

# Expanding Self-Help Imagery Rehearsal Therapy for Nightmares with Sleep Hygiene and Lucid Dreaming: A Waiting-List Controlled Trial

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**Summary.** Nightmares are a common disorder with serious consequences. Recently, the cognitive behavioral interventions Imagery Rehearsal Therapy (IRT) and exposure proved effective in a self-help format. The aim of the current study was to compare the following self-help formats to a waiting-list: IRT; IRT with sleep hygiene; and IRT with sleep hygiene and a lucid dreaming section. Two-hundred-seventy-eight participants were included and randomized into a condition. Follow-up measurements were 4, 16, and 42 weeks after treatment completion. Seventy-three participants completed all questionnaires and 49 returned the nightmare diaries. Contrary to our expectations, the original IRT was more effective than the two other intervention conditions. Moreover, IRT was the only intervention that convincingly proved itself compared to the waiting-list condition. However, these data should be interpreted with caution due to the low power and high dropout. Yet it seems that in a self-help format, IRT and exposure (which was validated previously) are the treatments of choice for nightmares.

**Keywords:** Nightmares; Self-Help; Imagery Rehearsal; Lucid Dreaming

## 1. Introduction

Nightmares are a common disorder affecting 2-5% of the general population (Bixler, Kales, Soldatos, Kales & Healey, 1979; Li, Zhang, Li & Wing, 2010; Schredl, 2010; Spoormaker & van den Bout, 2005). The DSM-IV-TR definition of nightmares is: "extremely frightening dreams that lead to awakening" (American Psychiatric Association., 2000), although various emotions have been reported in nightmares (Zadra, Pilon & Donderi, 2006) and direct awakening seems not to be associated with increased distress (Blagrove, Farmer & Williams, 2004).

Nightmares have serious nighttime consequences by disturbing the sleep (Kales et al., 1980) and also inflict daytime distress (Berquier & Ashton, 1992; Zadra & Donderi, 2000). Nightmares can be part of posttraumatic stress disorder (PTSD; Wittmann, Schredl & Kramer, 2007) and are associated with higher psychopathology scores (Hublin, Kaprio, Partinen & Koskenvuo, 1999; Levin & Fireman, 2002; Zadra & Donderi, 2000). However, it seems that nightmare distress rather than nightmare frequency is related to these psychopathology scores (Blagrove et al., 2004; Schredl, 2003). Moreover, a recent study found that nightmare frequency appears to be related to sleep complaints instead of mental

complaints (Lancee, Spoormaker & van den Bout, 2010b). These findings suggest that nightmares are best conceptualized as a sleep disorder that should receive specific diagnosis and treatment.

Nightmares can be adequately treated with cognitive-behavioral therapy (CBT; Spoormaker, Schredl & van den Bout, 2006; Wittmann et al., 2007). Imagery rehearsal therapy (IRT) and exposure are the two most thoroughly empirically tested treatments for nightmares (e.g. Burgess, Gill & Marks, 1998; Krakow, Kellner, Pathak & Lambert, 1995). In both treatments the nightmares are imagined during the day. In exposure, desensitization occurs by imagining the original nightmare; IRT employs exposure as well but the nightmare is imagined in a changed format.

Nightmare sufferers rarely receive treatment, probably because of the unavailability of trained cognitive-behavior therapists. Self-help treatment might provide a solution for the low accessibility of effective treatment. Recently we found IRT and exposure to be equally effective in a self-help format in ameliorating nightmares compared to a waiting-list and recording control group (Lancee, Spoormaker & van den Bout, 2010a); effects of IRT and exposure were sustained 42 weeks after the intervention (Lancee, Spoormaker & van den Bout, in press), but only 15-20% was totally nightmare free at this 42-week follow-up.

Expanding the self-help format with techniques such as lucid dreaming therapy (LDT) might further enhance treatment effectiveness. Lucid dreaming is a technique whereby the dreamer is aware that he/she is dreaming (Hobson, 2009; LaBerge & Rheingold, 1990). Lucid dreaming has been physiologically verified by volitional eye movements on the electrooculogram during rapid eye movement (REM) sleep (e.g., LaBerge, Nagel, Dement & Zarcone, 1981). Lucid dreaming frequency is moderately correlated with nightmare

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Submitted for publication: August 2010

Accepted for publication: October 2010

Table 1. Demographic Characteristics of Participants per Condition.

		Condition								Test	p =
		IRT (n = 67)		IRT+ (n = 75)		LDT (n = 71)		WL (n = 62)			
Mean age (SD)		33.4 (12.93)		38.9 (18.0)		36.5 (14.4)		35.5 (14.9)		F(3, 274) = 1.59	.19
Sleep duration (SD)		7.1 (1.30)		7.5 (1.55)		7.14 (1.40)		7.05 (1.40)		F(3, 274) = 1.23	.30
		n	%	n	%	n	%	n	%		
Gender	Male	10	5.9	21	28.0	17	23.9	15	24.2	$\chi^2(3) = 3.62$	.31
	Female	57	5.1	54	72.0	54	76.1	47	75.8		
Medication*	Yes	13	9.4	23	30.7	11	15.5	15	24.2	$\chi^2(3) = 5.33$	.15
	No	54	0.6	52	69.3	60	84.5	47	75.8		
In psychological Treatment	Yes	12	7.9	15	20.0	15	21.1	3	4.8	$\chi^2(3) = 8.04$	<.05
	No	55	2.1	60	80.0	56	78.9	59	95.2		
Self reported Trauma	Yes	46	8.7	51	68.0	53	74.6	39	62.9	$\chi^2(3) = 2.16$	.54
	No	21	1.3	24	32.0	18	25.4	23	37.1		

Note. \* Mostly Selective Serotonin Reuptake Inhibitors - SSRI's (> 90%)

frequency (Schredl & Erlacher, 2004), and it seems plausible that nightmares can trigger lucid dreaming (Schredl & Erlacher, 2004). In LDT for nightmares participants imagine their (changed) nightmare during the day while thinking that they are only dreaming (thereby triggering lucidity in the real nightmare). Because LDT targets the nightmare within the dream it might be specifically beneficial for people that suffer from non-recurrent nightmares.

