increases in dream vividness and minor activity. It remains unknown—yet particularly relevant—whether the DE behaviors of healthy subjects may predict future RBD symptoms.

As a newly described sleep phenomenon for normal adults, our preliminary observations of DE behaviors among pregnant and postpartum women have raised a number of additional methodological issues. First, what questions are best for eliciting reports of these behaviors? Our finding that some behaviors, especially motor enactments, increase in prevalence in the postpartum state appears inconsistent with evidence[7] that many parasomnias (e.g., nightmares) decrease in prevalence through pregnancy to the postpartum state. Nonetheless, these findings and our own are not necessarily inconsistent because DE behaviors are relatively unknown to researchers, are not probed on standard assessment instruments, and may thus be overlooked during testing. Similarly, sexual sleep behaviors were first documented only when specific questions probing their occurrence were implemented.[8]

Second, might DE behaviors be expressions of some other parasomnia, such as nightmares, somnambulism, or somniloquy? The dream enactments of RBD are typically associated with vivid nightmares,[1-3] and those of new mothers are associated with both nightmares and dream anxiety.[6] Also, because somnambulistic behaviors are unmasked by sleep deprivation,[9] it is possible that, even for mothers who report themselves to be asymptomatic for somnambulism, dream enactments are sleepwalking symptoms elicited by the sleep deprivation and disruption of pregnancy and the postpartum state. As for somniloquy, limited evidence indicates that episodes may be accompanied by elaborate dream content,[10] suggesting that enacted dream speech may not be differentiable from somniloquy.

Third, are different types of enactment behaviors interrelated or separate phenomena? In our previous study, the distributions of 3 types of behaviors differed for the pregnancy, postpartum, and nulligravid groups. For example, motor activity was more prevalent for postpartum (57%) than for either pregnant (24%) or nulligravid (25%) women, whereas emotional expression was more prevalent for nulligravid (56%) than postpartum (27%) women. Because the smaller size of our nulligravid group raised concerns about the representativeness of findings for all normal subjects, the assessment of additional samples was desirable. Also, because women recall dreams more often than do men,[11] comparative assessment of DE behaviors among male and female samples was needed.

Finally, does socially desirable responding bias the reporting of DE behaviors? Social desirability is the tendency for some respondents to give answers that they think will cast them in a more favorable social light, i.e., by inflating or downplaying responses to socially perceived "good" or "bad" behaviors, respectively.The issue of socially desirable responding on self-report sleep instruments is rarely addressed, even though it is known to influence the reporting of mental health symptoms.[12] In the absence of laboratory verification, reporting bias should be minimized in the assessment of these behaviors.

In sum, DE behaviors similar to those symptomatic of RBD have been documented in normal adult women and raise new questions about the exclusiveness of this symptom for RBD. Questions are also raised about the form of questioning that is optimal for assessing them, their relationship with other parasomnias, the diversity of their form in normal samples, their relation to personality traits, gender and habitual dream recall frequency and whether their reporting is influenced by socially desirable responding. The present work addresses these issues by assessing the prevalence, frequency, and correlates of DE behaviors in 3 separate samples of university undergraduates using increasingly specific questions to direct subjects in identifying their behaviors.

METHODS

Three samples of undergraduate students enrolled in introductory psychology courses (Table 1) participated in the research for course credit. Of a total of 1140 subjects, approximately two-thirds were female and one-third male. Subjects were first-year undergraduates (M_{age} = 19.9 ± 3.2 y, 20.1 ± 3.4 y, and 19.1 ± 1.6 y, respectively), and male and female subjects did not differ in age in any of the 3 samples.

All subjects gave informed consent and participated voluntarily (they were free to choose an alternative educational activity). They completed an extensive battery of questionnaires as part of a larger research program on personality and dreaming; the specifics of the batteries varied from study to study and are not described in detail here. The questionnaires included standardized personality instruments including the 13-item short-form of the Marlowe-Crowne Social Desirability Scale,[13] a measure of bias in responding in a socially favorable manner; the Tellegen Absorption Scale,[14] a measure of capacity for intensely focused attention, proneness to fantasy and to state dissociations, and disposition to experiencing altered states of consciousness; and the Toronto Alexithymia Scale (TAS-20),[15] a measure of inability to identify and communicate emotions. Also included were items probing for the recall of dreams (number/month), various dream types (e.g., nightmares, bad dreams, lucid dreams), and related parasomnias (sleepwalking, sleep-talking, sleep paralysis). Some results from Study 1 have been reported previously.[16] The 3 studies constitute a program-

matic series over which key questions concerning DE behaviors were clarified progressively as findings emerged. Studies 1 and 2 assessed behaviors generally, without specification of types or references to transition to wakefulness. Study 3 employed a more detailed series of items that specified both behavioral subtypes and their occurrence during transitions from dreaming to wakefulness.

