The Scientificity of Lucid Dream Research - A Theoretical and Empirical Approach

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Abstract

Before lucid dreaming (LD, dreaming while being consciously aware of the dream state) has become an established research field, it was associated with parapsychology. The respective science-theoretical and historical backgrounds are discussed in a theoretical part and applied to the questions (1) whether LD research can be stated scientific and (2) why LD was longtime considered parapsychological. A change of perspective has happened because dream theory was based on the assumption that dreams are purely unconscious. Given the result that the phenomenon is nowadays accepted within the scientific sphere, the view of the population is examined in a second part, by means of an online survey. Main goals were spread, reception, and evaluation of LD with respect to the phenomenon as such and the scientificity of LD research. A sample of 215 participants, of which 65% had a LD at least once, completed the survey. The general attitude towards both, the phenomenon and the research, is surprisingly positive. Another 55 subjects from a LD online forum were recruited. Statistical comparisons of evaluation of LD by forum members and broad population reveal significant results. Data was additionally analysed regarding the characteristics frequency of LD, scientific activity, gender and age. Congruent with the theoretical background, results suggest that the public has a very positive opinion on LD and the scientificity of LD research, but that LD is still not a widely known phenomenon. Overall, results imply that LD appliance, e.g. in psychotherapy, can be reinforced in view of the very positive attitude of the population.

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Declaration of Authorship

I hereby certify that this thesis has been composed by me and is based on my own work, unless stated otherwise. No other person's work has been used without due acknowledgement in this thesis. All references and verbatim extracts have been quoted, and all sources of information, including graphs and data sets, have been specifically acknowledged.

Contents

1 Introduction

A lucid dream (LD) is a dream in which the dreaming person knows that he or she is dreaming. This essay is about the public perception of this phenomenon and its investigation with respect to scientificity. Lucid dreaming is one exemplary psychological occurrence that has not always been part of the well known abilities of the human psyche. The topic has longtime been considered esoteric or parapsychological and was not scientifically acknowledged. But today, LD is content of modern science: there are scientific institutions that dedicate themselves to lucid dreams and are appreciated and supported. But who decides whether a topic is scientific or not? What does scientificity mean and what distinguishes it from non-scientificity? Looking at the history of lucid dream research one can see what was necessary for the topic to be scientifically acknowledged.

Lucid dreaming is a prime example for the fact that a topic of research receives no scientific acceptance until there is evidence, which means verifying through measurement in this context. There have been uncountable reports, but that did not convince dream researchers. LD was considered esoteric or mistaken until LaBerge proved the phenomenon existent by measurement. This huge change happened very late: Still in 1975 LD seemed so strange to dream researchers that they did not pay any attention (LaBerge, 1987, p.76). At this point the question arises why the researchers react to something strange with ignorance instead of testing. We believe that the opponents ignored it, because it did not fit into their view and maybe they even knew that it would challenge the dream theories. Because LD has longtime been connected to parapsychology, we wanted to know how far that was justified and how it is seen nowadays.

In a theoretical part we examine the border between scientificity and non-scientificity, starting with terminological and historical aspects. From a science-theoretical point of view we focus on an area of research that is interpreted and investigated from different perspectives: the parapsychology. We discuss different views of scientificity and discuss whether LD, which is an exemplary phenomenon that is examined and perceived miscellaneously, is a parapsychological phenomenon or not. After giving the theoretical background about conflicts of paradigms we will point out that these processes can be applied to lucid dream research. In the second part of the thesis we conduct a study on the scientificity of LD by means of an online survey. It is to be found out how established the phenomenon is among the population

and what kind of views are present and predominate within the population with regards to scientificity.

2 Theoretical approach: Phenomena at the Borders of Scientificity

The philosophy of science is a tremendous domain, difficult to grasp and impossible to get into a nutshell. Within the scope of this thesis, we tried to single out the relevant themes for our aim, which is the subsumption of lucid dream research in the science-theoretical context. This theoretical approach includes a general part about the borders of scientificity, examining historical, social and terminological aspects and a part about lucid dream research, including, to some extend, the application of the previously examined theory of science.

2.1 Defining Terms

When asking the question how scientifically a phenomenon is apprehended, it must first be clarified what scientificity means. Statements about scientificity cannot be separated into true and wrong because there are no universal and clear-cut definitions. There are numerous different apprehensions of the term. The questions how to distinguish science from non-science has a name: The demarcation problem. This problem is discussed by theoreticians of science. The most common solution to it is formulated by Karl Popper, this will be explained in section 2.3. Because lucid dream research was longtime seen as parapsychological, we wanted to know whether research can be classified as scientific, parascientific or pseudoscientific. Are these categories mutually exclusive? The three cannot be compared easily. According to Eberlein (1991) the term pseudoscience stands for investigations that are considered scientific by the executors, but rejected as unscientific by authorized scientists. The prefix *pseudo* refers to *false* or *pretended*[1]. Accordingly, *pseudo* describes the low credibility of research. Therefore pseudoscience tends towards non-science. For the prefix *para* it is more complicated: The Greek prefix para stands for "along, next to, with, beyond, against"[2] and equally

[1] Oxford Advanced Learner's Dictionary, Oxford University Press, 2005
[2] Duden, das Fremdwörterbuch, 7. Auflage, Mannheim 2001

wide are the interpretations of the term, reaching from unconventional science, pseudoscience to science of occult phenomena[3]. It is not clear whether *para* describes the content or the manner of research. If the content is meant, the term parascience refers to the science of paranormal occurrences:

> *If we designate something whose scope goes beyond or alongside normal experience with -para by analogy with words like paragenesis, paragoge, paragraph, paracope, paracusis, paralogism, paranois, parergon, etc., then we can perhaps refer to those phenomena which do not figure in the normal functioning of the pysche as parapsychic, and to the science which concerns itself with these phenomena as 'parapsychology'.* (Wolffram, 2009, p.36)

But if the manner of research is meant, the term parascience would refer to some approach beside science. This would point into the direction of pseudoscience. The different interpretations render unclear whether parascience is a subset of science (such as natural sciences or social science), or an outlying set (like pseudoscience and hence no science). Therefore the terms pseudoscience and parascience cannot be mutually exclusive. Parascience, the investigation of the paranormal, can be scientific or pseudoscientific, dependent on the applied methods (see section 2.4). In this thesis we use the term parapsychology for the scientific exploration of paranormal abilities (the latter are hereafter called PSI, for a more precise definition of PSI, see section 2.8.5).

Several other terms are mistakable as well. *Esoteric* is a collective term without clear definitions. It allows various interpretations reaching from religious and metaphysical to irrational or mystic. From a scientific point of view it has a negative connotation. In recent literature *esoteric* is often contrasted with *scientific* (Coghill, 2014; Alyushin, 2014; Herbst, 2014).
Thee following is another case of vagueness: There are different demands on the demarcation criterion. This makes it more complicated (like in the case

[3](Bauer, 1991) on Mauskopf, S. H. (ed.): *The Reception of unconventional science.* Boulder 1979; Alcock, J.: *Parapsychology: Science or Magic?* Elmsford (N.Y.), 1981; Bunge, M.:Demarcating Science from Pseusoscience, *Fundamenta scientiae 3* (1982) S. 369-388 and Driesch, H.: *Parapsychologie. Die Wissenschaft von den "okkulten" Erscheinungen.* 3. Auflage Zürich 1952.
Secondary references will be mentioned in footnotes throughout this thesis and will not appear in the reference list again, except if used again as primary reference.

of the word *para*). The formulation "empirical science contrasted to mathematics, logic, but also metaphysical systems" or "the criterion shall serve to identify pseudoscientific or metaphysical theories as such and to exclude them from the realm of empirical scientific knowledge", both by the same author (Popper, 1998, p.43), differ. In the first phrase mathematics, logic (and presumably philosophy as it partially deals with metaphysics) are excluded, whereas in the second pseudosciences are excluded. Though Popper might not have meant that mathematics and logic are pseudosciences, his definitions differ and are therefore vague and to some extent unintelligible. According to Kromney (2009) the demarcation criterion of empirical science distinguishes empirical scientific theories from other scientific and miscellaneous theories (Kromrey, 2009, p.31). At this point it should be clarified which disciplines come within the limits of empirical science, but this depends on the source. In the Oxford dictionary the words empirical and science have almost the same description. Elsewhere, natural sciences as well as social and cultural sciences count as empirical sciences, but mathematics and philosophy do not[4].

2.2 Different Ways of Research

In the modern empirical science the methods of data analysis coincide in many scientific disciplines: Statistical testing of hypotheses by means of significance tests is widely established. But the methods for data acquisition differ across the scientific disciplines: Psychology and other social sciences rely for the most part on reports by subjects. Natural sciences use instruments or machines as measurement devices (Hackmann, 1989). Mathematical proofs do not rely on real experiments, but on logic (Bortz & Döring, 2009, p.20). Neuroscientific experiments often use a combination of measurable data and reports of subjective perception. The question arises whether or not it is scientific to rely on reports by subjects instead of measured data. In other words, is it more reliable to use measured data than reported data? Since reported data can be biased by participants answering in a way they believe the experimenters to expected or by answering in a somehow unreliable way, one could assume that reports are less objectively observable and less provable than measured data, however, the method is scientifically accepted: In empirical social sciences the survey is the most frequently applied

[4]Gabler Wirtschaftslexikon, Springer Gabler Verlag

method for data collection followed by systematic observation of action and content analysis mostly of texts (Kromrey, 2009, p.301ff). But in the case of extraordinary experiences, this seems not to hold any more: In this case reports do not even rudimentally suffice. Therefore we have to differentiate between research in new topics and research in already established topics.

2.3 Scientificity according to Popper

A generally established criterion for scientificity was coined by Karl Popper in the 1970s. When Popper was concerned with scientificity, the current principle of demarcation between science and non-science was verification. Only sentences for which one could state what must be the case in order for the sentence to be true, were regarded as scientific. Verification was given through induction: universally valid sentences were drawn from observations. But this strategy was questioned by Popper. In *Die beiden Grundprobleme der Erkenntnistheorie* (*The Two Fundamental Problems of the Theory of Knowledge*) he argues against the induction principle. Popper agrees with David Hume who stated the induction problem: the question whether it is possible to verify universal sentences based on a finite set of observations[5]. Popper, like Hume, denies this possibility: with a finite set of observations, statements about infinitely many cases cannot be justified. To solve the induction problem, Popper introduced the criterion of falsifiability (instead of verifiability). Scientific theories (universal sentences) can only be disprovable, but not provable, because there could be future instances of disproof. This school of thought is called critical rationalism. For a theory to be scientific it must be falsifiable. According to Popper, scientific progress appears via this process: There is a problem, solved by a temporary theory. By eliminating mistakes a new problem and a new temporary theory arise (Schröder, 2006, p.26ff).

2.4 Critique on Popper and Current Views

Thomas Kuhn has a quite different view on scientific progress: He differentiates between two types of phases in the development of science. One type is the process described by popper. Kuhn calls this process scientific revolutions (see also Section 2.5.). The second type of phases is what happens between

[5]Schröder (2006, p.26), refering to Hume (1739)

two scientific revolutions: normal science where scientists work within one paradigm without questioning the current paradigm. Kuhn believes that falsification in Popper's sense, does not exist (Kuhn, 1997, p.157). New data or experience that disagrees with the current theory does not immediately lead to falsification of the theory because no theory agrees with every finding at every time. Disagreeing findings and theories bring forward normal science. Not until a new theory has triumphed against another, one can speak of falsification, but as well call it verification. Kuhn says a verification process is just asking which one of two competing theories fits better to the findings. According to Walach, Loucado & Römer (2014), Kuhn has proved Popper's way of reasoning insufficient. They further argue that a sucessfull scientific theory must consist of three components: (1) a good theoretical model, (2) a repeated and replicable observation and (3) a "communicative consensus within the scientific discourse and among those who wield the wands of power therein" (Walach et al., 2014).

Today, falsification and repeatability are still seen as the classical criteria of demarcation (Wolffram, 2009, p.18). Döring (2015) claims that a project can be called scientific if four standards of scientificity are fulfilled:

1. The research question must be scientific
2. The process of research must be scientific (the methodology must be approved)
3. Ethic requirements must be fulfilled and
4. The research project must be well documented for potential duplication.

Concerning the first standard, the scientificity of the research question, the author argues, the question should be empirically testable and explicable within the current state of knowledge. It should concern a topic for which there exists already assured knowledge (otherwise it would be parascientific)[6] and it should be clearly structured and circumscribed (otherwise it would be pseudoscientific) (Döring, 2015, p.6). Elsewhere, the author has formulated again four requirements that a scientific hypothesis must fulfill:

[6]Note of the author: At this point the question arises how new research content can be scientifically investigated, if the latter requires existing knowledge. This excludes a priori the possibility to examine a new topic.

1. It must refer to real circumstances that can be empirically tested[7].
2. It must be a universal claim, going beyond a single case.
3. It must have, at least implicitly, a formal structure like "if..., then...".
4. It must be potentially falsifiable. There must be conceivable events that contradict the hypothesis (Bortz & Döring, 2009).

Hence, falsifiability is still mentioned in up-to-date literature (2015). But it is just a piece of a bigger puzzle. In the late 1970s science theorists found out that the classical criteria were not reliable ways of distinguishing science from pseudo-science, but that demarcation "was a dynamic process that altered depending on historical and cultural exigencies."[8]
Popper's critical rationalism (by Popper) is indeed the most common scientific frame model (Bortz & Döring, 2009, p.22). Independent thereof, hypotheses testing (predictions by scientific hypotheses and nullhypotheses and subsequent control of hypotheses by significance tests) became established. These two schools are compatible: According to Bortz et al. (2009), Popper's falsification rule is compatible with the definition of a level of significance when taking into account that "data do not tell whether a hypothesis is true, but form the foundation for a decision for or against a hypothesis. Thereby the possibility of being wrong should be minimized, but can never entirely be ruled out" (Bortz & Döring, 2009, p.22f).

One can conclude here that falsification and empiricism are still seen as an important request but not the only criterion for demarcating science from non-science. Scientificity has no clear definition. It is a construction that depends on many variables. What counts as a scientific fact depends on social and cultural aspects and is to some extend determined by "powerful

[7]Another note of the author: The formulation is slightly vague and does not lead to a clear criterion, as no one can state what exactly is a real circumstance. Theoretically speaking, this renders impossible to find scientific evidence for something that has not yet been stated real. Science sets its own boundaries including only measurable substance. These boundaries seem unchallengeable behind the background of the current materialistic world view.

[8]Wolffram (2009, p.18) on H.M. Collins and T.J. Pinch, Frames of Meaning: the social construction of extraordinary science (London, Routeledge, 1982)

science editors of journals, newspapers and TV magazines, funding agencies, and political decisionmakers"[9].