A few case studies (Spoormaker, van den Bout & Meijer, 2003; Zadra & Pihl, 1997) and one randomized controlled study (Spoormaker & van den Bout, 2006) have studied LDT; all indicated that LDT was effective. In the controlled study, LDT was superior to a waiting-list on nightmare frequency but did not have an effect on secondary measures such as subjective sleep quality and PTSD complaints. LDT and IRT have a similar treatment structure which makes it possible to employ LDT as and 'add on' to IRT.

Moreover, nightmares and sleep quality have an inverse relationship (Ohayon, Morselli & Guilleminault, 1997; Schredl, 2003; Schredl, 2009). It is possible that nightmares have a direct effect on sleep (i.e. disrupting sleep patterns) or an indirect effect on sleep by inducing fear of going (back) to sleep. Some previous (uncontrolled) studies have used a combined approach of nightmare and insomnia treatment with promising results (e.g. Krakow et al., 2001; Swanson, Favorite, Horin & Arnedt, 2009). A section that specifically focuses on improving dysfunctional sleeping habits (sleep hygiene) could also be successful in a self-help format and have a beneficial effect as add-on to standard CBT for nightmares.

The aim of the current study was to compare the following self-help formats to a waiting-list: IRT; IRT with sleep hygiene (IRT+); and IRT with sleep hygiene and a LDT section (LDT). Expectations were:

- All treatment conditions have a beneficial effect compared to the waiting-list condition
- IRT+ ameliorates sleep quality compared to IRT
- LDT ameliorates nightmare frequency measures and nightmare distress compared to IRT and IRT+

## 2. Method

### 2.1. Participants

Participants were recruited from October 2007 to April 2009 through a Dutch nightmare website ([www.nachtmerries.org](http://www.nachtmerries.org)). The Netherlands has the highest internet penetration of Europe with 88% of the Dutch households connected to the Internet in 2008 (Statistics Netherlands, 2009). Inclusion criteria were: being eighteen years or older and having self-reported nightmares based on the SLEEP-50 (Spoormaker, Verbeek, van den Bout & Klip, 2005). Three-hundred-ninety-eight participants started the online questionnaire which 279 (70.1%) completed. Exclusion criteria were: high score on posttraumatic complaints (score > 53 on Dutch translation of the Impact of Event Scale - IES; Brom & Kleber, 1985), currently in treatment for PTSD, suicidal ideation, and schizophrenia. See Table 1 for demographic characteristics and see Figure 1 for flowchart and exclusion rates of participants'.

Of the 213 nightmare diaries sent out, only 49 (23.0%) were returned: 16 (23.9%) in the IRT, 16 (21.3%) in the IRT+, and 17 (23.9%) in the LDT condition. Return rates for the diaries were low but comparable with our previous self-help intervention study (Lancee et al., 2010a); this is probably because nightmare sufferers are reluctant to keep a log (Neidhardt, Krakow, Kellner & Pathak, 1992).

Table 2. Overview Self-Help Intervention.

Imagery Rehearsal Therapy (IRT)	IRT and sleep hygiene (IRT+)	IRT+ and Lucid Dreaming Therapy (LDT)
<ul style="list-style-type: none"> <li>▪ Recording</li> <li>▪ Writing down nightmares</li> <li>▪ Thinking about cognitive origin nightmare</li> <li>▪ Imaginative relaxation</li> <li>▪ Progressive muscle relaxation</li> <li>▪ Change ending nightmare</li> <li>▪ Imagining changed ending of nightmare (10-15 minutes a day)</li> <li>▪ Troubleshooting</li> </ul>	<p><i>IRT and</i></p> <p>If sleep quality is bad: Go to bed only when sleepy, use the bed and bedroom for sleep only, maintain a regular rising time, get out of bed and into another room when unable to fall asleep.</p>	<p><i>IRT and</i></p> <p><i>Sleep hygiene and</i></p> <p>Imagining nightmares during the day while thinking that it is only a dream - thereby triggering lucidity during the nightmare</p>

## 2.2. Procedure

The study was approved by the Medical Ethical Committee of the University Medical Center Utrecht. Participants could enter the baseline questionnaire after informed consent was given. Participants were subsequently randomized to one of four conditions: IRT (n = 70); IRT with sleep hygiene (IRT+; n = 76); IRT with sleep hygiene and lucid dreaming (LDT; n = 71); waiting-list (n = 62). Randomization was achieved by a computerized random number generator creating a random number table. Participants and project leader were not blind to the assigned condition. For the sample size we wanted to achieve similar power as in our former self-help study (Lancee et al., 2010a). This sample size was based on the fact that n = 51 is needed for adequate power (> 0.8) to detect significance at an effect size of  $d = 0.5$ . With a dropout of around 50% this meant that groups of around n = 100 were needed for each condition. However, due to low recruitment rates we could include fewer participants and a relatively high percentage dropped out. At 4-week follow-up, we now had a sample size large enough to find an effect size of 0.6 – 0.7 with an alpha of .05 and adequate power (> 0.8).