Subjects in Study 1 completed their questionnaire battery alone, and subjects in Studies 2 and 3 completed theirs in groups of 20–50. All subjects entered their responses on standard, optically scored, answer sheets using HB pencils. Following participation, they were given a thorough written debriefing. Records were optically scanned and verified manually by an assistant to remove records with incorrectly coded or out of range responses.

Target Questions

Study 1. Subjects were asked the following two nonspecific questions about DE behaviors: 1) *On how many nights did the following occur in the last year?…acting out of a dream (while still dreaming)*; 2) *How often did the following occur when you were younger (e.g., 4-16 years old)?... acting out of a dream (while still dreaming)*. The following 7-point response scale was provided for both items: *0: never; 1: 1 time/year; 2: 2-5 times/year; 3: 6-10 times/year; 4: 11-15 times/year; 5: 16-20 times/year; 6: 21 times/year or more*. In the same section as the first item, there appeared similarly-scored items dealing with past-year *sleep-walking* and *sleep-talking*. In the same section as the second item were similarly-scored items dealing with childhood *sleep-walking, sleep-talking, sleep terrors, nightmares* and *bad dreams*. The latter variables were also evaluated for the last 30 days (e.g., *How often have you experienced **nightmares** in the last 30 days?)* using the same 7-point response scale.

Study 2. Subjects were given the first nonspecific question from Study 1 revised to provide examples of behaviors. Specifically, they were asked: 1) *On how many nights did the following occur in the last year?…acting out of a dream while still dreaming (e.g., crying, laughing or arm/leg movements expressing a dream)*. The second question concerning childhood DE behaviors was identical to that in Study 1, as were the items dealing with *sleep-walking, sleep-talking, sleep terrors, nightmares* and *bad dreams*. The same 7-point response scale was used.

Study 3. Subjects were given a series of more specific questions about DE behaviors, including a sentence differentiating them from somnambulism and somniloquy (see instructions, Table 2). To further distinguish the two types of parasomnias, the somnambulism and somniloquy items were revised as shown in Table 2, questions 8 and 9. All items were accompanied by 4-point response scales: *0: Never; 1: Rarely; 2: Sometimes; 3: Often*.

Table 2—Items for Assessing Dream-Enacting Behaviors, Somnambulism, and Somniloquy in Study 3

The following questions [1-7] concern behaviors that are acted out while you are dreaming about them. The behaviors are different from sleep-walking or sleep-talking behaviors [questions 8-9] which are not accompanied by clear dreams.

1. How often have you awakened from a dream about talking to find that you are speaking out loud some of the words in the dream?
2. How often have you awakened from a sad dream to find that you are actually crying or sobbing?
3. How often have you awakened from a happy dream to find that you are actually smiling or laughing?
4. How often have you awakened from a frightening dream to find that you can still feel signs of fear in your body (e.g., racing heart, perspiration, tense muscles)?
5. How often have you awakened from an aggressive or angry dream to find that you are acting out some angry or defensive behavior (e.g., clenching a fist, punching, kicking, pushing)?
6. How often have you awakened from a dream with some other kind of movement in it to find that you are acting out that movement (e.g., waving, pointing, holding, sitting)?
7. How often have you awakened from an erotic dream to find that you are sexually aroused?
8. Do you ever have episodes of somnambulism (moving or walking in your sleep) where you did not clearly recall an accompanying dream?
9. Do you ever have episodes of somniloquy (speaking or making sounds in your sleep) where you did not clearly recall an accompanying dream?

Statistical Analyses

Prevalence estimates for all 3 studies were calculated by treating the dependent variables as binary (0 = *never* and 1 = *any other valid response*). To determine gender effects in Study 3, we conducted a multivariate analysis of variance (MANOVA) with gender as an independent variable and 7 DE behaviors as dependent variables, followed by a multivariate analysis of covariance (MANCOVA) with nightmares, somnambulism, and somniloquy as covariates. The independence of behaviors from the latter variables was further determined by principal components factor analysis (Kaiser normalization, varimax rotation, all Eigen values > 1), which included age as a variable. All analyses were completed using SPSS v16 software (SPSS, Chicago, IL).

