

Females' predisposition for lucid dreaming practice

Michael Raduga, Andrey Shashkov, and Zhanna Zhunusova

REMspace, Dover, DE, USA

Summary. The goal of this study was to examine possible gender differences related to achieving lucid dreaming (LD). This hypothesis originates from a few previous research works, different sleep patterns between genders, and practical observations. An online survey of 290 respondents and data from 16 experiments with 2155 reports were analyzed to test the hypothesis. The data show that females declare higher ability to induce LDs, and they are more successful in using the hardest LD induction method performed upon falling asleep. They rarely experience unintentional LD termination. The results of our study will aid the general understanding of not only LDs and related states but also gender differences in psychophysiology and general brain functions.

Keywords: Lucid dreams, lucid dreaming techniques, REM sleep, gender difference, phase state

1. Introduction

Lucid dreams (LDs) involve maintaining consciousness and self-control during dreams (LaBerge, 1985). Although LDs can occur during non-REM sleep (Dane & Castle, 1984; Mota Rolim et al., 2015; Stumbrys & Erlacher, 2012), this phenomenon usually occurs during REM sleep. LDs may differ from normal dreams due to higher activity in the prefrontal cortex at 40 Hz (Mota-Rolim SA et al., 2008; Voss et al., 2009). LDs are also associated with high functional connectivity between the anterior prefrontal cortex and temporoparietal association areas, which are usually deactivated during sleep (Baird et al., 2018). LDs have some practical uses (Mota-Rolim & Araujo, 2013). For instance, it is possible to use LDs for controlling a computer interface (Mallett, 2020), improving motor skills (Schädlich, 2018; Stumbrys et al., 2016), reducing nightmare (de Macêdo et al., 2019; Zadra & Pihl, 1997) and alleviating chronic pain (Zappaterra et al., 2014). A meta-analysis shows that 55% of all humans have experienced at least one LD (Saunders et al., 2016).

LDs can be achieved intentionally through many different techniques (Mota-Rolim et al., 2019; Stumbrys et al., 2012). If a person induces an LD while falling asleep or upon awakening, these experiences may feel like out-of-body experiences (Levitan et al., 1999; Mahowald & Schenck, 2005; Raduga, 2014). LDs and out-of-body experiences share some key features; for example, they both involve REM sleep and consciousness (LaBerge et al., 1988; Nelson et al., 2007). These features also relate to sleep paralysis (Dresler et al., 2012; Terzaghi et al., 2012; Voss et al., 2009) and false awakenings (Barrett, 1991). REM sleep and consciousness also could be found in other phenomena that happen to people as they wake up or fall asleep (e.g., succubus, incu-

bus, mystical and religious encounters, experiencing death, and even alien abductions) (LaBerge & Jane Gackenbach, 1988). For these reasons, all similar states with the two primary features of REM sleep and consciousness can be united under the umbrella term *phase state*, or simply *phase* (Raduga, 2004). According to our survey, 88% of people have experienced phase states in one form or another, with 43% of people reporting that they experience them relatively often (Raduga et al., 2020).

In theory, intentional LD practice could involve gender differences. This assumption is reasonable due to the natural differences between men's and women's sleep patterns. For example, females tend to need more sleep overall, spend less time in sleep stage 1 (N1) and more time in slow wave sleep (N3), and experience less REM sleep latency (Bixler et al., 2009). As LDs are closely related to sleep (especially REM sleep), this dissociative state could inherit some gender-related differences.

Such differences have been observed in previous LD studies. An online survey of 684 respondents indicated that spontaneous LDs were more frequent and longer for females, and females had less overall control over the plots of LDs (Stumbrys et al., 2014). Another online survey with 916 respondents revealed that overall control was indeed higher for males, whereas thought, realism, and dissociation were higher for females. Females also had higher dream anxiety levels and higher cognitive confidence (Yokuşoğlu et al., 2017). Though the differences were mostly numerical, females were more likely to experience different phase state forms in our previous live survey of 978 respondents (Raduga et al., 2020).

This list of evidence can be prolonged, and it shows that LDs are likely experienced differently by males and females. However, gender differences in terms of intentional LD practice are unknown. Perhaps one gender requires less effort than the other to achieve LDs. There is no research data on issues like this. Thus, research on this topic could uncover new and interesting aspects of LD. The present study addresses this issue.