The six week intervention and diary were sent to the intervention conditions directly after baseline questionnaires. The waiting-list condition only received a letter that the post-test would be in eleven weeks. Eleven weeks after completion of the baseline (four weeks after intervention plus one extra week due to mailing time), participants in all conditions filled out the online post-test questionnaire. If the post-test was not completed, participants received two reminders by e-mail, and one by regular mail. After completion of the post-test participants in the waiting-list condition were sent an intervention to fulfill ethical obligations. No data are thus available of the long-term effects of the waiting-list. Sixteen and 42 weeks after the intervention participants filled out post-test 2 and 3. The diary was returned directly after finishing the intervention.

## 2.3. Measures

Nightmare frequency, nightmare distress, and subjective sleep quality were measured by the 50-item SLEEP-50 (Spoormaker et al., 2005), a sleep questionnaire with good reliability ( $\alpha = 0.85$ , test-retest reliability 0.78). Compared with polysomnographic and clinical diagnoses, the SLEEP-50 shows good predictive validity for various sleep

disorders. In addition, the SLEEP-50 addresses the nightmare frequency for the past week, the amount of nights with nightmares a month, and the subjective sleep quality (1 'very bad' – 10 'very good'). For nightmares, the sensitivity was 0.84 and the specificity was 0.77 compared to clinical diagnosis. Moreover, six items (range 6 – 24) of the sleep impact subscale were used for a nightmare distress scale targeting the last seven days. In our study the sleep impact subscale was preceded by: 'Because of my nightmares...' (e.g., I am told that I am easily irritated').

Anxiety was measured by the Dutch version of the 20 item Spielberger Trait Anxiety Inventory (Van der Ploeg, 1980). The Trait Anxiety Inventory consists of twenty statements about how much anxiety is generally experienced (e.g. I feel content; 1 = almost never; 4 = almost always; range: 20 – 80). Reliability is good ( $\alpha$ , range 0.87 – 0.96; test-retest correlation is 0.84 – 0.88), and so is the validity (Van der Ploeg, 1980).

Depression was measured by a Dutch translation of the 20 item Centre of Epidemiological Studies-Depression scale (CES-D; Bouma, Ranchor, Sanderman & van Sonderen, 1995). The CES-D scale consists of 20 items. This scale (range 0 – 60) has good internal consistency ( $\alpha$ , range 0.79 – 0.92; test-retest correlation is 0.90), and the validity of the Dutch scale is promising compared to Beck Depression Inventory (e.g. correlation of 0.56 – 0.66; Bouma et al., 1995). The CES-D uses a cut-off score of 16 to indicate mild depression and 27 to indicate major depression disorder (Zich, Attkisson & Greenfield, 1990).

Posttraumatic stress complaints were measured by a Dutch translation of the 15 item IES (Brom & Kleber, 1985). Only participants who had experienced a trauma filled out the questionnaire (n =; 189; range 0 – 75). Cut-off scores to indicate PTSD is 26 in the Dutch version. This scale has good internal consistency ( $\alpha$  range: 0.87 – 0.96), and construct validity comparable with the original IES (van der Ploeg, Mooren, van der Velden, Kleber & Brom, 2004).

## 2.4. Diary

The nightmare diary was kept on a daily basis by all three intervention conditions for a six-week period. Participants filled out each day: quality of sleep (0 'very poor' – 7 'very good'); amount of nightmares; and intensity of nightmare (1 'not intense' – 7 'very intense').