RESULTS

Prevalence

Administration of the nonspecific question about DE behaviors resulted in similar response distributions for the *last year* and *childhood* prevalence estimates; 35.9% of subjects reported at least one episode (score > 0 on 7-point scale) in the last year, while 45.4% reported at least one/year in childhood (Figure 1, solid bars). These values were higher than those for somnambulism (12.4% and 35.0%; both $P < 0.0001$) but lower than those for somniloquy (54.2% and 67.0%; $P = 0.116$ and $P < 0.003$). The mean frequency of last year behaviors was 0.83 ± 1.36 or slightly less than 1/yr. For childhood, the mean frequency was 1.07 ± 1.50 or slightly more than 1/yr. Administration of the question with included examples also resulted in similar distributions for *last-year* (76.7% at least one/yr) and *childhood* (78.9%) prevalence estimates, although both of these were increased relative to the Study 1 estimates that were based on the nonspecific question alone (Figure 1, white bars, both $P < 0.00001$). The mean frequency of last-year behaviors was 2.15 ± 1.85 or slightly more than 2-5/yr. The mean frequency of childhood behaviors was 2.54 ± 2.00 or between 2-5 and 6-10/yr. The last-year prevalence estimate was higher than estimates for both somnambulism (13.8%, P

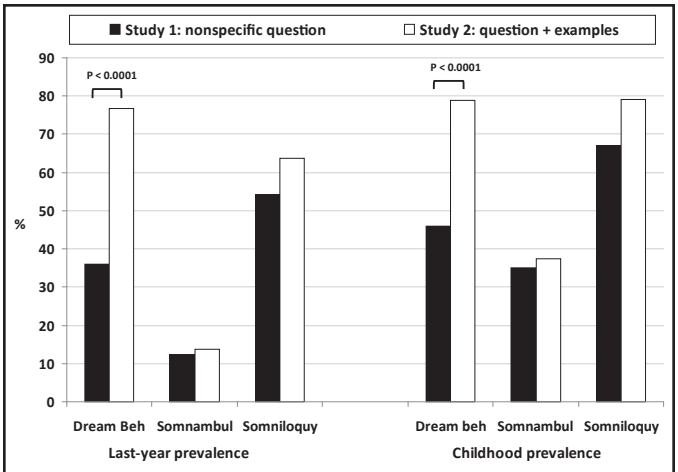

Figure 1—Subjects responding > 0 (out of 7) to items about dream-enacting behaviors, somnambulism, and somniloquy in reaction to either a nonspecific question or a question that includes examples. The question with examples dramatically increased prevalence estimates for dream-enacting behaviors but not estimates of somnambulism or somniloquy. *Last-year = estimate for previous year; Childhood = estimate for childhood (ages 4-16)*

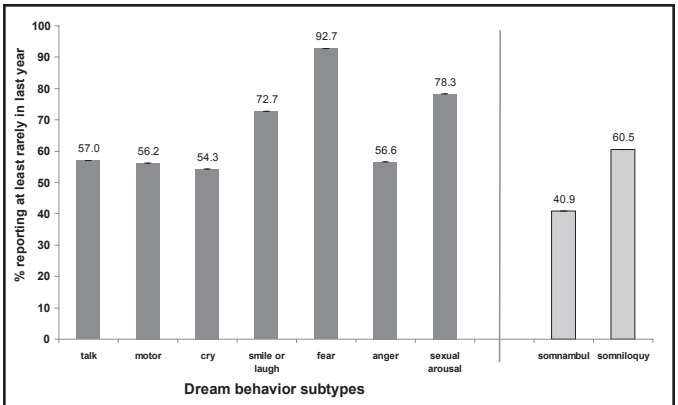

Figure 2—Prevalence of 7 subtypes of dream-enacting behavior, i.e., % subjects reporting speaking, motor activity, 4 types of emotions and sexual arousal at least *rarely* in the last year. Somnambulism and somniloquy estimates are presented at right for comparison.

Table 3—Frequency Distributions for 7 Dream Behavior Subtypes

		never	rarely	sometimes	often	Total
talk	%	43.0	32.7	18.4	5.9	100
motor	%	43.8	31.1	18.6	6.5	100
cry	%	45.7	28.9	17.6	7.9	100
smile or laugh	%	27.3	33.8	28.7	10.1	100
fear	%	7.3	22.6	40.8	29.3	100
anger	%	43.4	32.9	16.4	7.3	100
sexual arousal	%	21.7	27.1	34.4	16.8	100

< 0.00001) and somniloquy (63.6%; P < 0.05) and the childhood prevalence estimate was higher than that for somnambulism (37.4%; P < 0.0001) but not somniloquy (79.0%; P = ns). There was no change from Study 1 to Study 2 for prevalence estimates of either somnambulism (both P < 0.77) or somniloquy (P < 0.06 and P < 0.18).

In Study 3, DE behaviors were more prevalent than in Studies 1 and 2; 98.2% of subjects (486/495) reported one of the 7 subtypes at least *rarely* in the last year (Figure 2). This value remained high (87.1% or 431/495) when only subjects reporting a behavior at least *sometimes* in the last year are considered (Table 3). The prevalence of somniloquy was approximately the same (60.5%) as for Studies 1 (54.2%) and 2 (63.6%), whereas that for somnambulism (40.9%) was substantially larger (12.4% and 13.8%, respectively).