2.5 Changing Paradigms and Perspectives

It often happened in the history of science that something, that was at first assumed to be false, was recognized as true later on. This happens for various reasons, such as developing new techniques to prove a theory or changing the paradigms of scientificity. In *The Structure of scientific revolutions* Kuhn describes the process of changing of scientific paradigms: A paradigm is, after a crisis, replaced by a new paradigm. As a typical case he mentions the Copernican revolution: the change from the Ptolemean System (geocentric universe) to the Copernican system (heliocentric universe). This example depicts a huge change in the world view, but changes of paradigms do also happen in little. A weaker and younger example for a change of paradigms is the view on string theory. It is a theory that, after 40 years, is still highly influential within the elementary physics without ever being completely formulated or empirically proven (Dawid, 2008, p.399ff). The validity is highly trusted, but quantitative calculations seem to be beyond reach. Dawid (2008) argues as follows: Most theories have been discarded after 10 years if its validity could not be proven. As a consequence of this rule, less resources should be put into investigations of string theory, but string theorists have very much confidence which keeps them from discarding the theory. Thus, it seems, proponents and opponents of string theory have different paradigms of scientificity (Dawid, 2008).

The procedure of discarding a theory, if it could not be proven after a certain time, was criticized by Feyerabend, who argued that when asking after which period of time a theory will be discarded, every period of time would be arbitrary (and this would be no rational decision). Therefore one should not definitely discard a theory, but keep it in view as potential explanation

[9]Walach et al. (2014) about Emerson, G. B., Warme, W. J., Wolf, F. M., Heckman, J. D., Brand, R. A. & Leopold, S. S. (2010). Testing for the presence of positive-outcome bias in peer review. *Archives of Internal Medicine,170,1934-1939*; Henderson, M. (2010). End of the peer review show. *British Medical Journal, 340,738-740*; Lee, C. J., Sugimoto, C. R., Zhang, G. & Cronin, B. (2013). Bias in peer review. *Journal of the American Society for Information Science and Technology,64,2-17*; Ritter, J.M. (2011). Impact, orthodoxy and peer review. *British Journal of Clinical Pharmacology,72,367-368.*

candidate for future phenomena[10].

The development of LD research can theoretically be understood as such a change in paradigm (or at least, the foundations for a paradigm change have been laid), because the view on dreams, formed by Freud and other psychologists was strongly renewed after LaBerge proved LD existent in 1980.

Finally it should be mentioned here that often, just a change in designation can put another complexion on the matter. For example: Professor Mischo, former director of the IGPP Freiburg (Institut für Grenzgebiete der Psychologie und Psychohygiene [Institute for Border Areas of Psychology and Psychohygiene]) investigated demoniac obsession. He found parallels between demoniac obsession and multiple personality research (Lutzius, 1989, p.248), which is legitimate scientific research in contrast to the former. This indicates that two things can differ in their scientific legitimacy even though they designate the same thing or at least share certain features.

2.6 History and Status of the Parapsychology in Germany

During the nineteenth century, science had become very materialistic and rejected phenomena that could not be quantified. Experiments in psychology were restricted to measuring physiological responses to external stimuli (Wolffram, 2009, p.14ff). Experiments on paranormal abilities, such as telepathy, somnambulism, and telekinesis were performed, but not within the acknowledged sciences. Parapsychologists attempted not only to be a legitim scientific discipline, but also to distinguish their science from less scientific disciplines like spiritualism and occultism. From both sides, opponents and proponents of psychical research and parapsychology, these disciplines are concidered to have a border status (Wolffram, 2009, p.19). 1874 was the starting point of scientific interest in the paranormal, with the publication of the journal *Psychische Studien* [*Psychical Studies*] (Wolffram, 2009, p.23). The Psychologische Gesellschaft [Psychological Society, hereafter called PG] was founded in 1886. In 1887 the physician Albert von Schrenck-Notzing presented to the PG the findings of 40 experiments on obscure phenomena, including the transference of thoughts, the transference of one of the five

[10]Schröder (2006, p.142) on Feyerabend (1981, p.148)

senses to another part of the body and the elicitation of emotional and physical responses to visual and aural stimuli in the somnambulist Lina Matzinger. (Wolffram, 2009, p.33ff). The PG took Lina Matzingers abilities as a basis for a new science, 'experimental psychology'. This new science should show the influence of the mind on the body, lead the contemporary psychology away from strict materialism and result in more understanding of the human mind. The PG insisted that this new science would

> *vouchsafe the existence of the soul, expose the moral bankruptcy and scientific paucity of the dominant materialist World view, and ensure social stability* (Wolffram, 2009, p.35).

But Du Prel and Schrenck-Notzing had very different goals and ideologies: Schrenck-Notzing wanted to get phenomena from the foreign and inexplicable domain into the official sciences. And this is what remained the goal of the PG. Du Prel on the other hand veered himself away from the PG by pursuing his "Transcendental Psychology" with the intention to disprove materialism.

Today, the parapsychology is in a bad shape. Paranormal abilities are still a taboo topic in today's society (Lucadou & Wald, 2014). Eberhard Bauer from the IGPP Freiburg points out a paradox between the public interest in the occult and the prevailing ignorance of most scientists. The IGPP is the only institute that coorperates with a university (Lucadou & Wald, 2014). One possible reason why parapsychology is in such a bad way might be that the term is not protected by patent, which means that everyone can call oneself an expert in parapsychology or parapsychologist and spread unfunded assumptions (Bauer, 1991, p.136).

> *All in all the PSI research is not quite accepted. 130 years of research, [since the foundation of the Society of Psychical research in 1882] some at high-profile university institutions, have not really brought us any further toward some acceptance by the mainstream* [...](Walach et al., 2014).

On the other hand the Parapsychological Association (PA) has been a member of the "American Association for the Advancement of Science" (AAAS) since 1969, which points to at least some acceptance. Members of the PA who are at most scientists of natural, human or social sciences work at universities and other scientific institutes and investigate paranormal phenomena

(Bauer, 1991, p.137). According to Bauer (board member of the IGPP and member of the PA), the aim of parapsychology is often misunderstood: It is not to prove PSI existent, but to find possible explanations (systematically and scientifically) for a class of human experiences that are theory-neutrally and temporarily [11] called PSI (Bauer, 1991, p.138f).

2.7 Current Areas of Parapsychological Research

2.7.1 Out-of-body Experiences

A well-known type of extraordinary experience are out-of-body experiences (OBEs). This phenomenon is discussed here because it is examined by both neurologists and esoterics and also because the phenomenon shares some commonalities with lucid dreams. The scientific and esoteric interpretations of OBEs are deeply divided. Neuroscientists try to explain the phenomenon by physical processes in the brain, whereas esoterics count on the existence of non-physical processes.

There are neurobiological models for OBEs. One scientific attempt to explain OBE was performed by Blanke et al. (2002). They found out which part of the brain can elicit OBE and stimulated this part in order to evoke an OBE. They artificially induced the experience "by focal electrical stimulation of the brain's right angular gyrus"(Blanke, Ortigue, Landis, & Seeck, 2002). When stimulating that area they first evoked complex somatosensory illusions and at stronger stimulation, an OBE occurred. From the anatomical accordance of the two phenomena they concluded, that "it is possible that the experience of dissociation of self from the body is a result of failure to integrate complex somatosensory and vestibular information."(Blanke et al., 2002).

The following describes a rather esoteric interpretation of OBEs: The terms OBE and Astral journey are sometimes used synonymously. An Astral journey describes a change from the physical into the energetic world; there is an interpretation that one can, by an Astral journey, leave the physical world and enter another level: 'energy' or 'Feinstofflichkeit', that cannot be seen by physical means (Franz, 2001). One could also use energy to explain

[11] temporarily, as there might be explanations in the future; once there is an explanation, the experience would no longer called PSI

other scientifically inexplicable phenomena like paranormal abilities, according to interpretations from an esoteric viewpoint. The Astral body is the person's immortal part, which would survive the human death as energetic body (Lutzius, 1989). For the existence of an Astral body, also called subtle body, there is no evidence apart from parapsychological reports and theoretical ideas about the texture of the psyche (Franz, 2001, p.176).

OBEs share some features with lucid dreams. In both experiences there are to some extend two instances of the percipient's body or mind. Cecilia Green even thinks they

> *must be regarded as philosophically indistinguishable from lucid dreams. In both types of experience the percipient is observing a complete and self-consistent field of perception, and recognizes at the time that he is in a state which differs from that of normal waking life* (Green, 1968).

But on the other hand there is a big philosophical difference: in contrast to LD in which the dreamer knows that the dream body is not in the real world, practitioners of astral projections report on staying in the real world, but existing in a different form, namely the energetic astral body. Apparently, Green's claim for indistinguishability works out well for the scientific interpretation of OBEs, but not for the 'energetic' interpretation of OBEs.

This example shows that a phenomenon is regarded differently from the scientific and the esoteric point of view. To come back to the demarcation problem: We cannot show that such a kind of energy does not exist, therefore the claim of its existence is not a scientific one, taking falsifiability as demarcation criterion. But even if we do not focus on falsifiability, it can not be scientific, because there is no possibility to test it empirically, since the assumption of the energetic body includes that we can not detect it with physical means.

2.7.2 Generalized Quantum Theory

An up-to-date theory which provides a theoretical background for PSI was set up by Walach et al. (2014): The Authors propose the Generalized Quantum

Theory (GQT) as a model for PSI. Their approach proposes that parapsychological phenomena are instances of nonlocal correlations. They say PSI is a fringe area because: (1) There is no accepted background theory, (2) Observations are not replicable enough and (3) There is no consensus within the scientific discourse (non of the three requirements mentioned in section 2.4. is fulfilled). To overcome the first issue, the authors developed the GQT model as a theoretical frame. From the GQT they derive generalized entanglement correlations to explain PSI phenomenology. They propose a change in presuppositions in experiments: locality, one of the presuppositions, means that the "regions in our universe that influence each other causally need to be connected by a physical signal that exchanges energy in order to make the influence real"[12]. This is incompatible with PSI because PSI effects are independent of distance and time: Telepathic effects over long distances or precognition (communication of a mind with its future state) are examples for effects independent of distance and time. A nonlocal and non-causal model was needed. A nonlocal correlation, (or *entanglement*, a phenomenon discovered by Schrödinger in 1935[13]) describes "a situation whereby elements of a quantum system remain correlated no matter how separated they are in space or in time" (Walach et al., 2014). The authors apply entanglement to PSI: They display entanglement as a consequence of complementarity between global and local observables. In quantum theory the state of a subsystem (local observable) does not determine the state of the total system (global observable) (Walach et al., 2014). In telepathy, exemplarily for PSI effects, the global observable is connectedness (the two communicating persons are somehow related) and the local observable is separation (of the two individuals). The authors recognize that although this can be proven for quantum physics, the generalized case is just an assumption.

2.8 Phenomenon of Lucid Dreaming

2.8.1 History of Lucid Dream Research

Reports on the phenomenon of lucid dreaming have been around already a long time, whereas the corresponding research field is relatively new. Aris-

[12]Walach (2014) on Reichenbach, H. (1957). *The Philosophy of Space and Time.* New York: Dover

[13]Walach (2014) on Schrödinger, E. (1935). Discussion of probability relations between separated systems. *Proceedings of the Cambridge Philosophical Society,31,555-563*

totle wrote about the conscious mind telling him that what he experienced was only a dream (LaBerge, 1987). In India the phenomenon was known in the 10th century. LaBerge refers to a tantric text about methods that allow falling asleep without losing consciousness (LaBerge, 1987, p.34). A century later, in medieval Europe, Thomas Aquinas wrote about the ability to realize that what one is seeing is a dream and to distinguish things from their picture (LaBerge, 1987, p.35). The 19th century, brought the insight that the world of dreams is the world of the unconscious and not sphere of the gods. Scientists began to use dreams to approach the unconscious. In 1867, Marquis d'Hervey de Saint-Denys reports on more than twenty years of dream research. He demonstrated that it is possible to learn to dream consciously. At that time, several skeptics argued that this kind of dreaming was not possible and had to be a phantasy (LaBerge, 1987, p.40). In Freud's *Die Traumdeutung* [*The Interpretation of Dreams*] he mentions the phenomenon but just as censorship that intervenes if a dream content is too embarrassing[14]. The first who applied the term *lucid dreams* was Frederik Willems van Eeden. According to LaBerge, he provided the first serious scientific engagement with the topic. In 1913, he presented an essay to the *Society for Psychical Research* on 352 lucid dreams collected by himself (LaBerge, 1987, p.42). In the 20th century, LD research made great progress: In the 1930s, Hans Berger succeeded in measuring human brain activity and called the recordings *Electroencephalogramm* (LaBerge, 1987, p.56). Some of Berger's colleagues considered his measurements of alpha-waves as results of a mistake, but soon the invention of EEG was accepted and science gained much more insight into the brain. In the 1950s, the alternation of REM phases and non-REM phases was discovered and the connection between dreams and REM phases was established. Dream researchers developed a psychophysiological approach: electrophysiological measurements were correlated with subjective reports so that mental conditions could be validated by objective measurements.

However, the phenomenon was still considered and mysterious. In 1936, the *Journal of Abnormal Psychology* (Note, that the title contains the word abnormal.) published the essay "Dreams in Which the Dreamer Knows He is Asleep", in which the author argued against some fellow psychologists who claimed lucid dreams were just daydreams (LaBerge, 1987, p.48). According to LaBerge, the scientific interest in lucid dreams was so small precisely

[14]Permantier (1994) on Sigmund Freud: Die Traumdeutung (1900)

because parapsychologists were concerned with it.

> *Lucid dreams got into unjustified proximity to ghosts, telepathy, flying saucers and other things that are considered superstitious nonsense by traditional science* (LaBerge, 1987, p.66).

LaBerge depicts the case of Cecilia Green's book *Lucid Dreams* (1968): He refers to her book as the most elaborate work about the available literature at that time. Further, he depicts her work as written in a purely analytical style, but with nearly no success, because Cecilia Green's main area was parapsychology. Likewise, the book *Creative Dreaming* (1975) by Patricia Garfield which she presented on the annual meeting of the APSS (Association for the Psychophysiological Study of Sleep, founded in 1960), found no appreciation by experts, only by amateurish dreamers (LaBerge, 1987, p.75). In the late 1970s, lucid dreams started to be investigated in sleep laboratories. Stephen LaBerge is known to be the first who proved the existence of lucid dream using EEG and EOG in a laboratory. Indeed LaBerge was the first who published his success, but he writes that Keith Hearne had done almost the same studies. Therefore LaBerge ascribes the fame of being the first to have successfully sent a conscious and agreed massage from the dream world to Keith Hearne (LaBerge, 1987, p.87). He showed that a lucidly dreaming person can contact an observer by means of a previously appointed sequence of eye movement. He used eye movements because the eyes are exempted from the muscle paralysis during the REM phase. LaBerge presented his work in the APSS meeting in Tokyo in 1979. But neither of the scientific journals *Science* and *Nature* wanted to publish LaBerge's study. It was not until 1981 that the study was finally published (in *Perceptual and Motor Skills*) and that doubters were convinced that LaBerge's experiments were evidence of the existence of lucid dreaming (LaBerge, 1987, p.75 ff.).

