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Formal and Content-Related Characteristics of Dreaming and their Associations with Cognitive and Emotional Development amongst 4-8 Year-Old Children

Doctoral dissertation

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“Our life is composed greatly from dreams from the unconscious and they must be brought into connection with action. They must be woven together”

Anaïs Nin

DOI:10.14753/SE.2016.1935

Contents

DOI:10.14753/SE.2016.1935

DOI:10.14753/SE.2016.1935

DOI:10.14753/SE.2016.1935

List of Figures

DOI:10.14753/SE.2016.1935

DOI:10.14753/SE.2016.1935

List of Tables

DOI:10.14753/SE.2016.1935

List of Abbreviations

AAI: Adult Attachment Interview (see: 1.7.1.2: Measurement and Continuity of Attachment).

AIM: Activation- Input Source-Modulation model of Hobson & Friston (see:1.3: Theories of Dreaming and their Developmental Implications).

ANT: Attention Network Test by Fan et al. (see: 3.2.5: Measures of Executive Functioning).

B-H: Benjamini-Hochberg statistical control for Type I error (see: 3.3: Data Analysis).

CPM: Raven's Coloured Progressive Matrices (see: 3.2.4: Measures of Intelligence).

CSHQ: Child Sleep Habits Questionnaire (see: 3.2.7: A Measure of Sleep Quality).

EEG: Electroencephalogram or Electroencephalography (see: 1.1.1: Sleep Patterns and their Development).

EII: Emotional Interference Index of the Emotional Stroop Test (see: 3.2.5: Measures of Executive Functioning).

II: Incongruency Index of the Modified Fruit Stroop Test (see: 3.2.5: Measures of Executive Functioning).

MCAST: Manchester Child Attachment Story Task (see: 3.2.6: Measures of Attachment and Emotional Regulation).

NREM: Non Rapid Eye Movement phase of sleep (see: 1.1.1: Sleep Patterns and their Development).

REM: Rapid Eye Movement phase of sleep (see: 1.1.1).

S1, S2: NREM sleep stage1 and stage2 (see: 1.1.1: Sleep Patterns and their Development).

SDQ: Strength and Difficulties Questionnaire (see: 3.2.6: Measures of Attachment and Emotional Regulation).

SST: Strange Situation Test (see: 1.7.1.2: Measurement and Continuity of Attachment).

SWS: Slow wave sleep or deep sleep (see: 1.1.1: Sleep Patterns and their Development).

WISC IV: Wechsler Intelligence Scale for Children – Fourth Edition (see: 3.2.4: Measures of Intelligence).

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1 Introduction

1.1 Sleep and Dreaming from a Developmental Perspective

1.1.1 Sleep Patterns and their Development

The two most obvious states of consciousness during everyday life are the states of wakefulness and sleep. Sleep itself is divided into rapid eye movement (REM) sleep and non-REM (NREM) sleep. NREM sleep is characterized by low frequency high voltage electroencephalographic (EEG) activity, low muscle tone, the absence of eye movements, and regular heart and respiration rates. It can be further divided into 3 sleep stages based on distinct EEG features: stage1 (S1), stage2 (S2) and slow wave sleep (SWS or deep sleep) (Jenni & Dahl, 2008).

NREM is shown to enhance cortical plasticity and learning (Frank, Issa, & Stryker, 2001).

REM sleep is characterized by high levels of desynchronized mixed frequencies, relatively low voltage EEG activity, muscle atonia, irregular heart rate and respiratory patterns, and rapid saccadic eye movements (Jenni & Dahl, 2008). REM sleep provides the most favorable brain conditions for dreaming (Hobson & Pace-Schott, 2002), has emotional processing and mood regulatory functions (Stickgold, Hobson, Fosse, & Fosse, 2001; Walker & van der Helm, 2009), and was found to play a critical role in the consolidation of procedural but not declarative memory (Smith, 2001).

Nowadays the intertwined nature of sleep and waking states is widely recognized. Sleep is involved in a restorative metabolic function of the brain (Tononi & Cirelli, 2003) and plays a fundamental role in memory consolidation and learning facilitating brain plasticity (Hobson & Pace-Schott, 2002; Stickgold, 2005).

Sleep proceeds in cycles of REM and NREM sleep, in the order of: S1 (sleep onset), S2 (shallow sleep), SWS (deep sleep), S2, REM sleep. The distribution of states is unequal during the course of sleep, with more abundant SWS in the first half and more frequent and longer REM phases towards waking (Jenni & Dahl, 2008).

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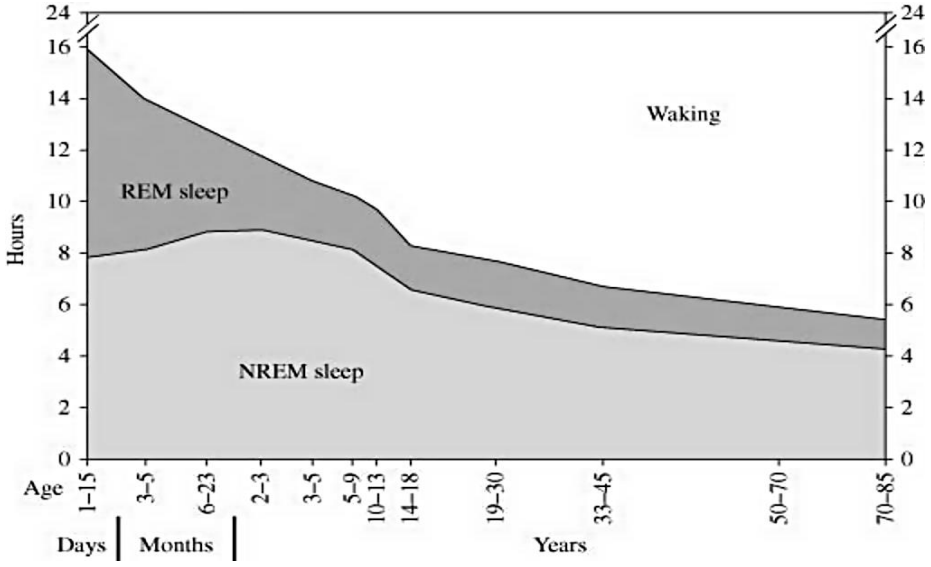

Figure 1. Sleep duration, REM and NREM sleep as a function of age (Huber & Tononi, 2009, p.471).

Developmental changes in sleep patterns occur in many aspects of sleep, for example:

- Newborns spend up to 16 to 20 hours asleep, which time is divided evenly between REM and NREM sleep (see Figure 1). Total sleep duration decreases across the first years of life including the gradual disappearance of daytime naps (Sadeh, 2008).
- The proportion of REM sleep decreases continuously throughout early childhood until in school-age it reaches the adult levels of 20-25% of total sleep time. Additionally until the 3rd month of age the initial sleep phase (at sleep onset) is REM sleep (Jenni & Carskadon, 2007).

1.1.1.1 Dreaming in the Context of the Development of Sleep

Sleep itself, which is the natural physiological background state of emerging dream experiences, follows well determined developmental trajectories (Dan & Boyd, 2007; Danker-Hopfe, 2011; Eisermann, Kaminska, Moutard, Soufflet, & Plouin, 2013). One could thus infer that the ontogeny of dreaming is governed by the major steps observed in the ontogeny of sleep, yet this is not actually the case. However, some remarkable associations between non-invasive indices of several sleep-related physiological processes and formal as well as content-related aspects of dreaming are evident from the literature.

A major breakthrough in the scientific investigation of dreaming was the discovery of rapid eye movement (REM) sleep related behaviors and their associations with dream experiences (Aserinsky & Kleitman, 1953). REM sleep possibly emerges at a very young age since the neurons responsible for lateral eye movements myelinate at an early stage of fetal development (Staunton, 2001). Later the newborn spends 50% of its sleep time in REM sleep that has been proven to be closely connected with the intensive neural development at this age (Jenni & Dahl, 2008). This fact made some scientists conclude that dreaming also occurs in this early age, and that it has a similarly important role in development (Staunton, 2001). Infants' REM sleep however differs from that of adults' both in EEG and in behavioral characteristics (Grigg-Damberger et al., 2007), thus its presence per se does not prove the existence of dreaming. According to some authors the elements of REM sleep gradually merge together throughout prenatal and postnatal development to form the more solid and distinct characteristics of adult REM sleep (Blumberg & Lucas, 1996). Therefore dreaming may go through a similar development, implying a gradual increase in component cohesion. What we know is that the intensity and vividness of dream experiences are related to the intensity of rapid eye movements during sleep (Berger & Oswald, 1962; Hong et al., 1997), which was also shown to be reliable in 5-8 year-old children (Foulkes & Bradley, 1989). Eye movements during REM sleep are negative measures of actual sleep need (Aserinsky, 1973; Lucidi et al., 1996), and parallel an observed reduction of dream recall in recovery sleep after sleep deprivation (De Gennaro et al., 2010). In accordance with the deeper sleep and increased sleep need in young ages, REM sleep eye movement activity is relatively low in children and is less organized in discrete bursts (Quadens, 2003). Thus, less vivid and less intense dreams, as well as lower dream recall frequency, would be predicted based on this physiological measure. Similarly, EEG coherence during wakefulness was shown to be reduced in childhood, referring to lower neural connectivity due to immature neural organization (Als et al., 2004; Barry et al., 2004; Grossmann & Johnson, 2007). As REM sleep and wakefulness share many EEG features, the inference that there is a reduced EEG coherence during REM sleep in children has strong indirect support. Since REM sleep EEG coherence was shown to correlate positively with emotions and reports of explicit face imagery in dreams

(Nielsen & Chénier, 1999), it is reasonable to assume that explicit faces and specific emotions are relatively rare in children's dreams.