Gender Differences

To determine gender effects, Study 1 and 2 responses were subjected to one-way analyses of variance (ANOVAs), and Study 3 responses were subjected to a MANOVA. For Study 1, there was no difference between males (0.91 ± 1.45) and females (0.78 ± 1.30) in the mean score for DE behaviors in last year ($F_{1,418}$ = 0.698, P = 0.404). Nor was there a gender difference for behaviors in childhood (M: 1.17 ± 1.60; F: 1.06 ± 1.49; $F_{1,418}$ = 0.494, P = 0.483). For Study 2, there were significant gender differences for both measures: behaviors in the last year (M: 1.72 ± 2.06; F: 2.34 ± 1.73; $F_{1,190}$ = 4.486, P = 0.035) and in childhood (M: 1.86 ± 1.95; F: 2.83 ± 1.96; $F_{1,190}$ = 9.865, P = 0.002). Controlling somnambulism, somniloquy, nightmares and bad dreams as covariates diminished these differences only somewhat: DE behaviors in last year ($F_{5,186}$ = 4.340, P = 0.039) and in childhood ($F_{5,186}$ = 9.648, P < 0.002). Adding habitual dream recall frequency (#dream/mo) to the preceding analyses reduced the difference for behaviors in the last year to a trend ($F_{1,185}$ = 2.504, P = 0.115) but did not diminish that for behaviors in childhood ($F_{1,185}$ = 24.927, P = 0.006).

For Study 3, a multivariate effect (Hotelling-T = 0.376, $F_{7,462}$ = 24.830, P < 0.0000001) and univariate effects demonstrated higher frequencies of speaking (P < 0.052), crying (P < 0.0000001), fear (P < 0.0002), and smiling/laughing (P < 0.059) behaviors for females and higher frequencies of sexual arousal (P < 0.0000001) behaviors for males (Figure 3). Anger and motor activity behaviors did not differ (both P > 0.37). Moreover, controlling somnambulism, somniloquy, nightmares, and bad dreams as covariates did not diminish the multivariate effect (T = 0.358, $F_{7,448}$ = 22.941, P < 0.0000001); rather, it rendered all 7 univariate effects significant at P < 0.000007, with females now also scoring significantly higher than males on anger and motor activity. Adding habitual dream recall frequency (#dreams/mo) as a covariate to the preceding analysis also did not diminish the multivariate gender effect (T = 0.377, $F_{7,461}$ = 24.190, P < 0.0000001) but upheld the significant effects for crying, fear, and sexual arousal (all P < 0.001) and the lack of effects for anger and motor activity (both P > 0.60), while reducing the effects for talking and smiling/laughing to weak trends (P < 0.13).

Independence from Somnambulism/Somniloquy

Exploratory factor analyses conducted on all 3 study samples distinguished DE behaviors from other parasomnia events (Table 4). For Studies 1 and 2, 11 variables were entered: DE behaviors (*in last year, in childhood*), somniloquy

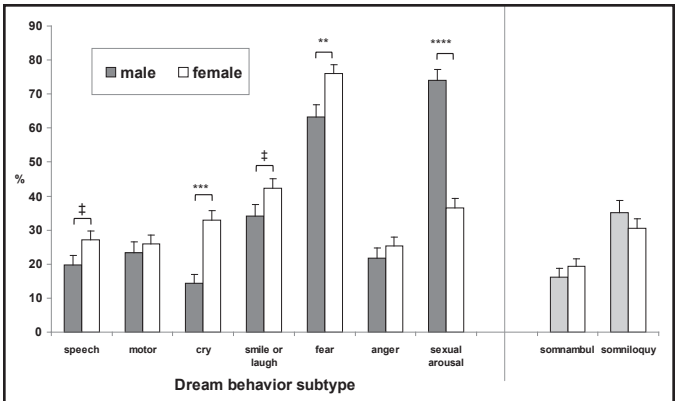

Figure 3—Gender differences in percent of subjects reporting dream speaking, motor activity, emotions and sexual arousal "sometimes" or "often." Females more frequently reported behaviors on all items except sexual arousal, which was characteristic of males (unpaired *t* tests for gender: ‡P < 0.06; **P < 0.005; ***P < 0.000001; ****P < 0.0000001). Somnambulism and somniloquy did not differentiate the sexes.

and somnambulism (*in last year, in childhood*), nightmares and bad dreams (*in last 30 days, in childhood*), and age. For Study 1, a 5-factor solution accounted for 75.6% of the variance and clearly grouped the 4 somniloquy and somnambulism items under one factor. Bad dreams and nightmares were grouped under 2 separate factors, one each for the *last 30 days* and *childhood* measures. The 2 dream behavior items grouped clearly on Factor 3, while age loaded alone on a distinct factor.