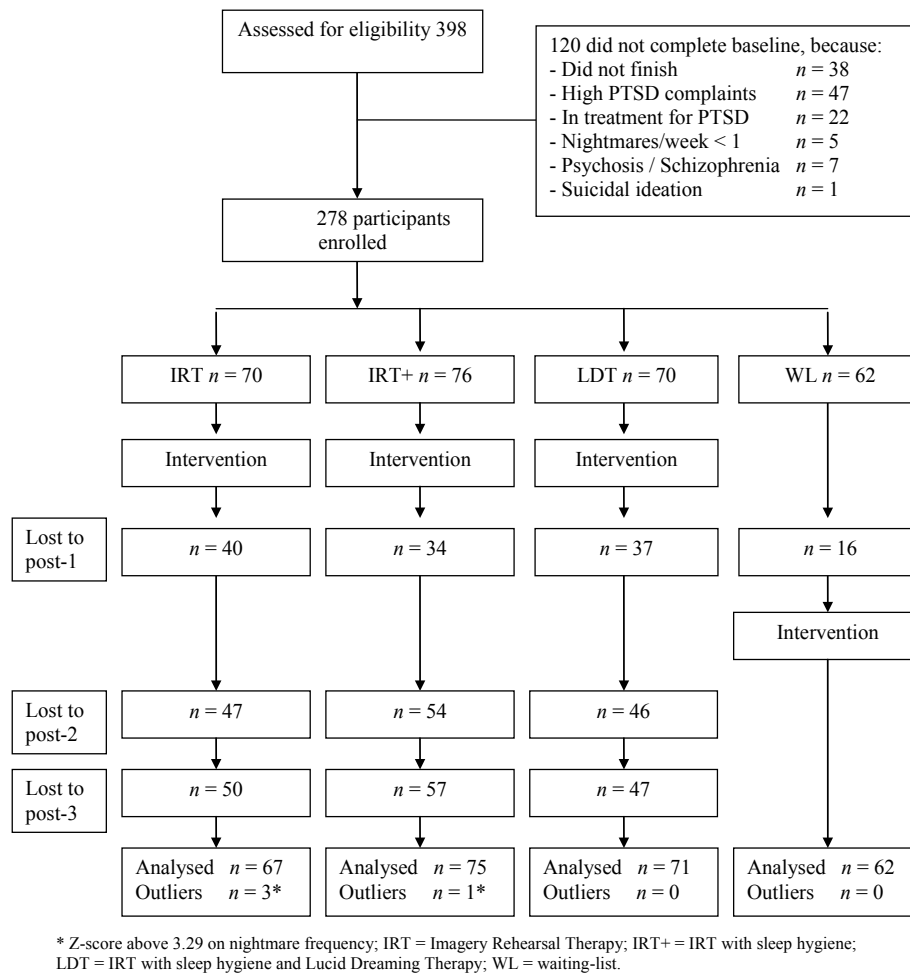


Figure 1. Flowchart and exclusion rates of participants’.

2.5. Intervention

For this study the self-help IRT booklet of Lancee et al. (2010a) was used (approximately 5800 words). IRT consists of exposure to nightmare imagery and instructs participants to imagine an altered version of the nightmare (Krakow & Zadra, 2006). The IRT book was expanded for the IRT+ condition with a sleep hygiene section of approximately 800 words employing sleep hygiene and stimulus control. In this section participants were instructed to go to bed only when sleepy, use the bed and bedroom for sleep only, maintain a regular rising time, avoid daytime naps and get out of bed and into another room when unable to fall asleep. Participants were told to improve their bedroom for sleeping by optimizing external factors like mattress softness, temperature, and light. Moreover, participants received specific instructions for what to do if a nightmare would occur; participants for instance received the suggestion to perform a muscle relaxation exercise and/or imagination of a safe place. In the LDT condition the IRT+ version (that also included the sleep hygiene section) was used with an extra lucid dreaming section (approximately 900 words). Participants in the LDT condition first received IRT instructions to think about the cognitive origin of the dream, change the nightmare ending, and imagine the changed nightmare. The

participants then received additional instructions to imagine the changed nightmare while thinking that it is only a dream (‘this is not real, but this is only a dream’). Moreover, participants received instructions to imagine during the day how they would change their nightmare while dreaming (see Table 2). Subjects in all three intervention conditions received a diary as part of their treatment.

2.6. Statistical analysis

An intention-to-treat (ITT) multilevel regression analysis was conducted to evaluate the success of the different interventions (Hox, 2002). Multilevel regression is an ITT procedure which allows participants with only one measurement to be included in the analyses (Hox, 2002). At baseline, fewer participants in the waiting-list condition were ‘in psychological treatment’ than in the other conditions (*p* < .05). Dropout was analyzed with logistic regression analyses. Attrition could have influenced post-test scores and therefore Cohens’ *d* estimations. To correct for this problem multiple imputation based on the ‘missing at random assumption’ was employed (Sterne et al., 2009). For the missing scores, ten separate datasets were generated with predictive mean matching. Changes in Cohen’s *d*’s were calculated with  $((M_{pre1} - M_{post1}) - (M_{pre2} - M_{post2})) / \sigma_{pooled-pre-test}$  (Morris, 2008).

Table 3. Means of Questionnaire Variables at Baseline, 4, 16, and 42 Weeks After the Intervention.

