

Exploring the relationship between creativity and lucid dreaming

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Lucid dreaming is a rare occurrence in which individuals are aware that they are dreaming and sometimes the dreamer is also able to control the dream. The metacognition experienced during lucid dreaming appears as prefrontal cortex activation that is not apparent during normal dreaming. Prefrontal cortical activity has also been linked to creativity. The current experiment measured the incidence of lucid dreams in an undergraduate population and examined a possible relationship between lucid dreaming and creativity. Participants were given a creativity test, followed by a short session that trained participants in pre-sleep autosuggestion techniques to aid in lucid dreaming. Participants kept a dream journal for next 7 days. At the conclusion of the week, subjects took a second creativity test. It was hypothesized that creative people would be more likely to lucid dream, and that perhaps training in lucid dream techniques may be able to boost creativity in participants. We found high rates of both current (59%) and lifetime (75%) lucid dream occurrence in our undergraduate population (n=295). Statistical analysis found no significant difference in creativity between lucid dreamers or non-lucid dreamers (n=47), nor was there any evidence that 7 days of pre-sleep autosuggestion increased creativity. However, lucid dreaming training over a longer period of time should be explored.

Abbreviations: DLPFC – Dorsolateral Prefrontal Cortex; EEG – Electroencephalogram; RAT – Remote Association Task; TTCT – *Torrance Tests of Creative Thinking*

Keywords: Autosuggestion; Sleep; Prefrontal Cortex; Cognition; Lucid Dreaming; Creativity

Introduction

Unlike ordinary forms of dreaming, lucid dreaming is a paradoxical state of consciousness while dreaming (Hobson, 2009). Lucid individuals are able to control some of the events of a dream while remaining asleep (Hobson, 2009). Throughout history people have debated whether lucid dreams are real or simply an imagined state. It is now known that lucid dreaming occurs during REM sleep, but efforts to define the neurological underpinnings beneath lucid dreams are challenging (La Berge, 1990; Stumbrys et al., 2013). Subjects participating in activation in areas of the brain that are typically deactivated in REM sleep,

laboratory sleep observations often struggle to sleep soundly in a lab and may fail to reach REM sleep or have lucid dreams (Maquet et al., 1996). Furthermore, until recently, researchers have either studied themselves or only very small groups of people (LeBerge, 1980).

Controversy exists about how the brain can be in two different states at once. Recent studies suggest that lucid dreams might be associated with increased brain activity in the frontal regions of the brain during REM sleep (Hobson, 2009). Lucid dreaming has been associated with including the bilateral precuneus, cuneus, parietal lobe, and prefrontal and occipito-

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temporal cortices (Dresler et al., 2012). Electroencephalogram (EEG) results show that the dorsolateral prefrontal cortex (DLPfC) is reactivated during lucid dreaming, whereas in normal dreaming, the posterior brain is activated (Hobson, 2009). When sleeping subjects become lucid, there is a shift in a 40Hz range located in the frontal brain region responsible for working memory and self-reflection (Stumbrys et al., 2013), characterizing waking consciousness.

From a neurocognitive perspective, this pattern of activation accounts for the reflective cognitive abilities that are characteristic of lucid dreaming (Dresler et al., 2012). It has been thought that if an increase in electrical activity were to occur in the non-lucid dreaming regions of the brain, there would be a resultant increase in the dreamer's awareness, initiating lucidity (Hobson, 2009).

Creativity involves both originality and functionality (Kersting, 2003). Franken (1993) defined creativity as "the tendency to generate or recognize ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others, entertaining ourselves and others". Therefore, from a cognitive perspective, creativity encompasses some degree of critical thinking. Neurologically speaking, creativity occurs not only in relaxed states of brain activity, similar to stages of sleep and dreaming, but also in active states of brain activity (Martindale and Hasenpus, 1978). Individuals who are considered creative can easily switch between these relaxed and active brain states (Ward and Saunders, 2003).

Creativity tests typically assess both convergent and divergent creative thinking, as both are components of creativity and critical thinking. The Torrance Tests of Creative Thinking (TTCT; Kim, 2011) is a multi-part test that evaluates creativity by

converting fluency, flexibility, originality, and elaboration into numbered statistics for evaluation. Overall analysis of the TTCT Abstractness of Titles subtest scores shows a score decrease starting from 1998, indicating a decrease in the creativity and critical thinking processes of children (Kim, 2011).