For Study 2, which employed a smaller sample, a slightly different 4-factor solution was obtained that accounted for 69.4% of the variance and that nonetheless distinguished DE behaviors from somnambulism, nightmares/bad dreams, and age factors. However, in this sample the 2 somniloquy items also loaded strongly on the same factor as the dream behavior items.

For Study 3, 12 variables were entered: the 7 dream behavior subtypes, somnambulism/somniloquy (*in last year*), nightmares/bad dreams (*in last 30 days*) and age. A 4-factor solution accounted for 59.4% of the variance and largely distinguished DE behaviors from both somnambulism/somniloquy and nightmares/bad dreams. Factor 1 grouped 6 of the 7 dream-enactment variables, with the exception of sexual arousal which loaded with age on Factor 4. Factor 2 clearly grouped nightmares and bad dreams while Factor 3 grouped somnambulism and somniloquy. However, dream-talking loaded moderately on the latter factor as well. Zero-order correlations revealed that dream-talking correlated more highly with somniloquy (r = 0.366) than with somnambulism (r = 0.233) although both relationships were highly significant (both P < 0.0000001). All other DE behaviors correlated with somniloquy at less than r = 0.260 and with somnambulism at less than r = 0.220.

Socially Desirable Responding Bias

There were no significant correlations between the social desirability total score and any of the 7 DE behavior items (all P > 0.134). Nor were correlations between social desirability and either somnambulism (r = −0.072; P = 0.118) or somniloquy (r = −0.060; P = 0.195) significant.

Table 4—Factor Loadings of Dream-Enacting Behaviors, Other Parasomnias and Age for Factor Analyses of 3 Study Samples

	Factor				
	1	2	3	4	5
Study 1 (N = 443)	**(20.2%)**	**(15.9%)**	**(15.3%)**	**(14.6%)**	**(9.6%)**
somniloquy (ch)	0.834	0.245	0.094	−0.077	0.144
somniloquy (yr)	0.784	0.105	0.140	0.035	0.160
somnambul (ch)	0.725	0.036	0.107	0.138	−0.199
somnambul (y)	0.541	−0.211	0.203	0.329	−0.380
bad dreams (ch)	0.113	0.894	0.101	0.123	−0.047
nightmares (ch)	0.123	0.860	0.061	0.215	−0.054
dream beh (y)	0.136	0.033	0.904	0.086	−0.042
dream beh (ch)	0.185	0.132	0.870	0.104	−0.020
nightmare (30 d)	0.095	0.132	0.055	0.855	−0.052
bad dream (30 d)	0.027	0.201	0.125	0.807	0.105
age	0.051	−0.110	−0.028	0.068	0.899
Study 2 (N = 201)	**(22.9%)**	**(21.0%)**	**(14.8%)**	**(10.6%)**	
somniloquy (ch)	0.829	0.040	0.264	−0.069	
somniloquy (y)	0.796	0.111	0.204	−0.198	
dream beh (y)	0.721	0.282	−0.035	0.240	
dream beh (ch)	0.701	0.298	−0.007	0.440	
bad dream (ch)	0.264	0.766	−0.069	−0.086	
nightmare (ch)	0.250	0.741	0.020	−0.076	
bad dream (30 d)	0.079	0.719	0.187	−0.034	
nightmare (30 d)	−0.073	0.667	0.390	0.235	
somnambul (y)	0.106	0.102	0.839	0.027	
somnambul (ch)	0.186	0.109	0.789	−0.071	
age	0.033	−0.100	−0.021	0.894	
Study 3 (N = 496)	**(22.1%)**	**(14.1%)**	**(14.1%)**	**(9.1%)**	
smiling/laughing	0.758	0.001	0.024	0.100	
anger	0.701	0.123	0.102	0.066	
crying	0.683	0.169	0.037	−0.088	
fear	0.632	0.126	0.099	0.079	
movement	0.531	0.128	0.338	−0.058	
talking	0.466	0.322	0.426	0.024	
bad dream (30 d)	0.168	0.853	0.017	0.032	
nightmare (30 d)	0.189	0.850	0.122	0.044	
somniloquy	0.106	0.026	0.843	0.017	
somnambul	0.087	0.051	0.788	0.007	
age	−0.157	0.196	−0.090	0.794	
sexual arousal	0.342	−0.145	0.134	0.655	

ch = childhood; y = last year; 30d = last 30 days; dream beh = dream behavior; somnambul = somnambulism

Relation to Dream Recall Frequency, Absorption, and Alexithymia

To further assess the relationship of DE behaviors to dream recall frequency, #dreams recalled/month was entered as a variable in each of the 3 previous factor analyses. In all 3 cases, dream recall loaded heavily only on the bad dreams/nightmares recall factor (Study 1: r = 0.573; Study 2: r = 0.438; Study 3: r = 0.698) but not on the DE behaviors factor (Study 1: r = −0.012; Study 2: r = 0.252; Study 3: r = 0.211) or any other factor.

