Studies for the Development of the Induction Method of Lucid Dreaming

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ABSTRACT
The mystery of dreams has always been an area of deep research. Lucid dreaming is when people realize they are awake, but they are dreaming. This work introduces and studies the induction methods of lucid dreams. We investigated whether the lucid dream occurred during rapid eye movement and investigated the ability to learn about lucid dreaming. Studies have shown that lucid dreaming has learnable characteristics that could provide insight into the healing process. We also review the inductive methods of lucid dreaming through cognitive technique and external stimulation. By summarizing different methods and studies, we found that cognitive techniques seem to be more reliable and effective than external stimuli, but no one method is superior to others because most methods produce mixed and contradictory results.

Keywords: *Lucid Dreaming, Induction techniques, Systematic Study for the Development, Virtual Reality*

1. INTRODUCTION

Lucid dreaming is defined as the dreamer is aware that they are dreaming. During lucid dreaming, the dreamer may have some degree of control over the scene, story, or characters that occur in the dream. The reality of dreams is often not questioned because people realize they are dreaming when they dream [1]. The reports of the lucid dream can be traced back thousands of years, it remains unverified until the last several decades by measuring eye movements [2]. These pioneer studies have confirmed that most lucid dreaming happened during the rapid eye movement (REM) stage, with rare exceptions occurring at non-REM sleep.

One pilot study by La Berge recorded a total of 389 lucid dreams as a subject to investigate the ability to learn lucid dreaming [3]. During these three years, the subject learned a mnemonic technique to induce mild lucid dreaming voluntarily. The results showed that subjects reported less than one lucid dream per month without any induction procedures. When using auto-suggestion, the result showed it had between 1 and 13 lucid dreams per month. Light sleepers can have 18 to 26 lucid dreams per night. The Mnemonic Induction of Lucid Dreams (MILD) helps people understand that higher MILD values mean more lucid dreams. Many associations are easily formed through mnemonic methods. According to this case, people can know that lucid dreaming is not innate, people can learn techniques to induce lucid dreaming. Since the MILD method has not been formally tested in other subjects, the generality of MILD will be left to future studies. General cognitive abilities were the subjects' ability to remember to perform expected actions and high levels of motivation and dream recall. All of these reasons might make MILD a valuable technique in general.

La Berge's studies illustrated the learnable characteristics of lucid dreaming, and later research have successfully demonstrated the valuable applications of lucid dreaming induction research [4]. One study looked at the remission of recurring nightmares in five cases and found the same results as other reports of using lucid dream training to treat nightmares. The results show that the therapeutic idea based on lucid dream induction is of great value [4]. Therefore, by evaluating different induction methods, we believe it could guide us to assess the advantages and disadvantages of each technique, thus contributing to the overall understanding of the therapeutic functions of lucid dreaming.

Our study aimed to review and evaluate different

categories of lucid dreaming induction methods, present a holistic view of current research progress, and propose future research direction.

2. EMPIRICAL REVIEW OF LUCID DREAM INDUCTION METHODS

As the study mentioned above, lucid dreaming - beaware of the dream while sleeping - is a learnable skill despite individual differences. An earlier study by La Berge has already introduced several common techniques [3].

3. METHOD AND RESULT

The authors conducted a three-year study to investigate and learn about the feasibility of lucid dreaming. In the first stage of Figure 1, the experimenter used self-suggestion. The subjects' results were similar to Garfield's, with an average of four to five lucid dreams per month. At the end of the first phase, the subjects made another mental observation before going to bed. A and B in the pictures show that the subjects reported having three times the average number of lucid dreams during the two months, respectively [3].