The central hypothesis of our study was that females require less effort than males to experience LDs, at least when using some LD induction methods. In other words, females are expected to have a higher predisposition to experienc-

Corresponding address:

Michael Raduga, REMspace Inc., 8 The Green, Ste A, Dover, DE 19901.

Email: obe4u@obe4u.com

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ing LDs in one form or another. This hypothesis is related to intentional, deliberate LD experiences, not spontaneous ones.

We hope that our study makes the LD topic more understandable, especially as it relates to gender differences in terms of brain processes.

2. Method

2.1. Research resource

We used two data sources to explore our hypothesis in detail. The first was an online survey created specifically for discerning gender differences. The second was a database of a few LD experiments performed in other studies that provides data that helped us to see how gender affects the achievement of LD-related goals, as well as data about the methods of LD induction itself.

The studies took place on a resource designed for collecting data from LD practitioners, who are given access to tasks related to LD completion. The volunteers of this study were given no financial rewards; they participated based on their personal motivation.

Since this study was performed by independent researchers, who have no institutional review board, it has no ethical approval.

2.2. Online survey

The survey took place on February 22-29, 2020. The questionnaire had eight questions, which asked respondents to provide the following information: 1 – Overall LD quantity in lifespan, measured in numbers. 2 – The most used LD method in personal practice, measured by simplified classification of LD induction methods (Raduga, 2004, 2020) as follows: *direct* method or DM (induced upon falling asleep or immediately after falling asleep), *indirect* method or IM (upon awakening), *ld* method or LDM (by becoming conscious while dreaming). 3 – The hardest LD method in personal practice. 4 – Frequency of achieving deliberate LD, measured in days. 5 – Frequency of spontaneous LD, measured in days. 6 – Frequency of deliberate LD out of 10 attempts, measured as the number of possible successful attempts. 7 – Possibility of achieving LD deliberately within three days, measured as either a positive or negative answer. 8 – Personal self-estimation of LD predisposition, measured as *hard*, *moderate*, or *easy*.

2.3. Experiments

Data collected from 16 accomplished experiments from separate studies were considered. These experiments took place between November 2018 and February 2020. All experiments were field experiments: LD practitioners received the tasks online and performed them on their own. They had to induce LD using any method and then complete the tasks (e.g., remembering their birth date). Then, the participants needed to report their outcomes, sharing all details that were important for the analysis. Then, reports were checked and processed.

Before taking part in our research, all volunteers gave their consent to participate in the experiments. They also had to confirm that they were over 18 years old and had no psychological or physiological problems that could be triggered by LD or REM sleep.

Because all the experiments had different goals, in the present study, we analyzed only data that were inherent to the LD experience in question. Such data included the gender of the volunteers, how many LDs they had experienced in their lives (<4, 4-10, 11-30, 31-100, 101-500, > 500). We also examined what LD induction methods participants used and what LD ending types they experienced. LD ending types were classified as *force* (awakening against one's will), *self* (intentional awakening), *dream* (falling asleep or entering the dream plot), *false* (false awakening), *outer* (awakening due to external sounds or other irritations).

2.4. Statistical analysis

Both data sets were analyzed using contingency tables and chi-square tests in JASP (Version 0.11.1). We analyzed all criteria and their pairings, with the significance level set to $\alpha = .05$ and Bonferroni corrections employed as post-hoc tests. All non-applicable data (*n/a*) were skipped during analysis either by removing the entire report (for experiments) or the respondent's entire file (for surveys) from specific pairings in which *n/a* appeared.

3. Results

3.1. Survey

The total number of survey participants was 290 (177 males and 113 females). According to the data, 13% of males need one week or less to experience an unintentional LD, while the same is true for 21% of females (50% more in comparison to males). No differences were found regarding intentional LD induction during this period; males' and females' scores were 34% and 35%, respectively.

Males and females showed the same proportions of favorite LD methods. DM was very rarely cited as the favorite (4% for males, 8% for females). IM was the favorite method for 39% of males and 34% of females, while LDM was most often the favorite for both genders (57% for males, 58% for females). The χ^2 -test analysis did not show any statistical gender differences regarding their favorite LD induction method.

