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Dream Recall Frequency and Unusual Dream Experiences in Early Adolescence: Longitudinal Links to Behavior Problems

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Unique dream patterns are related to psychopathological distress in adults. In adolescence, this was investigated almost exclusively regarding nightmares. This longitudinal study examines developmental trajectories of various adolescent-reported dream patterns, and their associations with parent-reported psychopathology (internalization and externalization problems) in early adolescence. Ninety-four 10- to 11-year-old normally developing children completed a week of sleep, dreaming, and pubertal development assessments. Parents reported behavior problems. Assessments were repeated after 1 and 2 years. Reports of unusual dreams decreased over time, and dream recall decreased among girls. Internalizing symptoms longitudinally predicted an increase in dream recall and unusual dreams. Moreover, unusual dreams longitudinally predicted increased behavior problems (internalization and externalization). Assessing dream patterns during early adolescence may help early detection of covert psychopathological distress.

Dreaming is the form that consciousness takes during sleep (Foulkes, 1999). While classic psychoanalytic theory has usually focused on the *content* of dreams, current research and theory largely take on a more *formal* approach, that is, explore the formal qualities of dreams (Hobson, 2002), such as dream recall frequency (DRF), emotional tone, bizarreness levels, and repetitiveness. This approach is based on the recognition that patterns of dreaming and recalling dreams are related to patterns of other characteristics of our consciousness and our subjective experience such as how we think, feel, recall, and imagine during waking. Variability in reporting mental content after awakening in the home setting is large: some seldom recall a dream, while others can describe their nocturnal experiences almost every morning (Schredl, 2007). Among adults, individual differences in various dreaming patterns are related to psychopathology and stress (e.g., Schredl, 2007; Soffer-Dudek & Shahar, 2009, 2011), as will be described in detail below. However, such research on children and adolescents is scarce (with the exception of research focusing on nightmares, as will also be detailed below). It has been argued that dream research is a fertile area for studying child development (Foulkes, 1999; Siegel, 2005). This is because dreaming patterns are related to cognitive and emotional functioning, as well as to socio-demographic factors such as age and gender (Schredl, 2007), and while the developmental aspects of sleep have been widely studied among children and adolescents, dream research has been largely neglected in these age groups. In this study, we focus on DRF and unique dream characteristics in a normally developing sample of early adolescents. We examine the associations of developmental trajectories of dream patterns with behavior problems (internalization and externalization). Below, developmental aspects of dreaming patterns, focusing on early adolescence, are introduced first, followed by a description of the associations between dreaming patterns and psychological distress and psychopathology, in adults, children, and adolescents.

Early adolescence, a transitional period involving puberty onset, involves a complex set of social, psychological, and physical changes, which are likely to induce various psychological stressors. The wide array of challenges that occurs during these crucial years brings about increased risk of the development of psychopathology (Spear, 2000; Steinberg et al., 2006). Thus, examination of correlates and indicators of psychological distress is especially important in this age group. Sleep patterns also change during this period: retiring times

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are delayed, sleep duration shortens, and weekend sleep becomes longer, with delayed rising times (Crowley, Acebo, & Carskadon, 2007; Sadeh, Dahl, Shahar, & Rosenblat-Stein, 2009). Poor sleep patterns lead to several negative consequences such as impaired learning abilities and deteriorated emotional functioning (Curcio, Ferrara, & De Gennaro, 2006; O'Brien, 2009; Pilcher & Huffcutt, 1996; Sadeh, 2007).

Unlike sleep patterns, direct measurement of dreams is unattainable. Thus, exploration of dream patterns is focused on subjective experience. For example, DRF represents the number of dreams that individuals report they remember after awakening. Laboratory studies measure DRF by intentionally awakening the participant from rapid eye movement (REM) sleep episodes, in which dreaming is most likely to be remembered. Such studies show that there is an increase in DRF from childhood to adolescence and adulthood (Foulkes, 1982, 1999; Nielsen et al., 2000; Strauch, 2005; but see: Foulkes, Pivik, Steadman, Spear, & Symonds, 1967). In adolescence, this increase was found mainly in boys (Strauch, 2005). Change in DRF with age parallels cognitive and emotional development during wakefulness (Foulkes, 1982, 1999). Although laboratory DRF and spontaneous DRF (as measured in the home setting, with a daily diary) are highly correlated (Lewis, Goodenough, Shapiro, & Sleser, 1966; Schredl, 2002), the latter is more suitable for exploring individual differences in DRF (Schredl, 2007) and daily DRF. Most longitudinal studies on DRF in childhood and adolescence were conducted in laboratories, resulting in small samples (Schredl & Reinhard, 2008b). In this study, we examine spontaneous DRF in early adolescence.

Notably, gender and puberty may play important roles in DRF. Females have higher DRF than males, possibly due to moderating factors such as interest in dreams, capacity of recalling emotional experiences, nocturnal awakenings, neuroticism, and depressive mood (Schredl, 2010b; Schredl & Reinhard, 2008b). As found in studies on adults, Brand et al. (2011) showed that females have higher DRF in an especially large sample of 5,580 adolescents. A meta-analysis (Schredl & Reinhard, 2008b) concluded that the gender difference in dream recall is smaller in children (under age 10), but larger in adolescents (ages 10–18), compared with adults, perhaps due to a gender-specific "dream socialization" with a peak in adolescence. Puberty is the process of transition into sexual maturity, involving interrelated brain, hormonal, physical, and psychological changes (Spear, 2000). Puberty has longitudinal relationships with sleep patterns in early adolescence (Sadeh et al., 2009), as well as with psychopathology onset, including emotional and behavioral disorders (Spear, 2000; Steinberg et al., 2006), and thus should be controlled so as not to confound an exploration of dream patterns.

Examining developmental trajectories of other dream patterns reveals a complex picture. For example, a study examining *nightmares* on a large sample of 4- to 17-year olds found no evidence of change in prevalence across age groups (Coolidge, Segal, Coolidge, Spinath, & Gottschling, 2010). However, Nielsen et al. (2000) reported that disturbing dreams increased in girls and decreased in boys from age 13 to 16, and Levin and Nielsen (2007) reported elevated nightmare frequency during childhood and adolescence that decreases with age. Most studies (e.g., Hublin, Kaprio, Partinen, & Koskenvuo, 1999; Levin & Nielsen, 2007; Nielsen et al., 2000; Schredl & Reinhard, 2011) reported that females have more nightmares than males, with some exceptions (Coolidge et al., 2010).

Nightmares and elevated DRF, along with a host of other unique dream experiences, constitute a single psychological construct in adults (Watson, 2001). Watson found this general dream dimension based on factor analyzing over 900 student dream questionnaires. This general construct is related to psychopathology both in nonclinical and in outpatient populations (e.g., Soffer-Dudek & Shahar, 2009; Soffer-Dudek, Shalev, Shiber, & Shahar, 2011). However, despite the importance of early adolescence as a period of risk of developing psychopathology, we failed to find any study treating various unique dream experiences as a single unified factor on any nonadult sample. In this study, the developmental trajectory of a unified dream-pattern factor is investigated, and its links to behavior problems are assessed.