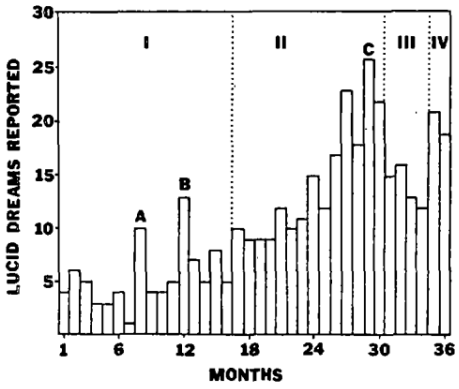

Fig.1 The feasibility of lucid dreaming

Following La Berge's illustration of the possibility of inducing lucid dreaming by learning, many scientists then began developing copious methods to increase the frequency of having lucid dreams. One study by Gackenbach has characterized various induction methods into two major categories based on when to operate the induction [5]. With Gackenbach's classification, techniques focused on daytime training are categorized as pre-sleep induction, while techniques operated during one's sleep are called sleep induction [5]. More modern research delineates lucid dream induction into three categories, which are also our focus today: 1) Cognitive techniques, 2) External stimulations, 3) and others [6]. Although somehow overlapping with previous classifications, newer studies incorporate more empirical evidence and attempt to integrate fragmented methods in a more systematic fashion.

In today's paper, people are mainly based on Stumbrys and his colleagues' 2012 paper, to review and summarize some common induction methods, including *cognitive techniques* and *external Stimulation* A total of 35 studies have been included in Stumbrys et al's review, involving both sleep laboratory and field experiments [6].