On the other hand, REM sleep theta (EEG frequency band between 4 and 8 Hz) power, shown to predict successful dream recall (Chellappa, Frey, Knoblauch, & Cajochen, 2011), is known to be high in children, and decreases during development (Feinberg & Campbell, 2013). Therefore we would expect a higher dream recall rate in children, which not only contradicts the previous assumptions, but numerous empirical investigations as well which suggest a lower dream recall rate in children.

The above inconsistencies and limited correlations of the psycho-physiological approach to dream research suggest that a descriptive analysis of dream reports in different age groups has its own merits in increasing the scientific understanding of the ontogeny of dreaming.

1.2 REM sleep, Dreaming, and Neural Development

REM sleep is associated with vivid oneiric experiences in adults and in verbal-aged children. Since REM sleep has a defined developmental pattern from foetal age to adulthood, some authors assume that the case is similar for dreaming as well (Staunton, 2001). Others assume that dreaming is a cognitive achievement dependent on the maturation of the visuospatial fields of the brain, and thus the formation of dreams is impossible for children with underdeveloped visuospatial skills, which is approximately until the age of 2 years (Foulkes, 1982, 1999). In fact the formation and development of human dreaming is still unknown in spite of inspiring results from adult dream research that associates dreaming with emotional and cognitive development as well as neural connectivity (Levin & Nielsen, 2009; Maquet et al., 1996, 2005; Nielsen & Levin, 2007).

REM sleep appears at an early stage of foetal development and plays an important role in neural maturation in childhood (Jenni & Dahl, 2008). Although, we do not know whether REM sleep in infancy is already associated with dreaming or if dreaming is a later-accomplished ability that develops on the basis of some cognitive and emotional skills, it is evident from research so far that dreaming and dream narratives in children develop parallelly to some cognitive, intellectual and social abilities (Colace, 2010;

Foulkes, 1982, 1999). On the other hand, dreaming is not necessarily associated with REM sleep as according to Solms (2003) it is initiated through a dopaminergic forebrain mechanism that is independent from the cholinergic brain stem mechanism that controls REM sleep. If this is the case the maturation of the forebrain mechanism could serve as a basis for predictions about the development of children's dreams. This latter possibility has not yet been investigated, but would also suggests the close connection between neuro-psychological development and the ontogeny of dreaming. Neuro-anatomical and cognitive as well as socio-emotional evidence suggests that the investigation of dreaming in childhood could contribute to the field of developmental neuroscience and human consciousness.

1.3 Theories of Dreaming and their Developmental Implications

Finding developmentally relevant implications in dream theories is not an easy quest, since these theories are mostly developed based on adult research and theorists rarely include relevant thoughts about developmental maturation. The only dream theory primarily based on developmental data is David Foulkes' developmental-cognitive dream theory (Foulkes, 1982, 1985). As content-related and organizational aspects of dreams were shown to mirror the stages of cognitive development described by Piaget (1976), and the waking correlates of dreaming were mainly cognitive and visuospatial in nature, Foulkes concluded that dreaming reflects the visual-constructive abilities of the children. From this view dreaming is considered to be merely a gradually-developing cognitive achievement showing parallel progression with the developmental stages of the theory of Jean Piaget (1976).

One of the first theoretical frameworks explaining the phenomenology of dreaming was developed by Freud (1913). The core of his hypothesis is that the psychological energy that in waking time normally flows from the perceptual towards the motor subsystems is reversed during sleep (due to the inhibition of the motor output) so that it flows from the unconscious wishes and memories to the perceptual side of the psychological system, and manifests in vivid imagery called dreaming. At the same time the censorship model states that unconscious wishes and content that infiltrate into dreams are incompatible with the rules of the superego functions. This implements a censorship on the dream

content making it unrecognizable and thus producing strange, complex, bizarre dream content. Since the superego develops relatively late during maturation of the child, the theory is a plausible explanation of Freud's own observations on children's dreams, namely that they are short, simple and transparent regarding unconscious wishes, lacking bizarreness.

One of the most cited dream theories is the activation-synthesis hypothesis (or activation- input source-modulation (AIM) model; Hobson & Friston, 2012), which states that dreams are the results of burst-like cholinergic activation originating from the brainstem, which creates a relatively activated environment that is accompanied by monoaminergic demodulation which together result in random bizarre hallucinatory brain activity. This vivid activity is perceived as meaningful and interpreted within the framework of previously stored memories and interpretation schemes, which is denoted as synthesis in the model (Hobson, 1977).

Another well-cited theory, the neuro-psychoanalytic model of Mark Solms (1997) contradicts the above hypothesis and claims (based on clinical studies and case reports of brain damaged patients) that REM sleep is a neither necessary nor sufficient condition for dream production. Moreover, it claims that specific forebrain mechanisms, including higher order cortical areas, are crucial in dream production. It also supports the topographical model of Freud, since the reverted information flow compared to wakefulness can be observed during dreaming: heteromodal associative cortices are activated first, while activation of secondary and primary sensory cortices comes last (backward projection mechanism).

Interestingly none of the latter two theories mention developmental aspects of dream production. However since higher order associative cortices are late-maturing anatomical structures, this could give a basis for specific predictions about dream development. On the other hand, within the framework of the activation-synthesis hypothesis the process of interpreting random activation patterns and associating them with existing memory traces (synthesis) could be a developmentally sensitive process. To the contrary, authors rather emphasize the random physiological activation as age-independent conditions determining the bizarreness of dreams, arguing against the

simplicity and realistic nature of the plots predicted by the psychoanalytic and cognitive-developmental theory.

A recent but developmentally relevant theory emphasizes the continuity between wakeful mind-wandering and dreaming. Domhoff & Fox in a recent review (2015) suggest a common neural basis for involuntary but organized mental acts appearing within different states of consciousness; namely the default network of the brain. Dreaming is interpreted as an enhanced version of waking mind-wandering since both states are supported by the active default network, which includes the medial prefrontal cortex, the posterior cingulate cortex, the medial-temporal lobe and the temporo-parietal junction. According to recent results, some of these hubs are even more active during REM sleep than at waking rest. The default network undergoes significant changes during development which includes a sparsely connected (fragmented) network at school age, which becomes significantly more integrated upon reaching adulthood (Fair et al., 2008). It is plausible that these changes would have a consequence on the appearance and characteristics of dreaming from childhood to adulthood.

1.4 Methods of Dream Research

In developmental dream research it is highly important to be familiar with the different data collection methods used in the studies since the results obtained in different settings using different methodology can be strikingly different, especially in the case of young children. We also have to be aware of the development of children's cognitive and emotional skills needed to report a highly intimate and personal dream event, experienced in a mental state distinct from the wakeful state of the dream report. This section briefly introduces the different methods and settings used in developmental dream research, and summarizes possible confounders affecting dream reports in children.

1.4.1 Laboratory Studies

The method usually consists of EEG monitoring with systematic REM (and/or NREM) awakenings and instant dream reports to the laboratory assistant personally (3-5 year-olds in Foulkes' study (1982) or via intercom. The most extensive laboratory investigation series was carried out by David Foulkes including a longitudinal study

(Foulkes, 1982, 1999) (children from 3 to 15 years) and several cross sectional ones (Foulkes, Hollifield, Sullivan, Bradley, & Terry, 1990; Foulkes, Larson, Swanson, & Rardin, 1969; Foulkes, Pivik, Steadman, Spear, & Symonds, 1967; Foulkes, 1967, 1979). Laboratory studies are considered the most neutral, unbiased and controlled way of dream collection by Foulkes (Foulkes, 1999) and many others since his works (Burnham & Conte, 2010). However results in dream characteristics especially in case of preschool aged children significantly differ in his laboratory studies from those carried out in other settings. Foulkes' explanation is that these dream report differences are due to a recall bias towards the exciting and emotionally important memories of morning awakenings and the confabulatory tendency that tends to fill in the gaps in the storyline (Foulkes, 1979) in both school and home studies. Others point out the possible detrimental effects of the unusual laboratory environment so that children may have difficulties talking about their dreams to the unknown interviewer, the environment may disorient them and cause them to forget their dreams (Resnick, Stickgold, Rittenhouse, & Hobson, 1994) or they may even be inhibited in experiencing the dreams themselves (Domhoff, 1969). Moreover, reading through the example dreams collected on nocturnal awakenings, one notices that some of the young children are simply unable to completely wake up for the interview. For example it is obvious from the transcript that Johnny (3-year- and 3-month-old), whose dream is the well cited *"Fish in a bowl on the riverside",* was half asleep during the interview, which made the interviewer eager to handle the situation and to be more suggestive than necessary. The following is a quote from the interview [Foulkes & Shepherd, 1971, pp. 24-26]:

"Examiner: Johnny. Hi. What were you dreaming about?
Johnny: (mumbles)
E: What? What were you dreaming about?
J: Fish.
E: What were the fish doing?
[…]
E: What about the dream of fish? What were they doing?
J: Just floating around.
E: Just floating around in the water?
J: Huh….

[…]

E: Were these fish in a river or were they just in a bowl? Like in somebody's living room.

J: In a bowl.

E: Where was this? Was it in somebody's house?

J: yeah.

E: Whose house was it?

[…]

J: Just on the side.

E: Was it a piece of furniture? Like on the table?

J: On this side I think.

E: On the side of what?

J: On the side of a river.

[…]"

The lack of full arousal during the dream interview could explain the short and mundane characteristics of Foulkes' dream reports, as well as the frequent appearance of fatigue and sleep as dream topics (25% of reports) of young children (Foulkes, 1982). The phenomenon of unsuccessful arousal from sleep during the night turned out to be a reported confounder in Resnick and colleagues' study (Resnick et al., 1994), where they wanted to collect dreams in a home setting by systematic nocturnal awakenings, with little success.