RELATIONSHIP OF DREAMING AND PSYCHOLOGICAL DISTRESS IN ADULTS

Changes in sleep are closely linked to several types of psychopathology in adults, such as affective disorders, anxiety disorders, eating disorders, and schizophrenia (Benca, Obermeyer, Thisted, & Gillin, 1992). Similarly, sleep problems are related to anxiety and depression in children and adolescents (Coulombe, Reid, Boyle, & Racine, 2010; Dahl, 1996; Sadeh, 2007). In fact, understanding the emotion regulation system cannot be complete without understanding the mechanisms of sleep and arousal, and vice versa (Dahl, 1996). Subjective experiences of dreaming are also related to emotional distress. In studying psychiatric disorders, several dream characteristics suggest important clinical and prognostic implications for the psychopathologic evolution of these diseases (Palagini & Rosenlicht, 2011). Below, we review relationships between various dream patterns and psychopathology.

Deep sleep involves low DRF (De Gennaro et al., 2009). Similarly, elevated DRF is associated with poor sleep quality and nocturnal awakenings (Schredl, 2007, 2010a), which are prevalent among sufferers of various psychiatric disorders (Benca et al., 1992). Elevated DRF is related to neuroticism (Schredl, 2010b) and to stress (Duke & Davidson, 2002; Schredl, 2007) in nonclinical populations. All of the above-mentioned research suggests that DRF is likely to be associated with behavior problems. However, DRF was associated with various mental disorders in some studies but not in others (Schredl, 2007). Moreover, despite the link between nocturnal awakenings and DRF, dream recall has not necessarily been viewed by theoreticians and researchers as negative. As stated above, its association with psychiatric disorders is questionable, and intuitively, remembering a dream does not feel like a disruption to our well-being. In addition, DRF is elevated when sleep is long (Schredl & Reinhard, 2008a; Soffer-Dudek & Shahar, 2011), probably due to awakening from REM sleep (Schredl & Reinhard, 2008a), and long sleep is usually associated with good sleep quality. Thus, the relationship of DRF with emotional distress demands further research.

Remembering more dreams should increase the likelihood of remembering specific or unique dream experiences, and indeed, DRF is part of a larger factor, including recall of various subjective dream experiences. Enhanced and unusual dream phenomena such as elevated dream recall, nightmares, recurrent dreams, flying dreams, and problem-solving dreams, comprise a single psychological construct labeled *general sleep-related experiences* (Watson, 2001). This construct was related to general psychopathological distress (including various scales such as depression, hostility, somatization, obsessive-compulsive symptoms, and psychoticism) in a nonclinical undergraduate sample (Soffer-Dudek & Shahar, 2009) and was elevated in a clinical outpatient population compared with controls (Soffer-Dudek, Shalev et al., 2011). Within the afore-mentioned outpatient sample, it was related to the degree that individuals felt that their mental illness disrupted their lives. It is also related to dissociation and schizotypy in nonclinical populations (Fassler, Knox, & Lynn, 2006; Giesbrecht & Merckelbach, 2006; Koffel & Watson, 2009; Soffer-Dudek & Shahar, 2009, 2011; Watson, 2001). In addition, this construct follows stressful life events (Soffer-Dudek & Shahar, 2009, 2011), and exposure to traumatic stress through the media (Soffer-Dudek & Shahar, 2010).

When examined individually, several kinds of unusual dream experiences are linked to psychological symptoms. The most widely studied dream phenomenon is *nightmares*. Nightmares are a central feature of posttraumatic stress disorder (Phelps, Forbes, & Creamer, 2008) and are also prevalent in other emotional disorders and in general anxiety and neuroticism in nonclinical populations (e.g., Chivers & Blagrove, 1999; Nguyen, Madrid, Marquez, & Hicks, 2002; Schredl, 2003). They are related to stress (e.g., Levin & Nielsen, 2007; Schredl, 2003) and predict suicidality among nontreatment-seeking populations (e.g., Cukrowicz et al., 2006; Tanskanen et al., 2001). Although considerably less-studied, *recurrent dreams* are also primarily negative or threatening in content (Zadra, Desjardins, & Marcotte, 2006) and are correlated with low psychological well-being, a measure composed of neuroticism, anxiety, depression, and general psychopathology (Brown & Donderi, 1986; Kroth, Thompson, Jackson, Ferreira, & Pascali, 2002), and with stress (e.g., Duke & Davidson, 2002). *Bizarre dreams* (dreams that are subjectively defined as strange) are correlated with thin boundaries (Hartmann & Kunzendorf, 2006–2007).

Two possible explanations for the association between enhanced and unique subjective dream experiences and behavior problems can be hypothesized based on current literature. The first focuses on dreaming constructs as negative and related to stress or psychopathology, while the second—as positive and related to coping. According to the first view, it is possible that enhanced dream recall and unusual dreaming follow psychological distress because of arousal stemming from emotional turmoil and preoccupation with the psychological stressor. Hyper-vigilance and arousal stemming from psychological distress continue to affect the brain while sleeping (Hall et al., 2007) and thus might bring about dreams that involve enhanced vigilance, perception, and memory, usually characteristic of waking. This view suggests that such unique dreams occur in sleep-wake "mixed states" (Koffel & Watson, 2009; Mahowald & Schenck, 2001) that are induced by distress and arousal (Soffer-Dudek & Shahar, 2011). Enhanced and unique dream patterns possibly characterize individuals with ruminative coping styles (Soffer-Dudek & Shahar, 2010), following excessive preoccupation with the psychological stressor, that persists to cause arousal and vigilance within sleep, and not just within waking (Soffer-Dudek & Shahar, 2011). Stress and rumination are associated and often "join forces" to induce psychopathology (Flynn, Kecmanovic, & Alloy, 2010; Skitch & Abela, 2009). Remembering many dreams and unusual dream experiences might also indicate attunement into one's inner fantasy life, daydreaming, and imagery (Koffel & Watson, 2009; Soffer-Dudek & Shahar, 2009) as well as one's own emotional life. This might be related to preoccupation with emotional concerns, especially internalizing problems.

The second view of the relationship of DRF and unique dreams with behavior problems focuses on dreams as a coping mechanism. This view also relates to the role of sleep in emotion regulation and emotion information processing (Walker & van der Helm, 2009). Picchioni et al. (2002) found that nightmares were related not only to stress, but also to elevated attempts at *coping* with stressful events (during the day). Thus, the authors concluded that nightmares might represent night-time attempts at coping and might in fact help alleviate stress. Also, it has been argued that nightmares might have an adaptive function, especially following trauma (Hartmann, 1998). According to this view, dreams make broader connections in the nets of the mind (i.e., connect various memories and experiences from the past and present that are not connected in waking), guided by the dreamer's dominant emotion (e.g., fear). According to Hartmann, this process is similar to psychotherapy: integrating painful experiences with other psychological material in a "safe place." This is compatible with findings whereby depressed people going through a divorce coped better a year later if their dreams incorporated their spouses (Cartwright, 1991). Importantly, Hartmann makes a distinction between normal nightmares after trauma, in which there is a gradual progression in associative content, versus post-traumatic stress disorder (PTSD) nightmares, in which this progression appears to be stuck in an early stage of replay. The association of nightmares and dreams with trauma might also stem from an evolutionary adaptive function, as dreams enable a simulation of coping with threatening events while sleeping (Revonsuo, 2000). According to this view, nightmares (including PTSD nightmares) might have been adaptive in our early ancestral environments. Finally, lucid dreams (dreams in which the dreamer is aware of dreaming) are related to resilience in the face of exposure to trauma (Soffer-Dudek, Wertheim, & Shahar, 2011) and are sometimes utilized as a therapeutic agent for coping with distressing nightmares (Brylowski, 1990; Spoormaker, van den Bout, & Meijer, 2003).