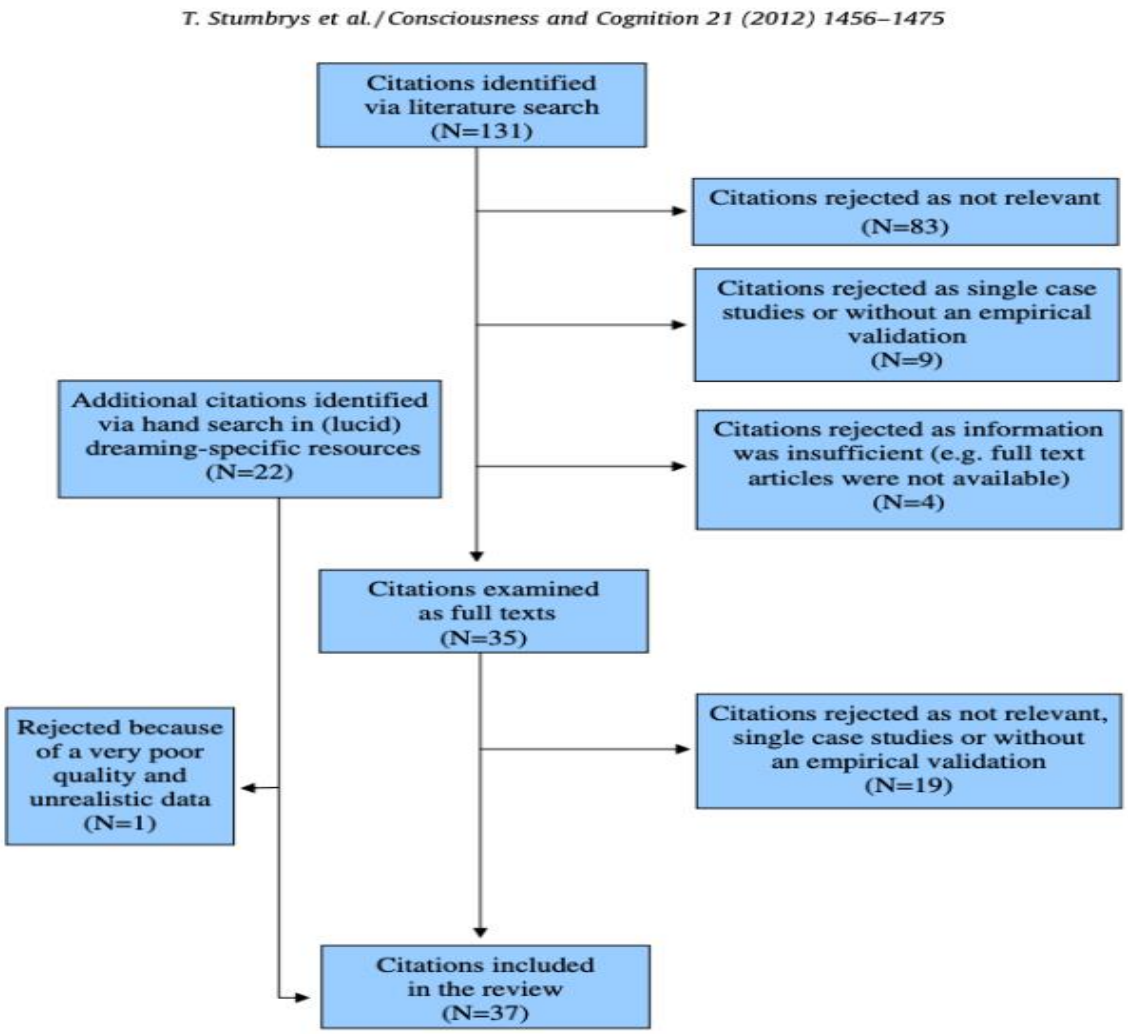

Fig.2 The common induction methods (flow chart)

The diagram above is a flow chart for the study of the identification process, which is the first review of the title and abstract. The review said 83 papers were described as irrelevant and did not induce lucid dreams. Another nine citations were rejected. The fourth reference was deleted due to the lack of information in the abstract [6].

2.1 Cognitive technique

Cognitive techniques generally refer to methods that focus on enhancing awareness during the dreaming state [7]. A total of nine cognitive techniques were mentioned in Stumbrys et al's review, including MILD, Reflection/reality testing, Intention, Autosuggestion, Tholey's combined technique, post-hypnotic suggestion, Alpha feedback, Dream re-entry, and Eclectic approaches [7].

The most often tested method, Mnemonic Induction of Lucid Dreams (MILD), requires participants to think about a dream, imagine being in a lucid dream, and focus on the feeling of realization of becoming lucid. Although the MILD practice is able to slightly increase the frequency of having lucid dreams, it turns out that repeatability and correlation remain relatively low. Other common cognitive techniques involve self-questioning and reality testing by asking self if one is dreaming during the daytime. There are mixed results for the reality testing techniques, where some studies successfully demonstrated it in laboratory settings, while others did not successfully increase the lucid dream frequency depending solely on reality testing. Similar to MILD methods, the Intention technique also requires that the person visualize being in a dream. One critical difference from the MILD method is that the Intention method emphasizes the recognition of being in a dream, while the MILD method accentuates remembering one's dreaming. As demonstrated in the previous case study, Autosuggestion is also used as a useful lucid dreaming induction technique, which instructs one to imply themselves to have a lucid dream during the night before falling asleep.

No	Reference	Item number on the Downs and Black's (1998) checklist																									Total score
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
1	Levitan (1989)	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	1	1	0	0	0	0	0	8
2	Levitan (1990a)	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	5
3	Levitan (1990b)	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	5
4	Levitan (1991a)	1	0	0	1	0	1	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	1	0	0	0	0	0	8