A long standing idea in creativity research is that both convergent and divergent thinking are needed for high levels of creativity. Convergent thinking focuses on deriving one concise answer to a given problem (Benedek et al., 2013). In addition, convergent thinking stresses speed of recall, reapplying previously learned material, and retrieving stored information (Benedek et al., 2013). However, divergent thinking focuses on producing inventive solutions to more open-ended questions (Benedek et al., 2013). In divergent thinking, many possible solutions are investigated and creative connections are made between these solutions. Usually, divergent thinking occurs prior to convergent thinking, when all of the possible solutions to the open-ended question are organized (Benedek et al., 2013).

The ability to lucid dream is correlated with higher self-confidence and autonomy (Doll et al., 2009). It is also thought that those who score higher on creativity tests are more apt to lucid dream (Doll et al., 2009). It is possible that facilitating lucid dreaming may be a useful tool for controlling the content of nightmares or night terrors. Like lucid dreams, night terror episodes (characterized by significant agitation and abrupt awakening with screaming and high autonomic arousal) are more common in children. The difference between nightmares and night terrors is that in night terrors, the individual has no awareness of the content of the episode, whereas, in nightmares, there is recall

(Kotagal, 2009). A study conducted by Hunt et al. (1992) showed that the appearance of night terrors and nightmares could be associated with lower levels of imaginative abilities. It may be that enhancing creativity may facilitate lucid dreaming and that lucid dreaming may be a tool to control the frightening content of nightmares and night terrors.

Voss et al. (2012) and Hobson (2009) state that lucid dreaming is a skill that can be learned through pre-sleep autosuggestion. Autosuggestion involves the process of making suggestions to the self. This process of self-suggestion prior to falling asleep is thought to influence the process of dreaming (Frenkel, 1971). By using pre-sleep autosuggestion, the DLPfC can be reactivated and lucidity may occur (Hobson, 2009). It has been stated that people not only can learn to become lucid in dreams, but also to self-awaken or to change the course of the dream (La Berge, 1980; Hobson, 2009). Based on these results, perhaps the ability to lucid dream possibly can be used as a way to help individuals who experience severe night terrors or have other potentially beneficial therapeutic effects.

Although many people report having at least one lucid dream in their lifetime, only about 20% of the population claims to lucid dream once a month or more (La Berge, 1990; Voss et al., 2012). Voss et al. (2012) found that lucid dreams seem to be more frequent in children enrolled in secondary schools than in adults, which implies that lucid dreams may be correlated to the development of cognitive functions. It has been shown that until a certain point in the schooling system, children are open-minded and are likely to give unique responses; however, due to the conformity promoted at schools and at home, many may lose the ability to come up with inventive ideas (Kim, 2011).

In this study, we evaluated the relationship between creativity and the ability to lucid dream, driven by the hypothesis that individuals who score higher on creativity are more likely to lucid dream. After an initial evaluation of creativity, pre-sleep autosuggestion lucid dream training was provided to all participants. Participants practiced these techniques daily for one week. The relationship between this training and lucid dreaming was evaluated. Creativity also was assessed post-training to evaluate whether consciously practicing techniques designed to induce lucid dreaming episodes impacted levels of creativity. It was hypothesized that individuals who evidenced higher levels of creativity would be more likely to lucid dream, and that training in lucid dream techniques would enhance creativity in participants.

Material and Methods

Participants

Approval for this research was obtained from Randolph-Macon College's Institutional Review Board. An anonymous 2-question survey was sent electronically via student email to the undergraduate population of 1312 students. Students were asked if they have ever been aware while dreaming that they were dreaming (not awake), and if they have had a lucid within the previous three months prior to the study (Appendix 1A). 295 students completed the questionnaire. The population of the institution is 47.6% male students and 52.4% female students.

Lucid dream training took place over a period of one week. Given that the majority of the research on lucid dreaming is conducted in the laboratory setting for periods of one to three nights, it was hypothesized that a one-week period would provide sufficient time for the experimental

training. Subjects were recruited for participation through a second campus-wide email. Subjects participated in one beginning training session and one exit session lasting approximately 30 minutes each, seven days apart.

Each participant signed an informed consent and was able to discontinue the study at any time. A total of 47 participants (2 males and 45 females) between ages 18 and 22 completed the study. Each student was given an identifying number to ensure confidentiality. Only the principle investigator was able to match the participant number with participant identity.