To determine if the frequency of DE behaviors is a function of absorption, subject absorption scores available for Studies 1

and 2 were added as variables to the factor analyses for those studies. For Study 1, absorption loaded heavily on a factor with dream recall frequency (r = 0.687) and lower on the DE behaviors factor (r = 0.282). Significant Pearson correlations between absorption and the frequency of *DE behaviors: last year* (r_{441} = 0.222, P < 0.000002) and *DE behaviors: as child* (r_{441} = 0.240, P < 0.000001) remained significant when dream recall frequency was partialled out (r_{440} = 0.199 and 0.221, both P < 0.00004). For Study 2, absorption loaded moderately (r = 0.457) on the DE behaviors factor and lower on the nightmare/bad dream/dream recall factor (r = 0.253). Again, significant correlations with *DE behaviors: last year* (r_{190} = 0.297, P < 0.00003) and *DE behaviors: as child* (r_{190} = 0.232, P < 0.002) remained so when dream recall frequency was partialled out (r_{189} = 0.253 and 0.193, both P < 0.008).

To determine if the reporting of DE behaviors was related to alexithymia, the TAS-20 score available for Study 1 was added as a variable to the factor analysis for that study. It loaded heavily and negatively on the age factor (r = −0.634) but not on the DE behaviors factor (r = 0.068), on either of the nightmares/bad dreams factors (last 30 d: r = 0.091; as child: r = −0.124), or on the somniloquy/somnambulism factor (r = −0.058).

DISCUSSION

DE behaviors are very prevalent among normal undergraduates, confirming our previous findings[6] and lending support to the conclusion that such behaviors are relatively prevalent in non-pathological populations. This finding, along with work demonstrating high prevalences of sleep paralysis, hypnagogic hallucinations, and disorders of arousal in the general population, supports the notion that state dissociations, i.e., combined or rapidly oscillating sleep/wake states, occur more commonly than is generally appreciated.[17,18] The behaviors we have documented resemble in type and variety those seen routinely in RBD evaluations but are much less frequent and probably less severe. RBD patients exhibit a variety of nonviolent behaviors such as laughing, speaking, eating, and sexual movements[2] in addition to violent behaviors such as kicking and punching. This was also the case for the present study where speaking, laughing, motor activity and sexual activity were frequently reported in addition to negative emotional expressions, such as crying, anger and fear. However, whereas RBD patients enact their dreams several times per week or even per night,[1] the healthy subjects in our sample (Study 2) reported them on average less than 6 times/yr. Also, RBD dream enactments are typically described as severe and often violent when accompanying vivid nightmares. It is unlikely that the DE behaviors of normal subjects are as severe, although we did not directly assess severity. However, the most prevalent of the 7 dream behavior subtypes assessed in Study 3, including fear, were clearly independent of nightmares and bad dreams. They were also independent of alexithymia, an impairment in the ability to identify and communicate emotions.[15] There was mixed evidence for a relationship between DE behaviors and absorption, a disposition to experience focused attention, fantasy, state dissociations and altered states of consciousness. Thus, although normal DE behaviors do not appear to constitute the expression of an underlying Nightmare Disorder or alexithymia deficit, they may reflect a disposition to heightened attentional engagement in imagery processes.

In sum, while it seems unlikely that the DE behaviors of normal subjects are either as frequent or as severe as those of RBD patients, longitudinal studies are still needed to determine if RBD DE behaviors are simply a more severe expression of this otherwise normal sleep characteristic, or whether future RBD behavioral symptoms may even be predicted by some qualities of normal dream enactment (e.g., episodes during periods of stress). Another question raised by these findings is whether normal DE behaviors are associated with specific dream functions such as affect regulation. Such a role was previously suggested by the increased prevalence of DE behaviors among new mothers, for whom infant care is an emotionally as well as physically demanding time. Such a role was also consistent with our findings[19] that DE behaviors are correlated both with how real an ongoing dream seems (r = 0.52, P < 0.001) and the emotional insight it engenders after awakening (r = 0.42, P < 0.001). A possibly related function for DE behaviors is suggested by evidence in rats[20] that the tactile feedback resulting from spontaneous muscle twitches during REM sleep atonia facilitates the functional adaptation of spinal reflexes (e.g., calibration of withdrawal reflexes); more elaborate movements related to dreaming in humans may reflect even more extensive, supraspinal adaptations.