DREAM PATTERNS AND PSYCHOLOGICAL PROBLEMS IN CHILDHOOD AND ADOLESCENCE

All of the above-mentioned studies focusing on enhanced and unique dreaming were conducted on adult samples, despite the importance of earlier stages in the formation of psychopathology. Research on the relationships between dreaming and psychopathological symptoms in childhood and adolescence is scant, except for research on nightmares. Studies on community-based samples usually find that nightmares are related to emotional and behavioral problems, such as depression, anxiety, posttraumatic stress, conduct disorder, and various axis II personality disorders (e.g., Coolidge et al., 2010; Coulombe et al., 2010; Hublin et al., 1999; Mindell & Barrett, 2002; Nielsen et al., 2000; Schredl, Fricke-Oerkermann, Mitschke, Wiater, & Lehmkuhl, 2009; Simard, Nielsen, Tremblay, Boivin, & Montplaisir, 2008; Wittmann, Zehnder, Schredl, Jenni, & Landolt, 2010; and see Kirov & Brand, 2011, for a review of psychiatric disorders related to nightmares in adolescence).

Few studies have been conducted on other dream variables and psychopathology in childhood and adolescence. One such study showed that DRF was higher among children faced with traumatic stress and with problems in psychological adjustment (Punamaki, 1997). Conversely, DRF was not found to be elevated in children with attention-deficit hyperactivity disorder (ADHD) compared with controls, although dreams of those diagnosed with ADHD were more negatively toned (Schredl & Sartorius, 2010). More research is needed on the relationship between DRF and psychological adjustment in children and adolescents. *Recurrent dreams* and psychological adjustment (including anxiety, opposition, shyness, aggression, hyperactivity, inattention, social withdrawal, and emotional problems) were assessed in 11-year olds (Gauchat, Zadra, Tremblay, Zelazo, & Sèguin, 2009). Recurrent dreams were related to aggression in boys but not in girls. Studies addressing dream bizarreness in children and adolescents exhibit different results. Punamaki, Ali, Ismahil, and Nuutinen (2005) found less bizarreness in children exposed to traumatic stress, and Hadjez et al. (2003) found schizophrenic adolescents' dreams to be more realistic, and thus less bizarre, than those of community controls.

In the present study, longitudinal relationships between dreaming variables and behavior problems are examined reciprocally. On one hand, evidence from research in adults suggests that certain forms of dreaming might be early indicators of psychological distress (e.g., Cukrowicz et al., 2006) that may promote early intervention in non-treatment-seeking samples. On the other hand, some studies found that psychological distress predicted an increase in unique dreaming patterns, but not vice versa (e.g., Soffer-Dudek & Shahar, 2009), suggesting that dreaming might be a consequence of emotional changes. In addition, some forms of dreaming, such as nightmares, might be related to attempts at *coping* with emotional distress (e.g., Hartmann, 1998; Picchioni et al., 2002). If this is true, we would expect early dreaming patterns to predict a *decrease* in psychopathology. A better understanding of longitudinal relationships between these domains might help us decipher the mechanisms at play.

To the best of our knowledge, studies on unusual or unique dream experiences as a single factor have been conducted only in adults. As mentioned above, such a factor has been suggested to represent emotional preoccupation and arousal and to be a clinical marker of psychological distress. A central aim of this study was to investigate whether associations between behavioral problems and dreaming exist in a nonclinical early adolescent sample, given the importance of this age group in the risk of the formation of psychopathology. Additionally, because studies on unique dream experiences and psychological symptoms were usually based on general measures of psychopathology, we opted to make a distinction between externalizing and internalizing problems to examine whether they have differential effects. We hypothesized that internalization would be more relevant to dreaming, because dream recall is related to preoccupation with one's emotional world. Finally, while enhanced and unusual dream experiences, reported retrospectively with a questionnaire, were repeatedly related to psychopathology in adults, the link between psychopathology and daily diary DRF is less consistent, both in adult and in adolescent literature. Thus, we aimed to assess retrospective enhanced and unusual dream experiences separately from daily diary DRF. Because sleep quality is related both to various forms of psychopathology (Benca et al., 1992), and to dreaming (e.g., Schredl, 2010b), we aimed to control for this factor when examining the relationship between dreams and behavior problems. Such statistical control enables the examination of the *direct* relationship between psychopathology and dreaming, that is not explained by poor sleep quality. This is important, because one might speculate that remembering dreams in general and unusual dreams in particular are merely a by-product of poor sleep, and sleep is the only factor directly affected by psychopathology. However, by controlling for sleep quality, we are able to explore *consciousness*, and how it is affected (or affects) psychopathology, regardless of the prevalence of associated sleep problems. We hypothesize that consciousness during sleep is affected by waking emotional distress, even when sleep quality remains intact.

To conclude, our goals in this study were

1. To assess and control for developmental effects, we first sought to examine the normative developmental trends of DRF and unusual dreaming during early adolescence, and whether they are moderated by gender or puberty. Based on existing literature, we expected an overall rise in DRF, especially among boys. We did not have a specific hypothesis regarding puberty. Also, we did not have a specific hypothesis regarding the developmental trajectory of unusual dreaming, as this construct has yet to be examined developmentally.
2. Within a nonclinical early adolescent sample, we sought to examine the relationships of DRF and unusual dreaming with behavior problems, while controlling for developmental effects and sleep quality. We expected positive cross-sectional and longitudinal links between these domains, and especially with internalization.

METHOD

Participants and Procedure

Participants were 94 urban Israeli children (53 girls, 41 boys; age: M = 10.52, SD = 0.32, range = 9.92–11.33), who completed the first assessment wave (Time 1). Eighty-two children (87.23% of Time 1 participants) completed Time 2, approximately 1 year later (46 girls, 36 boys; age: M = 11.54, SD = 0.33), and 71 (86.59% of Time 2 participants) completed Time 3, approximately 1 year subsequent to Time 2 assessment (39 girls, 32 boys; age: M =

12.51, *SD* = 0.31). Attrition analyses comparing the 71 three-wave completers with the 23 dropouts (*t*-tests for continuous variables and chi-square tests for dichotomous variables) on demographic data (age, sex, parental ages and education, order of birth, and socio-economic indicators), and on Time 1 study variables of interest (DRF, unusual dreaming, puberty, sleep, and behavior problems) showed no statistically significant differences, suggesting that attrition probably did not affect results.

As part of a larger study on neurobehavioral functioning and sleep during the transition to puberty, these 94 children were recruited from regular classes of four different elementary schools in the Tel-Aviv area. These schools varied in socioeconomic status (SES), but were all in the mid-high SES range. Letters describing the study and soliciting participation were sent to parents of approximately 240 fourth-grade students, along with consent forms for parents and children, and initial questionnaires. Ninety-eight families chose to participate (40.83%), but four were excluded due to chronic illness or medication use. The study adhered to appropriate ethical standards and was approved by Tel-Aviv University's Institutional Review Board and by the Israel Ministry of Education. All children and their parents signed informed consent, completed a packet of questionnaires, and received an actigraph as well as a sleep diary for a week of monitoring. According to parental reports, none of the children suffered from any chronic medical or psychiatric problems.