During the initial training session, participants were taught habits that promote lucid dreaming (Nieder, 2011, Appendix 1B). Participants were asked to practice self-suggestion, including pinching one's self upon entering a doorway. Studies have shown that by applying this technique during waking hours, subjects may become aware of when they are dreaming (Tholey, 1983). Each participant was also asked to keep a daily record of dreams for a period of seven days in a provided dream journal (Appendix 1C). The dream journals contained instructions on how to use the pre-sleep autosuggestion techniques, along with space to record any remembered details from their dreams during the previous night. Participants were informed that they could omit sensitive dream content from their dream journals if needed. In addition, participants were provided with the contact information for the Randolph-Macon counseling center as a resource to use at their discretion.

To encourage participants to practice the pre-sleep autosuggestion, a text message reminder was sent to each participant at 10 pm daily as a reminder to perform autosuggestion tasks and to use the designated dream journals. In order to control for differing lengths of sleep,

participants were advised to only record dreams from long sleep cycles (i.e. full nights of, on average, 7-8 hours of sleep). After seven days, subjects were asked to turn in their dream journals. An incomplete journal resulted in complete exclusion of that participant's data.

Pre-Sleep Autosuggestion Training

During the beginning training session, participants were informed about the purpose of the study and provided with information about how to induce lucid dreams with pre-sleep autosuggestion during REM sleep. A dream and sleep related questionnaire (including one suggestibility question adapted from Voss et al., 2012) was administered during this study entry session. One student responded affirmatively to a question that indicated suggestibility—"Do you often dream of blue squares?"—resulting in exclusion of that student's data.

Assessment of Creativity

A creativity test was administered at both the beginning and end training sessions (Appendix 1D). During both sessions, the participants took a divergent and convergent creativity test to assess the two main areas of creativity. Accuracy is considered when scoring convergent creative thinking tests, whereas fluency and originality are captured in divergent creative thinking tests (Benedek et al., 2013).

The Remote Association Task (RAT) was used as a measure of convergent creativity, defined as the ability for a person to come up with a single well thought out solution to a problem. Three words were provided, and participants were instructed to name a word that connected all three words together to determine their accuracy. Different versions of the RAT were used during the initial and final assessment. Divergent creativity, defined as the ability to

produce multiple solutions to a single open-ended problem that has no right or wrong solutions, was measured by asking participants to describe all the uses for a brick (entrance assessment), and naming objects with wheels (exit assessment) (Gonen-Yaacovi et al., 2013).

Data Analysis

The number of lucid dreams experienced by each subject over the 7-day period was calculated for each participant. Creativity scores on convergent and divergent measures were analyzed to examine any change in creativity before and after a week of pre-sleep autosuggestion (Appendix 1E). A t-test was then conducted between total creativity and number of lucid dreams per each creativity group.

Results

School-wide Survey

Our school-wide survey found that nearly 75% of students who responded had experienced a lucid dream at least once (221 of 295 respondents). Our survey also found that 59% of respondents had experienced a lucid dream within the past 3 months (173 of 293 respondents).

The sleep questionnaire administered during the entrance session found that 73.9% of study participants were able to lucid dream at any time before the study began, which mirrors the overall percentage of lucid dreamers we found in the general Randolph-Macon College population with our survey.

Creativity Study

Journals were read to detect lucid dreams, defined as dreams in which the participant stated an awareness of dreaming or an ability to change elements of the dream. One participant's lucid dream account (taken from his dream journal)

described a never-ending staircase that he climbed, eliminating dangerous things from each level. The dreamer stated that he was aware he was dreaming and was able to influence the course of events in his dream.

We found no initial overall, divergent or convergent creativity differences between lucid and non-lucid participants. T-test comparisons between the two groups showed no significant difference for overall creativity scores ($p = 0.40$) (Figure 1a), divergent creative scores ($p = 0.26$) (Figure 1b) or convergent creative test scores ($p = 0.38$) (Figure 1c).

Pre-sleep Autosuggestion

To assess the impact of pre-sleep autosuggestion lucid dream training on creativity, a dependent t-test was performed to measure any change in creative performance pre- and post-study for both lucid and non-lucid dreamers. Comparison by t-test showed that training did not significantly alter creativity scores on measures of overall creativity ($p = 0.38$) (Figure 2a), convergent creativity ($p = 0.40$) (Figure 2b), or divergent creativity ($p = 0.30$) (Figure 2c).