5	Levitan (1991b)	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	5
6	Edelstein and LaBerge (1992)	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	4
7	Levitan, LaBerge, and Dole (1992)	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0	6
8	Levitan and LaBerge (1994)	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0	6
9	LaBerge, Phillips, and Levitan (1994)	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0	6
10	LaBerge and Levitan (1995)	1	1	1	1	0	1	1	0	0	0	0	0	1	1	1	1	0	1	1	1	1	0	0	0	0	0	0	14
11	Purcell et al. (1986)	0	0	1	1	0	1	1	0	1	1	0	0	1	0	0	0	1	1	0	1	1	1	1	0	0	0	0	13
12	Zadra, Donderi, and Pihl (1992)	1	1	1	1	1	1	1	0	1	0	0	0	1	0	1	0	1	1	0	1	1	1	0	0	0	1	0	16
13	Schlag-Gies (1992)	1	1	1	1	1	1	1	0	1	1	0	0	1	0	0	0	1	1	1	1	1	1	1	0	0	0	1	18
14	Spoormaker and van den Bout (2006)	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	1	1	1	0	0	0	0	1	0	1	1	0	11
15	Paulsson and Parker (2006)	1	1	1	1	1	1	1	0	1	0	0	0	1	0	0	1	1	1	0	0	1	1	0	0	0	0	1	15
16	LaBerge et al. (1981)	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	5
17	LaBerge et al. (1988)	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	4
18	LaBerge (1988)	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	5
19	Hearne (1983)	1	0	1	1	0	1	0	0	0	0	0	0	1	0	1	1	0	1	1	1	0	0	0	0	0	0	0	9
20	Dane (1984)	1	1	1	1	1	1	0	0	1	0	0	0	0	0	1	0	1	1	1	1	0	0	1	0	1	1	0	15
21	Reis (1989)	0	0	0	1	0	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	6
22	Leslie and Ogilvie (1996)	1	1	0	1	1	1	0	0	1	1	0	0	0	1	1	0	1	1	1	1	0	0	0	0	0	1	0	14
23	Kueny (1985)	1	0	1	1	1	1	0	0	0	0	0	0	0	0	1	0	1	1	1	1	0	1	0	0	0	0	1	12
24	Ogilvie et al. (1983)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	2
25	Spoormaker, van den Bout, and Meijer (2003)	1	0	1	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	7
26	Galvin (1993) (sleep lab)	1	1	1	1	1	1	0	0	0	1	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	11
27	Galvin (1993) (field)	1	1	1	1	1	1	1	0	0	1	0	0	1	0	0	1	1	1	1	0	0	1	0	0	0	0	0	14
28	Malamud (1979)	1	1	1	1	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	8
29	Purcell (1988)	1	1	1	1	0	1	1	0	1	1	0	0	1	0	1	0	1	1	1	1	1	1	0	1	0	0	1	17
30	Hickey (1988) (sleep lab)	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	7
31	Hickey (1988) (field)	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	7
32	Ogilvie et al. (1982)	0	0	1	1	0	0	0	0	1	0	0	0	0	1	1	0	1	1	1	1	0	1	0	0	0	1	0	11
33	Zadra and Pihl (1997)	0	0	1	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5
34	Hearne (1978)	1	1	1	1	0	1	0	0	1	0	0	0	0	1	0	0	1	0	1	1	0	0	1	0	0	1	0	12
35	LaBerge (2004)	1	0	1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	7