Our results indicate that wording of the question about DE behaviors is a critical factor in estimating the magnitude of their prevalence. A nonspecific question about "acting out a dream while still dreaming" produced an overall prevalence rate (35.9%) that is lower than the rates from our previous study (40% to 63%),[6] for which some dream behavior subtypes were specified. In contrast, a more elaborate question that provided examples of behaviors (Study 2) produced a prevalence (76.7%) that is equal to or higher than that from our previous study. And, our use of an elaborate list of questions (Study 3) produced an even higher prevalence still (98%). These findings suggest that DE behaviors are common in the general population but are difficult for subjects to identify if detailed descriptions of the behaviors are not given. A similar conclusion about the wording of study questions was drawn in studies of sexual parasomnias[8] and sleep paralysis experiences.[21] In fact, Fukuda, et al.[21] found that different wordings of a question about sleep paralysis could lead to prevalence estimates as high as 52% or as low as 9%.

Several of the present findings suggest that normal dream enactments are not simply symptoms of somnambulism, somniloquy or other parasomnias. Factor analyses of responses from the 3 studies indicated that DE behaviors are for the most part intercorrelated and independent of somnambulism, nightmares and bad dreams. Exceptions to this include sexual arousal, which was more closely associated with age than with other DE behaviors or other parasomnias, and dream-talking, which was associated with somniloquy in Study 3. It may be that somniloquy is particularly difficult to differentiate from dream-talking. Arkin's[10] studies suggest that sleeptalking events may occur in both REM and NREM sleep and are particularly likely to correspond to recalled dream content in the former state. Without additional polysomnographic and videographic evidence to discriminate REM and NREM sleep stages, it may be impossible to distinguish between these two phenomena based on verbal reports alone.

It is also noteworthy that the prevalence and frequency estimates for DE behaviors in Study 2 were higher than those

in Study 1 even though the estimates for somnambulism and soliloquy in the two studies were not significantly different. This suggests that the more detailed question enabled subjects to identify dream-related behaviors *in addition to* those that they typically associate with somnambulism and soliloquy. The more detailed question did not appear to introduce a general response bias for increased yea-saying; nor did it increase the reporting of DE behaviors to the detriment of reporting either somnambulism or somniloquy (e.g., somnambulism episodes being reclassified as dream enactments). In contrast, the detailed questions from Study 3 were associated with a higher prevalence of somnambulism than in Studies 1 and 2. This may indicate that our use of the term somnambulism (rather than sleep-walking) and the inclusion of 'moving' in its definition led subjects to report more episodes in this category. It may also indicate that the dream content that accompanied some of the detailed dream behavioral episodes that subjects were reminded of by the prompts in Study 3 had since been forgotten, obliging them to classify those behaviors—incorrectly—as somnambulistic events. Finally, gender differences on all of the DE behaviors were independent of somnambulism and somniloquy, suggesting again that these are different phenomena.

Results from Study 3 suggest that at least 5 of the 7 dream behavior subtypes we examined were strongly interrelated. All 4 emotion items were highly intercorrelated and correlated with the item assessing dream-related movements. All 5 of these behaviors were significantly more prevalent for females than for males. On the other hand, dreamed sexual arousal appears to be distinct from the others as it was highly prevalent for males and correlated with age rather than with other parasomnias. Dream-talking, as mentioned earlier, was associated moderately with the other 5 behavior subtypes but to an almost equal degree with somniloquy as well.

No evidence was found that the reporting of DE behaviors was due to a bias toward socially desirable responding. Thus, there is thus little reason to doubt the veracity of our subjects' responses to these questionnaires. There was evidence that the reporting of at least some behaviors (e.g., motor activity, anger) varies with the gender difference in dream recall frequency that favors women;[11] however, factor analyses suggested that, apart from this gender relationship, DE behaviors are relatively independent of dream recall frequency. Similarly, the affective disorder alexithymia was found to be unrelated to this phenomenon.

Results for absorption scores were mixed but nonetheless consistent with the possibility of a personality trait involvement in DE behaviors. If replicated, the correlation between absorption and DE behavior frequency would support the notion that the behaviors express a more general disposition to state dissociation experiences. This follows from the finding that absorption is correlated with other state dissociation indicators in normal adolescents.[22] Further, the Tellegen absorption measure has been linked to the T102C polymorphism of the *5-HT2a* gene,[23] a regulator of the serotonergic system, thus raising the possibility of a genetically determined predisposition for DE behaviors.

Some methodological considerations nonetheless limit the generalizability of the findings and suggest improvements for future research. Although our findings demonstrate some progress validating the construct of DE behaviors (correlations with other measures, distinct factor structure) and of excluding social desirability as a response bias, our use of retrospective questionnaires are an important limiting factor. Such questionnaires rely on long-term memory which may be unreliable or confounded by other factors. It is possible, for example, that our subjects' episodic memories for their behaviors were inaccurate (e.g., falsely remembering enacting behaviors that were, in fact, only dreamed to have occurred) or that common schemas about DE behaviors, such as those conveyed in movies and books, distorted the recall and reporting process. As sporadic phenomena, DE behaviors are not easily studied in the sleep laboratory; however, long-term home sleep logs or ambulatory recordings of high frequency responders would provide more prospective and objective measures. Retrospective questionnaires may nonetheless prove valuable as screening tools for both clinical and basic research studies.