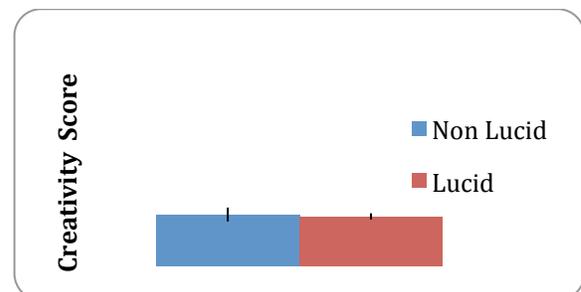


Figure 1a. The overall average creativity scores of lucid and non-lucid dreamers were calculated, and there was no significant difference between lucid and non-lucid creativity scores. (t-test, p -value= 0.40, lucid mean=0.22, lucid SEM=0.01, non-lucid mean=0.23, non-lucid SEM=0.03; $n=34$ for lucid dreamers and $n=12$ for non-lucid dreamers).

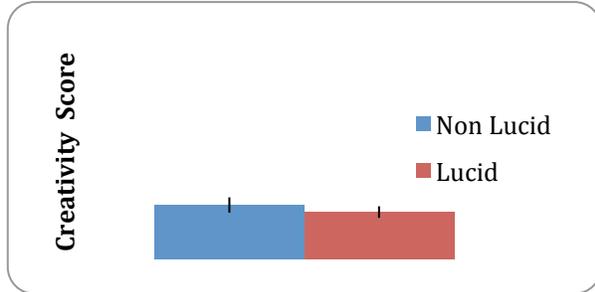


Figure 1b. The average divergent creativity scores were determined for lucid and non-lucid dreamers (t-test, p-value= 0.26, lucid mean=0.21, lucid SEM=0.03, non-lucid mean=0.24, non-lucid SEM=0.03; n=34 for lucid dreamers and n=12 for non-lucid dreamers).

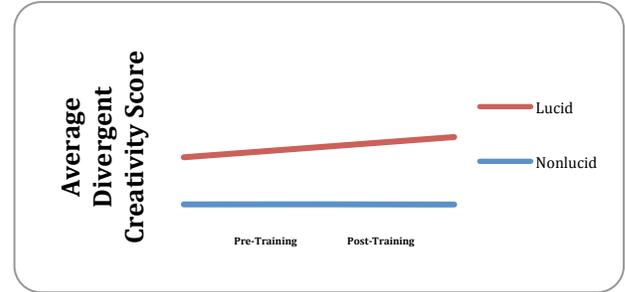


Figure 2b. The difference between divergent creativity scores between lucid and non-lucid dreamers before and after sleep autosuggestion training (t-test, p-value= 0.40; n=34 for lucid dreamers and n=12 for non-lucid dreamers).

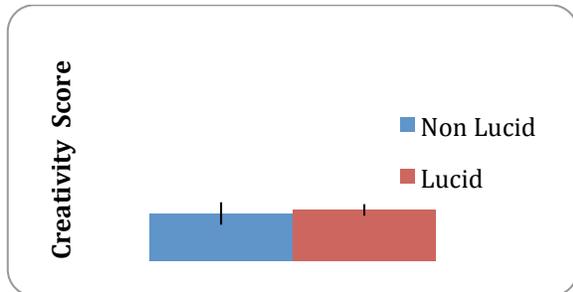


Figure 1c. The average convergent creativity scores were determined for lucid and non-lucid dreamers (t-test, p-value= 0.38, lucid mean=0.23, lucid SEM=0.03, non-lucid mean=0.22, non-lucid SEM=0.05; n=34 for lucid dreamers and n=12 for non-lucid dreamers).

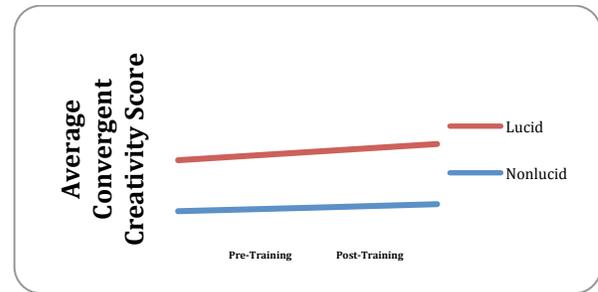


Figure 2c. The difference between convergent creativity scores between lucid and non-lucid dreamers. (t-test, p-value= 0.30; n=34 for lucid dreamers and n=12 for non-lucid dreamers).