Fig.3 The included studies

Research data indicate that 27 studies used cognitive techniques to induce lucid dreams. Cognitive techniques were used in 22 field experiments and 5 sleep laboratory studies. Methods used to induce lucid dreams include: lightness (memory-induced lucid dreams), reflexes or reality tests, intention, Thorley's combined techniques, self-suggestion, dream re-entry, posthypnotic suggestion, and alpha feedback [7].

Method	Effectiveness evidence level	References
1.Cognitive techniques		
1.1. Dream-initiated (DILD)		
1.1.1. MILD	Green	Edelstein and LaBerge (1992), Kueny (1985), LaBerge (1988), LaBerge et al. (1994), Levitan (1989, 1990a, 1990b, 1991a, Levitan and LaBerge (1994), and Levitan et al. (1992)
1.1.2. Reflection/reality testing	Green	Dane (1984), LaBerge (1988), Levitan (1989), Levitan and LaBerge (1994), Malamud (1979), Purcell (1988), Purcell et al. (1986), and Schlag-Gies (1992)
1.1.3. Intention	Green	Schlag-Gies (1992), Spoormaker et al. (2003), Spoormaker and van den Bout (2006), and Zadra and Pihl (1997)
1.1.4. Autosuggestion	Yellow	Levitan (1989) and Schlag-Gies (1992)
1.1.5. Tholey's combined technique	Green	Paulsson and Parker (2006) and Zadra et al. (1992)
1.1.6. Post-hypnotic suggestion	Yellow	Dane (1984), Galvin (1993), and Purcell et al. (1986)
1.1.7. Alpha feedback	Red	Ogilvie et al. (1982)
1.2 Wake-initiated (WILD)		
1.2.1. Counting	Yellow	Levitan (1991b)
1.2.2. Body image	Yellow	Levitan (1991b)
2. External stimulation		
2.1. Light stimulus	Green	LaBerge (1988), LaBerge et al. (1988), LaBerge and Levitan (1995), Levitan and LaBerge (1994)
2.2. Acoustic stimulus	Yellow	Kueny (1985), LaBerge et al. (1981), Ogilvie et al. (1983), and Reis (1989)
2.3. Vibro-tactile stimulus	Yellow	Reis (1989)
2.4. Electro-tactile stimulus	Yellow	Hearne (1983)
2.5. Vestibular stimulation	Yellow	Leslie and Ogilvie (1996)
2.6. Water stimulus	Red	Hearne (1983)
3. Miscellaneous		
3.1. Drug application		
3.1.1. Donepezil	Yellow	LaBerge (2004)
3.2. WBTB[a]	Green	Edelstein and LaBerge (1992), LaBerge et al. (1994), Levitan (1990a, 1991a), and Levitan et al. (1992)

Note: Effectiveness evidence levels: Green – method was demonstrated to be successful in several empirical studies; Yellow – method showed some success but findings were not replicated or are ambiguous; Red – method was not successful. Reference lists include empirical studies in which these methods were empirically verified.