		Baseline M (SD)	4 weeks M (SD)	d - 1	16 weeks M (SD)	d - 2	42 weeks M (SD)	d - 3
Nightmare frequency week	IRT	6.45 (5.17)	2.48 (3.41)	-0.77***	2.14 (3.15)	-0.83***	1.47 (1.26)	-0.96***
	IRT+	5.56 (4.32)	4.12 (4.60)	-0.33***	5.73 (7.94)	0.04 <sup>ns</sup>	4.37 (5.28)	-0.28**
	LDT	6.08 (4.40)	4.03 (5.21)	-0.47***	4.12 (4.59)	-0.45***	4.50 (5.59)	-0.36**
	WL	6.42 (4.55)	4.78 (4.31)	-0.36**				
Nights with nightmares per month	IRT	16.01 (8.59)	8.36 (7.44)	-0.89***	7.18 (8.29)	-1.03***	4.05 (2.97)	-1.39***
	IRT+	15.97 (8.56)	11.74 (9.52)	-0.49***	12.36 (10.28)	-0.42*	11.47 (10.71)	-0.53**
	LDT	17.04 (9.19)	10.32 (8.89)	-0.73***	11.12 (9.82)	-0.64***	9.50 (9.82)	-0.82***
	WL	16.15 (8.53)	13.83 (9.26)	-0.27 <sup>ns</sup>				
Nightmare distress	IRT	16.18 (4.07)	12.18 (3.95)	-0.98***	11.27 (4.08)	-1.21***	10.59 (3.48)	-1.37***
	IRT+	14.72 (4.55)	13.34 (4.87)	-0.30***	12.86 (5.09)	-0.41 <sup>φ</sup>	12.22 (4.47)	-0.55**
	LDT	16.06 (4.79)	13.32 (4.40)	-0.57***	13.56 (5.13)	-0.52***	13.18 (5.00)	-0.60*
	WL	14.95 (4.40)	14.54 (4.46)	-0.09 <sup>ns</sup>				
Depression	IRT	19.76 (9.84)	13.96 (8.71)	-0.59***	13.24 (8.71)	-0.66***	12.68 (7.36)	-0.72**
	IRT+	19.76 (10.52)	17.41 (12.78)	-0.22**	15.68 (11.08)	-0.39**	16.79 (10.02)	-0.28 <sup>ns</sup>
	LDT	19.52 (10.13)	13.44 (10.45)	-0.60**	14.20 (12.83)	-0.53 <sup>ns</sup>	13.83 (12.11)	-0.56 <sup>ns</sup>
	WL	20.08 (12.09)	19.28 (12.84)	-0.07 <sup>ns</sup>				
Anxiety	IRT	47.19 (11.69)	42.37 (10.53)	-0.41*	41.52 (10.26)	-0.49**	41.05 (10.71)	-0.53**
	IRT+	46.77 (10.69)	43.32 (12.19)	-0.32***	40.86 (11.55)	-0.55**	42.05 (10.08)	-0.44*
	LDT	47.86 (11.92)	41.97 (12.86)	-0.49**	40.92 (13.81)	-0.58*	41.54 (13.30)	-0.53 <sup>ns</sup>
	WL	46.73 (12.49)	45.76 (13.06)	-0.08 <sup>ns</sup>				
PTSD	IRT	30.98 (16.11)	34.79 (17.37)	0.24 <sup>ns</sup>	23.29 (21.00)	-0.48 <sup>ns</sup>	23.92 (16.60)	-0.44 <sup>ns</sup>
	IRT+	26.82 (15.74)	33.44 (18.56)	0.42 <sup>ns</sup>	25.79 (15.64)	-0.07 <sup>ns</sup>	21.64 (19.04)	-0.33 <sup>ns</sup>
	LDT	25.51 (17.68)	18.74 (14.84)	-0.38 <sup>ns</sup>	22.41 (15.41)	-0.18 <sup>ns</sup>	25.06 (16.33)	-0.03 <sup>ns</sup>
	WL	29.69 (17.99)	34.41 (19.08)	0.26 <sup>ns</sup>				
Sleep quality	IRT	5.49 (1.53)	5.93 (1.77)	0.29**	6.50 (1.57)	0.66***	6.84 (1.42)	0.88***
	IRT+	5.48 (1.45)	5.79 (1.69)	0.21**	5.86 (1.64)	0.27**	6.05 (1.43)	0.40***
	LDT	5.42 (1.35)	6.15 (1.37)	0.54***	6.28 (1.43)	0.64***	6.46 (1.32)	0.77***
	WL	5.69 (1.43)	6.15 (1.07)	0.32**				

Note. \* =  $p < .05$ ; \*\* =  $p < .01$ ; \*\*\* =  $p < .001$ ;  $φ = p .05 - .06$ ; IRT = Imagery Rehearsal Therapy; IRT+ = IRT with sleep hygiene; LDT = IRT with sleep hygiene and Lucid Dreaming Therapy; WL = waiting-list.

In the diary the variables were originally measured per day but were transformed to a weekly period; time is thus indicative for the relative change over one week. This does not apply to nightmare frequency per week which was log-transformed to meet the assumption of normality. One diary from the IRT+ condition was excluded from the analyses because of a z-score of above 3.29 (18 nightmares in the first week of the diary); two diaries from IRT+ and three from LDT were excluded because the participants completed only the first (two) week(s). A significance level of  $p < .05$  (two-sided) was used throughout the study.

### 3. Results

#### 3.1. Attrition rates

At 4-week follow-up, 29 (43.2%) participants in the IRT, 42 (56.0%) in the IRT+, 34 (47.9%) in the LDT, and 46 (74.2%) in the waiting-list condition completed the questionnaire. A higher percentage of participants in the waiting-list condition returned the questionnaire than in the IRT ( $p < .001$ ), IRT+ ( $p < .05$ ), and LDT condition ( $p < .01$ ). No significant differences in dropout were found between the intervention conditions. In the LDT condition, older participants ( $M = 39.8$ ;  $SD = 15.7$  versus  $M = 33.5$ ;  $SD = 12.6$ ) and females (male:  $n = 6$ ; 35.3%; female:  $n = 28$ ; 51.9%;  $p < .05$ )

Table 4. Changes Between Conditions in Cohen's *d* for Nightmare and Secondary Variables in Questionnaire 4 (post-1) and 42 (post-3) Weeks After the Intervention.

	Nightmare frequency	Nights with nightmares	Nightmare distress	Depression	Anxiety	PTSD complaints	Sleep quality
Post -1							
IRT * IRT+	0.50*	0.52 <sup>φ</sup>	0.53*	0.31 <sup>ns</sup>	0.12 <sup>ns</sup>	0.32 <sup>ns</sup>	-0.05 <sup>ns</sup>
IRT * LDT	0.42 <sup>ns</sup>	0.21 <sup>ns</sup>	0.45 <sup>ns</sup>	0.14 <sup>ns</sup>	0.13 <sup>ns</sup>	-0.61 <sup>ns</sup>	0.08 <sup>ns</sup>
IRT * WL	0.56***	0.83***	0.79***	0.57*	0.32 <sup>ns</sup>	-0.06 <sup>ns</sup>	-0.08 <sup>ns</sup>
IRT+ * LDT	-0.09 <sup>ns</sup>	-0.30 <sup>ns</sup>	-0.07 <sup>ns</sup>	-0.17 <sup>ns</sup>	0.01 <sup>ns</sup>	-0.93*	0.14 <sup>ns</sup>
IRT+ * WL	0.07 <sup>ns</sup>	0.31 <sup>ns</sup>	0.24 <sup>ns</sup>	0.28 <sup>ns</sup>	0.21 <sup>ns</sup>	-0.37 <sup>ns</sup>	-0.03 <sup>ns</sup>
LDT * WL	0.16 <sup>ns</sup>	0.59**	0.30 <sup>ns</sup>	0.44 <sup>φ</sup>	0.19 <sup>ns</sup>	0.52 <sup>φ</sup>	-0.17 <sup>ns</sup>
Post-3							
IRT * IRT+	0.80**	0.89***	0.43**	0.21 <sup>ns</sup>	0.22 <sup>ns</sup>	0.18 <sup>ns</sup>	-0.41 <sup>ns</sup>
IRT * LDT	0.78**	0.68**	0.60***	0.24 <sup>ns</sup>	0.15 <sup>ns</sup>	0.35 <sup>ns</sup>	-0.33 <sup>ns</sup>
IRT+ * LDT	-0.02 <sup>ns</sup>	-0.17 <sup>ns</sup>	0.16 <sup>ns</sup>	0.03 <sup>ns</sup>	-0.06 <sup>ns</sup>	0.17 <sup>ns</sup>	0.09 <sup>ns</sup>