1.4.2 Home-based Studies

In a typical home arrangement one of the parents is trained to carry out a structured dream interview with the child upon either spontaneous or scheduled morning awakenings (Colace, 2010; Resnick et al., 1994). In older ages the children might carry out the interviews themselves and tape record them (Strauch & Lederbogen, 1999). These are the typical equivalents of written dream diaries of adults, that latter are sometimes used with children as well, especially under situations where equipment for recording could be difficult to access (Helminen & Punamäki, 2008; Punamäki, Ali, Ismahil, & Nuutinen, 2005). On the one hand this setting may offer security to the children (home environment, the presence of the parent) and facilitate the process of dream recall; on the other hand, some reliability questions arise. Could a parent be a

proper interviewer? Parents may feel certain expectations regarding their child's dreaming (Foulkes, 1999) and pressure the child to serve the assumed needs. Some authors claim that parents can be reliable interviewers if they receive adequate training beforehand, furthermore recording the entire course of the interview allows the researcher to control parental influence on the dream report (Resnick et al., 1994). Another concern could be the scientific comparability of dream interviews coming from different parents with various personalities and relationships with their children.

There is still an extensive debate amongst researchers regarding the differences in dream content resulting from home studies compared to laboratory studies. Both adult and developmental results show diversions with home dreams tending to contain more aggressive interactions and being generally more dramatic than laboratory dreams (Domhoff, 1969; Domhoff & Kamiya, 1964; Foulkes, 1979; Hall & Van de Castle, 1966; Resnick et al., 1994; Weisz & Foulkes, 1970). Some opinions and results are controversial (Foulkes, 1979).

1.4.3 School-based Studies

In a school environment (preschool, primary or secondary school) typically a researcher or a caregiver would carry out the interview either individually (Beaudet, 1990; Colace, 2010; Honig & Nealis, 2012; Muris, Herckelbach, Gadet, Moulaert, & Merckelbach, 2000) or in a group setting (Adams, 2001). When dealing with very young children (2-year-olds) researchers might use rather dramatic means of reporting such as free play sessions (Despert, 1949). Most authors choosing this method emphasize the benefits of the good relationship between the interviewer and the children, which is free of parental suggestions and expectations toward dreaming, but provides a safe environment. School interviews usually take place over one or two sessions, however some settings allow children to report their current dreams over a period of time (Honig & Nealis, 2012). Either way, the major drawback of this method is the time lapse between the interview and the dream experience.

1.4.4 Questionnaire-based Studies

The palette of questionnaire based assessment is very wide. It is commonly used when the focus of examination is on a specific aspect of dreaming - most typically nightmares

and bad dreams (Li et al., 2011; Nielsen et al., 2000; Schredl, Blomeyer, & Görlinger, 2000; Schredl, Pallmer, & Montasser, 1996; Simard, Nielsen, Tremblay, Boivin, & Montplaisir, 2008). It gives an opportunity to request a written account of a specific dream experience, which is typically the "last remembered dream" (Avila-White, Schneider, & Domhoff, 1999; Crugnola, Maggiolini, Caprin, Martini, & Giudici, 2008; Kimmins, 1920; Oberst, Charles, & Chamarro, 2005; Saline, 1999). The questionnaire form is also used to elicit formal characteristics of children's dreams (Colace, 2006).

Questionnaires are cost effective and allow large quantities of data to be examined. Their major drawback is that the obtained data are indirect and less connected in time to the dream experience, making questionnaires potentially less reliable than interview methods. Another dilemma concerns the source of information, which has to be the parent in case of young subjects (Colace, 2006; Simard et al., 2008). Evidence shows that parents tend to underestimate the frequency of children's nightmares (Schredl, Fricke-Oerkermann, Mitschke, Wiater, & Lehmkuhl, 2009a), and possibly introduce other biases. Written information can be obtained reliably from children in the preadolescent and adolescent age, however under the age of ten years the "last remembered dreams" data are considered to be less reliable, mostly because children tend to use their waking imagination in creating or augmenting dream reports (Domhoff, 2003). However using an adequate sample size and age group this method has been shown to be useful when comparing its results to previous findings (Avila-White et al., 1999; G William Domhoff, 1996).

1.4.5 Credibility of Children's Dreams

Amongst the various methodological concerns that developmental dream researchers face, the evaluation of dream report credibility is a central issue.

Characterizing children's understanding of dreaming as a phenomenon has challenged researchers since Piaget, who claimed that children only achieve a full picture of the non-physical, private, internal nature of dreams by the age of 11 years (Piaget, 1929). Contrary to Piaget's findings current research from Woolley and Wellman (1992) found that children as young as 3 years old can understand dreams as being non-physical, internal, and unavailable to public perception. These latter findings are confirmed by Meyer and Shore (2001), who concluded that 4 to 5 year-old children increasingly

understand that dreams are personal constructions and are not part of the external word. While Piaget found that preschoolers believed that dreams come from outside the dreamer, Woolley et al.'s (Woolley & Boerger, 2002) findings reveal *"an impressive understanding of the origin of dream contents by four and five year olds"*[p. 27], confirmed by Kinoshita (1994) who found that preschool aged children were able to distinguish dream entities from real entities. Similarly young children turned out to be surprisingly good at differentiating between reality and fantasy (Sharon & Woolley, 2004), and even 4-year-olds were able to use mental categories to define dreams (Cassi, Pinto, & Salzarulo, 1999).

The problems of dream report accuracy and possible distortions during recall raise questions about certain cognitive abilities in children. Researchers approach the question of recall from the direction of memory tasks relating to daytime verbal and visual memory performance, with varying results. Although Foulkes (1999) did not find any relationship between memory and dream recall frequency, Colace (2010) found a correlation between long term memory and the bizarreness of dreams in case of the youngest age group (3-5 year-olds). Verbal abilities and sociability were found to have a role in report frequency (Foulkes, 1999) and bizarreness (Colace, 2003, 2010) in the 3-5 year-old group. However, Foulkes remained skeptical about the reliability of dream reports from children under 5 years, because gregariousness but not the expected cognitive skills predicted the report rate, and dream report frequency did not increase with age as expected (in fact 3-year-olds reported more dreams than 5-year-olds). Consequently one could assume both memory and verbal skills as possible moderating factors of young children's dream reports, but as these abilities develop their influence on report frequency or bizarreness diminishes.

As language assists children in distinguishing objects and in structuring their perceptual field, verbal and symbolic abilities may also affect dream narrations in a different aspect. According to Bauer (1976), the lack of an optimal differentiation between internal representations and objective reality in preschoolers is reflected in their dream descriptions. In his interview-based study preschoolers tended to identify the appearance (or another arbitrary characteristic) of the object as a sufficient condition for them to be regarded as fearful, for example: *"His face looked ugly"* [p.72]. Older children tended to specify the aggressive actions and causes in more detail as to why

they find an object frightening. This phenomenon may occur as children might not differentiate between symbols from actions or objects they represent. This may explain why most studies found children's dreams to be particularly short and undetailed, and possibly described by only one dream scenario. Especially given that dream report frequency in the youngest age group was correlated with social and verbal skills (Foulkes, 1999), it is possible that these children pick a reasonable, important, or emotionally significant aspect of their dream content when they report their dream narratives (Bauer, 1976).

On the other hand, emotional load in dreams may influence children's dream narratives in a negative way. Despert (1949), in her nursery-based study, points out that sometimes dreams are heavily loaded with feelings that could not be tolerated in waking life. According to her conclusions this intolerance supposedly has a role in the phenomenon that sometimes children with such dream content will refuse to reveal the dream material. This issue has to be faced when studying children's dreams and nightmares, especially for young ages and when the primary sources of information are the mothers.

So far evidence tends to demonstrate children as somewhat limited but still competent dream reporters. But the question remains: to what extent does waking fantasy fill in the gaps in the storyline of dreams? This is the question that the researcher has to decide subjectively since, as Foulkes noted (1999) *"there is no absolute way to verify dream reports, whether those of children or adults"* [p.34]. However researchers should try to establish certain reference points which may help to operationalize this dilemma (Colace, 1998, 2010).

1.5 Overview of the Development of Dreaming

The major components of the emerging psychological architecture of human beings have been shown to be characterized by a specific developmental pattern. Thus we could infer that dreaming can be characterized by a specific psychogenesis as well. The results regarding the sequence of events involved in the development of dreaming however are strikingly controversial. Even the descriptive level of dream analysis seems to be hampered by methodological difficulties, thus there is no consensus on whether

dreams are significantly different amongst age groups and what the specific nature of this difference is.

Striving for a clearer picture, below we summarize scientific results related to children's dreaming, and systematically analyze the findings based on different methodologies, since the research method chosen has a significant impact on the results and conclusions.

1.5.1 Preverbal and Early Verbal Dreams (0-3 year-olds)

Investigation of preverbal children's dreams is rather limited, restricted mainly to observational studies based on Freudian theories mostly from the first half of the twentieth century (see for review: Ablon & Mack, 1980; Murray, 1995; Wilkerson, 1981).

1.5.1.1 Observational Studies and their Relevance

Observation was a frequently used approach in early studies that focused on dreaming in early childhood. Such studies aim to infer the inner experience of dreaming by observing the children and the overlap between their daytime and nighttime behaviors. Some of these reports are anecdotal, but might contribute to the overall understanding of the largely neglected field of developmental dream research.