[a] WBTB technique was tested empirically only in combination with MILD.

Fig.4 Lucid dream induction techniques

2.2 External stimulation

Unlike cognitive techniques which focus on enhancing the awareness of the lucid dream, external stimulation tries to intentionally induce lucid dreaming by either the physical stimuli or medicines. For example, a total of six media have been mentioned in Stumbrys' review paper, including Light, Acoustic stimulation, Vibro-tactile. Electro-tactile, Vestibular, Water, and Drugs [7]. All external stimulations are administered during the sleep, specifically the REM (Rapid Eye Movement) stage, which only differs in the media of performing the stimulation. Light stimulation, Acoustic Stimulation (a voice or a noise) are less effective than MILD techniques. Studies of Vibro-tactile stimulation, electro-tractile stimulation, and vestibular stimulation have provided complicated and inconclusive results. Water stimulus was shown to have no effect on dream lucidity. According to Stumbry et al, there is only one study looking at the effect of the drug - Donepezil, and found that higher doses of Donepezil can increase the frequency of lucid dreaming, but with some adverse effects [7]. Since the Stumbry 2012, one study also found that Galantamine, a kind of neuro inhibitor, could successfully enhance the lucidity of the dream [8].

	Lucidity		Reflectiveness		Interactive behavior		Role change		Constructive action		Fear/threat	
	Range 0–2		Range 1–6		Range 1–6		Range 1–6		Range 1–6		Range 1–6	
	M	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*
(B1)	0.26	0.08	2.23	0.19	2.4	0.22	2.03	0.21	1.4	0.16	1.77	0.24
(WBTB)	0.69	0.18	2.6	0.21	3.17	0.25	1.94	0.22	2.17	0.22	1.85	0.21
(WBTB + P)	0.4	0.11	2.65	0.28	3.14	0.22	1.77	0.24	2.14	0.25	2.25	0.27
(WBTB + G)	1	0.15	3.63	0.32	3.94	0.22	2.11	0.29	3.14	0.31	2.43	0.27
(MDR)	0.4	0.09	2.91	0.3	3.66	0.23	2.17	0.25	2.54	0.27	2.03	0.25
(MDR + P)	0.37	0.117	3	0.28	3.51	0.24	1.88	0.26	2.29	0.24	2	0.22
(MDR + G)	1.03	0.139	4.2	0.29	4	0.18	2.54	0.32	2.8	0.28	2.94	0.25
(B2)	0.31	0.11	3.14	0.28	3.4	0.23	2.57	0.29	3.03	0.28	1.8	0.22

(B1) = Pre-study baseline; (WBTB) = Wake back to bed; (WBTB + P) = Wake back to bed + placebo; (WBTB + G) = Wake back to bed + galantamine; (MDR) = Meditation and Dream Reliving; (MDR + P) = Meditation and Dream Reliving + placebo; (MDR + G) = Meditation and Dream Reliving + galantamine; (B2) = Post-Study Baseline.

Fig.5 Means and standard deviation

	(B1)	(WBTB)	(WBTB + P)	(WBTB + G)	(MDR)	(MDR + P)	(MDR + G)	(B2)
(B1)				L^2 $d = 1.12$ R^3 $d = 1.01$ I^3 $d = 1.23$ C^3 $d = 1.27$	I^2 $d = 1.00$ C^2 $d = .84$	I^2 $d = .89$ C^2 $d = .43$	L^2 $d = 1.17$ R^3 $d = 1.40$ I^3 $d = 1.27$ C^3 $d = 1.00$ F^2 $d = .77$	R^2 $d = .66$ I^2 $d = .81$ C^2 $d = 1.14$
(WBTB)							R^2 $d = 1.05$ F^1 $d = .85$	
(WBTB + P)				L^1 $d = .91^*$			R^2 $d = 1.01$	
(WBTB + G)					L^1 $d = .91^*$	L^1 $d = .95^*$		L^2 $d = 1.05$
(MDR)							L^1 $d = .96$ R^2 $d = .87$	
(MDR + P)							L^1 $d = 1.00$ R^1 $d = .87$	
(MDR + G)								L^2 $d = 1.15$ F^1 $d = .90$
(B2)								

Fig.6 Bonferroni pairwise and cohen d effect sizes.