Measures

Dreaming. Dreaming was assessed with two measures.

Daily diary dream recall frequency. A daily diary assessed DRF with a single item, namely "How many dreams did you dream last night?" The child was requested to check one of four responses: *0, 1, 2, 3 or more*. This diary was administered for seven schooldays at each assessment wave, and responses to the DRF item were averaged across these 7 days to produce a single DRF score for each assessment wave. Using a daily dream log to assess DRF is more accurate than measuring it by retrospective estimation (Beaulieu-Prevost & Zadra, 2007). Test–retest correlations for this scale were as follows: $r = .51$, $p < .001$, $r = .24$, $p = .059$, and $r = .07$, *ns*, for Times 1–2, 2–3, and 1–3, respectively. Stability of daily diary DRF has not yet been examined across 1- and 2-year lags (Schredl & Fulda, 2005). In this study, high stability was achieved only from Time 1 to Time 2.

Enhanced and unusual dreaming. A questionnaire on sleep and dream patterns was administered once at each assessment wave, containing seven items pertaining to dreaming. These were the following: "I wake up scared or from a nightmare in my sleep," "I remember dreams," "I dream about scary things," "I dream strange dreams and dreams that I can't understand," "I keep having this weird dream over and over again," "I remember my dreams for a long time," "I think that dreams have an effect on me and my life." These items were phrased in simple language, so as to suit the study sample's age group. The response scale included 1 (*never*), 2 (*sometimes*), 3 (*often*), and 4 (*nearly always*). To check whether these seven items represented one single component or more, we conducted principal components analyses on Time 1 scores. All items were significantly related to all of the other items, without multicollinearity (R-matrix determinant = .12). Kaiser's measure of sampling adequacy indicated good fit of the data for performing factor or principal components analyses (Kaiser-Meyer-Olkin [KMO] = .74). Only one component was extracted (i.e., only one component had an eigenvalue higher than 1). Observing a scree plot strengthened the conclusion that these items represented a single construct, as the slope between one and two factors was extremely steep, but almost horizontal from two and on. Thus, we averaged the seven items into a single scale, labeled *Enhanced and Unusual Dreaming* (EUD). Cronbach's alphas for EUD at Times 1, 2, and 3 were as follows: .80, .63, and .71, respectively. Test–retest correlations for EUD were the following: $r = .65$, .52, and .59, $p < .001$, for Times 1–2, 2–3, and 1–3 respectively. These high test–retest correlations are similar to those reported on general sleep-related experiences in adults (Soffer-Dudek & Shahar, 2009, 2010). Although EUD includes a dream recall item, correlations between DRF and EUD were nonsignificant (although Time 1 scores were marginally significant), with $r = .17$; $r = .06$; and $r = .08$, for Times 1, 2, and 3, respectively. This empirical differentiation between the two dream measures is consistent with a conceptual one, as DRF measures recall in the morning, and EUD measures recall for a longer time span, as well as recall of unusual dreams. Recall of unusual dreams and recall for longer periods of time, compared with morning recall, is probably more contingent upon motivational and personality characteristics such as interest in dreams or attunement to one's inner imagery world.

Sleep patterns. Sleep was measured at each assessment wave via actigraphy. Actigraphic measurement is established as a valid and reliable method of objective sleep pattern assessment (Sadeh & Acebo, 2002). Sleep diary data were used to detect and remove possible artifacts from actigraphic data. The children were given miniature actigraphs (Mini Motionlogger; Ambulatory Monitoring, Inc, Ardsley, NY) and were instructed to wear these on their nondominant wrist when preparing for sleep and remove them in the morning. The actigraph was set to collect data in the standard mode of 1-min epochs and amplifier setting 18. Actigraphic raw data were translated to sleep measures using the actigraphic scoring analysis program (ASA). These sleep measures were validated against polysomnography with agreement rates higher than 90% (Sadeh, Sharkey, & Carskadon, 1994). In this study, to control for sleep quality, we used actigraphic sleep efficiency (SEF): percentage of true sleep time from total sleep period. Specifically, SEF is calculated as the percentage of minutes recognized as sleep (by the actigraph's algorithm) out of the entire sleep duration (from sleep onset to awakening in the morning). We controlled for this measure when exploring longitudinal relationships between dreams and behavior problems. Assessment of test–retest reliability based on repeated measurements over 7 days of monitoring resulted in $r_{tt} = .88$. Stability of SEF across assessment waves was as follows: $r = .68$, .68, and .61, $p < .001$, for Times 1–2, 2–3, and 1–3 respectively. SEF ranged between: 81.66–98.97, 82.45–99.00, and 82.96–99.15, at Times 1, 2, and 3, respectively.

Behavior problems. These were assessed using the Child Behavior Checklist (*CBCL*; Achenbach & Edelbrock, 1983). For each child, a parent (usually the mother) answered this 113-item questionnaire, assessing a wide array of behavioral and emotional problems. Ratings are on a 3-point scale ranging from 0 (*not true*) to 2 (*often true*). Items produce a global score and eight specific subscale scores: Anxious or Depressed, Somatic Complaints, Withdrawn, Attention Problems, Thought Problems, Social Problems, Aggression, and Delinquent Behavior. In addition, two main subscale scores can be computed: Internalization and Externalization, and these were used in this study. The Hebrew version of the CBCL is validated (Zilber, Auerbach, & Lerner, 1994). Cronbach's alpha was .84, .90, and .79 for externalizing problems, and .85, .92, and .90 for internalizing problems, at Times 1, 2, and 3, respectively. The correlations between internalizing and externalizing problems were $r = .52$, .68, and .63, $p < .001$, at Times 1, 2, and 3, respectively. Stability across time points was $r = .64$, .47, and .38, $p < .001$, for externalizing problems, and $r = .78$, .58, and .58, $p < .001$ for internalizing problems, for Times 1–2, 2–3, and 1–3 respectively.

Puberty. Children reported puberty levels using the Sexual Maturation Scale (*SMS*; Taylor et al., 2001), which is based on line drawings of Tanner stages of pubertal development. The questionnaire scale ranges from 1 to 5, with 1 representing a pre-pubertal state and 5 representing a postpubertal state. The links between sleep and pubertal development were the focus of an earlier publication based on this sample (masked for review). The validity of self-reported pubertal development is supported by previous research, showing appropriate correlations with physician reports (e.g., Brooks-Gunn, Warren, Rosso, & Gargiulo, 1987; Carskadon & Acebo, 1993; Morris & Udry, 1980), although this issue is under debate (Schlossberger, Turner, & Irwin, 1992). The pubic hair scale and the genitals-breast development scale were averaged to create a continuous global puberty score. Different aspects of pubertal development do not always converge into discrete stages, and thus, a continuous score is preferable than stages for representing puberty (Shirtcliff, Dahl, & Pollak, 2009) (However, results were unchanged when using the separate scale scores). Means and standard deviations of puberty scores were $M = 1.85$, $SD = 0.63$ for Time 1, $M = 2.67$, $SD = 0.81$ for Time 2, and $M = 3.26$, $SD = 0.80$ for Time 3. We used only Time 1 scores for this study, to avoid multicollinearity with time, as will be described below.

Demographic data. These were gathered once (at Time 1), via child and parent reports, including data on age at first assessment, sex, physical and mental health, parents' age, education, workload, family size, family structure, and birth order.