One of the first published observers of children's dreams is Freud, who based his conclusions on his own and friends' children's spontaneous morning dream reports and words spoken during their sleep (Freud, 1913). According to Freud, young children's dreams are short and simple, are based on experiences from the preceding day, and usually deal with emotions that are intensive or unprocessed reminiscences of daytime events. These dreams are usually free from distortions and bizarre elements until about the age of 5. Following Freud's oeuvre in the early 1900's, observational studies became popular amongst psychoanalysts. Their main focus was to investigate those questions that Freud left unanswered: when do we start to dream and what nature could the early preverbal dreams have? Numerous authors moved away from Freud's original idea of dreams having a primary purpose of wish-fulfillment towards the broader concept of re-experiencing emotionally intensive or demanding situations thus helping the dreamer deal with emotional material.

One of these early observations of putative dream experiences in infancy is from von Hug-Hellmuth (1919) who recognized the splashing movements and laughter of a nearly 1-year-old girl in her sleep as being identical to those of the previous day playing in the pool. Grothjahn (1938) observed a 2-year-4-month-old boy in his sleep and also his waking life, finding similar overlaps between his activities in the two different states of consciousness. These similarities were also confirmed by the boy's own verbal reports of his dreams. The author concludes: *"... [numerous dreams] would indicate that the child was struggling with strong and strange emotions which he could not work through during the excitement and rapidity of reality"* [p. 512]. Other authors also found very close connections between young children's dreams and their everyday life, emotional events and difficulties (see Erickson, 1941; Niederland, 1957).

One of the first observers, Piaget (1999) was somehow more cautious about concluding the presence of mental imagery linked to nighttime behavior patterns. He claimed that the first dreams occur around 1.9-2 years of age, when children are able to confirm their nighttime behavior by telling about the dream in the morning. His observations were supported by a laboratory study, which showed that 2-year-olds were able to report their dreams on nighttime awakenings (Kohler, Coddington, & Agnew, 1968).

Observational studies on children's nightmares and bad dreams also emphasize their importance in emotional processing and development. A good example of this is a case study by Anderson (1927), who considered the nightmare of a 2-year-8-month-old girl as a reconditioning of a previous fearful experience. The girl had had a frightening experience with a black dog one year before the dream, resulting in a fear of black dogs which later disappeared. After the nightmare (triggered by an awake encounter with a dog), her fear reappeared and extended to all dogs in general. Here the dream acted as a means of releasing an emotional response that was inhibited in her waking life and had the effect of reconditioning the fear reaction. Likewise Fraiberg (1950) considered nightmares as one of the symptoms typically appearing following traumatic events during the second year of life. These observational reports obviously are not enough to prove the dream experience itself, which is why these early authors tried to find out as much as possible about the child's everyday experiences, family life, emotional and cognitive development. Modern sleep research indirectly supports this method by showing that dream-enacting behaviors are prevalent in healthy subjects and are

independent of other parasomnias such as nightmares and sleepwalking (Nielsen, Svob, & Kuiken, 2009). These studies have many methodological shortcomings: they are neither systematic nor controlled and sometimes rely solely on the parents' observation reports. On the other hand, they provide a very important aspect of dream research; the personal experience and roles of specific dreams in one's life, which quantitative research involving large number of subjects cannot consider.

1.5.1.2 An Early Fusion of Quantitative and Observational Research

Despert's (1949) systematic research is unique in using individual play sessions as an interview frame. The study involved 190 dreams of 39 children between the ages of 2 to 5 years and found that all of the frequent dreamers were amongst the anxious children; however those anxious children, who were inhibited in their daytime behavior, play and imagination, did not report any dreams at all. In the collected dreams most of the dominant characters were humans, which, if other than parents, were usually put in fearful roles. In Despert's sample *"unpleasant dreams far outnumbered pleasant ones"* [p.170], and she found that 2-year-olds mostly dreamt about being bitten, devoured and chased. According to the author dreams serve as an outlet for the discharge of anxiety and aggressive impulses which would not be tolerated during the conscious state. This intolerance supposedly has a role in the phenomenon that sometimes children with such dream content will refuse to reveal the dream material. This issue has to be faced when studying children's dreams and nightmares, especially in young ages and when the sources of information are the mothers.

1.5.1.3 Foulkes' Contribution to the Dreaming of Children Under 3 Years

Foulkes (1999) found that neither memory nor verbal skills but only cognitive visuospatial abilities were in significant and consistent relationship with dream recall frequency throughout the age groups of 3 to 15 year-old children. His conclusion is that the maturation of certain cognitive functions, especially visuospatial abilities, are necessary for dream production, and thus young children (under the age of 3) are not likely to be capable of dreaming at all (Foulkes, 1987). This inference caused an extensive debate amongst dream researchers over the nature of dreaming.

1.5.2 Preschoolers' Dreams (3-5 year-olds)

Preschoolers' dreams, due to verbal improvements, are well studied using various methods including laboratory interviews (Foulkes et al., 1990, 1969; Foulkes, 1967, 1979, 1982, 1987, 1999), home dream interviews (Colace, 2010; Resnick et al., 1994), questionnaires (Colace, 2006; Hawkins & Williams, 1992) and kindergarten interviews (Bauer, 1976; Colace, 2010; Despert, 1949; Honig & Nealis, 2012; Kimmins, 1920; Muris et al., 2000).

1.5.2.1 Laboratory Interviews

In Foulkes' studies the dream reports of 3 to 5 year-olds are infrequent (17% of REM awakenings) and brief (average 14 words). They usually lacked a narrative or storyline, movements or actions (static imagery), an active self-character, human characters or interactions and feelings in their dreams. Instead they frequently dreamt about body-state themes, especially those relating to a sleeping self, and about animals. Typical dreams of this age were *"I was sleeping in the bathtub"* or *"I was sleeping in the co-co stand, where you get Coke from"*. According to Foulkes the strikingly barren nature of these dream reports represents children's habitual dream life since spontaneous morning dream reports are selected by recall bias towards the exciting and emotionally important memories showing dreams much more colorful than they usually are (Foulkes, 1979).

1.5.2.2 Dream Interviews at Home

Two studies conducted in home setting yielded somewhat different results to those of the laboratory studies (see Table 1). In Colace's (2010) study the dreams tended to be longer (mean word count: 35 words), moreover Resnick and colleagues (Resnick et al., 1994) found no difference in dream recall frequency between the 4 to 5 and 8 to 10 year-old age groups (56% and 57%, respectively). Thus only the younger age group differs compared to Foulkes' findings (17%), even though they measured report frequency of morning recall and not of REM awakenings. One of the most striking differences is the frequency of active self-participation in the dreams, which reached 85% in the younger age group (Resnick et al., 1994). Resnick also found that the most frequent characters in young children's dreams were family members (29% of all characters) and other known children (28%). To illustrate the above, we cite the dream report of a 3 year- and 6 month-old child: *"I dreamed that I woke you up [the mother]*

and caressed you, gave you a little kiss and hugged you, and then gave a kiss to dad." [Colace, 2010, p.105]

In contrast to laboratory findings (Foulkes found no distortions in settings and characters; Foulkes, 1982) both studies reported some bizarreness in the dreams of young children, although using different methods of assessment. Using their own bizarreness scale Colace and colleagues (Colace, Violani, & Solano, 1993) found bizarre elements in 19% of the dreams of this age group. On the other hand, Resnick found that 34% of the reports contained bizarre elements among the 4 to 5 year-olds using Hobson's rating system (Rittenhouse, Stickgold, & Hobson, 1994). It is interesting to note that amongst the 3 categories of bizarreness (discontinuities, incongruities, and uncertainties) 'uncertainties' were totally absent among preschoolers, while in the older age group it counted for one third of the bizarreness scores.

1.5.2.3 Dream Interviews at the Kindergarten

These studies yielded similar results to those of the home interviews, challenging Foulkes' conclusions. They agree that most dreams of 2 to 5 year-olds contain an active self (59.4% (Honig & Nealis, 2012)) and human characters (80% (Beaudet, 1990), main characters were family members in 30%, strangers in 10.5% and friends in 3.5%, while 43% included animal characters (Honig & Nealis, 2012)), that almost all of them depict motion and activities (81.2% (Honig & Nealis, 2012)), and that feelings appearing in the dreams are common (in 75.9% (Honig & Nealis, 2012)). They also found young children's dreams to be short and simple, typically consisting of only one sentence, but the content appears much more diverse than that in Foulkes' studies. Below is the dream report of a 3 year- and 5 month-old boy who dreams of seeing his deceased grandmother in the form of a soft toy, demonstrating the emotional relevance and the bizarreness that young children's dreams could possibly include: *"I dreamed the bunny and the she-bunny, now the she-bunny was grannie and she was with C [the boy's younger sister] and the blue bunny was with me…"* [Colace, 2010, p.171]

1.5.2.3.1 Fears and Scary Dreams

Scary dreams and nightmares were found to be prevalent as 74% of the preschoolers (4-6 year-olds) reported having scary dreams (Bauer, 1976). Typically scary dreams of

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preschoolers were found to be about imaginary creatures, personal harm and animals, according to Muris and his colleagues (Muris et al., 2000). At the same time frequent nightmares showed no or little relationship with life events and behavioral problems but were associated with fears of going to bed, night terrors, snoring and sleep talking (Hawkins & Williams, 1992). Similarly, Jersild et al. (Jersild, Markey, & Jersild, 1933) also found that children's unpleasant dreams reflect subjective fears, rather than objective life experiences. Since the nature of fears and bad dreams seem to be closely connected, the above mentioned pattern of fears might be linked to children's dream reports through linguistic and symbolic development, as described in section 1.4.5: Credibility of Children's Dreams.

Table 1. Typical differences in results associated with different dream collection methodologies from preschool to preadolescent ages.