Outcome Measures	*M* difference	*SD*	df	t	Cohen's *d*
Lucidity	−1.25	1.7	34	-4.65^{***}	1.02
Reflectiveness	−2.17	3.05	34	-4.21^{***}	.80
Interactive	−1.28	2.40	34	-3.16^{**}	.66
Role Change	−1.00	3.55	34	−1.66	.36
Constructive	−1.57	2.55	34	-3.63^{*}	.68
Fear/Threat	−1.11	3.05	34	-2.15^{*}	.48

* $p < .05$.
** $p < .01$.
*** $p < .001$.
[1] WBTB + G and MDR + G.
[2] WBTB + P and MDR + P.

WBTB + G > WBTB + P was not supported; Hypothesis 2: MDR + G > MDR + P was not supported; Hypothesis 3: MDR + G > WBTB + G was not supported.

Fig.7 conditions vs combined placebo conditions

The results of this double-blind study suggest that further research combining cognitive strategies with cholinesterase inhibitors may provide a way for the general population to achieve wakefulness and enhance the ideal properties of non-wakefulness in their dreams. Although the combination of MDR and galantamine significantly increased desired outcome measures compared to galantamine alone, the absolute enhancement of the galantamine effect by MDR led to significant differences between MDR + G and some non-galantamine conditions, particularly in terms of reflection and fear/threat. The findings further explore this integrated approach to make greater dream awareness and responsiveness more accessible to the general population and those who suffer from painful dreams.

Comprehensive treatment options like MDR + G may eventually lead to dream-based nightmares and trauma resolution for relatively inexperienced dreamers. Based on these findings, further studies in clinical populations seem warranted [8].

By summarizing different methods and studies, people found that the cognitive techniques appear to be more reliable and effective than external stimulation, but there is no method absolutely better than others because most methods yield mixed and contradictory results. One limitation of Stumbrys et al's review might be the time scope of the targeted literature. Most papers they have examined were from the late twentieth century, with a few conducted in the early 2000s. Although their review tries to cover as wide a range of studies as possible, no studies published after the 2010s are included. Despite the two conventional categories of the induction methods -Cognitive techniques and External stimulations, a recent study has adopted a more advanced approach by using virtual reality. The results indicate that lucid-dream-like training via VR greatly increases the lucid dreaming frequency [1]. However, due to the lack of literature that integrates conventional with innovative methods, we could not compare their reliability and effectiveness. Therefore, we hope there could be more empirical-based experiments that compare different induction techniques.

3. DISCUSSION

The recovery of reflective cognitive capabilities, including self-reflection and volitional control, in lucid dreaming, makes it become a rare phenomenon, bringing people to a hallucinatory world where they feel as real as any other waking experience but remain physiologically asleep [1]. As lucid dreaming occurs, one will experience a fully immersive and authentic virtual reality (VR). This experience, to some extent, is similar to dream-like virtual reality -- in which the virtuality of a phenomenal experience is created and the subject's feeling of being inside the virtual world is activated [9].