Data Analyses

The longitudinal design of the study produced a hierarchical data structure: level-1 data measured at three time points were nested within level-2 units (i.e., individuals). Thus, we employed multilevel linear modeling (MLM). Our sample size was deemed fit for this type of statistical assessment according to simulations reported by Maas and Hox (2005). We used SPSS MIXED MODELS (Armonk, NY), version 19.

Before running MLM models, we conducted missing values analysis that suggested that data were missing completely at random (*Little's MCAR test*: $\chi^2_{(417)} = 424.15$, $p = .39$). Thus, missing data in this study is most likely *ignorable nonresponse*, which does not bias results in multilevel models (Schafer & Graham, 2002). To increase power, we imputed missing values using multiple imputations (MI). Five imputed data sets were created, and we report pooled results. However, as suggested by Tabachnick and Fidell (2007), we also conducted all analyses on the nonimputed data set. Results were unchanged, unless stated otherwise.

Examination of developmental trajectories of dreaming. First, we sought to assess developmental trends of dream measures, by examining the main and interactive effects of time and relevant background variables (including gender, age, and puberty at Time 1) that significantly correlated with dream variables. We used only Time 1 puberty measurements to avoid multicollinearity with time. Multicollinearity is even more problematic in multilevel models than in ordinary regression (Tabachnick & Fidell, 2007). After examining Pearson product-moment correlations, each of the dream measures was predicted by time (assessment wave, centered to Time 1), gender (dummy coding: 0—boys, 1—girls), and a two-way interaction between time and gender. All predictors were entered as fixed effects, and time was entered as a random effect. We used restricted maximum likelihood (REML) estimation and autoregressive-type covariance structure for random effects. This covariance structure assumes that measurements made on adjacent years are more likely to be correlated than those made further apart.

Links between dreaming and behavior problems. Next, we examined the relationships of dream constructs with behavior problems. To this aim, we examined correlations between child-reported dream measures (namely DRF and EUD), and parent-reported behavior problems, at all three assessment waves. We also attempted to identify longitudinal effects between these domains using MLM. We omitted predictors that previously did not have a statistically significant effect and added behavior problems (internalization or externalization), as well as sleep quality, to MLM models. These continuous variables were grand-mean centered. In addition, to assess the reverse direction of prediction, additional models treated behavior problems as outcomes, predicted by dream variables, while controlling for sleep quality, time, and gender.

RESULTS

Table 1 presents percentages of boys and girls who recalled no dreams, 1–4 dreams, and five or more dreams per week (at each assessment wave), according to the daily dream diary. Table 2 presents means, standard deviations, and correlations of gender, age, puberty, DRF, EUD, and SEF. As can be seen in the table, dream variables were uncorrelated with age and with puberty. Thus, age and puberty were omitted from subsequent analyses. DRF at Time 1 and EUD at Time 3 were related to gender, such that girls had higher dream scores. There was one statistically significant positive correlation between EUD and SEF. Table 3 presents means, standard deviations, and correlations of behavior problems (internalization and externalization) with other study variables. As can be seen in the table, there were statistically significant correlations between both dream variables and internalizing and externalizing problems.

The top part of Table 4 presents the longitudinal model predicting DRF by gender, time, and their two-way interaction. As shown in the table, the interaction term was statistically significant ($b = 0.15$, $SD = 0.07$, $t_{(111.67)} = 2.10$, $p < .05$). Probes of this interaction revealed that among girls, there was a statistically significant decline in dream recall over time ($b = -0.16$, $SD = 0.05$, $t_{(111.67)} = -3.25$, $p < .01$), while no such effect existed among boys ($b = 0.00$, $SD = 0.05$, $t_{(114.29)} = 0.11$, *ns*). In addition, only at

TABLE 1
Percent of Children (Boys and Girls Separately) Who Reported "No Dreams," "1–4 Dreams," or "5 or More Dreams" per Week During Each Assessment Wave, Based on the Daily Dream Diary

Wave	*Gender*	*0 Dreams (%)*	*1–4 Dreams (%)*	*5 or More Dreams (%)*
Time 1	Boys	45.95	29.73	24.32
	Girls	16.00	40.00	44.00
Time 2	Boys	35.29	44.12	20.59
	Girls	26.83	58.54	14.63
Time 3	Boys	63.33	26.67	10.00
	Girls	44.74	44.74	10.53

TABLE 2
Means, Standard Deviations, and Correlations of Gender, Age and Puberty at First Assessment, Dreaming, and Sleep Quality, at All Assessment Waves: Time 1, Time 2, and Time 3

Measure	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1. Gender	1.00											
2. Age 1	−.04	1.00										
3. PUB 1	−.12	.14	1.00									
4. DRF 1	_.21*_	−.04	−.13	1.00								
5. DRF 2	.01	.02	−.04	_.56***_	1.00							
6. DRF 3	−.03	.08	−.19†	.09	_.29**_	1.00						
7. EUD 1	.05	.15	.08	.17†	.14	.20†	1.00					
8. EUD 2	.14	.15	−.12	.11	.06	.16	_.67***_	1.00				
9. EUD 3	_.22*_	.00	−.04	.03	−.06	.08	_.54***_	_.56***_	1.00			
10. SEF 1	_.27**_	.11	−.03	.10	.05	.03	.06	.05	−.08	1.00		
11. SEF 2	_.30**_	.00	−.07	.05	.07	.07	.10	.08	.09	_.68***_	1.00	
12. SEF 3	_.37***_	.09	−.04	.09	−.02	.01	.19†	_.23*_	.15	_.61***_	_.68***_	1.00
M		10.52	1.85	0.55	0.46	0.37	2.07	1.92	1.85	93.63	93.58	93.27
SD		0.32	0.62	0.62	0.54	0.50	0.62	0.43	0.41	4.00	3.97	3.42

Note. PUB = puberty; DRF = dream recall frequency; EUD = enhanced and unusual dreaming; SEF = sleep efficiency.
Correlations with gender represent point-biserial correlations. Boys = 0, girls = 1. Italics represent statistical significance.
$^{\dagger}p < .10$; $^{*}p \leq .05$; $^{**}p \leq .01$; $^{***}p \leq .001$.

TABLE 3
Means, Standard Deviations, and Correlations of Behavior Problems (Internalizing and Externalizing) With Other Study Variables, at All Assessment Waves: Time 1, Time 2, and Time 3

Measure	*INT 1*	*INT 2*	*INT 3*	*EXT 1*	*EXT 2*	*EXT 3*
Gender	.12	.06	.06	_−.21*_	−.12	−.01
AGE 1	.04	.05	.06	.07	.04	.15
PUB 1	−.05	_−.23*_	−.10	−.05	−.12	.06
DRF 1	.15	.17†	_.39***_	.02	.09	_.22*_
DRF 2	_.29**_	_.33***_	_.27**_	.17	.16	.00
DRF 3	.08	.12	_.21*_	.02	.02	.05
EUD 1	_.22*_	_.28**_	_.27**_	.05	.13	_.27**_
EUD 2	_.26**_	_.35***_	.17	.11	_.26**_	.17
EUD 3	.18†	_.23*_	_.28**_	−.09	.08	.10
SEF 1	.05	.06	.02	−.05	−.16	−.07
SEF 2	.10	.11	.10	−.10	−.18†	−.10
SEF 3	.07	.04	−.12	.08	−.06	−.07
M	6.74	7.63	7.52	6.07	6.45	5.28
SD	5.87	7.84	6.34	5.06	5.99	3.61

Note. INT = internalizing symptoms; EXT = externalizing symptoms; PUB = puberty; DRF = dream recall frequency; EUD = enhanced and unusual dreaming; SEF = sleep efficiency.
Correlations with gender represent point-biserial correlations. Boys = 0, girls = 1. Italics represent statistical significance.
$^{\dagger}p < .10$; $^{*}p \leq .05$; $^{**}p \leq .01$; $^{***}p \leq .001$.