Studies	Setting	Age groups in years		
		3-5	5-9	
			5-7	7-9
Mean/median word count				
Foulkes (1999)	laboratory	14	41	72
Colace (2010)	school	23	41-46	
Colace (2010)	home	35	46	
Dreams with emotions				
Foulkes (1999)	laboratory	8%	10-25%	
Honig (2012)[J]	preschool	75.9%		
Despert (1949)	preschool	most dreams		
Dreams with human characters				
Foulkes (1999)	laboratory	17%[a]		
Honig (2012)	preschool	89%		
Dreams with active self-representation				
Foulkes (1999)	laboratory	13%[b]		
Honig (2012)	preschool	59.4%		
[c]Resnick et al. (1994)	home	85%	89%	
Dreams with bizarre elements				
Foulkes (1999)	laboratory	present from 5 years		
Colace (2010)	school & home	32%	58%	
[c]Resnick et al. (1994)	home	34%	49%	
Dreams with kinematic imagery				
Foulkes (1999)	laboratory	26%		
Honig (2012)	preschool	81.2%		

[a]17% refers to the percentage of dreams containing family members, other known persons appeared less often and strangers were totally absent.
[b] Percentage of dreams with self-movement of any sort
[c] In Resnick et al.'s study, age groups correspond to four to five years and eight to ten years.

1.5.2.4 Questionnaire-based Dream Assessment

The only questionnaire based dream study that was not specifically focused on nightmares and bad dreams of children, was carried out by Colace (2006). In his parent-recorded questionnaire he assessed dream attitudes, dream frequencies, and characteristics of the last reported dream of children between 3 and 9 years. He found that 60% of the 3 to 5 year-olds reported at least one dream to their parents in the last month. Most of the parents rated their children's dream reports as being short stories (57.6%, rather than short or long sentences: 32.6%), and most of them as having at least some bizarre elements (54.4%). Dream characters are most frequently family members (present in 60% of the dreams), active self-representation is predominant (56%), and social interaction is frequent (in 67.4% of all reported dreams). Aggressive content is rare (in 17.9% of the dreams), which might be explained by the parent's possible bias towards presenting more pleasant dreams.

1.5.3 Children's Dreams in Primary School-Age (5-9 year-olds)

In this age range children become more skilled, and their dream reports become more and more reliable (Foulkes, 1999), making it possible to assess dreams in written form directly from the children (Helminen & Punamäki, 2008; Kimmins, 1920; Oberst et al., 2005).

1.5.3.1 Laboratory Interviews

According to Foulkes, the strongest dream quality changes occur around the ages of seven and eight, with the children's reports getting not only more frequent (43%) and becoming significantly longer with more complex narrative structure, but with active self-representation together with thoughts (10% of all reports) and feelings also appearing in dreams. Foulkes first observed kinematic imagery and social interactions in dreams between 5 to 7 years. In this age group dream recall frequency was correlated reliably with visuospatial skills, which urged Foulkes to conclude that the development of this domain makes dreaming possible. Dream distortion or bizarreness was quite rare between 5 to 9 years of age. Based on his findings, Foulkes claimed that dream recall frequency was not associated with the adjustment of waking anxiety, thus concluded that it is not personal problems or conflicts that prompt children's dreaming, rather it is the cognitive competencies that allow them to be more accomplished dreamers.

1.5.3.2 Interviews at Home and at School

Colace collected dream reports from 3 to 7 year-old children (via parents interviewing the children every morning according to a given semi-structured interview method) and found that almost half of the children (47%) between 5 and 7 reported relatively complex dream narratives and 58% of the reports contained at least 1 bizarre element. Bizarreness in the dream reports correlated with various cognitive abilities (linguistic skills, attention, symbolization and visuospatial skills) (Colace, 2010).

Colace's school based studies yielded similar results. He concluded that the developmental achievement that allows dreams to show even highly bizarre narrative is already present at the age of 5: *"There was a horse, it was all green with red eyes, so this horse took mum, […] she was the horse's wife […] my eyes became red because I was the daughter of these two people, … of this horse and of this and of … mother"* [dream report of a 5 year- and 10 month-old girl, (Colace, 2010, p.120)].

1.5.3.3 Dreams Assessed by Questionnaires

Oberst (Oberst et al., 2005) collected dream accounts from 120 children using the "last remembered dream" method amongst 7 to 18 year-olds. Her results indicate that gender differences characteristic of the adult population (Domhoff, 1996) start to emerge even in her youngest age group (7-8 years) and develop throughout adolescence to adulthood. She found that boys tend to dream more about male characters, whereas girls have a more balanced character ratio (male/female character ratio: 79% and 38%, respectively), and for most of the groups boys show more physical aggression and aggressive interactions (aggression/character index: 61% for boys and 24% for girls). All aggression variables were highest in the youngest age group (60-87% of dreams contained at least 1 aggressive interaction), who were also more often victims than aggressors in their dreams (victimization in 87-90% of all dreams with aggression); both tendencies decreased with age.

1.5.3.3.1 Assessing Nightmares

Assessing the relationships between waking life and nightmares Li and colleagues (Li et al., 2011) found that frequent nightmares were associated with a constellation of child, sleep and family related factors, such as comorbid sleep disturbances, parental

predisposition, child hyperactivity, mood disturbances, and poor academic performance. Extreme conditions in waking life, such as war trauma, have a distinctive effect on children's dreams, as high levels of aggression and death scenes appeared in dreams of children reported in an early study conducted during the First Word War (Kimmins, 1920). Helminen and Punamäki (2008) also found a strong effect by examining the dreams of Palestinian children from traumatic and non-traumatic environments between the ages of 6 to 16 years. They found enhanced dream recall (mean dream recall in the trauma group: 4.13 versus non-trauma group: 2.89) with more contextual images (90% versus 74%) among the highly traumatized children. Exposure to severe trauma was usually associated with a higher level of post traumatic symptoms and a high intensity of negative emotional imagery, however this was not the case for those children in the trauma group whose dreams incorporated highly intense positive emotional imagery. This relationship between the emotional processing of traumatic events and dreams is also shown in the dreams of children suffering road traffic accidents (Wittmann, Zehnder, Schredl, Jenni, & Landolt, 2010): between 2 and 6 months post-accident, the incidence of posttraumatic nightmares decreased in parallel to the decline in PTSD symptoms. Similarly Terr (1979), dealing with children who had been kidnapped, found that all of the children had had dreams about the traumatic event, including unremembered night terrors (60% of the children), exact repeat dreams (52%), modified playback dreams (52%) and disguised dreams (17%) that incorporated symbolically some aspects of the event. He found that those children who had good abilities to verbalize their feelings tended to have more variety of dreams related to the trauma, had more memories about their dreams and could use their associations to gain relief in their psychiatric interviews.

Studies assessing nightmares and bad dreams of school-aged children emphasize the association between feelings, emotional regulation, coping mechanisms and dreams, and conclude that dreams are correlated with (Foster & Anderson, 1936; Li et al., 2011) or even promote emotional processing and work through (Bauer, 1976; Helminen & Punamäki, 2008; Terr, 1979).

1.5.4 Dreaming in Preadolescence (9-14 year-olds)

1.5.4.1 Laboratory Interviews

Foulkes found that the dream report frequency between the ages of 9 to 11 reached a median of 79%, close to the typical adult REM dream reporting frequency (85-90%), with report frequency and length becoming stable individual parameters of each child. Together with these changes, visuospatial skills, although still associated with report frequency, had relatively less influence on dreaming than other personal/social variables likewise in adults (Foulkes, 1999). Similarly to others (Schredl, Fricke-Oerkermann, Mitschke, Wiater, & Lehmkuhl, 2009b; Simard et al., 2008), Foulkes also found that the frequency of unpleasant dreams became stable within this age span, so that the number of such dreams between 9 to 11 years predicted the same prevalence 5 years later. According to Foulkes' findings this is also the point when dreaming starts to reflect personality; for example children who frequently dream of an angry self, display hostility during the presleep period as well. Along with personality, gender roles seem to be reflected in dreams starting at preadolescence (Trupin, 1976). An interesting pattern that arises among the 13-15 year-olds is that a number of the REM dream reports seem to lose some of the achieved vividness, kinematic characteristics, social interaction, busyness and narrative complexity, and become more similar to non-REM dream reports. This phenomenon, together with the lower report rate (73%) compared to the 9-11 year-olds, could be connected to ongoing neural changes (synaptic pruning) in the adolescent age, as Soffer-Dudek also hypothesizes based on similar recall frequency patterns in her work (Soffer-Dudek & Sadeh, 2012). Similarly in her laboratory study, Strauch (2005) found an almost continuous increase in dream report frequency from 9-15 years, with a slight relapse from 79% at 9-11 to 74% at the 11-13 years age group for girls. Other aspects of her findings (Strauch & Lederbogen, 1999; both in the laboratory and in the home study) are in line with Foulkes' results, like the gradual appearance of active self, an increase in social interactions, the inclusion of speech, and the relative scarceness of feelings associated with dreams. Overall aggression/friendliness percentage declined for boys (70% at 9-11 years) and increased for girls (36% at 9-11 years), arriving at the same level at 11-15 years (51% and 61% respectively). All children tended to be victims of aggression rather than being aggressors. Dream

bizarreness seemed to change continuously throughout the age range: bizarre or unlikely dreams (lacking any relation to the waking world) decreased with age (from 31% to 15% of all dreams), but inventive dreams (combining waking experiences in an unusual manner) increased (from 29% to 44%) showing the development of higher level cognitive skills, as separate waking memories had to be combined into new entities.