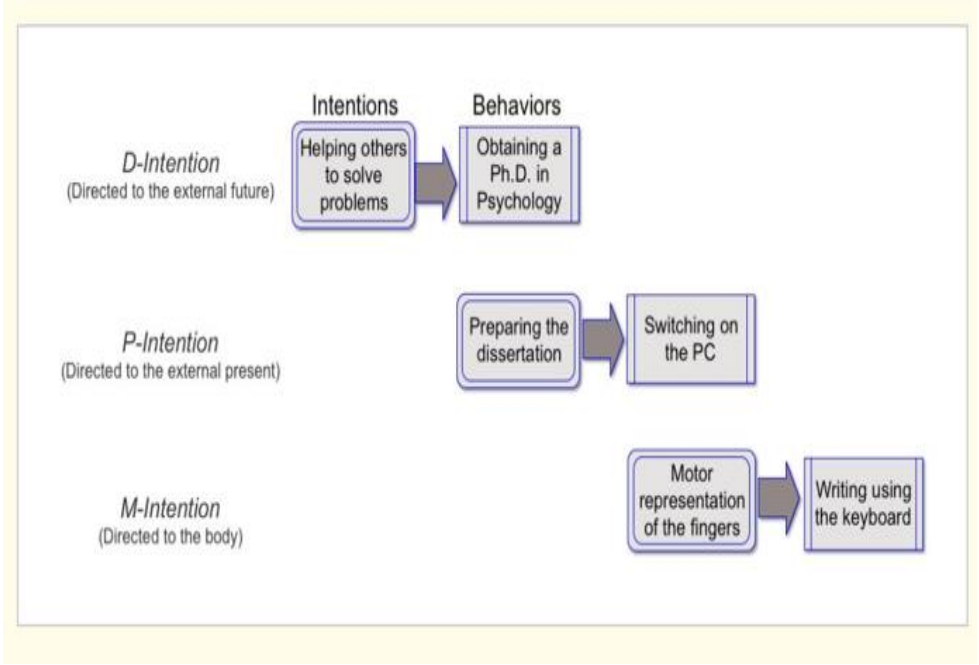

Fig.8 Intentional levels

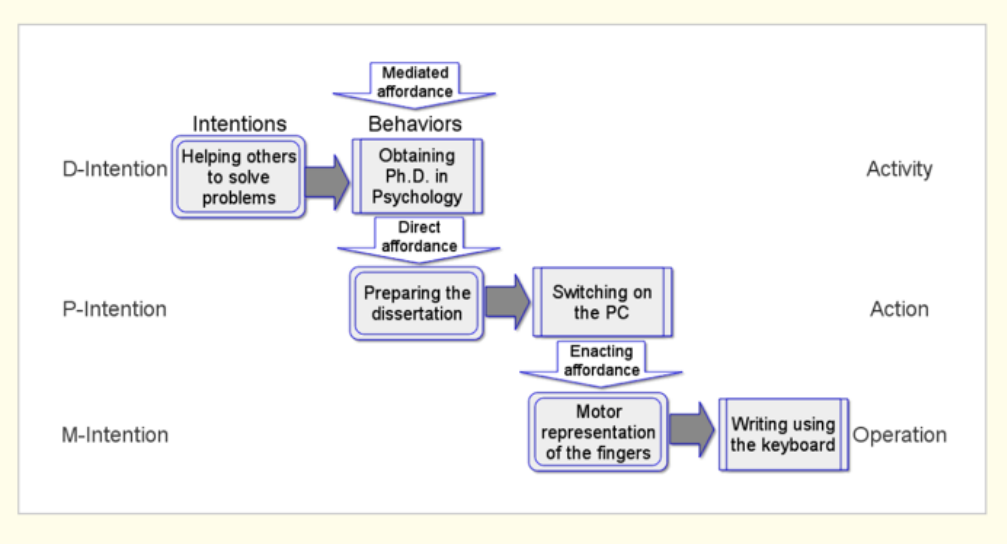

Fig. 9 The intentional chain

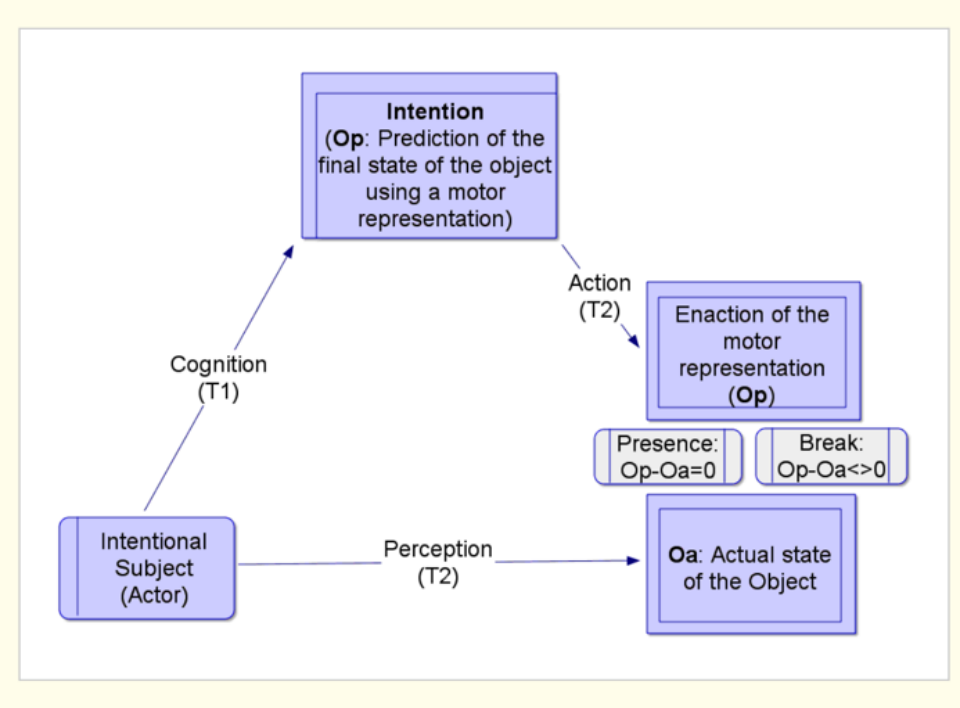

Fig. 10 The feeling of pressure

In recent years, scientists began using VR training as one method to induce lucid dreaming. The mechanism of VR training is to incorporate pieces of VR contents into a dream, serving as memory retrieval cues, to subsequently boost the effects of lucid dreaming induction while staying awake. Although VR demonstrates its effectiveness for increasing lucidity compared to those participants in traditional lucid dream training groups, the effects are moderate or only applied to some individuals [1]. Thus, more research is required to maximize its effectiveness.

In summary, given the formidable challenge of accessing dream content imposed by the subjective nature of dreaming, effective inductions-- facilitating lucid dreaming's occurrence and increasing its frequency-- indeed shed a light on the search for empirical exploration of the dream. With the support of novel brain imaging methods, such as EEG or fMRI, the differences between lucid and non-lucid REM sleep have been identified [10]. However, the lack of neuroimaging data and current reliance on retrospective reports, which are prone to distortion and forgetting, tentatively prevents people from comprehending the neural mechanism of lucid dreaming and explain whether lucid dreaming is a mixture between wakefulness and REM state or merely a unique product in the REM state [10].

Despite the limitations on recent progress, lucid dreaming-- a method of cognitive restructuring-- can open vast and exciting opportunities in clinical domains

and provide practical applications for a broader audience. Nightmares, which most patients with post-traumatic stress disorder (PTSD) experience, can be indeed alleviated through lucid dreaming induction. By triggering lucid dreaming, there is a high potentiality for patients to reconcile or suppress their fear within the dream state and enhance their understanding of themselves [11]. Athletes can utilize lucid dreaming for sports simulation training. They can challenge themselves by perfecting current skillful movements and acquiring new ones without getting injured in the manipulable space [12].

4. CONCLUSION

In our paper, we have recapitulated the conventional and innovative methods of lucid dreaming induction, including cognitive techniques, external stimulation, and virtual reality training. While all techniques have successfully helped induce lucid dreaming in a laboratory setting, the size and scope of studies varied, thus most of them may lack generalizability to the real world. Moreover, the mechanism behind lucid dreaming has not yet reached unanimity, and scientists are trying to understand the phenomenon better with the advancement of neuroscience. It, therefore, needs to conduct more research and delve further into the impacts of lucid dreaming and lucid dreaming training [13].

As probably the superlative form of immersive experience, lucid dream attracts people's attention with its hyper-realistic characteristics with minimal risks. Benefited from the development of technologies, a growing number of lucid dreaming induction methods have been investigated in recent years. However, the risk assessments receive less attention from the public, and the overall understanding of the lucid dreaming mechanism still remains unclear in most parts. In future studies, we are looking forward to more comprehensive examinations of lucid dreaming with the empirical approaches, both on its benefits and risks.

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