> *Lucid dreaming, which was for many scientists connected to occultism and parapsychpology, was now acknowledged part of the academic science and as such a legitimate object of investigation* (LaBerge, 1987, p.84).

2.8.2 Considerations from the Science-theoretical Point of View

Phenomena that do not fit into the current view of an acknowledged science seem to be unnoticed as long as the phenomenon cannot be explained within

the current paradigm. Paradigms, fundamental views of research, are presupposed and not questioned like a theory. Not until a paradigm-challenging finding is verified, does a conflict of paradigms arise. This is the reason why LD was ignored for so long. Consciousness in dreams did not fit into the view of dream research. Dreams were regarded as purely unconscious, there was no place for consciousness. Lucid dreaming could not be integrated into the dream theories, and therefore elicited a conflict of paradigms: a stage in which a new paradigm fights back an old paradigm and establishes itself (Permantier, 1994). But this was not possible until the phenomenon was doubtlessly verified in sleep laboratories. Only then the established psychology began to deal with the topic. Seemingly, for some of us, it is not even possible to *think* a thought that does not fit into our view of the world.

2.8.3 An Example of University Research

Sleep Communication is a method developed by Kristoffer Appel (Ph.D. at the University of Osnabrück). During a sleep communication experiment stimuli, e.g. lights and tones are presented to a dreaming person, whose brain waves are recorded using EEG. The stimulus, generated using a coding scheme (e.g. Morse code), gets incorporated into the participant's dream, which possibly leads to lucidity (if the dreamer was not already lucid). The dreamer decodes the message and answers by similar means: He/she encodes a message into a body signal, for example eye movement. In REM sleep (when most of the lucid dreams occur), muscle movement is mostly inhibited, but eye movements occur in the wake world when the dreamer moves his/her dream eyes and can be recorded and analysed using EOG . For example the dreaming person sends the eye signal *left, right, left, right, left, right* which was previously defined as *"I am lucid"* according to prior agreement with the experimenter. To declare that the subject is sleeping, EEG, EMG and EOG data are analyzed. With this method, it is possible to send messages with arbitrary content from the wake world to the sleep world and vice versa from the sleep world to the wake world, using dream incorporations, lucid dreaming, body signalling and a message coding scheme (Appel, 2013).

The approach can be stated scientific according to the standards of Döring (2015), as the four requirements are fulfilled:

- The research question is scientific (refers to a real issue: brain waves and body signals of human subjects)

- The process of research is scientific (EEG, EOG and EMG are approved methods)
- Ethic requirements are fulfilled (the study was executed in agreement with the ethics committee)
- The research project is well documented for potential duplication and future research (as it is noted down in a master's thesis)

2.8.4 An Example of Alternative Research

A current study which we use as an esoteric example of LD research is "Communication with deceased persons", conducted by Anne-Katrin Puhle at the University of Gothenburg[15]. Her study investigates the realness of deceased dream persons. She aims at finding instances where a lucidly dreaming participant receives information from a deceased person. It is about information that the dreamer could not have received otherwise, which would prove the realness of the informant, the deceased person. A classical example would be a dream of the location of an undiscoverable testament. According to Puhle, we can on the one hand never be sure that a piece of information has not already been in the memory of the dreamer without the dreamer being aware of the knowledge (this is called cryptomnesia), but on the other hand the attempt might still be worthwhile, because science is based on evidences, not proofs, anyway.

There are ongoing discussions in LD internet forums about the question whether a dream character is real or a projection of the dreamer's subconscious mind. We believe that this question is not going to be solved soon. According to the falsification criterion for scientificity, this question is not a scientific one, as it is not disprovable. But irrespective of whether it is scientific or not, communication with deceased people in lucid dreams can have useful applications, for example when somebody wants to tell a deceased person something, e.g. an apology. Even though the dream character may not be real, the conscious communication might still bring peace to a worried mind.

[15]Information on her ongoing studies are based on personal email contact with the author.

2.8.5 Is LD Research Scientific?

Today, LD, is still seen as an extraordinary or exceptional mental state (Voss, Frenzel, Koppehele-Gossel, & Hobson, 2012). Why is the association with parapsychology so fatal? LD is a state of consciousness that many people never experience, or have never even heard of. It is a phenomenon beside the normal, widely known processes of the human psyche. Why should it not be investigated by parapsychological researchers? We believe the problem is that parapsychology is associated with supernatural, for some people also scary occurrences. We think it is theoretically unproblematic[16] to call it parapsychological (interpretng the prefix para as refering to content, not to the way of research), only pseudopsychological would be inapplicable.
Can LD research be understood as parapsychology? Again, it depends on the interpretation of the term: If we interpret parapsychology as "already/still partly represented at universities or content of research and/or teaching performed by few university employees"(Eberlein, 1991, p.8), this interpretation includes LD research, as it is performed at universities, but only by few employees. But if we interpret parapsychology as PSI research and PSI as "interactions between an organism and its surrounding (or between two organisms) that are suggestive of an effect that seems to reach beyond our current understanding of the scope and function of sensorimotor channels" (Bauer, 1991, p.138), then LD research is not included, because LD does not fall under the definition of PSI, as it deals with interactions between an organism and itself. LD research does therefore not fall under the definition of PSI research. But we have do divide LD research here: dream sharing (the idea that two people can meet in a dream dreamed of both people simultaneously), or the communication with deceased people (described in the section above) would be an interaction between two organisms, not explicable with our current understanding of scope and function of sensorimotor channels, and would therefore fall under the mentioned PSI definition. But sleep communication (as mentioned in section 2.8.3.) does not fall under PSI, as the transmission of auditory and visual stimuli between two organisms does not reach beyond our current understanding of sensorimotor channels. Therefore we can conclude that there is normal psychological, as well as parapsychological LD research, and both parts can be scientific (again, interpreting parapsychology as the scientific exploration of PSI). In other words, we can conclude

[16]but in view of the negative connotation of *parapsychology* we do not actually use the term.

that LD is no PSI effect, but certain ideas using LD, such as mentioned in section 2.8.4. include PSI effects.

3 Empirical approach: The Scientificity of Lucid Dream Research - a Sociocultural Study

3.1 Goal of the Study

We have shown in the theoretical part of this thesis that LD is now accepted in the scientific realm, but still conceived as a special or altered state of consciousness. The question was then: How is LD conceived by the general public? The goal of the study was to find out whether the opinion of the population reflects what the scientific scene proposes, namely the acceptance of lucid dream research. We aimed to collect information about the public state of knowledge and experience with lucid dreaming. It was to be investigated how the phenomenon is valued with respect to its eventual paranormal features. Also, the research of lucid dreaming was to be assessed. We aimed to find possible correlations between the background of the participants (like scientific activity) and their assessment of the scientificity. Further, we aimed to draw a boundary within the phenomenon of lucid dreaming, which shows what the public believes.

Concretely, there were four main aims to be investigated:

- How well known is lucid dreaming and wherefrom?
- How is the phenomenon estimated, rather normal psychological or parapsychological?
- How is the research of lucid dreaming estimated, rather scientific or unscientific?
- Which properties of lucid dreaming are believed to exist; in which aspects do people believe and which aspects are rather rejected by the public?

3.2 Material and Methods

3.2.1 The Survey

We conducted an online questionnaire called "Wissenschaftlichkeit von Klarträumen" [The scientificity of lucid dreams]. The survey was arranged using the online tool "LimeSurvey" (free and open source). The IKW (Institut für Kognitionswissenschaft [Institute of Cognitive Science]) offers a Server for students, called "Cognitive Science LimeSurvey Server". A duplicate of the survey was titled "Wissenschaftlichkeit von Klarträumen (2)" and carried out with a group of lucid dreaming forum members. This left us with two identical studies: (1) with public access without any restrictions and (2) with visitors of lucid dreaming internet forums. We did this to find out whether skilled lucid dreamers have a different view on what is possible. Analysis of only the first study allowed us to draw inferences about the spread and the opinion of lucid dreaming in the general public.

Propagation
For (1) the survey was spread through the internet platform Facebook, via email to friends and their families and colleagues, and via asking people on the street in the city of Osnabrück. In order to get unbiased results, we excluded students from the Cognitive Science program from participation, because they might have heard of the topic in class[17]. For (2) we put the survey online on three web pages:
1. www.klartraumforum.de
2. www.kt-forum.de and
3. www.facebook.com/Klartraumforum[18].

The Questions
The survey contained 28 questions. The whole questionnaire in german language can be found in the appendix. For each of the four goals there were several questions in the survey. Questions targeting goal 1 were: Have you already heard of lucid dreaming?(q1); If yes, where or how have you heard of lucid dreaming?(q2); Did you ever have a lucid dream?(q3); If yes, how

[17]Nevertheless, we cannot exclude that we mistakenly included cognitive science students, as the participants did not have to specify their study program

[18]Unfortunately we can not exclude the possibility that beneath group (1) are also some forum members, because we did not ask specifically "Are you a member of a lucid dreaming internet forum?".

often do you have lucid dreams?(q4); If no, would you like to have lucid dreams?(q5); What are your answers based on: gut feeling, scientific literature, esoteric literature, other literature, reports or other?(q9)

Questions targeting goal 2 were: Imagine you were in a lucid dream, how unusual (normal, taken for granted, remarkable) would you consider the situation?(q6); Regard the following words and rate how good they fit to the phenomenon of lucid dreaming: usual, morbid, desirable, verifiable, nice, abstruse, insane, insightful, bad, supernatural, meaningful, unnormal, esoteric, measurable, good, dangerous(q7).
The subjects also had to compare lucid dreaming to other mental phenomena (hypnosis, telepathy, meditation, non-lucid dreaming, spook, clairvoyance)(q10).

Aiming at answering question group 3 the word rating task was done again for the research of lucid dreams with 14 adjectives: reasonable, worthwhile, stupid, weird, scientific, unnecessary, good, esoteric, important, abstruse, unscientific, objectively provable, relevant, bad (q8) (Note the difference between the two word rating tasks: the first one is about the phenomenon as such and the second one about the research of the phenomenon.)

To answer question group 4, that means, to draw a border within the range of properties and applications of lucid dreaming, we presented mini stories to the participants, which they had to estimate with respect to (a) possibility and (b) provability. There were eleven mini stories to be rated:
The first mini story asked, whether a lucid dream is possible at all(q11). The next was, whether the occurrence of a lucid dream can be proven in a sleep laboratory(q12). The next four questions dealed with sleep communication: It was asked whether a lucidly dreaming person can communicate with a wake observer(q13). Following, this communication was specified by explaining how the sleeper can move his eyes and thereby send a signal to the waking world(q14; this is how LaBerge proved lucid dreaming existent, see section 2.8.1.). Afterwards, the other direction of communication was asked: Can an observer send information into the lucid dream of a test person?(q15). Again, in the next question the sleep communication was explained further: the observer sends auditory signals standing for letters, like in the morse alphabet(q16; this is what Kristoffer Appel does in his Ph.D. studies, see section 2.8.3.). The next three questions dealed with communication with

deceased people: first, whether a non-lucid dream, in which somebody talks to a deceased person, can occur(q17). Second, whether a lucid dream with the conscious decision to talk to a deceased person can occur(q18), and third, whether a lucid dream, in which somebody receives information from a deceased person, which the dreamer could not receive without the dream, can occur(q19, this is what Puhle tries to find out, see chapter 2.8.4.). Another mini story aimed at learning effects in lucid dreams (Can a person consciously exercise a task during lucid dreams and perform better the next day?(q20) In order to include also possible applications of lucid dreaming that are rather esoteric, like the third of the deceased-people-questions (which at least we believe to be not scientifically provable) we included the question, whether it is possible to have a out-of-body experience and enter another world during a lucid dream(q21). Additionally some questions related to the participants' background were included (gender(q22), age(q23), profession(q24), scientific activity(q25), educational attainment(q26), spirituality(q27) and finally a free comment(q28)). Question codes which are used in the results section and discussion can be found in Table 11.

The questions were presented in roughly ascending order with respect to their noteworthiness. With noteworthiness we mean a higher level of complexity, especialness or rareness, based on our own assessment. For example, we think the story of an acquaintance who had a LD is much less noteworthy than the story of someone receiving information from a deceased person. We chose this order, because the participants should be gently led to the topic and not be directly confronted with a story about deceased people and trips to other worlds.

The Word Rating Task and Context Dependency
Taking into account that the following procedure is vague and allows no definite statements, we divided the adjectives of the word rating task (q7 and q8) in positive and negative ones. The eight rather positive ones were: *good, nice, insightful, desirable, verifiable, meaningful, measurable* and *usual*. The eight rather negative ones were: *abstruse, insane, supernatural, unnormal, esoteric, dangerous, bad* and *morbid*. We are aware of the difficulties here. For words like *good* it is obvious that it has a positive connotation, but for words like *esoteric*, the meaning depends on many factors. As context we use scientificity, therefore we considered *esoteric* as negative. Even though there are scientists who are spiritual and for whom *esoteric* might be a positive

word and even though science and esoteric or spirituality do not necessarily exclude each other, we assume the wider spread opinion is that *esoteric* has a negative connotation from a scientific point of view (see section 2.1.).

3.2.2 Participants

In total, 385 people took part in the online survey. 309 of those were from the broad population and 76 lucid dream forum members. For analysis we only regarded completely filled questionnaires, of which we had 55 from forum members and 215 broad population members (see Table 1). This means we had a drop out rate of about 30%.

Group	**took part**	**completed the questionnaire**
broad population	309	215
forum members	76	55
total	385	270

Table 1: Participants in the online survey

After discarding the incomplete data we had 106 males and 156 females. In the forum group were 40 males and 15 females and in the broad group were 66 males, 141 females and 8 who gave no answer[19](see Table 2).

3.2.3 Analysis

The data was analysed using MATLAB R2014b and LibreOffice Calc (version 3.5.7.2 Build ID: 350m1(Build:2)).

Groups
The groups for analysis (except for the forum member group) were arranged

[19]In the gender question we should have given more options than just male and female. Behind the background of today' s (trans-)gender topic, it is understandable that several subjects commented that they would have preferred having an option besides male and female.