TABLE 4
Estimates of Fixed Effects for Multilevel Linear Models Examining Developmental Trends in Daily Dream Recall Frequency (Model A) and Enhanced and Unusual Dreaming (Model B)

Parameter	*Estimate*	*SE*	*df*	*t*	*p*	*Lower b.*	*Upper b.*
A. DRF[a]							
Intercept	0.66	0.08	106.74	8.20	≤.001	0.50	0.82
Time	−0.16	0.05	111.67	−3.25	≤.005	−0.25	−0.06
Gender	−0.25	0.12	106.74	−2.03	≤.05	−0.49	−0.01
Time × gender	0.15	0.07	111.67	2.10	≤.05	0.01	0.30
B. EUD[b]							
Intercept	2.08	0.06	199.55	33.24	≤.001	1.95	2.20
Time	−0.08	0.03	112.77	−2.45	≤.05	−0.14	−0.01
Gender	−0.06	0.09	199.55	−0.62	*ns*	−0.25	0.13
Time × gender	−0.06	0.05	112.77	−1.28	*ns*	−0.16	0.03

Note. *df* = degrees of freedom; Lower b. = Lower bound within a 95% confidence interval; Upper b. = upper bound within a 95% confidence interval; DRF = dream recall frequency; EUD = enhanced and unusual dreaming.
[a]Model A model fit: −2 *log likelihood* = 431.93, *parameters* = 12.
[b]Model B model fit: −2 *log likelihood* = 317.83, *parameters* = 12.

Time 1, there was a statistically significant effect of gender, according to which girls had higher dream recall ($b = -0.25$, $SD = 0.12$, $t_{(106.74)} = -2.03$, $p = .05$). At Times 2 and 3, there were no gender differences ($b = -0.09$, $SD = 0.08$, $t_{(92.00)} = -1.11$, *ns*, and $b = 0.06$, $SD = 0.10$, $t_{(81.77)} = 0.62$, *ns*, for Times 2 and 3, respectively). Figure 1a presents means and standard errors of DRF over time, separately for boys and girls. Presented in the bottom part of Table 4 is a similar model with EUD as the outcome. The only statistically significant effect was a negative main effect of time, suggesting a decline in EUD scores over time ($b = -0.08$, $SD = 0.03$, $t_{(112.77)} = -2.45$, $p < .05$). Figure 1b presents means and standard errors of EUD over time.

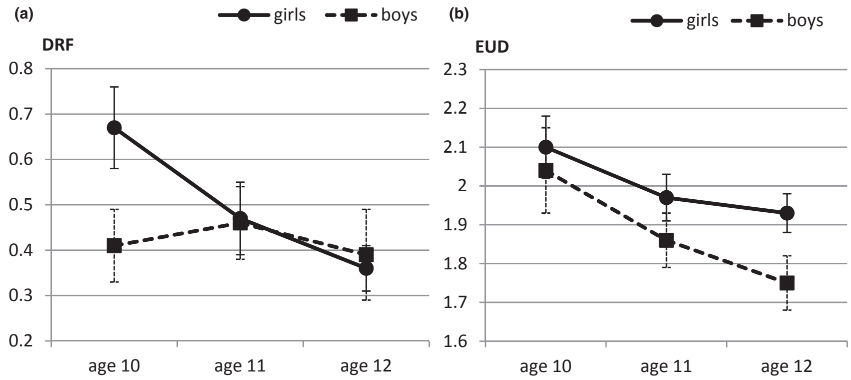

FIGURE 1 Means and standard errors (±1 *SE*) of dream recall frequency (DRF; a) and enhanced and unusual dreaming (EUD; b) for boys and girls on all three assessment waves.

Table 5 presents models predicting dreaming variables (DRF or EUD) by behavior problems variables (internalizing or externalizing). The following were the predictors in each model: a behavior problem variable (either internalizing or externalizing problems), sleep quality, and developmental background variables that proved to be relevant based on previous models. As can be seen in the table, internalization problems predicted both DRF (b = 0.02, SD = 0.01, $t_{(84.36)}$ = 2.50, p < .05) and EUD (b = 0.01, SD = 0.00, $t_{(8.51)}$ = 2.91, p < .05) over time, in a positive direction, that is, elevated internalization scores were related to elevated reports of dreaming (notably, when performing these analyses in the nonimputed data set, INT predicted EUD, but did not reach statistical significance when predicting DRF). Externalizing problems did not predict either dream variable.

Table 6 presents models predicting behavior problems by dream variables. Predictors in each model (one predicting internalizing problems and one predicting externalizing problems) were dreaming variables (DRF and EUD), sleep quality, and background variables (time and gender). As can be seen in the table, EUD predicted both internalizing (b = 1.31, SD = 0.66, $t_{(156.76)}$ = 2.00, p = .05) and externalizing (b = 1.21, SD = 0.58, $t_{(225.45)}$ = 2.10, p < .05) problems over time, while DRF did not.

DISCUSSION

The main findings of this study pertain to the relationships between child-reported DRF and EUD on one hand, and parent-reported behavior problems on the other hand. Cross-sectional and longitudinal relationships were found between these domains. Specifically, we found that both DRF and EUD were significantly correlated with both types of behavior problems, but especially with internalizing problems. Additionally, while controlling for a host of potentially intervening background factors, we found that EUD at age 10–11 predicted an increase in externalizing and internalizing problems over time. Also, internalizing problems at age 10–11 predicted an increase in both DRF and EUD over time. These findings are a testament to the importance of dream research as the effects of sleep quality (a potential confound) were controlled for. Despite the importance of early adolescence as a period of psychobiological challenges and increased risk of the development of psychopathology (Spear, 2000; Steinberg et al., 2006), and despite the relationship found in adults between various dream patterns and psychopathological distress and symptoms (e.g., Cukrowicz et al., 2006; Soffer-Dudek & Shahar, 2009), such relationships have usually not been examined in early adolescence (with the exception of studies focusing solely on nightmares, as cited above). This study is, to the best of our knowledge, the first to show that different forms of unusual dreaming, assessed as a unified factor (in the form of EUD), are related to behavior problems in early adolescence.