1.5.4.2 Dream Diaries and Questionnaire Studies

Findings using the 'last remembered dream' method show many similarities with laboratory studies (Avila-White et al., 1999; Crugnola et al., 2008; Saline, 1999), most interestingly about aggression and gender differences, which become more prominent in the preadolescent age (Crugnola et al., 2008; Saline, 1999).

1.5.4.2.1 Nightmares and Disturbing Dreams

Dream diaries are typically used to assess the dreams of children living under traumatizing conditions. Punamäki and colleagues (Helminen & Punamäki, 2008; Punamäki et al., 2005; Punamäki, 1999) found that children who had waking traumatic experiences reported more unpleasant, mundane, and fragmented dreams, involving death and destruction themes, with typical feelings of anger, anxiety, and hostility. Bilu (2013), examining Israeli and Arab children's dreams found similar results: children living closer to disturbed areas or the "enemy" had significantly more "encounter dreams" involving meeting characters from the other side pervaded with aggression and overt violence. Levine, however, studying Irish, Bedouin, and Israeli children's dreams, found that culture and norms had a stronger effect on dreams than the closeness or exposure to conflicts (Levine, 1991).

Questionnaire-based nightmare and bad dream studies typically show that nightmare frequency is highest between the ages of 5 to 10 (Li et al., 2011; Schredl & Pallmer, 1997, 1998), and is related to other sleep disorders (Li et al., 2011; Schredl et al., 2000), trait anxiety (Mindell & Barrett, 2002; Schredl et al., 2000, 1996), emotional problems (Schredl et al., 2009a, 2009b; Soffer-Dudek & Sadeh, 2012), accumulated stress in waking life (Schredl et al., 2000) and behavior problems (Li et al., 2011; Schredl & Sartorius, 2010). Moreover, the strongest predictor is again having had nightmares at a previous testing time (Schredl et al., 2009b; Simard et al., 2008). Although nightmares

are shown to be a stable feature of childhood, investigations may show some influence of television watching on aggressive and scary dreams (Viemerö & Paajanen, 1992). It is still not clear if nightmare frequency is affected by television or whether bad dreams take up the program content, but nightmare content seems to change with the popular scary figure of the time (Schredl, Anders, Hellriegel, & Rehm, 2008).

1.6 REM sleep, Dreaming and Cognition in a Developmental Framework

1.6.1 Dreaming and Awareness

Cognitive awareness in dreaming is shaped by the neural functioning of the brain in REM sleep, but it still has properties that strongly resemble those of wakeful functioning. Generally dreams feature reasonably integrated social perception and actions suggesting a high level of correspondence between neuro-cognitive functioning and comparable experiences during waking (Domhoff, 2003). Systematic studies comparing waking and dreaming cognitive- and metacognitive-functioning found no significant differences in internal commentary, attention processes, and public self-consciousness (Kahan & LaBerge, 1996). However, they found choices and event related self-reflection (Kahan, LaBerge, Levitan, & Zimbardo, 1997) to be different in dreaming compared to wake functioning.

Amongst the few cognitive functions that are known to be inactive during dreaming, probably the most important are the reduced functioning of executive skills, focusing, and tracking thoughts. The other exception to adequate cognitive functioning is certain functions of episodic memory; for example the dreaming state does not support the integration of memory components in a manner similar to wakeful experiences, it instead gives way to novel combinations of the elements. It is possible that dreaming, instead of being facilitated by executive cognitive processes, uses an emotional-perceptual activation that organizes elements of retrieved memories according to emotional tendencies and preferences of the dreamer (Roar Fosse & Domhoff, 2007).

Lucid dreaming is a special case of REM dreaming which, due to more extent brain activation patterns, enables the dreamer to know that they are dreaming and in many cases also intentionally control the dream events (LaBerge, 2007).

Lucid dreaming by definition involves higher order cognitive skills (Kahan & LaBerge, 1994) and reflective self-awareness (Voss, Holzmann, Tuin, & Hobson, 2009) during REM sleep, and is also associated with the development of cognitive functions, such as abstract thinking and cognitive insight (Voss, Frenzel, Koppehele-Gossel, & Hobson, 2012). Although one study found that the occurrence of lucid dreaming is higher during childhood and decreases after reaching young adulthood (Voss et al., 2012), differences in cognitive functioning were only assessed and found between lucid dreamers and controls in adulthood; showing lucid dreamers to have better attentional skills and perform with shorter reaction times in the Stroop Test (Blagrove & Hartnell, 2000).

1.6.2 Cognitive Skills, Intelligence and Dreaming

Unfortunately there are no systematic studies investigating the relationship between cognitive abilities and dream reports other than the laboratory studies, which found reliable association between visuospatial skills (measured by the Wechsler Intelligence Scale for Children, WISC IV) and dream recall frequency (Foulkes et al., 1990; Foulkes, 1982, 1999). Although direct correlations with cognitive measures were not presented, these studies also reported an age-related improvement in certain features of dream report, such as motion imagery, active self-representation, the representation of human characters, interactions and voluntary actions, which also implies a parallel maturation with cognitive skills (Foulkes, 1982, 1999; Strauch & Meier, 1996; Strauch, 2005). Other than the laboratory studies only isolated pieces of evidence can be found that show possible parallel development between characteristics of dream reports and cognitive maturation. Colace (2010), using home and kindergarten interviews, found a correlation between dream bizarreness and various cognitive abilities, such as linguistic skills, long term memory capacity, attention span, symbolization, visuospatial skills and superego development (Freud, 1913), the latter was measured by performance in situational story stems of social normativity (Colace, 2010). Thus dream bizarreness seems to be the only dream content feature that has been proven to be correlated with cognitive processes and skills not only in developmental but in adult studies as well (Cicogna, Occhionero, Natale, & Esposito, 2007; Colace, 2003).

1.6.3 Executive Functioning and REM Sleep/ Dreaming

Frontal cortical areas (especially anterior cingulate and prefrontal areas) that are active during REM sleep are also found to be core supporters of executive attention, measured by the Stroop Test (van Veen & Carter, 2005). Considering the possibility that the default network provides the neural basis for dreaming (G William Domhoff & Fox, 2015; as described in section 1.3), and considering the indirect evidence that the maturation (increase in coherence) of the default network is connected to better executive functions during aging (Fair et al., 2008), we have a valid base to assume that executional attentional skills might be reflected in dreaming.

In a wider sense attention (measured here by the Attention Network Test, see section 3.2.5: Measures of Executive Functioning) can be modelled as the interaction among three well defined, independent components – namely alerting, orienting and executive control (Fan et al., 2002) – with different neuroanatomical bases (Corbetta & Shulman, 2002; Fan, Flombaum, McCandliss, Thomas, & Posner, 2003). The alerting system (responsible for achieving and maintaining an alert state), on the basis of previous studies on vigilance, was associated with right frontal and parietal regions (Coull, Frith, Frackowiak, & Grasby, 1996). The Orienting Network (responsible for the selection of information from sensory input) is associated with parietal and frontal areas especially the superior parietal lobe and the temporo-parietal junction (Corbetta, Kincade, Ollinger, McAvoy, & Shulman, 2000). The executive system (or conflict network, which is responsible for resolving conflict amongst responses) is often studied using conflict tests (such as the Stroop Test) which activate middle frontal areas (anterior cingulate) and lateral prefrontal cortex (MacDonald, 2000).

Nightmare sufferers were found to exhibit impaired measures of waking frontal executive functions. They showed longer reaction times in the Go-NoGo Test when emotional distractors were presented and also showed a general slowing tendency in the Emotional Stroop Test compared to healthy subjects (Simor, Pajkossy, Horváth, & Bódizs, 2012). On the other end of the dreaming continuum, lucidity (awareness of dreaming during the dream itself) was correlated positively with the activity of the ventromedial prefrontal cortex (Neider, Pace-Schott, Forselius, Pittman, & Morgan, 2011). The effectiveness of the executive functions controlled by fronto-cortical areas in lucid dreamers were also shown in a study (Blagrove, Bell, & Wilkinson, 2010), where

they found lucid dreamers to have better attention skills and to perform with shorter reaction times in the Stroop Test in case of incongruent stimuli. Nightmares tend to engage the dreamer into realistic threatening events typically lacking the dreamer's awareness and leaving the dreamer's self-ineffective, unable to control the dream events. On the contrary, lucid dreaming is associated with elevated levels of self-awareness (Voss et al., 2009) and control and higher order cognitive skills (Kahan & LaBerge, 1994). In this view the two phenomena might represent the extremes of self-awareness and effectiveness scale during dreaming, with regular dreams scoring in between the two extremes. It is hypothesized that attentional skills are required to perform such self-awareness in case of lucid dreamers (Blagrove et al., 2010) and that nightmare sufferers would be characterized by impaired prefrontal and fronto-limbic functions (Simor, Pajkossy, et al., 2012), so that in both cases these functions in REM sleep would be reflected in waking neuropsychological tests as well.

1.7 REM sleep, Dreaming Versus Emotional Regulation and Attachment

1.7.1 Attachment and Emotional Development

Attachment theory in a broader sense incorporates a theory of social development which has its roots in the primary relationship of an infant to a caregiver, and describes the patterns of close interpersonal relationships throughout the lifespan (Bowlby, 1988; Bretherton, 1985; Main, Kaplan, & Cassidy, 1985). These interpersonal patterns appear to be quite stable over time and are referred to as attachment styles in adulthood: these modulate many biopsychosocial phenomena, including stress response (Diamond, 2001; Gunnar, Brodersen, Nachmias, Buss, & Rigatuso, 1996), social functioning (Bretherton, 1992; Main et al., 1985), psychological well-being (Bódizs, Simor, Csóka, Bérdi, & Kopp, 2008; Maunder & Hunter, 2001), health behavior (Maunder, Hunter, & Lancee, 2011), and also sleep disturbances (Keller & El-Sheikh, 2011; Troxel, Cyranowski, Hall, Frank, & Buysse, 2007; Verdecias, Jean-Louis, Zizi, Casimir, & Browne, 2009).