Group	**Age**	**Gender**		
		female	male	no answer
broad population	32.5	141	66	8
forum members	24.7	15	40	
total	30.9	156	106	8

Table 2: Age and gender of the participants

after data collection. As forum members received a different link for participation, they have formed a group beforehand. All other groups are based on subjective answers from the questionnaire. The afterwards arranged group characteristics are:

- scientific activity
- gender
- spirituality
- age
- experience

For group arrangement we took the whole data (215 broad population and 55 forum members, resulting in a sample of 270 participants) and divided it into two groups as follows: For scientific activity we divided the participants into one group of those who consider themselves as scientifically active (in a yes-no question design) and one without this trait. Likewise, for spirituality the grouping was based on the subjective answers: Participants who answered 1-3 (on a scale reaching from 1 to 6) in question 27 form the non-spiritual group and participants who answered 4-6 form the spiritual group. As a measurement for experience we used the frequency of lucid dreams. As frequent lucid dreamers we denoted those who dream lucidly at least once a month (congruent with the terminology of Schredl(2011) and Thomas, Snyder and Gackenbach (1988)). For age comparisons we put the participants of age under 30 in one group and took those of age 30 and older as comparison group. Unfrequent lucid dreamers and those who never have lucid dreams form the comparison group. It must be noted here, that these group characteristics are not mutually exclusive: The data of each participant is part of

one group per characteristic. For instance, one participant can belong to the groups broad population, scientifically active, female, not spiritual, over 30 and frequent LD. For some analysis certain groups were excluded, this will be mentioned in the respective results section. Group sizes are displayed in Tabel 3.

subgroup 1	**sample size**	**subgroup 2**	**sample size**	**no answer**	**total**
broad population	215	forum members	55	0	270
scientifically active	118	not scientifically active	146	6	270
male	106	female	156	8	270
under 30	175	30 and older	95	0	270
frequent LD	79	unfrequent LD	191	0	270

Table 3: Sample sizes of the arranged groups

Statistical Tests

The 28 questions with, in parts, multiple subquestions yield in a total of 79 variables (one variable per subquestion). We computed the correlation coefficients between all variables. We defined correlations to be significant correlations at a p-value of 0.05 and below. When we speak of correlations in the results section and discussion, we mean significant correlations without explicitly mentioning it. Group comparisons were calculated with the means of co-existing groups. We decided to take the mean as main comparative value and not the median, because on a scale reaching from 1 to 5, extreme values do not act like outliers that falsely shift the value. As significance tests we applied two-sample Kolmogorov–Smirnov tests, as well as t-tests and permutation tests. The mentioned p-values are those from the permutation test, if not stated differently. As a significance level we used an alpha of 0.05 for the permutation test (and alpha below 0.01 as strong significance). For the Kolmogorov–Smirnov test we included weak significance of p-values between 0.05 and 0.1. We mention only those differences as sig-

nificant if both the two-sample Kolmogorov–Smirnov test and permutation test provide values below significance levels. The procedure was the following: If the Kolmogorov–Smirnov test delivered significant values, including weak significance, we proceeded with the t-test and permutation test. If the p-value of the permutation test was below 0.05, the respective comparison was mentioned as significant. Presumably, results of the permutation test are more reliable than those of the t-test, as the t-test has the assumption of underlying normal distributed data (which we do not have assured for our data), whereas permutation tests, also called randomization tests, do not have that assumption.

3.2.4 Expectations

We expected higher evaluation by forum members than by the broad population, as the former are likely to be highly interested in LD, since they visit the online forum. We expected scientifically active people to be more critical, behind the background of the scientific rejection in the past. For gender and age effects we did not make any predictions. Besides, we expected three patterns: Firstly, higher evaluations of the subquestions for possibility than for provability. Secondly, for the question pairs 13,14 and 15,16 we expected a higher rating of 14 and 16 because in both pairs the second question explains what was meant in the previous. We thought that people are not familiar with the topic and rate low at 13 and 15, but that once they read how this should work, they will believe that it is possible. Thirdly, for the different aspects of LD we expected descending evaluations; we assumed the most people believe in the existence of LD, but only few in the communication with deceased people (and other aspects like sleep communication in between).

3.3 Results

3.3.1 Aim One: Spread of Lucid Dreaming

Of the broad population participants 64% have heard of lucid dreaming before taking part in this study (Of the 55 forum members, 100% have already heard of it). 70% of all subjects already had at least one lucid dream in their lifetime (65 % of the broad population and 89 % of the forum members). Of those who did never have a lucid dream, 60% would like to be able to dream

lucidly, 13% would not like it, and 27% chose *I don't care*.
We could not find age effects on experience with LD: 69,7 of the under 30 years group and 69% of the 30 and older group have had at least one lucid dream. Frequencies for young and old people are depicted in Figure 1. For gender differences in LD prevalence we found a trend but no significant effect: 67% of our male participants had at least one lucid dream and 64% of the females. Here only the data of the broad population was taken into account, as the forum group contains more males than females, which would possibly falsify the outcome.

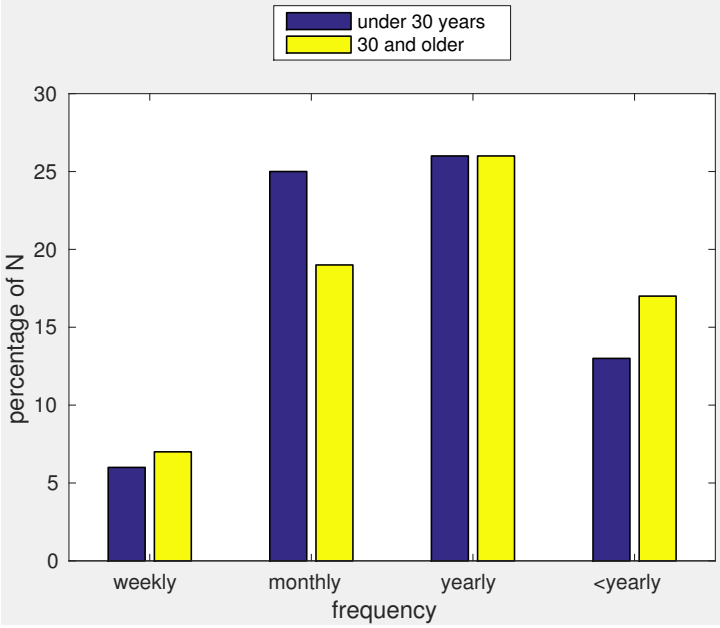

Figure 1: Frequency of LD, comparison for age. N(under 30)=175, N(30 and older)=95. All subjects taken into account.

The sources of information on LD are distributed as follows: Concerning the way participants have heard of LD, many of the participants used the comment box to tell us where they heard of lucid dreaming and wrote "TV report". However, the most mentioned source of information people rely on are reports of acquaintances (see Figure 2). The subjects were further asked what their answers were based on. The majority of the broad population participants (75%) have based their answers on gut feeling. 6% rely on scientific literature, not a single participant relies on esoteric literature, 2

% chose other literature and 4% refer to reports of acquaintances. 14% chose "other" (which was explained in a comment and contained mostly own experience). Likewise the forum members claim to have based their answers on gut feeling (36%), scientific literature (33%) and other (30%), non of them chose esoteric literature, other literature or reports of acquaintances as answer.

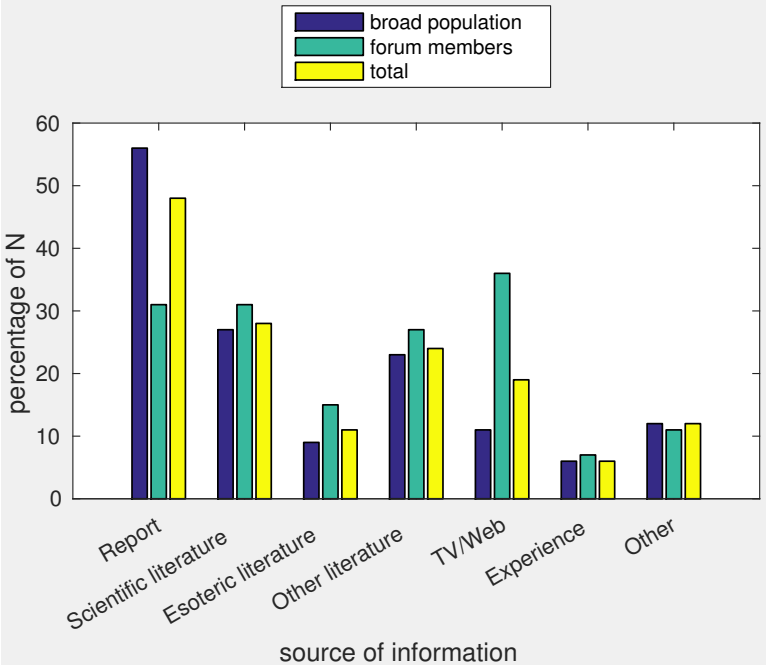

Figure 2: Percentage of participants refering to the depicted sources of information. N(broad population)=215, N(forum members)=55. The percentages do not add up to 100, as multiple choice was possible. "Other" includes i.a. school, college and art.

3.3.2 Aim Two: Evaluation of the Phenomenon

The subjects compared LD with other mental states or activities (q10) as follows: Hypnosis was estimated as remarkable as lucid dreaming. Telepathy, spook and clearvoyance were estimated more remarkable than lucid dreaming. Meditation and non-lucid dreaming were estimated less remarkable than lucid dreaming.

For the subjectively estimated reaction on a lucid dream (q6), the respective means are to be found in Table 4.

Reaction	**broad population (Mean)**	**forum members (Mean)**
wonder about it	4.5	4.0
find it unusual	4.8	4.5
find it normal	5.4	5.7
take it for granted	4.9	4.7

Table 4: Means of the estimation of the reaction to the experience of a LD (q6), broad population compared to forum members. Possible answers were 1(not at all) - 10(totally).

In the following, the results of the word rating task are displayed. The subjects had to estimate how good a word fits to LD on a scale reaching from 1(not at all) to 5(totally). We refer to a high number as high evaluation or rating. Generally, taking all subjects into account, all positive adjectives about lucid dreaming are rated higher than the negative ones (see Figure 3). The means of the evaluation of all words, sorted downwards can be seen in Table 5.

Word	**Mean**	**Word**	**Mean**
good	3.6	abstruse	2.5
nice	3.6	insane	1.8
insightful	3.5	supernatural	1.7
desirable	3.2	unnormal	1.7
verifiable	3.0	esoteric	1.7
meaningful	2.9	dangerous	1.6
usual	2.7	bad	1.4
measurable	2.5	morbid	1.2

Table 5: Results of the word rating task for the phenomenon(q7). Displayed are the means of the evaluation, sorted descending. Only broad population data taken into account. Possible answers were 1(not at all) - 5(totally).

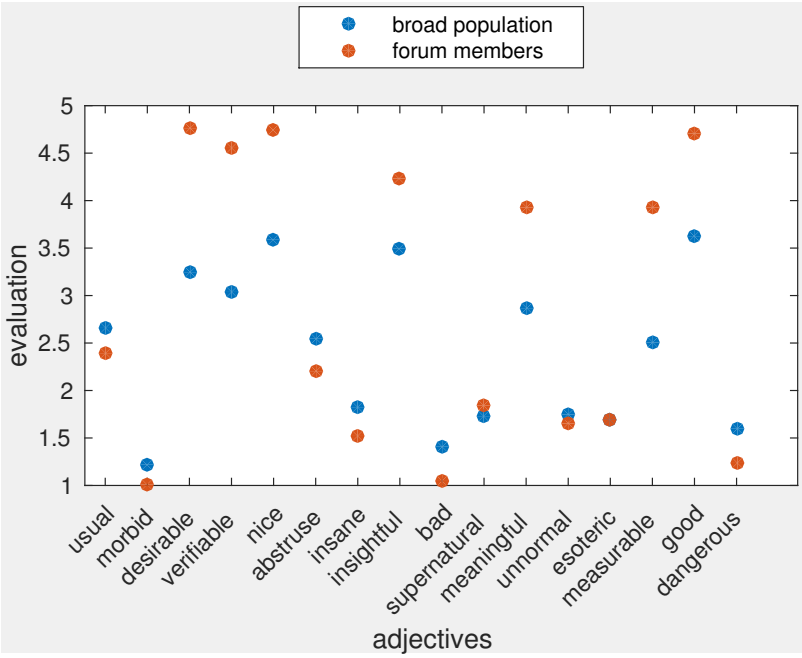

Figure 3: Results of the word rating task for the phenomenon: Means of the evaluation of the adjectives, comparison of forum members and the broad population group. Possible answers were 1(not at all) - 5(totally).

Comparison for Forum Members vs Broad Population
When comparing forum members to the broad population group it is noticeable that seven out of eight positive words (all but usual) are rated higher by forum members than by the broad population, mostly with a significant difference. Six out of seven negative words (all but esoteric, here is almost no difference) are rated lower by the forum members. The means for both groups, as well as significance can be found in Table 10.

Comparison for Scientific Activity
Eight out of eight negative words are rated higher by the scientific group than by the unscientific group. We found strong significant differences for the words abstruse and insane, as well as significant differences for unnormal. Six out of eight positive words (all but desirable and insightful) are rated lower by the scientific group, compared to the unscientific group.

Comparison for Gender

It is noticeable that females rate six positive words lower than males. Strongly significant are desirable, verifiable and nice. Good and measurable were significant. Only 2 of 8 positive words (insightful and usual) are rated higher by females, without significance. There were no salient gender differences for negative words.

Comparison for Spirituality
The words about the phenomenon are not evaluated remarkably different by spiritual people than by non-spiritual people. But there are two strongly significant differences: the words supernatural and esoteric are rated higher by spiritual participants.

Comparison for Frequency
We compared frequent lucid dreamers (once a month or more) to unfrequent lucid dreamers (less then once a month) and found that all eight positive words are rated higher by frequent lucid dreamers than by the comparison group and all eight negative words are rated higher by the comparison group. A significant difference was found for meaningful and strongly significant differences were found for usual, desirable, verifiable, nice, measurable and good.

3.3.3 Aim Three: Evaluation of the Research

Like for the evaluation of the phenomenon, generally, the positive adjectives are rated higher than the negative ones. The means of the word ratings can be found in Table 7.

Comparison of Forum Members vs Broad Population
The results of the forum members differ from those of the broad population: Seven out of seven words about the research are rated higher by the forum members, strong significant differences were found for the following words: reasonable, worthwhile, scientific, good, important, objectively provable, relevant. Seven out of seven negative words are rated lower by the forum members, significant are unnecessary and bad.

Comparison for Scientific Activity
Six out of seven negative words (all but unscientific) from the word rating task for lucid dream research are rated higher by the scientific group com-

Group	**report (Mean)**	**evidence (Mean)**
heard of LD	9.5	7.7
never heard of LD	8.5	7.2
under 30	9.1	7.5
30 and older	8.7	7.4
scientifically active	9.1	7.5
not scientifically active	9.0	7.4
male	8.9	7.7
female	9.0	7.4
forum members	9.9	9.5
broad population	9.0	7.5

Table 6: Averaged evaluation of the mini stories report and evidence. Possible answers 1(not at all) - 10(totally). Only broad population data taken into account, except for explicit mention in line 9.

pared to the unscientific group. We found a significant difference for the word abstruse. Six out of seven positive words (all but relevant) are rated lower by the scientific group. There is a significant difference for good.