Our findings in this study support both directions of prediction between dreaming patterns and behavior problems. Our findings do not support the "dreams as coping" hypothesis, as an increase in EUD predicted an *increase* in behavior problems, and not a *decrease*. However, it is important to note that, while this study does not support the hypothesis that dreams predict positive outcomes, we did not assess lucid dreams, which constitute a separate factor [Watson, 2001] and might in fact be positive or related to coping; Soffer-Dudek & Shahar, 2009; Soffer-Dudek et al., 2011). The finding whereby an increase in internalizing problems predicted an

TABLE 5
Estimates of Fixed Effects for Multilevel Linear Models Predicting Dream Variables From Behavior Problems

Parameter	*Estimate*	*SE*	*df*	*t*	*p*	*Lower b.*	*Upper b.*
A. DRF[a]							
Intercept	0.65	0.09	89.93	7.57	≤.001	0.48	0.82
Time	−0.17	0.05	90.74	−3.24	≤.005	−0.27	−0.07
Gender	−0.21	0.13	87.65	−1.65	*ns*	−0.47	0.04
Time × gender	0.12	0.08	90.92	1.58	*ns*	−0.03	0.28
SEF	0.00	0.01	145.75	0.48	*ns*	−0.01	0.02
INT	0.02	0.01	84.36	2.50	≤.05	0.00	0.03
B. DRF[b]							
Intercept	0.66	0.08	94.28	7.80	≤.001	0.49	0.83
Time	−0.16	0.05	90.69	−3.08	≤.005	−0.26	−0.06
Gender	−0.25	0.13	96.87	−1.94	*ns*	−0.51	0.01
Time × gender	0.17	0.08	92.08	2.12	≤.05	0.01	0.32
SEF	0.01	0.01	232.05	0.87	*ns*	−0.01	0.03
EXT	0.01	0.01	282.97	1.43	*ns*	0.00	0.02
C. EUD[c]							
Intercept	2.04	0.06	90.88	35.76	≤.001	1.93	2.15
Time	−0.11	0.03	83.22	−3.88	≤.001	−0.16	−0.05
SEF	0.01	0.01	142.90	0.94	*ns*	−0.01	0.02
INT	0.01	0.00	8.51	2.91	≤.05	0.00	0.02
D. EUD[d]							
Intercept	2.03	0.06	94.34	35.06	≤.001	1.92	2.15
Time	−0.10	0.03	92.07	−3.64	≤.001	−0.15	−0.04
SEF	0.01	0.01	160.17	0.89	*ns*	−0.01	0.02
EXT	0.01	0.01	55.72	1.17	*ns*	−0.01	0.02

Note. Estimates of fixed effects for multilevel linear models predicting dream variables (Models A, B predicting DRF and Models C, D predicting EUD) from behavior problems (Models A, C including internalizing symptoms and Models B, D including externalizing symptoms), controlling for the appropriate developmental trends.
df = degrees of freedom; Lower b. = lower bound within a 95% confidence interval; Upper b. = upper bound within a 95% confidence interval; DRF = dream recall frequency; EUD = enhanced and unusual dreaming; SEF = sleep efficiency; INT = internalizing symptoms; EXT = externalizing symptoms.
[a]Model A model fit: −2 *log likelihood* = 415.76, *parameters* = 14.
[b]Model B model fit: −2 *log likelihood* = 444.12, *parameters* = 14.
[c]Model C model fit: −2 *log likelihood* = 303.47, *parameters* = 12.
[d]Model D model fit: −2 *log likelihood* = 307.59, *parameters* = 12.

increase in dream variables over time replicates and extends findings on general sleep-related experiences conducted on adult samples that found an elevation in unusual dreaming patterns following psychopathological distress (e.g., Soffer-Dudek & Shahar, 2009). The finding whereby an increase in child-reported EUD predicted an increase in parent-reported internalizing as well as externalizing problems across 2 years suggests that certain dream variables might serve as early markers of emotional distress, or early markers of risk of developing behavior problems.

Changes in sleep and dreaming are among the most common nonspecific responses to stress (Sadeh, 1996). Remembering dreams and unusual dream experiences might be a useful clinical marker, indicating the existence of distress that might otherwise be covert (Soffer-Dudek & Shahar, 2010). Perhaps more attention should be given to dreams during early adolescence, a sensitive period that is susceptible to emotional turmoil. For example, it might be useful for clinicians to ask regularly about dreaming experiences within a psychiatric intake or as a screen at the pediatrician's office. Although, it is important to note that our sample is a nonclinical one and that our findings pertain to normal-range behavior problems and not to a clinically defined psychopathology. It is yet unknown to what extent dreams can serve as prodromal indicators of psychiatric problems. Soffer-Dudek and Shahar (2011) showed that while daily stress predicted an increase in daily reports of unusual dreaming, this effect was moderated by trait dissociation. Thus, personality traits interact with emotional distress in affecting consciousness. In

TABLE 6
Estimates of Fixed Effects for Multilevel Linear Models Predicting Behavior Problems From Dream Variables

Parameter	*Estimate*	*SE*	*df*	*t*	*p*	*Lower b.*	*Upper b.*
A. INT[a]							
Intercept	6.97	0.76	99.36	9.19	≤.001	5.47	8.48
Time	0.61	0.29	83.76	2.11	≤.05	0.03	1.18
Gender	−1.23	1.09	90.65	−1.13	*ns*	−3.40	0.93
SEF	−0.13	0.13	65.04	−0.98	*ns*	−0.38	0.13
DRF	0.92	0.57	194.39	1.63	*ns*	−0.20	2.05
EUD	1.31	0.66	156.76	2.00	≤.05	0.02	2.61
B. EXT[b]							
Intercept	5.68	0.60	111.67	9.42	≤.001	4.49	6.88
Time	−0.27	0.27	94.14	−1.01	*ns*	−0.80	0.26
Gender	0.76	0.67	89.83	1.11	*ns*	−0.60	2.12
SEF	−0.12	0.11	75.70	−1.04	*ns*	−0.34	0.11
DRF	0.40	0.48	242.87	0.84	*ns*	−0.54	1.35
EUD	1.21	0.58	225.45	2.10	≤.05	0.07	2.35

Note. Estimates of fixed effects for multilevel linear models predicting behavior problems (Model A predicting internalizing symptoms and Model B predicting externalizing symptoms) from dream variables (DRF and EUD), controlling for background variables. *df* = degrees of freedom; Lower b. = lower bound within a 95% confidence interval; Upper b. = upper bound within a 95% confidence interval; DRF = dream recall frequency; EUD = enhanced and unusual dreaming; SEF = sleep efficiency; INT = internalizing symptoms; EXT = externalizing symptoms.
[a]Model A model fit: −2 *log likelihood* = 1719.92, *parameters* = 14.
[b]Model B model fit: −2 *log likelihood* = 1590.14, *parameters* = 14.

addition, because there are individual differences in dreaming patterns regardless of emotional distress (for example, due to interest in dreams), it is questionable whether or not norms can be created for unusual dreaming, and thus, it might be difficult to determine how much unusual dreaming is too much. Nevertheless, reports of an increase in such dreaming, experienced by individuals in comparison with their own subjective experience of dreaming patterns in the past, may indeed be of clinical importance. Further research in clinical populations is required.

As we hypothesized, internalization was more strongly related to dreaming patterns than externalization. This is compatible with the notion that individuals who are more preoccupied with their emotional life (making them more vulnerable to internalizing emotional distress) are also more likely to be interested in, and recall, their dreams. These might be individuals with "thin boundaries;" boundary thinness or thickness is a personality trait pertaining to permeable boundaries between different states of the mind, in aspects such as identity, perception, thoughts, feelings, and consciousness states (Hartmann, 1991). It is associated with high neuroticism, emotional sensitivity, and various MMPI scales and is related to elevated DRF and nightmares in adults (Harrison, Hartmann, & Bevis, 2005–2006; Hartmann, 1991; Hartmann & Kunzendorf, 2006–2007; Schredl, 2007, 2010b) and in older adolescents (Cowen & Levin, 1995). Future studies should explore the utility of such definitions in early adolescence, as they might prove useful in detecting elevated risk of internalizing problems.