Note. \* =  $p < .05$ ; \*\* =  $p < .01$ ; \*\*\* =  $p < .001$ ; <sup>φ</sup> =  $p .05 - .06$ ; significance levels were calculated based on multilevel regression coefficients; Nightmare frequency was z-log transformed; IRT = Imagery Rehearsal Therapy; IRT+ = IRT with sleep hygiene; LDT = IRT with sleep hygiene and Lucid Dreaming Therapy; WL = waiting-list.

Table 5. Pre-post Measurements on Diary Variables With Corresponding Cohen's *d*.

		Week 1			Week 6			Δ <i>d</i> compared to		
		n	M	SD	n	M	SD	<i>d</i>	IRT	IRT+
Nightmare frequency week	IRT	16	4.00	(2.25)	16	1.50	(1.71)	-1.11		
	IRT+	13	3.62	(1.98)	13	1.77	(1.01)	-0.93	0.31	
	LDT	14	3.36	(2.44)	14	2.14	(2.88)	-0.50	0.55	0.28
Nights with nightmares	IRT	16	3.56	(1.82)	16	1.50	(1.71)	-1.13		
	IRT+	13	3.38	(2.06)	13	1.77	(1.01)	-0.78	0.24	
	LDT	14	3.14	(2.14)	14	2.00	(2.54)	-0.53	0.46	0.23
Sleep quality	IRT	15	4.52	(1.21)	15	4.70	(1.19)	0.14		
	IRT+	13	4.78	(1.16)	12	4.79	(1.34)	0.02	-0.11	
	LDT	14	4.71	(0.71)	13	5.10	(1.19)	0.54	0.14	0.26
Nightmare intensity	IRT	15	3.88	(1.54)	11	4.62	(1.79)	0.39		
	IRT+	13	4.19	(1.26)	11	4.35	(1.16)	0.24	-0.25	
	LDT	13	4.29	(1.51)	8	2.66	(0.99)	-1.07	-2.26***	-2.05*

Note. IRT = Imagery Rehearsal Therapy; IRT+ = Imagery Rehearsal Therapy with sleep hygiene; LDT = IRT with sleep hygiene and Lucid Dreaming Therapy; \*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$ ; Nightmare frequency was z-log transformed.

were more likely to complete the questionnaire.

At 42-week follow-up, 19 (28.4%) participants in the IRT, 19 (25.3%) in the IRT+, and 24 (33.8%) in the LDT condition completed the questionnaire.

### 3.2. Questionnaire data

At 4-week follow up, IRT was superior in ameliorating nightmare frequency and nightmare distress compared to IRT+

( $p < .05$ ) and the waiting-list ( $p < .001$ ). Moreover, it was effective in ameliorating depression compared to the waiting-list condition ( $p < .05$ ). At 4-week follow-up, LDT was effective on nights with nightmares compared to waiting-list condition ( $p < .01$ ).

At 42-week follow-up IRT was superior on all nightmare variables compared to the two other conditions ( $p < .05$ ). Pre-post test means can be found in Table 3 and Figure 2; changes in Cohen's *d* in Table 4.

Table 6. Multilevel Regression Coefficients for Diary Variables

	Nightmare frequency per week		Nights with nightmares		Mean nightmare intensity	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
<b>IRT</b>						
Constant	-0.48	(0.14)***	-0.85	(0.32)**	1.63	(0.32)***
Time	-0.20	(0.04)***	-0.69	(0.22)*	0.13	(0.24) <sup>φ</sup>
Time <sup>2</sup>	-	-	0.06	(0.04) <sup>ns</sup>	-	-
Baseline	0.68	(0.10)***	0.90	(0.05)***	0.69	(0.07)***
IRT+	ns	ns	ns	ns	-0.45	(0.24) <sup>φ</sup>
IRT+ *time	ns	ns	ns	ns	ns	ns
IRT+ *time <sup>2</sup>	ns	ns	ns	ns	-	-
LDT	ns	ns	ns	ns	-1.07	(0.24)***
LDT*time	ns	ns	ns	ns	-0.36	(0.11)***
LDT*time <sup>2</sup>	ns	ns	ns	ns	-	-
<b>IRT+</b>						
Constant	-0.34	(0.14)*	-0.85	(0.30)***	1.18	(0.35)***
Time	-0.14	(0.04)***	-0.89	(0.24)***	0.01	(0.07) <sup>ns</sup>
Time <sup>2</sup>	-	-	0.12	(0.05)**		
LDT	ns	ns	ns	ns	-0.63	(0.24)*
LDT*time	ns	ns	0.56	(0.34) <sup>φ</sup>	-0.24	(0.11)*
LDT*time <sup>2</sup>	ns	ns	-0.09	(0.06) <sup>ns</sup>	ns	ns
<b>LDT</b>						
Constant	-0.28	(0.13)*	-0.38	(0.32) <sup>ns</sup>	0.55	(0.35) <sup>ns</sup>
Time	-0.13	(0.04)***	-0.33	(0.23) <sup>ns</sup>	-0.234	(0.08)**
Time <sup>2</sup>	-	-	0.03	(0.04)	-	-

Note. IRT = Imagery Rehearsal Therapy; IRT+ = Imagery Rehearsal Therapy with sleep hygiene; LDT = IRT with sleep hygiene and Lucid Dreaming Therapy; <sup>φ</sup> =  $p < .1$ ; \*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$ ; Nightmare frequency was z-log transformed.