Comparison for Spiritualily
The adjectives about the research are not evaluated remarkably different by spiritual people than by non-spiritual people. There are no significant differences, but a small trend: the positive words are rated higher by the non-spiritual group and the negative words are rated slightly higher by the spiritual group.

Comparison for Gender
Females rate all but one word (unnecessary) lower than males, regardless of the connotation of the words (scientific and unscientific are equal at the second decimal place for both sexes). A significant difference was found for objectively provable.

Comparison for Frequency

Word	Mean
reasonable	4.1
good	4.0
scientific	4.0
worthwhile	3.9
important	3.5
relevant	3.4
objectively provable	3.1
esoteric	1.7
unnecessary	1.6
abstruse	1.5
unscientific	1.5
stupid	1.3
weird	1.2
bad	1.2

Table 7: Means of the word evaluation of the research (q8), here displayed in descending order, not in order of presentation to the participants. All data taken into account. Possible answers were 1(not at all) - 5(totally).

All seven positive words about the research are rated higher by frequent lucid dreamers. Strongly significant differences can be found for objectively provable and relevant, a significant difference for important. Likewise, all negative words are rated lower, except for stupid and insane, where hardly any differences exist (mean for stupid 1.27 for frequent and 1.26 for unfrequent, similarly close for insane). We found strongly significant differences for unnecessary and esoteric.

3.3.4 Aim Four: Differentiations between Features

The evaluation of the 11 mini stories in the order of presentation is shown in Table 8.

Sleep Communication
We compared the evaluation of the subquestions for possibility and provability (the expected pattern was a decrease from possibility to provability). We

found a slight possible-provable-decrease for the first question (sending1). But for sending2 and receiving2, the provability is estimated higher than the possibility, and no difference for receiving1 was found. Between question pairs (sending1 and sending2 form a question pair) we expected increases. We found a small increase between questions sending1 and 2. But in the receiving mini stories, receiving2 is not rated higher than its precursor. We found differences for gender: females rate all of the eight subquestions of sleep communication lower than males. Strong significance is found for sending2, possible and provable and receiving2, possible. In the comparison for spirituality it is noticeable that all eight subquestions are rated higher by the non-spiritual group, with one strongly significant difference for OBE, possible. The comparison for spirituality can be seen in Figure 4. When comparing frequent lucid dreamers to non frequent lucid dreamers, one can see that all sleep communication questions are rated higher, all of them with strong significance, except for receiving1 and 2, each for provability. The respective means of the average (all data) evaluation of the sleep communication questions can be found in Table 9.

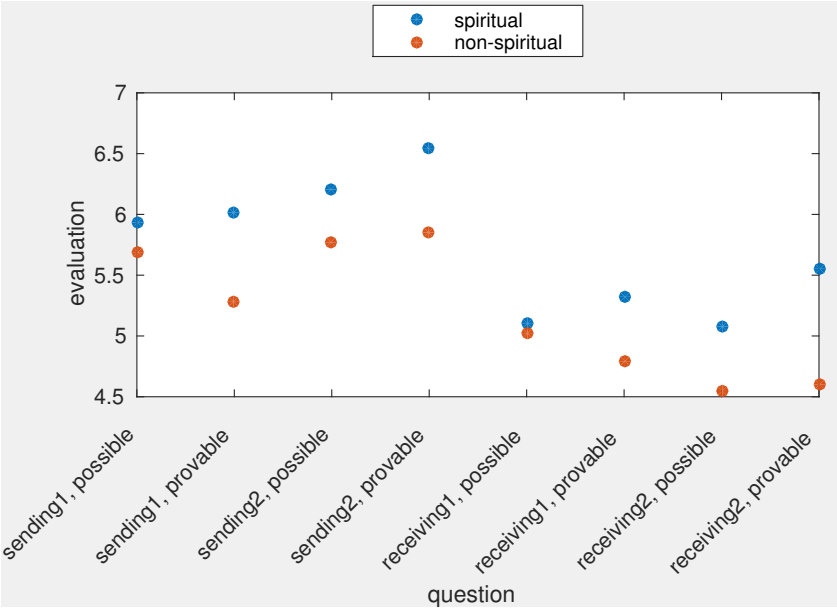

Figure 4: Means of the evaluation of the sleep communication questions, comparison for spirituality. Possible answers were 1(not at all) - 10(totally).

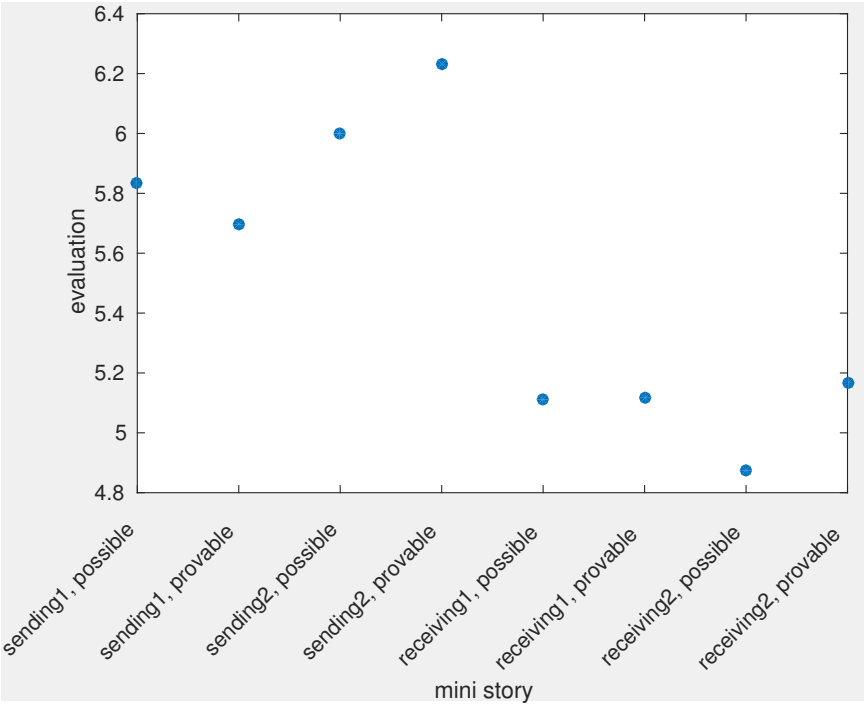

Figure 5: Means of the evaluation of the sleep communication questions, all subjects taken into account. Possible answers were 1(not at all) - 10(totally).

Dreaming of Deceased People

Taking all data into account, it is noticeable that for all of the three question pairs (possible and provable), provability is rated lower than possibility. Besides, there is a clear descent from deceased2 to deceased3. Differences of broad population data and forum members can be seen in Figure 6. Forum members rate deceased2 and deceased3 strongly significantly higher in possibility but not in provability.

The comparison for scientific activity is inconspicuous. Females rate all of the deceased-questions higher than males in both possibility and provability, with strongly significant differences for deceased1, provable and deceased3, provable. The only exception is deceased2,possible: here, females rate strongly significantly lower. In the comparison for spirituality, it is noticeable that deceased 1 and 2 are rated higher by the non-spiritual group and deceased3 is rated higher by the spiritual group, but without significance. The comparison for LD frequency is inconspicuous, except for deceased3, possible. This

subquestion is rated strongly significantly higher by frequent lucid dreamers than by the comparison group.

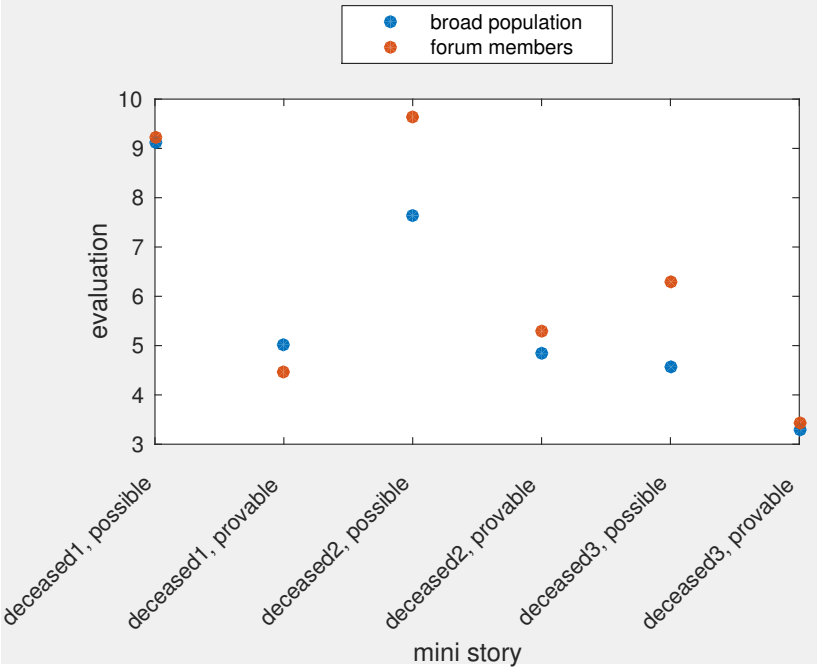

Figure 6: Means of the evaluation of the mini stories on deceased persons, comparison forum members to broad population. Possible answers were 1(not at all) - 10(totally).

Learning and OBE through LD

Learning within a LD is estimated significantly higher by forum members than by the broad population (for both possibility and provability). For the OBE question, the possibility is rated higher, but the provability is rated lower by forum members (see Figure 7). We found a difference for gender: learning through LD is rated strongly significantly higher by females (for both possibility and provability). The comparison for spirituality revealed that OBE, possible is rated significantly lower by the spiritual group. The group of frequent lucid dreamers evaluates learning strongly significantly higher than the non-frequent group.

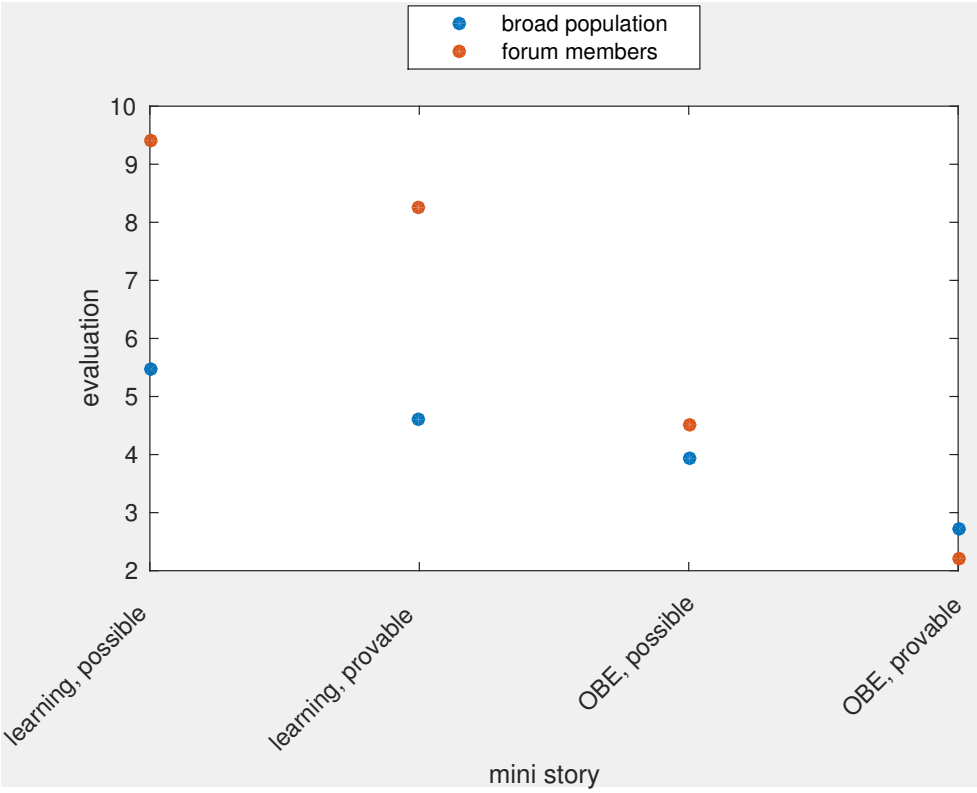

Figure 7: Means of the evaluation of the questions on learning and OBE, comparison between broad population and forum members. Possible answers were 1(not at all) - 10(totally).

3.3.5 Miscellaneous Findings

We found a negative correlation between age and having heard of LD (**). Having had a lucid dream at least once and the evaluation of the word esoteric are negatively correlated(**). Between spirituality and rating the word esoteric is a positive correlation(*). But here, esoteric might be meant not as negative. Also the evaluation of the rather special mini stories deceased3 and OBE are positively correlated with spirituality.

Word	**broad population (Mean)**	**forum members (Mean)**	**significance**
report	9.0	9.9	**
evidence	7.5	9.5	**
sending1, possible	5.3	8.0	**
sending1, provable	5.2	7.4	**
sending2, possible	5.1	9.3	**
sending2, provable	5.4	9.3	**
receiving1, possible	4.5	7.5	**
receiving1, provable	4.5	7.3	**
receiving2, possible	4.2	7.4	**
receiving2, provable	4.5	7.5	**
deceased1, possible	9.1	9.2	
deceased1, provable	5.0	4.5	
deceased2, possible	7.6	9.6	**
deceased2, provable	4.9	5.3	
deceased3, possible	4.6	6.3	**
deceased3, provable	3.3	3.4	
learning, possible	5.5	9.4	**
learning, provable	4.6	8.3	**
OBE, possible	3.9	4.5	
OBE, provable	2.7	2.2	

Table 8: Means of the mini story evaluation, broad population compared to forum members. Significant differences are displayed by * (strongly significance by **). Possible answers were 1(not at all) - 10(totally).

Mini story	**Mean**
sending1, possible	5.8
sending1, provable	5.7
sending2, possible	6.0
sending2, provable	6.2
receiving1, possible	5.1
receiving1, provable	5.1
receiving2, possible	4.9
receiving2, provable	5.2

Table 9: Means of the evaluation of the sleep communication mini stories. All data taken into account. Possible answers were 1(not at all) - 10(totally).

Word	**broad population (Mean)**	**forum members (Mean)**	**significance**
usual	2.7	2.4	
morbid	1.2	1.0	** [a]
desirable	3.2	4.8	**
verifiable	3.0	4.5	**
nice	3.6	4.7	**
abstruse	2.5	2.2	
insane	1.8	1.5	
insightful	3.5	4.2	**
bad	1.4	1.1	**
supernatural	1.7	1.8	
meaningful	2.9	3.9	**
unnormal	1.7	1.7	
esoteric	1.7	1.7	
measurable	2.5	3.9	**
good	3.6	4.7	**
dangerous	1.6	1.2	**

Table 10: Means of the word evaluation of the phenomenon (q7), broad population compared to forum members. Possible answers were 1(not at all) - 5(totally).