Notably, correlations between EUD and behavior problems were more consistent compared with correlations between DRF and behavior problems. This might be due to a methodological difference (effects are found more readily when using retrospective reports than with a daily diary), or it might stem from an actual difference in the degree of relationship between different dream characteristics and psychological adjustment. This pattern is consistent with previous literature, reviewed above, showing more clear and consistent correlations between unusual dream characteristics and psychological symptoms than between DRF and psychological symptoms. Indeed, only EUD, and not DRF, predicted behavior problems longitudinally.

Additional notable findings of this study pertain to developmental effects of dreaming patterns. While research on the developmental trends of sleep patterns during the transition to puberty is abundant (e.g., Crowley et al., 2007; Sadeh et al., 2009), dreaming patterns have received little attention. Based on research showing an increase in REM-awakening DRF from childhood to adolescence (Foulkes, 1982), we expected DRF to rise during the period of the study. Contrary to our prediction, DRF exhibited a decline over time among girls. In boys, there was no significant trend in any direction over time, similar to null findings by Foulkes et al. (1967) in adolescent boys. The EUD questionnaire also exhibited a decline over time, across both sexes.

We suggest two explanations for this somewhat unexpected finding. From a methodological point of view, it is possible that at least part of the discrepancy between our findings and the comprehensive works of Foulkes (1982), as well as the more recent study by Strauch (2005), stems from utilizing different methodologies. While the above-mentioned previous studies were conducted in laboratories and measured DRF upon REM awakenings, in the present study, DRF was measured in natural environments with a daily diary asking respondents to indicate the number of dreams they recalled from the night, and also using a retrospective questionnaire (EUD). Siegel (2005) underscored the importance of different studies utilizing different methodologies, such as laboratory collection, daily journals reported by the child, and parental reports, to receive a full picture of children's dreaming. However, delving deeper into the literature reveals that we are not the first to report a decline in dream recall during puberty, and this finding is not necessarily specific to daily diary DRF or questionnaire measurement. Specifically, Foulkes (1982) reports the following DRF values for REM awakenings in different age groups: 15% at age 3–4, 31% at age 5–6, 43% at age 7–8, 79% at age 9–10, 79% at age 11–12, and 73% at age 13–14. Foulkes treated this as an overall increase, but it is possible that the small decline in the final age group was of scientific significance.

Thus, a second explanation for the decline we found in dreaming is a theoretical one and pertains to more general issues of child development. This diversion from the expected general maturational course might be explained by unique characteristics of brain development during the period of puberty onset. Specifically, MRI studies have shown that around the expected age of the onset of puberty, the volume of gray matter in the frontal and parietal lobes reaches a peak and starts decreasing thereafter (Giedd et al., 1999). McGivern, Andersen, Byrd, Mutter, and Reilly (2002) interpreted these findings as suggesting that the onset of puberty might be a period of neural reorganization that compromises cognitive functioning. McGivern et al. as well as other studies have shown developmental "regressions" on specific cognitive tasks between 11 and 13 years of age (Anderson, 2002; Anderson, Anderson, Northam, Jacobs, & Catroppa, 2001; McGivern et al., 2002), supporting the idea that this age period has unique neurocognitive characteristics. It is possible that dream reports increase when examined through a longer time span, from early childhood to late adolescence, but that around the time of puberty onset there is a plateau and even a temporary "regression" that parallels a waking cognitive one. This would be compatible with Foulkes's assertion that dream recall in childhood is related to cognitive and emotional development (Foulkes, 1982, 1999). Future replications are needed for these findings.

Another developmental finding in this study pertains to the previously known gender difference, according to which females have higher DRF than males. Our longitudinal model exhibited such a difference only at Time 1. This partially contradicts existing literature, as a recent meta-analysis suggested that the gender difference is weak in childhood (under age 10) and strong in adolescence (ages 10–18) (Schredl & Reinhard, 2008b), and Brand et al. (2011) found such a difference in older adolescents (mean age around 18). On the other hand, this finding is compatible with findings by Strauch (2005) who showed that at ages 9–11, boys recalled fewer dreams than girls, but their dream recall improved over time, until they "caught up" with the girls at the third wave of the study (ages 13–15). Possibly, the gender difference in DRF changes between age 10 and 18 and should be inspected more closely in different age groups. If there is indeed a regression or plateau in cognitive capacities during the onset of puberty, it is possible that girls experience it earlier, due to earlier puberty onset. This might explain findings on gender differences in various ages. It is also important to note that there was a significant correlation between EUD and gender at Time 3, suggesting higher EUD scores for girls. More research is needed to investigate the similarities and differences of the developmental trajectories of EUD and DRF.

Limitations of this study should be noted. First, our sampled population was a relatively homogenous, urban Israeli population, limiting generalization. Second, while psychometric properties of our dream measures were adequate, they should be further investigated and validated. For example, while daily diary DRF and retrospective reports of DRF are related to REM-awakening DRF (e.g., Lewis et al., 1966; Schredl, 2002), we do not know the extent of their validity in children and adolescents. In addition, our EUD measure was tailored specifically for this study and thus not validated

by previous data. However, it is important to remember that our focus was on subjective experience, more so than on actual differences in children's dream frequency. Also, the EUD measure produced adequate reliability and stability measures. Thus, there is initial evidence for the validity of this instrument. In addition, it should be noted that daily diary DRF, as opposed to retrospective questionnaires, is more valid and less susceptible to biased recall (Beaulieu-Prevost & Zadra, 2007). Third, with the exception of sleep quality, this study's variables were measured subjectively, thus being more susceptible to bias and shared method variance. As noted before, we were interested in subjective dream experiences, and indeed, dreams cannot be measured directly. However, behavior problems and puberty were also assessed with questionnaires. Self-reported puberty is sometimes criticized, as it might represent over- or under-
estimation in certain age groups (e.g., Schlossberger et al., 1992). But our interest was in individual differences within a fixed age group (Time 1 scores). As for behavior problems, the relationships found in this study were between child-reported dreaming (DRF and EUD), and parent-reported problems. Because they rely on different reporters, they are less susceptible to shared method variance. Finally, our findings of a statistically significant decrease in DRF were limited to girls, meaning that they rely on a relatively small sample. Future replications are needed to determine whether there is indeed a "regression" in the overall expected rise in dream reports from childhood to adolescence.

Within the context of these limitations, our findings were robust, as the 2-year longitudinal relationship between dreaming and internalizing problems was replicated across both dream measures, and EUD longitudinally predicted both types of behavior problems. Our findings have scientific and clinical implications. First, because developmental trends in dreaming, a subject largely neglected in this age group may shed light on sleep, cognitive, and emotional regulation in general, as these systems are inter-related (Dahl, 1996). Second, because unusual dreams may be useful in detecting emotional turmoil during a delicate, risky age period of early adolescence. While nightmares have previously been related to psychopathology in this age group (e.g., Coolidge et al., 2010; Coulombe et al., 2010), we suggest that other subjectively reported enhanced and unusual dream characteristics such as elevated long-term dream recall, recurrent dreams, bizarre dreams, and an interest in dreams, might be linked to psychopathology in a similar way, and may be utilized to detect emotional distress. Future studies on emotional changes in early adolescence should pay attention to subjective dream experiences as a possible indicator of psychopathological risk.

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