### 3.3. Diary data

Multilevel regression analyses showed that all conditions significantly decreased nightmare frequency ( $p < .05$ ). Nights with nightmares also decreased in all conditions, but only for IRT this reduction was significant ( $p < .05$ ; Table 5, 6). The IRT and IRT+ condition appeared superior compared to LDT in ameliorating nights with nightmares, however, between group differences were insignificant (Table 6, Figure 3). LDT seemed superior on sleep quality compared to the two other conditions; however, this increase was insignificant on all accounts ( $p > .05$ ). LDT demonstrated superior effects ( $p < .05$ ) in comparison to the two other conditions on mean nightmare intensity; IRT had a negative effect on mean nightmare intensity (Table 5, 6; Figure 3).

## 4. Discussion

In this study we set out to investigate whether expanding IRT with sleep hygiene and lucid dreaming increases efficacy. To our surprise, both LDT and IRT+ showed a smaller

decrease in nightmare measures compared to IRT. Moreover, IRT was the only condition that convincingly proved itself compared to the waiting-list. In contrast to our expectations, IRT seems to be the most effective self-help treatment of all intervention conditions.

Before we discuss the implications of these findings in detail we want to address some limitations of this study. Low power was probably a reason that some of the observed differences were not significant (such as the insignificant differences on the secondary measures). Moreover, this study suffered from a higher dropout rate than our former study. We think this might be because in the former study a self-help intervention for nightmares was delivered for the first time in the Netherlands; volunteers participating in that study might have been more motivated. With multiple imputations we tried to correct for these dropout effects (Sterne et al., 2009). However, measurements that are missing cannot be replaced; they can only be estimated. Therefore, the results are less reliable, particularly for the long term measurements. This implicates that conclusions are preliminary.

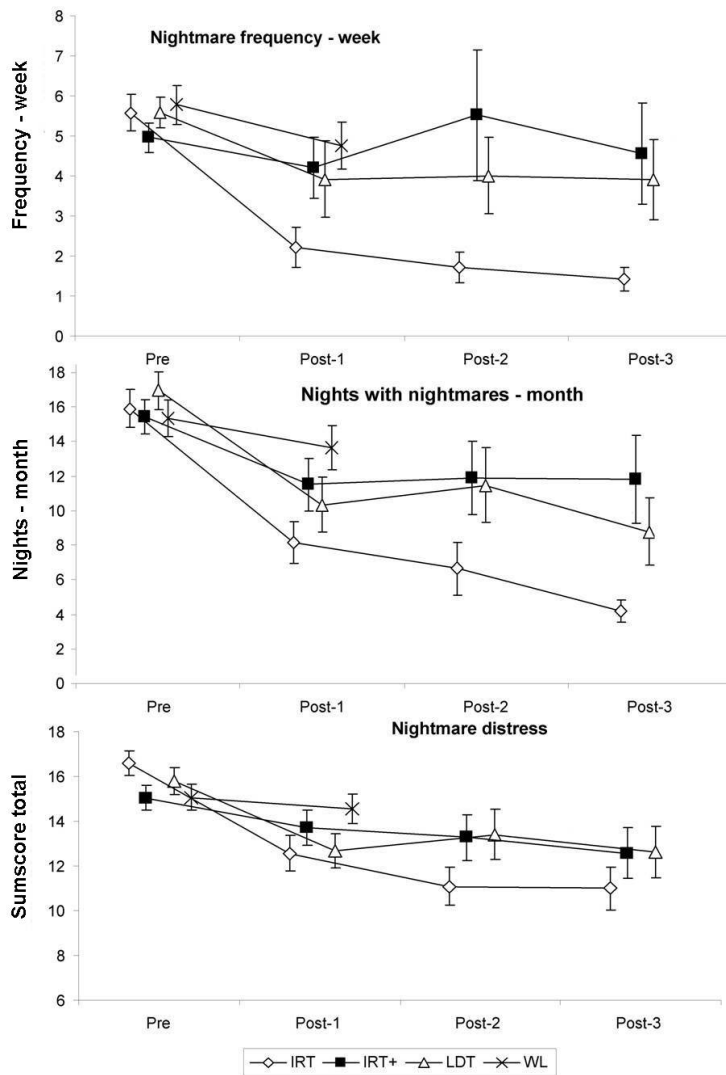


Figure 2. Nightmare Frequency per Week, Nights With Nightmares per Month, and Nightmare Distress at Baseline, 4 Weeks (post-1), 16 Weeks (post-2), and 42 Weeks (post-3) After Treatment..