[a] In the case of the word morbid, all 55 forum members chose the same answer, therefore there is no variance and the Kolmogorov–Smirnov test delivers no significant value (even though the distributions are different), but the permutation test does. We decided to keep the general process of performing first a Kolmogorov–Smirnov test and, only if the distributions are different, also a permutation test.

Question code	**Content of the respective mini story**
report	whether a lucid dream is possible at all (q11)
evidence	whether the occurrence of a lucid dream can be proven in a sleep laboratory (q12)
sending1	whether a lucidly dreaming person can communicate with a wake observer (q13)
sending2	this communication is specified by explaining how the sleeper can move his eyes and thereby send a signal to the waking world (q14)
receiving1	whether an observer can send information into the lucid dream of a test person (q15)
receiving2	the sleep communication is explained further: the observer sends auditory signals standing for letters, like in the morse alphabet (q16)
deceased1	whether a non-lucid dream, in which somebody talks to a deceased person, can occur (q17)
deceased2	whether a lucid dream with the conscious decision to talk to a deceased person can occur (q18)
deceased3	whether a lucid dream, in which somebody receives information from a deceased person, which the dreamer could not receive without the dream, can occur (q19)
learning	whether learning effects in lucid dreams can occur (by consciously exercise a task during lucid dreams and perform better the next day) (q20)
OBE	whether it is possible to have a out-of-body experience and enter another world during a lucid dream(q21)

Table 11: Question codes of the 11 mini stories and short discriptions. The numbers in brackets refer to the exact formulation of all questions as presented to the subjects; this can be found in the appendix.

3.4 Discussion

Main Findings
The public's view on LD seems to be congruent with the acceptance of the scientific realm. Altogether, LD research seems to be accepted and approved: the positive words are rated higher than the negative words, independent of the group, see Tabel 5 (We interpret a high evaluation of the positive adjectives as a positive opinion on LD and a high evaluation of negative words as low or negative opinion on LD, or the research in the respective question). Like argued in the theoretical part, results of the empirical study imply that the phenomenon can be classified as moderately exceptional, but not as PSI effect: It is ranked more remarkable than non-lucid dreaming and meditation, as remarkable as hypnosis and less remarkable than telepathy, spook and clearvoyance. Concerning scientificity, the results of the question about evidence of LD indicate that the sleep laboratory as a measurement device is generally conceived trustworthy and that evidence is considered possible. As expected, forum members rate much more positive compared to the broad population and scientifically active people are more critical than their comparison group.

Observable Patterns
We expected these patterns:

- A decrease within the possible-provable pairs (because provability implies possibility, but not the other way round)
- An increase within question pairs from sending1 to sending2 and receiving1 to receiving2 (because 2 specifies the content of 1 in both cases)
- A rough decrease between the mini stories (because we presented them in ascending order with respect to specialness).

The first pattern was found in most of the possible-provable pairs, but surprisingly, at sending2 and receiving2 the provability is rated higher than the possibility. This could, according to a participant, be explained by the chain of thoughts *"I don't know whether it is possible or not. But if it is possible, it is provable for sure, because eye movements can be measured."*
The second expected pattern was found only for the forum members for one of the question pairs (increase from sending1 to 2), but surprisingly not for

the question pair receiving1 to 2. The broad population group shows no increase in any of the two pairs. This was unexpected. Specifying the content of the previous mini story did not lead to a higher evaluation. Maybe the participants thought that the experimenters had invented the stories, maybe the content was just not conceivable to them or maybe it was a combination of both.

The third pattern was clearly found as expected: With increasing specialness, the evaluation decreases (Figure 8). The participants believe in descending strength in the existence of LD (mean 9.0), the evidence in a sleep laboratory (mean 7.5), learning effects from LD (mean 5.5), the ability to send signals to a lucidly dreaming person (mean 5.3), the ability to communicate with deceased people through LD (mean 4.6), the ability to receive signals from a lucidly dreaming person (mean 4.5), and the ability to have an out-of-body experience (mean 3.9)[20].
This order roughly resembles our expectations. The term roughly was used, because we estimated no explicit order but the trend towards the left side.

As expected, communication with deceased people was found to be an aspect of LD, which most people do rather not believe in. The pattern of deceased1 rated higher than deceased2 and deceased3 rated the lowest, is visible. The question of interest was deceased3 (receiving real information by deceased people through LD). Spiritual people rate this higher than non-spiritual people, which might be explained by the belief in some form of an afterlife, which is common in many religious teachings (Wortmann, J. H. & Park, 2008). The deceased-questions are rated higher by females than by males. This is remarkable, as other areas (word rating tasks and mini stories about sleep communication) are estimated lower by females. Possibly the gender imbalance in the spiritual group (74 females and 42 males) might have an impact on these findings.

Reception of LD and LD Research
Taken the data of all subjects together, all positive words are rated higher than all negative ones. This holds for the evaluation of the phenomenon,

[20]deceased1 and 2 are not integrated into this range, as the purpose of these was just to prepare the participants for deceased3, besides, the content is already covered with the existence of LD

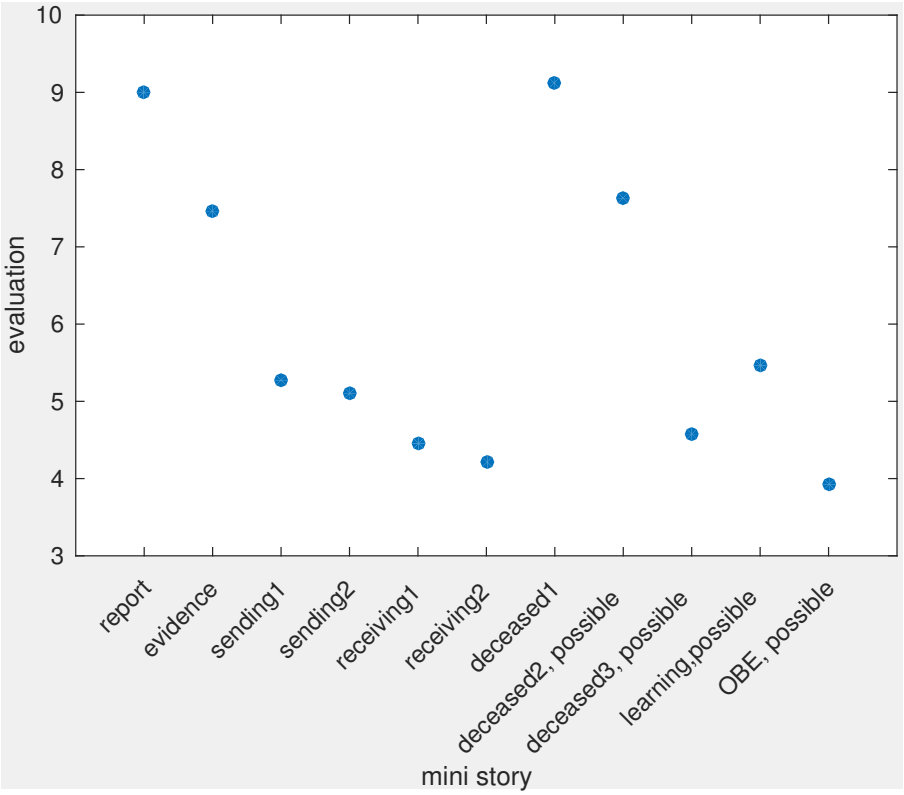

Figure 8: Evaluation of all 11 mini stories by the broad population group. Only the subquestions for possibility are displayed for better comparing. Possible answers were 1(not at all) - 10(totally).

as well as for the evaluation of the research. The scientifically active people are more critical (rate the positive words lower and the negative words higher compared to the unscientific people). Speculative, this effect could be explained by the tendency to answer more centrally and choose less extreme values. As expected, LD forum members show more enthusiasm for LD, which is plausible, as the forum members dedicate themselves to the phenomenon by choice. The results for the comparison for frequency are similar to the comparison forum members versus broad population, because the forum members and the high frequency group strongly overlap strongly. Generally, the participants are very open to the phenomenon: even those who have never heard of lucid dreaming rather believe that LD can be scientifically verified (mean = 7.16 of 10 possible). LD seems to be an impressive

phenomenon. A majority of 59,8% of those who never had a LD would like to be capable of it. LD research is considered rather scientific: The broad population group believes that lucid dreaming can be verified in a sleep laboratory, irrespective of the group characteristics (mean 7.5 calculated without forum members, mean 7.9 with the forum members and 7.2 for participants who have never heard of LD).
Seemingly, the topic is rather new to the population. In a free comment at the very end of the questionnaire many participants conveyed that the topic was very special, but highly interesting and the survey was different from ones they had previously completed. Besides, some questions remained unanswered by several participants, due to lack of decisiveness. Participants claimed they do not have a clue and were unable to decide for an answer. This unsureness is understandable as 46% of the participants have heard of LD for the first time when filling in this survey. This confirms the expectation that the phenomenon is still a special and remarkable topic that is new to many people.
The finding that most of the aspects of LD are rated higher in possibility than in provability suggests that the research is, although evaluated well, apparently also limited in its explanatory power: several aspects of LD are considered possible, or at least not excluded to exist, but without trusting the research to be able to verify it.

Comparison with Previous Findings
Our results for the prevalence of LD (within the broad population group) differ from those of Schredl et al. (2004): They found that 82 % of the population had at least one lucid dream. Different from that, the same authors found in another study only 51% (Schredl & Erlacher, 2011). Lying between these two findings, we found that 65% had at least one LD. The outcomes of the present study concerning LD frequency are also located between the findings of Schredl et al. (2004) and Schredl et al. (2011), as displyed in Figure 9.
We tried to find out which of the two studies by Schredl et al. better reflects the LD prevalence. The high prevalence in Schredl et al. (2004) might be explained by the fact that the participants were mainly psychology students and mainly women. That the gender imbalance towards female might have biased the results is presumably not of high importance, as both Voss et al. (2013) and the present study revealed a slightly higher LD prevalence in males, not females. But the imbalance towards psychology students could have biased the results, as psychology students might be more involved in

LD, as they possibly have heard of the topic in class. However, Schredl et al. (2011) conducted a representative study (Sample size was 919 completed participations), thus these findings might be more reliable.
For comparing the results of the lucid dream frequency we changed the categories of Schredl's results. He distinguished between the categories: Less then once a year, About once a year, About two to four times a year, About once a month, About two to three times a month, About once a week, Several times a week[21]. Schredl (2011) found that the experience of at least one lucid dream increases with age. We could not find such effects, but we agree that younger people are more frequent lucid dreamers than older people. In Figure 1 frequencies for young and old people are depicted. One can see a left shift for the under 30 group. This fits to Voss et al. (2012) who found evidence for prevalence of LD during brain maturation during childhood and early adolescence. There have been previous findings for sex differences in lucid dream frequency (Voss, Schermelleh-Engel, Windt, Frenzel, & Hobson, 2013) towards males. We can slightly confirm these findings: 66.7% of our male participants had at least one lucid dream and 63.8% of the females, not including the forum members' data.
In the present study we found gender differences at evaluating the words and mini stories (Females rate all of the eight subquestions of sleep communication lower than males and the majority of adjectives are rated lower by females). This could possibly be explained by more cautious behaviour of females when filling in questionnaires, but this is pure speculation, as there is, as far as we know, no respective literature.

Reaction to a LD

As expected, the forum members are less astonished about a LD, find it less unusual, more normal and taken for granted, compared to the broad population group.
Surprisingly, the means of two rather contradicting estimated reactions (finding it unusual and taking it for granted) are almost the same. As the data does not accumulate in the middle, but is distributed over all possible answers (1(not at all) - 10(totally)), we assume, the mean was no good indicator at this point. We looked at correlations between reactions and there the results

[21] We recalculated them to match our categories (less then once a year, once or more a year, once or more a month, once or more a week). See Figure 9

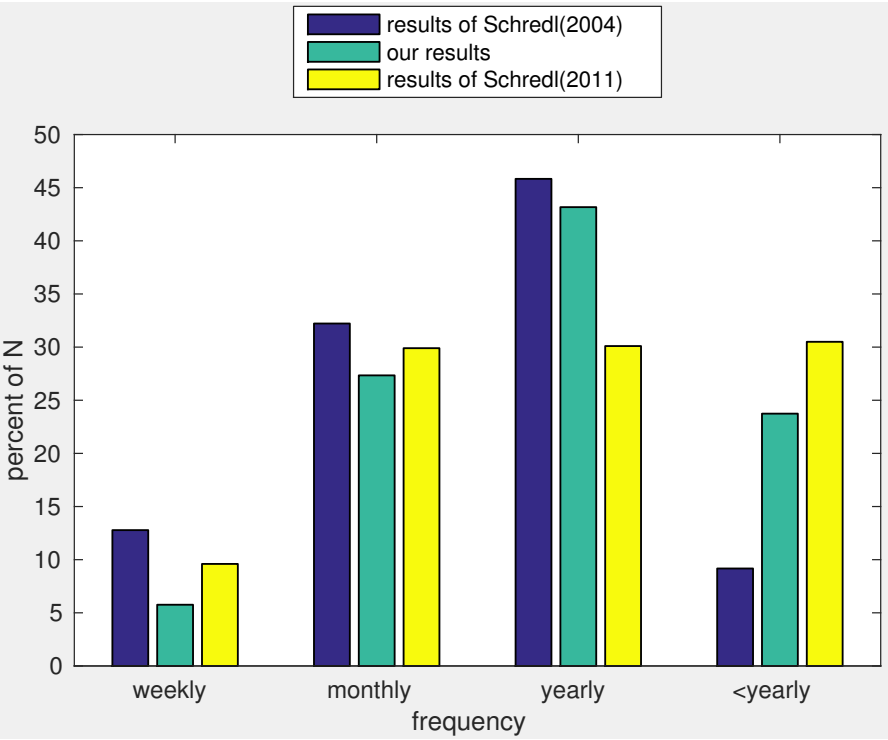

Figure 9: Frequency of LD, comparison of our data with Schredl et al. Percentage of participants grouped into different lucid dream frequencies. N(Schredl,2004)=360, N(present study)=215, N(Schredl,2011)=469

reflected our expectations that positive and negative reactions should oppose. We found significant positive correlations between the reactions finding it unusual and wondering about it and negative correlations between finding it unusual and finding it normal as well as between finding it unusual and taking it for granted. Hereby we assured that the participants answered the question sincerely. Besides, we found negative correlations between wondering about it and the possibility of the report of LD, the LD of a deceased person and the OBE. We assume the means of the estimated reactions were similar as there is an even distribution in both contradicting reactions.