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REFERENCES

1. Mahowald MW, Schenck CH. REM sleep parasomnias. In: Kryger MH, Roth T, Dement WC, eds. Principles and practice of sleep medicine. 4th ed. Philadelphia: Elsevier Saunders, 2005:897-916.
2. Oudiette D, De C, V, Lavault S, Leu S, Vidailhet M, Arnulf I. Nonviolent elaborate behaviors may also occur in REM sleep behavior disorder. Neurology 2009;72:551-57.
3. Nielsen TA. Disturbed dreaming in medical conditions. In: Kryger M, Roth N, Dement WC, eds. Principles and practice of sleep medicine. 4th ed. Philadelphia: Elsevier Saunders, 2005:936-45.
4. Obama B. Dreams from my father. A story of race and inheritance. New York: Three Rivers Press, 1995.
5. Fisher BE, McGuire K, Honeyman K. Relationships between nocturnal activity, parental ratings of daytime activity and measures from the Children's Sleep Behaviour Scale. Can J Beh Sci 1994;26:477-83.
6. Nielsen T, Paquette T. Dream-associated behaviors affecting pregnant and postpartum women. Sleep 2007;30:1162-69.
7. Hedman C, Pohjasvaara T, Tolonen U, Salmivaara A, Myllyla VV. Parasomnias decline during pregnancy. Acta Neurologica Scandinavica 2002;105:209-14.
8. Shapiro CM, Trajanovic NN, Fedoroff JP. Sexsomnia--a new parasomnia? Can J Psychiatr 2003;48:311-17.
9. Joncas S, Zadra A, Paquet J, Montplaisir J. The value of sleep deprivation as a diagnostic tool in adult sleepwalkers. Neurology 2002;58:936-40.
10. Arkin AM. Sleep-talking: Psychology and psychophysiology. Hillsdale, New Jersey: Lawrence Erlbaum, 1981.
11. Schredl M, Reinhard I. Gender differences in dream recall: a meta-analysis. J Sleep Res 2008;17:125-31.
12. Bardwell WA, Ancoli-Israel S, Dimsdale JE. Response bias influences mental health symptom reporting in patients with obstructive sleep apnea. Annals of Behavioral Medicine 2001;23:313-17.
13. Reynolds WM. Development of reliable and valid short forms of the Marlowe-Crowne Social Desirability Scale. J Clin Psychol 1982;38:119-25.
14. Tellegen A, Atkinson G. Openness to absorbing and self-altering experiences ("absorption"), a trait related to hypnotic susceptibility. J Abnorm Psychol 1974;83:268-77.
15. Bagby RM, Taylor GJ, Parker JDA. The twenty-item Toronto Alexithymia Scale - II. Convergent, discriminant, and concurrent validity. J Psychosom Res 1994;38:33-40.
16. Nielsen TA, Kuiken D, Alain G, Stenstrom P, Powell R. Immediate and

delayed incorporations of events into dreams: further replication and implications for dream function. J Sleep Res 2004;13:327-36.
17. Mahowald MW, Schenck CH. Evolving concepts of human state dissociation. Arch Ital Biol 2001;139:269-300.
18. Mahowald MW, Schenck CH. Dissociated states of wakefulness and sleep. Neurology 1992;42 (suppl 6):44-52.
19. Kuiken D, Nielsen TA. Individual differences in orienting activity mediate feeling realization in dreams: [1] Evidence from retrospective reports of movement inhibition. Dreaming 1996;6:201-17.
20. Petersson P, Waldenstrom A, Fahraeus C, Schouenborg J. Spontaneous muscle twitches during sleep guide spinal self-organization. Nature 2003;424:72-75.
21. Fukuda K. One explanatory basis for the discrepancy of reported prevalences of sleep paralysis among healthy respondents. Percept Mot Skills 1993;77:803-7.
22. Muris P, Merckelbach H, Peeters E. The links between the Adolescent Dissociative Experiences Scale (A-DES), fantasy proneness, and anxiety symptoms. J Nerv Ment Dis 2003;191:18-24.
23. Ott U, Reuter M, Hennig J, Vaitl D. Evidence for a common biological basis of the Absorption trait, hallucinogen effects, and positive symptoms: epistasis between 5-HT2a and COMT polymorphisms. Am J Med Genet B Neuropsychiatr Genet 2005;137B:29-32.