Males and females showed differences in terms of the perceived difficulties of different LD methods. The data show that 71% of males and 70% of females found DM the hardest (71% for both), 14% of males and 23% of females found IM the hardest, and 15% of males and 7% of females found LDM the hardest. Thus, for males, IM is the easiest LD induction method; for females, LDM is the easiest. The χ^2 -test confirmed that there is a statistically significant relationship between hardest LD method and gender ($\chi^2 (2, N = 264) = 6.887, P = .032$). Furthermore, the post-hoc tests showed significant gender differences for DM and LDM ($P_{\text{bonferroni}} = .006$) but not for IM (Table 1).

Table 1. Hardest LD method estimation and gender

LD Methods	Male (N = 161)	Female (N = 103)	Total (N = 264)
DM	115 (71%)	72 (70%)	187 (71%)
IM	22 (14%)	24 (23%)	46 (17%)
LDM	24 (15%)	7 (7%)	31 (12%)

Note: DM = direct method; IM = indirect method; LDM = lucid dreaming method.

Table 2. Used LD methods and gender

LD Methods	Male (N = 1131)	Female (N = 930)	Total (N = 2061)
DM	188 (17%)	241 (26%)	449 (21%)
IM	406 (36%)	289 (31%)	695 (34%)
LDM	537 (47%)	400 (43%)	937 (45%)

Note: DM = direct method; IM = indirect method; LDM = lucid dreaming method.

Females more often than males declare their ability to induce deliberate LD within three days (78% vs. 65%). The χ^2 -test confirmed a statistically significant relationship between declared ability to induce LD within three days and gender ($\chi^2 (2, N = 262) = 4.859, P = .028$). Moreover, post-hoc tests showed significant differences between negative declaration and gender ($P_{\text{bonferroni}} < .002$) and between positive declaration and gender ($P_{\text{bonferroni}} = .036$).

It was found that 91% of males declared having an inability to achieve LD in less than half of their attempts, whereas the same was true for 82% of females. The χ^2 -test confirmed a statistically significant relationship between participants' gender and their declarations of their ability to induce LD in half of their attempts ($\chi^2 (2, N = 263) = 4.906, P = .027$). Post-hoc tests showed significant differences between negative declarations of the ability to induce LD in half of one's attempts and gender ($P_{\text{bonferroni}} < .002$). No such significant difference was found for positive declarations.

3.2. LD experiments

We analyzed 2155 reports completed by 523 volunteers (313 males and 210 females), which were gathered from 16 experiments. Males were able to achieve the LD goals in 77% of reports, and females' overall success rate was 79%. The χ^2 -test analysis did not show a statistical difference between gender and the ability to achieve goals in LD.

Females used the DM induction method 59% more often than men (26% vs. 17%) and less often used the IM method (31% vs 36%) and LDM method (43% vs 47%). The χ^2 -test confirmed a statistically significant relationship between the frequency of LD induction method and gender ($\chi^2 (2, N = 2061) = 26.929, P < .001$). Post-hoc tests showed significant differences between DM and gender ($P_{\text{bonferroni}} < .003$), IM and gender ($P_{\text{bonferroni}} < .033$), and LDM and gender ($P_{\text{bonferroni}} < .003$) (Table 2).

Females were less likely to experience unintentional awakening during a LD (55% vs. 64%). This difference was confirmed by the χ^2 -test: $\chi^2 (2, N = 2059) = 25.400, P < .001$. The post-hoc tests showed a significant difference between forced LD ending and gender ($P_{\text{bonferroni}} < .005$) but not for other pairs (Table 3).

4. Discussion

In theory, males and females could have different abilities related to LD practice. In order to explore this possible gender difference, we conducted an online survey and analyzed 2155 LD reports.

4.1. Hypotheses confirmation

The data show that females often declare their ability to guarantee LD within three days. Most of them are success-

Table 3. LD ending types and gender

LD Methods	Male (N = 1131)	Female (N = 930)	Total (N = 2061)
Dream	178 (16%)	168 (18%)	346 (17%)
False	48 (4%)	37 (4%)	85 (4%)
Force	731 (64%)	502 (55%)	1233 (60%)
Outer	50 (4%)	69 (7%)	119 (6%)
Self	131 (12%)	145 (16%)	276 (13%)

Note: Dream = falling asleep or getting into the dream plot; False = false awakening; Force = awakening against the will; Outer = awakening from external sounds or other irritations; Self = intentional awakening.

ful in half of their attempts and are often successful when using the hardest LD induction method. In addition, they rarely experience unintentional awakening during a LD.