Sleep Communication

As expected, the forum members consider the whole series of sleep communication mini stories much more possible and provable, compared to the broad population. We assume, the forum members have more knowledge about ex-

perimental research. On the homepage of one of the forums (www.klartraumforum.de), where we posted the survey, the cover picture is (presumably) an EOG curve (see Figure 10).

Figure 10: Cover picture of the internet platform www.klartraumforum.de

Extended Subgroup Analysis
The results refer to the total data set, including 215 broad population members and 55 forum members. One could object that the explanatory power of several comparisons can be biased by unbalanced forum member fractions in comparison groups (The scientifically active group contains 14% forum members and the unscientific group 23% forum members. The gender comparison is strongly affected: 9% of the females are forum members and 38% of the males are forum members. The comparison for spirituality is only slightly imbalanced: the spiritual group contains 18% forum members and the non-spiritual group 23%). On account of this, we conducted further analysis. After recalculating, while leaving the forum members out, the results are affected as follows: For gender, nearly all significant effects disappear when excluding forum members. All remaining significant differences are the word nice, rated higher by males and deceased3 in both, possibility and provability, rated higher by females. The trend towards females rating lower in all sleep communication questions might be explained away by the forum members containing more males and lifting the mean of the males. After excluding the forum members all but one of the eight sleep communication questions are rated higher by females (but just by trend without significance, see Figure 11).
As the forum members and the high frequency group overlap strongly, the comparison for frequency changes after excluding forum members. All but one (the word usual) p-value lose the significance (presumingly because of the few frequent lucid dreamers in the broad population group). Sending1 and sending2, both in provability, are for an unknown reason evaluated higher by unfrequent lucid dreamers.

For spirituality the recalculation makes almost no difference. Slightly more p-values reach significance. The difference for the word esoteric is no longer significant, but deceased3,possible (higher by spiritual) and learning,provable (higher by non-spiritual) gain significance.
In the comparison for scientific activity all but one (the word good) of the significant differences remain significant. The interpretation that scientifically active people are more critical must be left open: In the word rating task for the phenomenon both, the negative words and the positive words, are rated higher by scientifically active participants, which might imply that scientific participants just rated with a trend to higher numbers (pointing against being critical). On the other hand, there are significant effects for negative, but not for positive words (pointing towards being critical). The sleep communication questions are all rated higher by scientifically active people, as can be seen in Figure 12. This difference was not visible when including the forum data, presumingly because there were many forum members in the unscientific group, who lifted the mean. The higher (though not significantly) evaluation might be due to scientifically active people having better knowledge on sleep laboratory measurement possibilities than their comparison group.

Limitations and Future Research
Our sample was not representative, therefore all interpretations must be treated with caution.
Open questions remain: What explains the effect that the deceased-questions are rated higher by females than by males and higher by spiritual people than by non-spiritual people. Within the spiritual group are more females than males. Therefore, we don't know what has an effect on the deceaded-questions: gender or spirituality. To identify the effect, we would need a 2-factor analysis. This would go beyond the scope of this thesis, as we restricted the data analysis to descriptive statistics, correlations and significance tests.

Implications
With the present study we provide indications that the public's opinion is congruent with the scientific acceptance of LD. Both, the phenomenon of LD as such and the LD research, are well received by the population. The scientific evaluation of LD is generally considered possible. We conclude that LD research should be supported in the future because it can smooth the

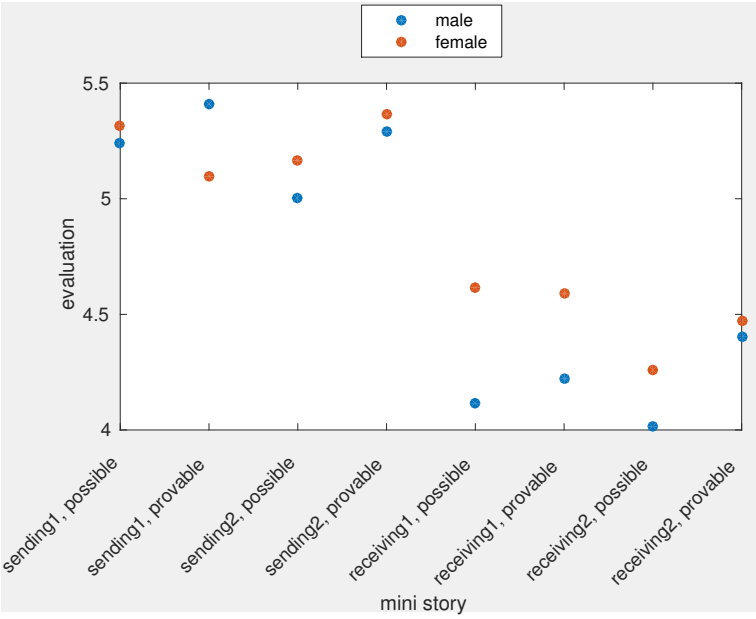

Figure 11: Evaluation of the sleep communication questions, comparison for gender, only broad population data taken into account. Possible answers were 1(not at all) - 10(totally).

way to further understanding more on altered cognitive states and processes and have clinical indications. The findings of previous studies (Voss et al., 2012; Zadro & Pihl, 1997) indicate that LD can help in the treatment of nightmares or anxiety disorders, as well as support self-healing processes[22]. Reports about patients, who found psychical reasons for their illness through consciously dealing with it in lucid dreams, raise hope for future therapeutic applications. We therefore suggest that LD should be integrated into the standard methods of psychotherapy. This should be possible, especially now that we have pointed out the public's very positive attitude towards lucid dreaming.

[22]Permantier (1994) on Gackenbach,J. and Bosveld, J. (1991). *Herrscher im Reich der Träume*, orig. *Control your dreams*, New York., übersetzt von Christian Stephan, Aurum Verlag Braunschweig.

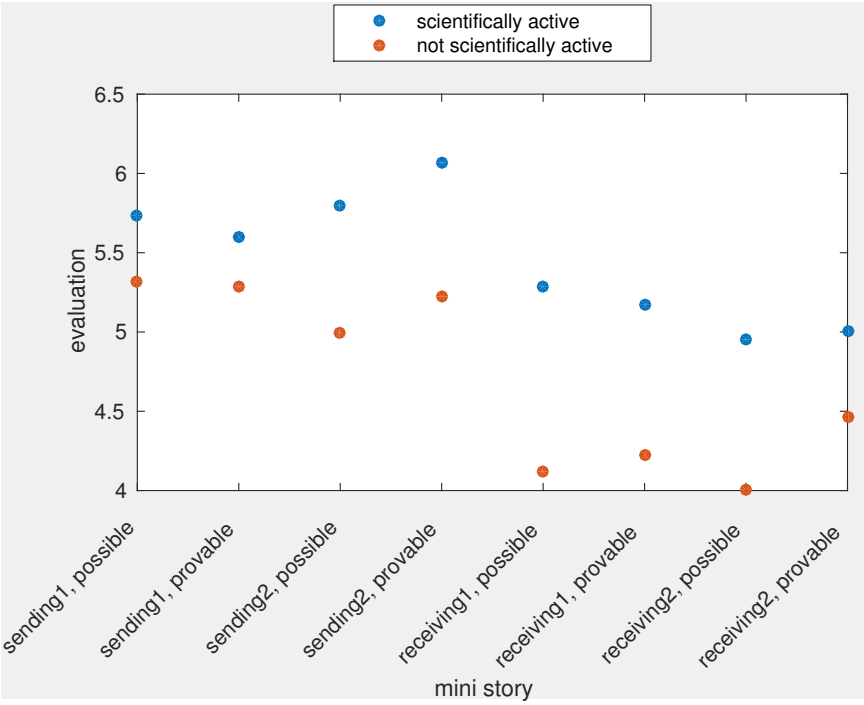

Figure 12: Evaluation of the sleep communication questions, comparison for scientific activity, only broad population data taken into account. Possible answers were 1(not at all) - 10(totally).

4 Overall Conclusion

In the theoretical part of this thesis we examined the scientific status of lucid dreaming, which is a phenomenon, which was longtime considered unscientific. From a science-theoretical point of view we examined the research of extraordinary phenomena and pointed out that both, the unscientific and the scientific exploration of LD, which is an exemplary phenomenon that is examined and perceived miscellaneously with respect to scientificity, are present. Whether LD research can be seen as parapsychology or normal psychology strongly depends on the respective definitions. Further, we discussed how processes like conflicts of paradigms and scientific revolutions can be applied to lucid dream research. Behind the background of lucid dreaming being nowadays accepted and approved in the domain of science, we investigated current views on LD. By means of a sociocultural study we provide indications that the population is in accordance with the acceptance by the scientific sphere. Taking both parts into account, we feel confident claiming that lucid dreaming is a normal psychological phenomenon, which can be scientifically examined. LD is not to be classified a PSI effect, but rather a mental phenomenon or skill that lies somewhere between the normal functions of the human mind and extraordinary abilities, with *extraordinary* not in the sense of something inexplicable, but in the positive sense of special or remarkable.
Why was lucid dreaming so long connected to PSI? LD was an altered state of consciousness, that was not explicable within the view on dream theory. Nowadays there are explanatory attempts that are based on measured EEG data and neuroanatomical correlates, not on pure speculations. The phenomenon of lucid dreaming needed the scientific evidence in order to be recognized and raised. The high interest in lucid dreaming, the existence of literature, research groups and a variety of applications have persisted before the scientific change of perspective that happened as response to LaBerge's evidence, but in order to get published and supported it seems indispensable for a research field to be empirically proven.

We tried to stay neutral in this work, which was quite difficult, because words like *unscientific*, *esoteric* or *alternative* have negative connotations. This leads us to conclude that investigating exceptional topics of research is, among other reasons, so difficult because one has to deal with prestressed terminology.

Why do borders between sciences and pseudosciences exist? Where are these borders and who is responsible for them? Why can the human not accept something without having scientific prove for it? Why must every observable thing also be explicable and every theoretical question be answered with yes or no? Why can inexplicable phenomena not be accepted as those? Is a scientific prove a universal truth? These science-theoretical considerations cannot be pursued in this thesis, but highly contributed to the motivation for writing it.

A final thought: One approach does not work without the other: Metaphysical considerations are not scientific, but they play an important role in scientific theoretical approaches; one can declare them [metaphysical considerations] as unscientific, but not as senseless (Popper, 1998, p.44). It still seems to be applicable how Max Planck phrased it:

> *A big scientific idea does not establish itself in the way that its opponents are gradually convinced - making a volte-face is a rarity - but rather in the way that the opponents gradually die out and the following generations are familiarized with the idea in the first place.* (Planck, 1955)

There is nothing to find fault with disagreeing world views. But completely excluding the view of others is what constrains us.

5

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6 Appendix

6.1

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6.3 The Questionnaire

Wissenschaftlichkeit von Klarträumen

Luzides Träumen oder Klarträumen ist eine besondere Art zu Träumen, bei der man weiß, dass man träumt. Man ist bei Bewusstsein, obwohl man schläft.

Hallo! Vielen Dank, dass Sie sich die Zeit nehmen an meiner Studie teilzunehmen!

In meiner Studie geht es um die Erforschung des Phänomens Klarträumen.

Die Umfrage dauert ungefähr 20 Minuten. Wenn Sie sich bei einer Frage nicht sicher sind, markieren Sie bitte trotzdem die Antwort, die am ehesten auf Sie zutrifft.

Bitte drücken Sie nicht den Zurück-Knopf (oben links in ihrem Browser), denn das führt zum Abbruch der Umfrage. Sie können also nicht zur vorigen Frage zurückkehren.

Viele Grüße,

Katharina Lüth, Universität Osnabrück

Diese Umfrage enthält 28 Fragen.

Teil 1 von 4: Vorkenntnisse

Hier werden Ihre Vorkenntnisse des Themas Klarträumen erfragt.

1 []

Haben Sie schon mal etwas von dem Phänomen Klarträumen gehört? *

Bitte wählen Sie nur eine der folgenden Antworten aus:

- ○ Ja
- ○ Nein

2 []

Wo oder wie haben Sie vom Klarträumen gehört?

*

Bitte wählen Sie alle zutreffenden Antworten aus:

- ☐ Erzählungen von Bekannten
- ☐ wissenschaftliche Literatur
- ☐ esoterische Literatur
- ☐ andere Literatur
- ☐ Sonstiges: _____

3 []

Hatten Sie schon einmal einen luziden Traum? *

Bitte wählen Sie nur eine der folgenden Antworten aus:

- ○ Ja
- ○ Nein

4 []

Wie oft haben Sie luzide Träume? *

Bitte wählen Sie nur eine der folgenden Antworten aus:

- ○ meistens ein- oder mehrmals pro Woche
- ○ meistens ein- oder mehrmals pro Monat
- ○ meistens ein- oder mehrmals pro Jahr
- ○ weniger als einmal im Jahr

Teil 2 von 4: Bewerten

Hier werden Sie gebeten ihre spontane Meinung/Intuition anzugeben.

5 []

Würden Sie gerne selbst luzid träumen können? *

Bitte wählen Sie nur eine der folgenden Antworten aus:

- ○ ja
- ○ nein
- ○ ist mir egal

6 []

Bitte stellen Sie sich folgende Situation vor: Sie schlafen und bemerken dass Sie sich gerade in einem Traum befinden (Sie sind also in einem Klartraum).

Diese Frage können Sie auch beantworten, wenn sie noch nie einen Klartraum hatten.

Bitte wählen Sie auf der Skala von 1 bis 10 die Möglichkeit, die Sie am passendsten finden. Die 1 steht für "garnicht", die 10 für "völlig". *

Bitte wählen Sie die zutreffende Antwort für jeden Punkt aus:

	garnicht 1	2	3	4	5	6	7	8	9	völlig 10	ich kann die Frage nicht beantworten
Wie sehr würden Sie sich darüber wundern?	○	○	○	○	○	○	○	○	○	○	○
Wie ungewöhnlich schätzen Sie diese Situation ein?	○	○	○	○	○	○	○	○	○	○	○
Wie normal schätzen Sie diese Situation ein?	○	○	○	○	○	○	○	○	○	○	○
Wie selbstverständlich finden sie das Auftreten dieser Situation?	○	○	○	○	○	○	○	○	○	○	○

7 []

Bitte betrachten Sie die folgenden Wörter und wählen Sie aus, wie gut ihrer Meinung nach das Wort zum Phänomen Klarträumen passt. Auf der Skala steht die 1 für "garnicht" und die 5 für "völlig". Wenn Sie zum Beispiel finden, dass Klarträume etwas völlig normales sind, wählen Sie bei "normal" die Option "5".