In a psychological sense secure attachment includes emotion regulation, the sense of a reliable and safe environment and the experience of self-agency. At a very young age it is necessarily the mother who regulates the infant's affects; she makes the environment responsive through her sensitive presence, which slowly teaches the infant that they can

influence this environment with their activities and signals. This experience will serve as the basis of the later developing self-confidence. The inner physiological/psychological mechanism that enables the child to recognize and regulate its own emotions develops on the basis of continuous and tuned interactions between the caregiver and the infant (Fonagy, Gergely, Jurist, & Target, 2004).

Secure attachment provides basis and courage for the individualization and the exploration of the environment as well. The absence of the attachment figure temporarily blocks the explorative behavior. Thus secure attachment is fundamental for the development of cognitive and social skills (Bowlby, 1988). When the child gets scared during the exploration of the environment, fear activates the attachment system (the child seeks contact with the caregiver), the availability and reaction of the caregiver reduces the stress response and provides a model for controlling the environment. The above-described dynamic balance between the attachment and exploratory systems is characteristic of secure attachment when an infant is able to use the caregiver as a *"secure base from which to explore"* (Bowlby, 1988; Cassidy, 2008, p.8).

If the caregiver is not responsive or does not respond according the needs of the infant the attachment becomes insecure and compensatory mechanisms will become dominant. These mechanisms have a wide range of behavioral manifestation, from attention-seeking to complete withdrawal from relationships (Fonagy et al., 2004).

1.7.1.1 The Emergence of Mentalization

The model of mentalization is based on the attachment theory (Fonagy & Target, 2003) and emphasizes understanding interpersonal relationships on the level of mental states that develop through early interactions. Those infants whose signals are interpreted by the caregiver as signals of mentally active beings motivated by their own desires and preferences, will learn how think and feel about themselves similarly, and will be able to read others' mental states as well as their own. This skill develops at the age of 3-4 years when children start to understand that the other's acts are not organized simply by logical expectations but according to the other's own inner desires and intentions. They also learn that the representations inside other people's minds are not perfect matches of reality, and, similarly, their own feelings and desires are not part of the reality of others.

The above described processes are crucial in developing boundaries between the self and other significant people, and also for the developing symbolic representation skills.

The caregiver's capacity to reflect the emotional state of the infant in a marked and modified manner helps the child learn how to label and deal with affective states. For example an insecure/preoccupied mother struggling with her own anxieties might reflect the child's fear too realistically (and could easily mix their own worries into that reflection in such a way that lacks the healthy distance between marked reflection of feelings and real feelings), and would thus further confuse and scare the child. This kind of reflecting would not only undermine the child's emerging ability to represent and to deal with emotional states but would confuse the boundaries between the self and the other. This mechanism, leading to boundary confusion, is predicted to be the basis for psychopathologies, such as borderline personality disorder.

1.7.1.2 Measurement and Continuity of Attachment

The observation method and detailed categorization of the attachment styles was developed by Mary Ainsworth, who studied attachment behavior in action during her Strange Situation Test (SST; Ainsworth, Blehar, Waters, & Wall, 1978). The test categorizes the behavioral patterns that a child (under 2 years of age) and a caregiver display upon entering an unknown room; how they cope with the new environment, how they maintain contact, and how they react to short separation situations. On the basis of her observations, Ainsworth identified 4 attachment categories. Securely attached (B) children are prone to explore the environment in the presence of the caregiver, they prefer to avoid strangers, they are desperate when the caregiver leaves the room but when the caregiver returns they are easily soothable and, once settled, they are soon back to exploration. There are infants who do not appear to be desperate at all when the caregiver leaves and they do not urge for closeness and soothing when the caregiver is back. These are the insecure/avoidant (A) children who try to minimize contact with the caregiver even at times of danger. The insecure/ambivalent (C) infant has difficulties exploring the environment or getting away from the immediate closeness of the caregiver. They show strong stress reactions when the caregiver leaves the room, but the caregiver's return does not soothe the child, as if they were angry with the caregiver.

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Secure attachment grows in the environment of mutually tuned emotional interactions with the caregiver, where the caregiver rarely displays an extreme or exaggerated affective state, thus they are able to control the child's occasionally fragmented or extreme responses even in a stressful situation. Caregivers of avoidant children cannot react calmly and soothingly to the exaggerated affective states of the infant which affective states possibly are already the results of maltreatment. As a consequence, these children overcontrol and avoid emotions and possibly their caregiver as well. In contrast, ambivalent children under-control their emotions and give increased signals to the caregiver in order to make them respond. Their stimulus threshold is low and their attention is focused on maintaining contact with the parent, but they remain frustrated even if the parent is available. This strategy is usually a result of fluctuating, unpredictable care and parental presence. Children with disorganized attachment (D) form the fourth category, whose behavior is not controlled but seems to be fragmented. They either do not have any behavioral strategy (they freeze or display stereotype movements) or they fluctuate between avoidant and ambivalent styles. This fluctuation is manifested in the form of sudden changes of one behavior into its opposite (for example: approaching but suddenly, with a shift, moving away from the caregiver). It is hypothesized that the parent in this case is a source of danger and security at the same time, thus the motivations of the behavioral system are highly conflicted (Fonagy & Target, 2003). This latter category is also associated with serious neglect, maltreatment, and abuse (Main & Hesse, 1990).

The above mentioned attachment patterns, developing during the course of affective interactions between the infant and the caregiver, later become part of the personality and affect the adult individual's relationships through expectations and behavioral schemes. These schemes are often called *"internal working models"* and they involuntarily form our social interactions and emotional coping styles. Since they are not conscious motivations, these working models are resistant to change, and, through modeling and parenting styles, often affect the attachment behavior of the next generation (Fonagy, Steele, Moran, Steele, & Higgitt, 1993).

DOI:10.14753/SE.2016.1935

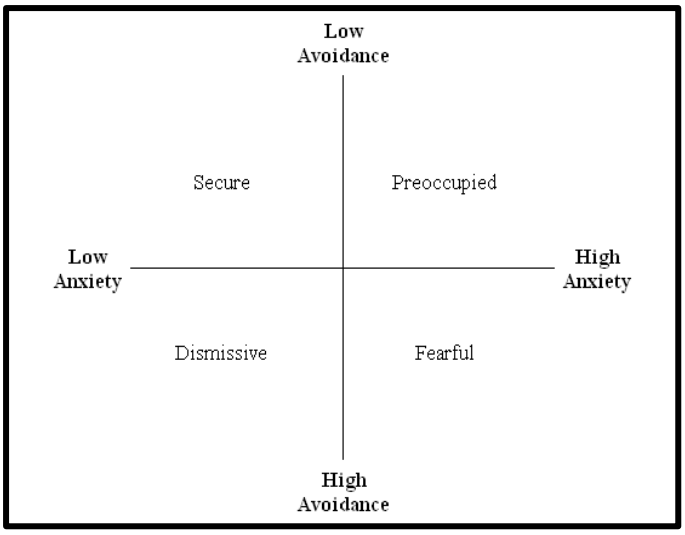

Figure 2. The two dimensional model of attachment according to Bartholomew and Horowitz (1991).

Several existing questionnaires measure adult attachment, some of which adapted the internal working model theory to form two dimensions (attachment anxiety and avoidance), along which lie the four attachment categories (Csóka, Szabó, Sáfrány, Rochlitz, & Bódizs, 2007; Ravitz, Maunder, Hunter, Sthankiya, & Lancee, 2010). According to these adaptations, from an early age experiences are interpreted based on these dimensions: the first is the child's picture about themselves (model of self or attachment anxiety) and the second is the child's model about the others (model of other or attachment avoidance). If the individual creates a picture of a positive, loveable self and senses the others as supportive and valuable then according to the model they are securely attached. Similarly if the individual's picture of themselves is positive (low anxiety) but they have a negative picture of others (high avoidance), than they are considered avoidant (or dismissive in adults). Anxiously-attached individuals (preoccupied) show the opposite pattern (high on anxiety and low on avoidance) and according to the popular model of Bartholomew and Horowitz (1991), fearful attachment is characterized by high anxiety and avoidance at the same time (see Figure 2.).

A different approach is taken by the Adult Attachment Interview (AAI; George, Kaplan, & Main, 1996), which is a structured narrative interview about attachment relationships, childhood experiences, separation, loss, and parental caregiving. Evaluation is based on the narrative structure; coherence, and emotional integrity. The way these features are related to the narrated life events is crucial.

For children between the ages of 4 up to 8 years, a story stem based projective interview method was developed called the Manchester Child Attachment Story Task (MCAST; Green, Stanley, Smith, & Goldwyn, 2000) which contains elements of both the SST and the AAI. It is based on short story stems that are introduced by the interviewer and that

contain everyday stress situations. The child's task is to finish the story and resolve the situation in their own way. The stories are played with dolls in a dollhouse, including child doll and an attachment figure doll. Besides the actual attachment behavior displayed through the dolls, narrative coherence and mentalization capacities are also measured.

1.7.2 REM sleep and Dreaming Versus Attachment and Emotional Development

In connection to the above attachment characteristics an attachment hypothesis has been developed by McNamara and colleagues (McNamara, Dowdall, & Auerbach, 2002; McNamara, 1996; Zborowski & McNamara, 1998), which concludes that REM sleep and dreams in part may selectively influence and even promote attachment with specific regard to the developing and the insecurely attached human organism.