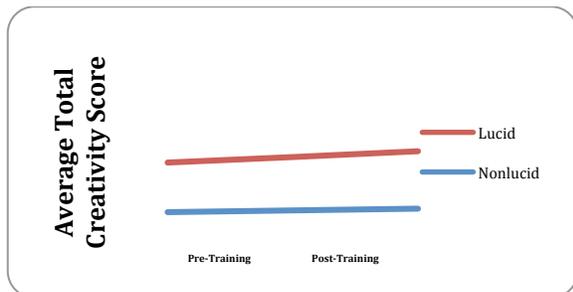


Figure 2a. The difference between overall creativity scores between lucid and non-lucid dreamers before and after sleep autosuggestion training (t-test, p-value= 0.38; n=34 for lucid dreamers and n=12 for non-lucid dreamers).

Discussion

The findings of this study did not show a relationship between creativity and the ability to lucid dream. One participant was able to effectively learn to lucid dream by the end of the study despite only using auto-suggestive techniques for a very brief span of time. However, the experimental design was an observational study of the characteristics of lucid dreams and did not include an intervention group. Hence, a conclusion cannot be made from the one participant that demonstrated an acquired ability to lucid dream.

Nearly 75% of surveyed undergraduate students reported at least one lucid dream in their lifetime (293 respondents out of a total undergraduate population of 1312). The subsequent finding

that 73.9% of our creativity study participants had previously experienced a lucid dream at some point reinforces this number. Our results also show that 59% of respondents are current lucid dreamers, meaning that within the last 3 months, they have had been aware that a dream is not actually reality. At 59%, the reported number of lucid dreamers in our undergraduate population surveyed is higher than previous research on adults detected—a study in a Japanese undergraduate population showed a lifetime lucid dream rate of 47% (Erlacher et al., 2012), while a study in German adults found a rate of 51% (Schredl and Erlacher, 2011).

Our survey results possibly reflected only those who dream more in general and thus were more inclined to respond to the voluntary survey. But even if we assume that all the other non-respondents in our college population are not currently lucid dreamers, the percentage of lucid dreamers would still be 13.3% (173 out of a student population of 1312). The higher number of reported lucid dreamers reported in this study may also be due to the relatively young age (approximately 18 to 22) of the undergraduate population surveyed.

Lucid dream studies in children are scarce, and our study uses participants who are neurologically on the edge of moving into adulthood. Published studies have reported an inverse relationship between age and lucid dream status, but even so, our numbers are much higher than previous studies, including 51.9% of children aged 6-19 (Voss et al. 2012).

A British study found that lucid dreams occur in about 45% of 10-14 year olds (Schredl et al., 2012). In a study of 694 children in Germany, 58% of 6-year-olds reported having lucid dreams, but the frequency of lucid dreams declined as age increased in their population—only 18% of 16-year-olds and 7.1% of 19-year-olds

reported frequent lucid dreams (Voss et al., 2012).

Indeed, age is a factor in both the ability to be highly creativity and in the ability to lucid dream. Blagrove's (2000) study looking at locus of control and the ability to lucid dream (as well as creativity) found lucid dreamers have a higher need for cognition and self-assessed creativity than non-lucid dreamers; they attributed these aspects to cognitive flexibility. Creative people may not be more likely lucid dream, but individuals who believe they have more control over their life may also perceive they have control of their dreams therefore, individuals who believe that they are creative may be more effective lucid dreamers, despite their actual creativity levels.

Conclusions from this study are hampered by the fact that all participants were taught to use autosuggestion to lucid dream, and the fact that the study had a relatively low N number and lost participants throughout the experiment. In addition, the participants were allowed to record data on their own time and were trusted to be truthful about their experiences. Despite the steps taken to ensure dream journal anonymity, the intimate nature of the subject matter may have resulted in unreliable dream reporting.

No conclusions can be made for the hypothesis that the ability to lucid dream can be effectively learned within a short time frame (La Berge et al., 1990). It is possible that there is a correlation between age and the effectiveness of pre-sleep autosuggestion on lucid dream status. Future studies could examine the link between age and the ability to learn to lucid dream, hypothesizing younger individuals would be more easily trained to lucid dream.