Ich halte Klarträume für.... *

Bitte wählen Sie die zutreffende Antwort für jeden Punkt aus:

	1 (garnicht)	2	3	4	5 (völlig)
gewöhnlich	○	○	○	○	○
krankhaft	○	○	○	○	○
erstrebenswert	○	○	○	○	○
nachweisbar	○	○	○	○	○
schön	○	○	○	○	○
abstrus	○	○	○	○	○
irrsinnig	○	○	○	○	○
erkenntnisreich	○	○	○	○	○
schlecht	○	○	○	○	○
übernatürlich	○	○	○	○	○
bedeutungsvoll	○	○	○	○	○
unnormal	○	○	○	○	○
esoterisch	○	○	○	○	○
messbar	○	○	○	○	○
gut	○	○	○	○	○
gefährlich	○	○	○	○	○

8 []

Wie schätzen Sie die Erforschung von luziden Träumen ein?

Bitte wählen Sie die Möglichkeit, die Ihnen am passendsten erscheint. Auf der Skala steht die 1 für "garnicht" und die 5 für "völlig".

Ich halte die Erforschung von luziden Träumen für.... *

Bitte wählen Sie die zutreffende Antwort für jeden Punkt aus:

	1 (garnicht)	2	3	4	5 (völlig)
sinnvoll	○	○	○	○	○
erstrebenswert	○	○	○	○	○
blöd	○	○	○	○	○
spinnerhaft	○	○	○	○	○
wissenschaftlich	○	○	○	○	○
unnötig	○	○	○	○	○
gut	○	○	○	○	○
esoterisch	○	○	○	○	○
wichtig	○	○	○	○	○
abstrus	○	○	○	○	○
unwissenschaftlich	○	○	○	○	○
objektiv belegbar	○	○	○	○	○
relevant	○	○	○	○	○
schlecht	○	○	○	○	○

9 []

Woran machen Sie die Antworten aus der letzten Frage am ehesten fest? *

Bitte wählen Sie nur eine der folgenden Antworten aus:

- ○ Bauchgefühl
- ○ wissenschaftliche Literatur
- ○ esoterische Literatur
- ○ sonstige Literatur
- ○ Erzählungen von Bekannten
- ○ anderes (bitte in der nebenstehenden Box kommentieren)

Bitte schreiben Sie einen Kommentar zu Ihrer Auswahl

10 []

Bitte vergleichen Sie das Phänomen Klarträumen mit einigen anderen Phänomenen/Zuständen.

Wenn sie von einem der Phänomene nur eine ungefähre Ahnung haben, wählen sie die Antwort, die Ihnen spontan am passendsten erscheint.

Nur, wenn Sie eins der Phänomene garnicht kennen, wählen Sie bitte "ich kann die Frage nicht beantworten".

*****

Bitte wählen Sie die zutreffende Antwort für jeden Punkt aus:

	weniger außergewöhnlich als Klarträumen	so außergewöhnlich wie Klarträumen	außergewöhnlicher als Klarträumen	Ich kann die Frage nicht beantworten
Hypnose finde ich...	○	○	○	○
Gedankenübertragung finde ich...	○	○	○	○
Meditation finde ich....	○	○	○	○
nicht-luzides Träumen finde ich...	○	○	○	○
Spuk finde ich...	○	○	○	○
Hellsehen finde ich...	○	○	○	○

Teil 3 von 4: Glauben, Schätzen

Hier werden Sie gebeten, sich verschiedene Situationen vorzustellen und diese einzuschätzen.

11 []

Ein Bekannter erzählt Ihnen, dass er in der vergangenen Nacht einen luziden Traum hatte. Er berichtet davon, dass er während er schlief bei Bewusstsein war und wusste, dass er sich in einer Traumwelt befindet.

Bitte wählen Sie auf der Skala von 1 bis 10 die Möglichkeit, die Ihnen am passendsten erscheint. Die 1 steht für "ich stimme garnicht zu" und die 10 für "ich stimme völlig zu". *

Bitte wählen Sie die zutreffende Antwort für jeden Punkt aus:

	garnicht 1	2	3	4	5	6	7	8	9	völlig 10	ich kann die Frage nicht beantworten
Ich halte so eine Art von Traum für möglich	○	○	○	○	○	○	○	○	○	○	○

12 []

Person A arbeitet als Schlafforscher in einem Schlaflabor und hat einen Nachweis dafür erbracht, dass ein schlafender Versuchsteilnehmer sich gerade in einem luziden Traum befindet.

Bitte wählen Sie auf der Skala von 1 bis 10 die Möglichkeit, die Ihnen am passendsten erscheint. Die 1 steht für "ich stimme garnicht zu" und die 10 für "ich stimme völlig zu". *

Bitte wählen Sie die zutreffende Antwort für jeden Punkt aus:

	garnicht 1	2	3	4	5	6	7	8	9	völlig 10	ich kann die Frage nicht beantworten
Ich halte das für möglich	○	○	○	○	○	○	○	○	○	○	○

13 []

Person B schläft. Person C beobachtet Person B. Person B hat einen Klartraum und kann mit Person C kommunizieren.

Bitte wählen Sie auf der Skala von 1 bis 10 die Möglichkeit, die Ihnen am passendsten erscheint. Die 1 steht für "ich stimme garnicht zu" und die 10 für "ich stimme völlig zu". *

Bitte wählen Sie die zutreffende Antwort für jeden Punkt aus:

	garnicht 1	2	3	4	5	6	7	8	9	völlig 10	ich kann die Frage nicht beantworten
Ich halte das für möglich.	○	○	○	○	○	○	○	○	○	○	○
ich halte das für wissenschaftlich belegbar.	○	○	○	○	○	○	○	○	○	○	○

14 []

Person B aus der vorigen Frage erklärt nun wie sie während eines luziden Traums mit einem wachen Beobachter Person C kommunizieren kann:

Durch Augensignale kann die träumende Person B mit der Außenwelt kommunizieren. Sie macht bewusst abwechselnde links- und rechts-Bewegungen mit den Augen (unter den geschlossenen Augenlidern), die von einem Beobachter gemessen werden können.

Bitte wählen Sie auf der Skala von 1 bis 10 die Möglichkeit, die Ihnen am passendsten erscheint. Die 1 steht für "ich stimme garnicht zu" und die 10 für "ich stimme völlig zu". *

Bitte wählen Sie die zutreffende Antwort für jeden Punkt aus:

	garnicht 1	2	3	4	5	6	7	8	9	völlig 10	ich kann die Frage nicht beantworten
Ich halte das für möglich.	○	○	○	○	○	○	○	○	○	○	○
ich halte das für wissenschaftlich belegbar	○	○	○	○	○	○	○	○	○	○	○

15 []

Person D glaubt, sie kann während sie wach ist, Signale zu einer schlafenden, luzide träumenden Versuchsperson senden.

Bitte wählen Sie auf der Skala von 1 bis 10 die Möglichkeit, die Ihnen am passendsten erscheint. Die 1 steht für "ich stimme garnicht zu" und die 10 für "ich stimme völlig zu". *

Bitte wählen Sie die zutreffende Antwort für jeden Punkt aus:

	garnicht 1	2	3	4	5	6	7	8	9	völlig 10	ich kann die Frage nicht beantworten
Ich halte das für möglich.	○	○	○	○	○	○	○	○	○	○	○
ich halte das für wissenschaftlich belegbar.	○	○	○	○	○	○	○	○	○	○	○

16 []

Person D aus der vorigen Frage erklärt nun wie sie während sie wach ist Signale zu einer schlafenden, luzide träumenden Versuchsperson senden kann:

Durch Pieptöne in bestimmten Kombinationen kann Person D dem luzide träumenden Versuchsteilnehmer beliebige Botschaften mitteilen.

(wie beim Morsealphabet: zum Beispiel steht die Tonabfolge "kurz, lang" für den Buchstaben A.)

Bitte wählen Sie auf der Skala von 1 bis 10 die Möglichkeit, die Ihnen am passendsten erscheint. Die 1 steht für "ich stimme garnicht zu" und die 10 für "ich stimme völlig zu". *

Bitte wählen Sie die zutreffende Antwort für jeden Punkt aus:

	garnicht 1	2	3	4	5	6	7	8	9	völlig 10	ich kann die Frage nicht beantworten
Ich halte das für möglich.	○	○	○	○	○	○	○	○	○	○	○
ich halte das für wissenschaftlich belegbar.	○	○	○	○	○	○	○	○	○	○	○

17 []

Person E schläft und hat einen normalen (nicht-luziden) Traum. Sie träumt, dass sie sich mit einem verstorbenen Verwandten unterhält.

Bitte wählen Sie auf der Skala von 1 bis 10 die Möglichkeit, die Ihnen am passendsten erscheint. Die 1 steht für "ich stimme garnicht zu" und die 10 für "ich stimme völlig zu". *

Bitte wählen Sie die zutreffende Antwort für jeden Punkt aus:

	garnicht 1	2	3	4	5	6	7	8	9	völlig 10	ich kann die Frage nicht beantworten
Ich halte das für möglich.	○	○	○	○	○	○	○	○	○	○	○
ich halte das für wissenschaftlich belegbar.	○	○	○	○	○	○	○	○	○	○	○

18 []

Person F träumt des Öfteren von ihrer verstorbenen Mutter. In einer Nacht hat sie einen luziden Traum und unterhält sich im Traum mit ihr. Person F stellt bewusst Fragen, wie "Weißt du noch damals, der Urlaub am Meer?" Es gefällt der Person F, denn auf diese Weise behält sie ihre Mutter gut in Erinnerung.

Bitte wählen Sie auf der Skala von 1 bis 10 die Möglichkeit, die Ihnen am passendsten erscheint. Die 1 steht für "ich stimme garnicht zu" und die 10 für "ich stimme völlig zu". *

Bitte wählen Sie die zutreffende Antwort für jeden Punkt aus:

	garnicht 1	2	3	4	5	6	7	8	9	völlig 10	ich kann die Frage nicht beantworten
Ich halte das für möglich.	○	○	○	○	○	○	○	○	○	○	○
ich halte das für wissenschaftlich belegbar.	○	○	○	○	○	○	○	○	○	○	○

19 []

Person G träumt des Öfteren von ihrer verstorbenen Tante, welche einen Koffer hinterlassen hat, zu dem niemand den Schlüssel findet.

In einer Nacht hat Person G einen luziden Traum. Sie nutzt ihre Chance und fragt im Traum die Tante wo sie den Schlüssel zu dem Koffer aufbewahrt hat und die Tante sagt es ihr. Am nächsten Tag findet die Person G den Schlüssel an dem Ort, den die Tante ihr beschrieben hat.

Bitte wählen Sie auf der Skala von 1 bis 10 die Möglichkeit, die Ihnen am passendsten erscheint. Die 1 steht für "ich stimme garnicht zu" und die 10 für "ich stimme völlig zu". *

Bitte wählen Sie die zutreffende Antwort für jeden Punkt aus:

	garnicht 1	2	3	4	5	6	7	8	9	völlig 10	ich kann die Frage nicht beantworten
Ich halte das für möglich.	○	○	○	○	○	○	○	○	○	○	○
ich halte das für wissenschaftlich belegbar.	○	○	○	○	○	○	○	○	○	○	○

20 []

Person H spielt ein Spiel, bei dem man einen Tischtennisball aus einem Meter Entfernung in eine Tasse werfen muss. Es gelingen ihr nicht viele Treffer. In der Nacht hat die Person einen luziden Traum. Sie entscheidet sich dazu die Gelegenheit zu nutzen und im Traum das Spiel zu üben. Am nächsten Tag kann die Person H das Spiel besser, sie trifft öfter die Tasse.

Bitte wählen Sie auf der Skala von 1 bis 10 die Möglichkeit, die Ihnen am passendsten erscheint. Die 1 steht für "ich stimme garnicht zu" und die 10 für "ich stimme völlig zu". *

Bitte wählen Sie die zutreffende Antwort für jeden Punkt aus:

	garnicht 1	2	3	4	5	6	7	8	9	völlig 10	ich kann die Frage nicht beantworten
Ich halte das für möglich.	○	○	○	○	○	○	○	○	○	○	○
ich halte das für wissenschaftlich belegbar.	○	○	○	○	○	○	○	○	○	○	○

21 []

Person I kann sich im luziden Traum dazu entscheiden, die wahrnehmbare Welt zu verlassen und eine Reise ins Jenseits/ in eine andere Wirklichkeit zu machen. Nach dem Aufwachen sagt die Person, sie sei tatsächlich im Jenseits gewesen.

Bitte wählen Sie auf der Skala von 1 bis 10 die Möglichkeit, die Ihnen am passendsten erscheint. Die 1 steht für "ich stimme garnicht zu" und die 10 für "ich stimme völlig zu". *

Bitte wählen Sie die zutreffende Antwort für jeden Punkt aus:

	garnicht 1	2	3	4	5	6	7	8	9	völlig 10	ich kann die Frage nicht beantworten
Ich halte das für möglich.	○	○	○	○	○	○	○	○	○	○	○
ich halte das für wissenschaftlich belegbar.	○	○	○	○	○	○	○	○	○	○	○

Teil 4 von 4: Hintergrund

Hier werden Sie gebeten noch einige Fragen über sich zu beantworten.

22 []

Sind Sie männlich oder weiblich? *

Bitte wählen Sie nur eine der folgenden Antworten aus:

- ○ weiblich
- ○ männlich

23 []

Wie alt sind Sie? *

Bitte geben Sie Ihre Antwort hier ein:

24 []

Welchen Beruf üben Sie aus? *

Bitte geben Sie Ihre Antwort hier ein:

25 []

Sind sie momentan Wissenschaftlich tätig? (Sie sind wissenschaftlich tätig, wenn Sie zum Beispiel an einer Universität oder Forschungseinrichtung arbeiten oder studieren.)

***

Bitte wählen Sie nur eine der folgenden Antworten aus:

- ○ Ja
- ○ Nein
- ○ Ich kann die Frage nicht beantworten

26 []

Welches ist ihr höchster Bildungsabschluss? *

Bitte wählen Sie nur eine der folgenden Antworten aus:

- ○ Hauptschulabschluss
- ○ Realschulabschluss
- ○ Abitur/Fachabitur
- ○ Universitätsabschluss
- ○ Promotion
- ○ Professur
- ○ Ich kann die Frage nicht beantworten

27 []

Würden Sie sich als auf irgendeine Art gläubig/ spirituell bezeichnen?

(unabhängig davon zu welcher Glaubensrichtung oder Weltanschauung Sie sich zählen)

***

Bitte wählen Sie nur eine der folgenden Antworten aus:

- ○ garnicht
- ○ fast garnicht
- ○ eher weniger
- ○ eher ja
- ○ sehr
- ○ völlig
- ○ Ich kann die Frage nicht beantworten

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Möchten Sie uns noch irgendetwas mitteilen, oder einen Kommentar abgeben?

Bitte geben Sie Ihre Antwort hier ein:

6.4 Data and Matlab Files

I transfer the used data sets and analysis files to the work group around Prof. Dr. Gordon Pipa. These can be found on the attached CD.