We can state that females have a higher predisposition than men in some specific LD-related aspects, which proves our central hypothesis: gender affects LD practice. We suppose that this finding primarily originates from inborn psychophysiological differences between genders, which need to be further explored.

The most interesting part of our research is that it was accomplished using two approaches: an analysis of declared abilities and actual results from experiments. Therefore, this work provides a more accomplished picture and correlations than other related work. At the same time, we considered reports only from experienced LD practitioners, and these practitioners were also respondents in the survey. Therefore, our research is primarily based on people who are intimately familiar with LD. As such, higher-quality information regarding deliberate LD practice could be found in future research. For example, if we could base our research on ordinary people who experience LDs only occasionally, the findings would be different.

Attempt efficiency. Compared to males, females more often declare their ability to guarantee a LD experience within three days. In addition, more females than males are successful in at least half of their attempts to enter a LD intentionally. At the same time, men did not present any advantages over women related to any of the questions related to LD technique efficiency, though both genders were similar in many aspects.

Methods. The most apparent difference between genders in LD practice has been observed in relation to DM. The χ^2 -test did not show a statistically significant relationship for favorite LD method (even though twice as many females than men prefer DM). However, this could be the result of insufficient data, as the percentages were very low. The difference was apparent in actual practice, as females appeared to use DM much more often than males, and it was confirmed statistically this time. Another noteworthy difference is that females are half as likely as males to consider LDM to be the hardest method. Considering the above discussion, females are better in two out of three primary LD methods, including the hardest one. The data show that the majority of both genders consider DM to be the hardest LD induction method, but females are more likely to use it in practice.

Achieving goals. Though Stumbrys and his colleagues found that females have less control than males during LD (Stumbrys et al., 2016), our analysis showed no difference,

as we considered achieving predetermined goals in LD as a benchmark for this kind of control. Though females are not better in this aspect, they are not worse, either. We suppose that this contradiction originates from the type of data considered. Our data was based on practical tasks rather than a survey. In any event, we think that with more specific goals (or similar goals), the results could be different; however, when considering all goals in general, we do not expect to see a significant gender difference.

LD ending. The most unexpected result was related to LD ending type. Specifically, it was surprising that females experience unintentional awakenings during LDs significantly less often than males. We believe that this finding is related to females' predisposition for LD in general as well as its specific aspect in the form of LD duration. We are currently performing four experiments on this topic, and the preliminary results show a dramatic difference between genders in terms of LD practice. A similar difference was observed by Stumbrys and his colleagues (2016).

5. Limitations

In general, it is difficult to state with certainty that females are significantly more proficient LD practitioners than men. In many practical aspects, there is no gender difference. Even where statistical differences are observed, they do not tend to be dramatic. Therefore, although we showed gender difference related to LD practice, LD should not be regarded as a closed topic for males.

We actively excluded suspicious volunteers and did not provide financial rewards for completing tasks. Nevertheless, there fake or misleading reports could be present in our data, as the most questionable part of our research is the narrative nature of the results. Even if we suppose that the results could be compromised, the reports are similar to data presented in most other studies in this research area (most of these studies originate from the same narrative data type).

Most of the volunteers and respondents were located in Russian-speaking regions. We can suppose that the outcomes of similar studies could be different if performed by people of different countries, cultures, races, education levels, and even climates.

Only 290 and 523 volunteers participated in the survey and experiments, respectively. Our results could have been more accurate and credible if we had involved more participants. Finally, this study focused on experienced LD practitioners, and it is difficult to gather a large number of LD practitioners to take part in a scientific study.

6. Conclusions and Future Studies

We examined males' and females' predispositions for LD practice. Survey results, combined with data from 16 previous experiments, helped us to confirm the hypothesis that gender affects some aspects of intentional LD practice. We found that females tend to experience fewer problems than men, and they experience faster and more reliable results. However, we do not know why this inborn ability exists in females' brains; this topic could be examined in future studies. If we look at the situation from a scientific point of view, females could be regarded as better volunteers for LD research projects. The gender difference in LD practice that was uncovered in this study provides opportunities for studying the human brain.

We have performed many LD experiments, in which we have seen or have expected to see different forms of females' predispositions to the practice. This could be related to LD duration, the specific goals that participants were asked to achieve, or other factors. Additional studies should be performed in this direction because it is a highly unexplored topic that may provide us with interesting and useful knowledge about human nature, consciousness, and the brain in general.

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