Though this study shows no supported correlation between creativity and the ability to lucid dream, this research may allow for

the testing of other cognitive traits and functions that could potentially assist in the ability to lucid dream, such as the effectiveness of the chosen pre-sleep autosuggestion techniques chosen. Fully utilizing the possibilities lucid dreams offer would likely take an extended period of training and strict training regiments, a more controlled sleep environment, as well as a training program for participants. Further and more controlled research on lucid dreams may provide additional information on the subjectivity of consciousness while awake and asleep.

Appendix 1

A. Questionnaire inquiring about sleep/dream habits, and a suggestibility test (based on Voss et al. 2012).

Sleep and Lucid Dreaming Study

Cell phone number for text messages: _____

Circle your gender: Male Female How old are you? _____

- 1) When do you usually turn out the lights at night? _____
- 2) How long does it take you to fall asleep? _____
- 3) When do you get up in the morning? _____
- 4) Do you take naps and if yes, how often? _____
- 5) Can you recall your dreams and if so, how often? (Circle one)
 - Almost every morning
 - Often
 - Sometimes
 - Very seldom
 - Never
- 6) Have you ever thought – while the dream was going on – “this is only a dream, it’s not really happening” (Circle one)
 - Yes
 - No
- 7) How often does it happen now that you notice that the dream is not for real while it goes on? (Circle one)
 - Almost every night
 - Often
 - Sometimes
 - Very seldom
 - Currently not at all
- 8) When was the last time you had a lucid dream? _____
- 9) Do you remember how old you were when you had your first lucid dream? _____
- 10) Can you usually change or control what happens in such a dream? (Circle one)
 - Yes
 - No
- 11) Were you lucid last night? (Circle one)
 - Yes
 - No
- 12) Do you sometimes dream of blue squares? (Circle one)
 - Yes
 - No

B. Lucid dreaming awareness protocol instructions (based on Neider et al., 2011).

1. I will give you a dream journal in which to write all your dreams for the next 7 days. Keep the journal and a pen within reach of your bed, perhaps on a night table or under your pillow. Every time you wake up from sleep, even in the middle of the night, write down everything that you dreamed as best as you can remember. Sometimes it is difficult to remember things in the beginning but it will get easier. Don't wait to write your dreams later as this does not work well.
2. Try to go to bed at the same time each night (within an hour). Make sure you have 8 hours to sleep each night or more. So if you have to wake up at 6:45am, make sure you are in bed by 10:45pm.
3. When you lie down to sleep (both the first time and each time after you wake up at night), spend a minute or two thinking about these things, telling them to yourself:

I am going to remember all of my dreams that I dream tonight

When I dream, I will know that I am dreaming

When I dream, I will be in control of my dreams, able to do what I want to

After I dream, I will wake up and write my dreams in my dream journal
4. Don't forget to write all of your dreams down as soon as you wake up and include descriptions of being aware that you were dreaming and/or being in control of dream if that happened.

C. Sample page from the dream journal

Did you dream last night?
Yes ___ No ___

Were you aware you were dreaming?
Yes ___ No ___

Were you able to influence the course of events in your dream?
Yes ___ No ___

If so, please provide as much detail of your dream as possible.

D. Introductory session creativity test: Part I tests convergent creativity, while Part II tests divergent creativity.

Session I Questionnaire ID number: _____

Part I
Instructions: Look at the three words and find a fourth word that is related to all three.

Falling Actor Dust _____

Bass Complex Sleep _____

Thread Pine Pain _____

Cloth Sad Out _____

Puss Tart Spoiled _____

Athletes Web Rabbit _____

Big Leaf Shade _____

Hall Car Swimming _____

Stick Light Birthday _____

Sore Shoulder Sweat _____

Part II
Name all the uses for a brick:

E. Exit session creativity test: Part I tests convergent creativity, while Part II tests divergent creativity.

Session 2 Questionnaire ID number: _____

Part I

Instructions: Look at the three words and find a fourth word that is related to all three.

Rock Times Steel _____

Blood Music Cheese _____

Magic Plush Floor _____

Cotton Bathtub Tonic _____

Jump Kill Bliss _____

Stop Petty Sneak _____

Measure Desk Scotch _____

Ink Herring Neck _____

Cherry Time Smell _____

Snack Line Birthday _____

Part II

Name as many things with wheels that you can:

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