Nonetheless, the general pattern in the questionnaire data was clear. On all accounts IRT performed better (however, not always significantly so) than IRT+ and LDT. In our former study (Lancee et al., 2010a), we found exposure and IRT to be equally effective, and we suggested that exposure might be the key element in treating nightmares. In this study, we found that expanding IRT with hygiene and/or LDT seems to deteriorate efficacy. This was not expected because LDT has showed to be effective in treating nightmares (Spoormaker & van den Bout, 2006) and targeting sleep has been empirically validated in people suffering from insomnia (Morin et al., 1999). Adding these elements in a self-help format might confuse participants and as a consequence they may employ only parts of the separate treatments, thereby failing to exercise the proposed key element of nightmare treatment: exposure.

Employing stand alone LDT (or the current LDT protocol without sleep hygiene) could have improved treatment outcome. The instructions of the LDT section were short and could have been too minimal, although they were in line with previous protocols that could successfully induce lucidity

in a subgroup of participants (Spoormaker & van den Bout, 2006; Spoormaker et al., 2003). However, an interaction effect may have affected our results: It may be detrimental instead of additive to learn LDT in addition to IRT because of complexity and self-efficacy reasons. In any case, LDT appears more difficult to learn than IRT, and this would suggest that a self-help format may not be the most optimal treatment delivery method for LDT because support from a therapist is essential to mastering lucid dreaming. Our recommendation is that future lucid dreaming research uses a face-to-face setting to compare original IRT with original LDT.

Another surprising finding was that adding a sleep hygiene section did not enhance treatment efficacy, not even on sleep quality. This is in contrast to uncontrolled treatment studies whereby a combined approach for insomnia and nightmares showed promising results (e.g. Krakow et al., 2001; Swanson et al., 2009). In the self-help format, the sleep hygienic guidelines (such as getting out of bed when unable to fall a sleep) might have provided a more intrusive / difficult treatment module that may have confused participants, or if adherence to this module could not be sustained, a reduced motivation to adhere to other treatment modules. It is possible that in order to improve sleep hygiene directly a more elaborate sleep intervention and/or face-to-face contact is required.

The effects observed in the questionnaire data were largely similar in the diary data: All conditions ameliorated nightmare frequency as measured by a diary. No significant improvements were found by including sleep hygiene to IRT. Moreover, The IRT and IRT+ condition were superior compared to LDT in ameliorating nightmare frequency measures; the lack of power was probably the reason that these differences remained insignificant. The opposite effect was found for the mean nightmare intensity, where LDT had a larger decrease on nightmare intensity compared to IRT and IRT+ (IRT even had an increase). IRT might only ameliorate the low intensity nightmares; leaving the high intensity nightmares unchanged. Another explanation could be that LDT has more effect on nightmare intensity, because nightmare sufferers achieve a sense of control with the lucid dreaming technique. These diary data should be handled cautiously as well, but as diaries can be seen a more objective form of measurements (Levin & Nielsen, 2007) future studies should try to find ways to limit attrition in diaries.

Nonetheless, all intervention conditions showed an effect on nightmare measures, but only IRT showed a significant effect compared to a waiting-list control condition. It seems that for self-help therapy, exposure and IRT are the currently the best available treatments for nightmares. IRT may be a treatment that is more appealing to patients as it provides a more positive, empowering manner to perform exposure. Self-help therapy for nightmares is a promising technique, especially because of its cost effectiveness and ability to reach a large number of nightmare sufferers.



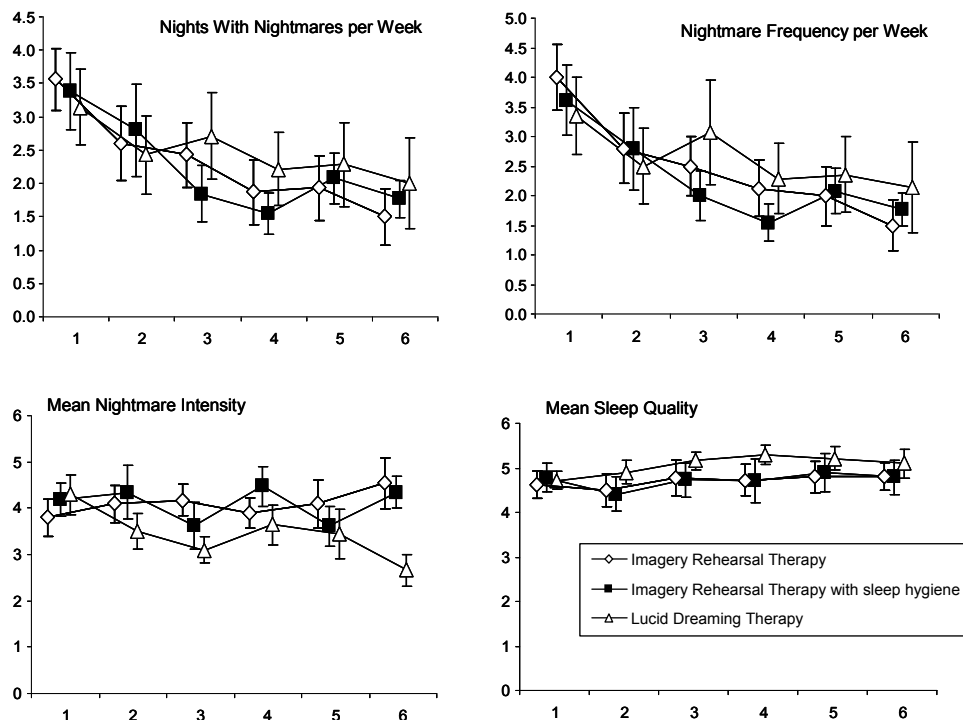


Figure 3. Six Week Overview for Diary Variables per Condition.

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