According to McNamara and associates' hypothesis the most striking differences are present between preoccupied subjects (willing to be attached and seeking for reflections from others) and avoidant subjects (avoiding attachment, devaluating close relationships) regarding both attachment attitudes and dream recall frequencies, with avoidant subjects also avoiding REM sleep and dreaming. These are the categories (of insecure attachment) most different from each other on both the anxiety and the avoidance scales.

There is a growing number of evidence regarding sleep characteristics of children in favor of the attachment theory. Insecure/ambivalent (identical to preoccupied in adults) babies showed significantly more sleep disturbances at 6 and 15 months of age (measured by mother reported night awakening times and durations of night waking episodes) than their avoidant counterparts (Mcnamara, Belsky, & Fearon, 2003). Moreover, reduced REM latency is observed in case of anxiously attached adults (Patrick McNamara, Pace-Schott, Johnson, Harris, & Auerbach, 2011).

The basis of attachment theory of dreaming has its roots in common neuro-anatomical systems of attachment, emotional functioning and REM sleep. Literature based on brain lesion studies (Solms, 1997, 2003) and brain imaging techniques (Braun, 1997; Maquet et al., 1996) result in concordant information about the brain areas that are likely to be involved in dream formation. It has been discovered that the medial prefrontal cortex,

anterior cingulate cortex, limbic region, and basal forebrain together with the occipito – temporal region and visual association cortex are more active in REM sleep than in NREM sleep. This REM specific activity practically includes the circuits of fronto-limbic emotional network (including amygdale, orbito-frontal cortex and ventro-medial prefrontal areas) (Steklis & Kling, 1985). In awake-functioning limbic structures such as amygdale are associated with emotional responses especially fear responses (Adolphs, Tranel, Damasio, & Damasio, 1995; Feinstein, Adolphs, Damasio, & Tranel, 2011), and the ventromedial prefrontal cortex is involved in emotion regulation and fear extinction processes (Hänsel & von Känel, 2008; Urry et al., 2006). These results support the psychological models of dreaming that connect dreaming with one's affective experiences and suppose an emotional regulational function of dreams (Cartwright, Luten, Young, Mercer, & Bears, 1998; Cartwright, 2011; Nielsen & Levin, 2007). Theories and empirical findings suggest that REM-sleep and/or dreaming may indeed promote the resolution of emotional difficulties and the improvement of next-day mood (Cartwright, Agargun, Kirkby, & Friedman, 2006; van der Helm et al., 2011; Walker & van der Helm, 2009). Importantly, specific dream contents and characteristics have also been associated with the functioning of the above mentioned brain areas. For instance according to Nielsen and Levin's neurocognitive theory, emotionally loaded dreams, especially nightmares can be a consequence of a disruption in the cooperation of the emotionally weighted subcortical areas and prefrontal-cortical areas, which are unable to down-regulate those emotions, resulting in ineffective emotional regulation (Levin & Nielsen, 2007; Nielsen & Levin, 2007).

1.7.2.1 Attachment Styles as Represented in Dream Content

Results from studies examining dream narratives and contents suggest that general emotional concerns and relationship patterns appear vividly and frequently in the dreams of adult individuals (Cartwright et al., 2006; Hartmann, 2010; Nielsen, Stenstrom, & Levin, 2006).

McNamara and his colleagues (McNamara, Andersen, Clark, Zborowski, & Duffy, 2001) expected and found more frequent dream recall, more intense dream emotions in insecurely attached university students (both measures higher in ambivalent students than avoidant ones), but did not find differences in directly attachment related dream

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content between the securely and insecurely attached groups. Similarly, Selterman and Drigotas (2009) concluded that the emotional content of the dreams represented reliably the participants' attachment style, with insecurely attached individuals experiencing more stress, conflict and anxiety in dreams with romantic partners. On the contrary they could not confirm a systematic relationship between attachment anxiety (ambivalent style) and dream recall frequency. A recent study of Mikulincer et al. (Mikulincer, Shaver, & Avihou-Kanza, 2011) however found clear connections between dream content and attachment styles: participants with high attachment anxiety expressed more closeness-related wishes and more negative views of the self, at the same time high attachment avoidance was associated with the expression of more avoidance-related wishes and more negative views of others, as predicted on the basis of attachment theories. Similarly, in another study Selterman et al. (Selterman, Apetroaia, & Waters, 2012) revealed a significant relationship between attachment security and the degree to which dreams about romantic partners followed the *"secure base script"* (cognitive event representation of the temporal-causal structure and content of the exploration-secure base dynamics that are common amongst securely attached people, see section 1.7.1: Attachment and Emotional Development) (Waters & Waters, 2006). Supporting this already established relationship between attachment styles and dream emotions, Csóka et al. (Csóka, Simor, Szabó, Kopp, & Bódizs, 2011) found that early maternal separation (an early break in the attachment relationship) correlated significantly with frequent nightmares in adulthood.

DOI:10.14753/SE.2016.1935

2 Aims and Hypotheses

The hypotheses of this study are discussed along the three main aims that form the three main blocks of the results section.

2.1 Descriptive Analysis of Dream Content throughout the Development Over 4 to 8 Years of Age

Our aim here is to give a description of 4-8 years old children's dream characteristics and dream content in a familiar home environment and using a reasonably neutral and controlled method of dream collection.

I focused on those dream characteristics that diverge most prominently across different dream collection methods and those that would have a special relevance in a developmental perspective. These are: human, family and animal characters, home, school and unclear settings, social interactions, kinematic imagery and activities, cognitive reflection, bizarreness, emotional load, dream quality, and the dream's effect on daytime mood. My main theses guiding the descriptive research aspects of the study, based on previous laboratory and non-laboratory based findings, are the following:

1. Human characters (as opposed to animal characters), active self-representation and kinematic imagery are predominant in the dream plots, irrespective of the age of the dreamer.
2. The majority of the dream reports contain kinematic imagery, including self-initiated actions in the dreams in all age groups.
3. Social interactions, self-reported emotions, cognitions, and bizarreness are already present in young children's dreams (4-5-year-olds).
4. We expect an age related decrease in the relative amount of animal and family characters, home and unclear settings.
5. We expect an age related increase in the relative amount of school settings, activities, cognitive presence, social interactions, bizarreness, and self-reported emotions.
6. We expect gender related differences in dream recall, male–female character ratio, and aggressive interactions in the dream reports.

DOI:10.14753/SE.2016.1935

2.2 Correlational Analysis to Unravel the Associations between Cognitive Development and Dream Characteristics in Childhood

Based on the direct and indirect evidence listed in the introduction section, suggesting the relationship between the developments of cognitive functions and dreaming, we hypothesize the following:

1. Dream recall frequency is expected to show a positive correlation with visuospatial skills. The length of dream records is hypothesized to correlate with verbal abilities and memory capacity.

2. Dream features that go through certain age-related development (human characters, actions, interactions) are expected to be directly positively associated with cognitive maturation as quantified by the performance indexes in neuropsychological tests (Fruit Stroop Test, ANT) measuring executive functions. Verbal actions in dreams are expected to correlate with verbal abilities.

3. The quality of interactions (friendly or aggressive) is expected to associate with the Emotional Stroop measures.

4. We expect bizarreness in dreams to show a positive correlation with the maturation of general intelligence and executive functions (Fruit Stroop Test, ANT).

5. We expect the activity and agency of the self and conscious presence in the dreams to be related to executive functioning (Fruit Stroop Test, ANT) including the control of emotional interference (Emotional Stroop Test). In case of consciousness in the dreams we also expect an association with measures of general intelligence.

6. We expect the measures of emotional dream content and quality to correlate with executive control (Fruit Stroop, ANT) and emotional processing skills (Emotional Stroop).

DOI:10.14753/SE.2016.1935

2.3 Correlational Study to Explore the Relations between Emotional Development (Attachment and Emotional Behavior), Sleep Disturbances and Dream Characteristics in Childhood

Based on the scarce evidence existing about the relationship between emotional problems, attachment and dreaming and considering developmentally important dream features I hypothesize the following:

1. Measures of emotional development (SDQ total score, emotional problems, internalization and externalization problems) and attachment (MCAST attachment, disorganization, narrative coherence and mentalization) will positively correlate with dream recall frequency, dream settings, social interactions, activities including exploratory activity, emotional content, dream quality and dream's effect on daytime mood, measures of self-effectiveness and bizarreness.

Based on literature on sleep quality and dreaming I hypothesize the following:

2. Sleep related problems (CSHQ total score) will be correlated with dream recall frequency, social interactions, cognitions, bizarreness and emotional content and dream quality.

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3 Method

3.1 Subjects

The research participants were 40 children and their parents recruited from different schools and kindergartens in Budapest, Hungary, who agreed to take part in the study. We contacted several kindergartens and schools in the city, placed posters about the research and distributed flyers. We also initiated personal contact with the parents by giving short introductory talk at parent-information days at the schools. Because of the difficulties of gathering enough participants for the age groups, we decided to continue recruiting by having parents who had already participated in the research send out information and personal experiences to fellow parents via school email lists and social media. This latter method, presumably because parents trusted personal experiences of known other parents and children more than unknown researchers, turned out to be the most effective way of participant collection. In other words we used convenience-sampling and snowball-sampling as participant sampling methods in this time- and energy-demanding study.

The children were between the ages of 4 to 9 years (min: 3.8, max: 8.7, mean: 6.3 years, SD: 1.6). In order to detect age-related differences in dream content we evenly sorted them into 3 age groups: 14 children (7 females) between the ages 3.8 and 5.5 years (Group1), 12 children (7 females) between the ages of 5.51 and 7 years (Group2), and 14 children (7 females) between the age of 7.01 and 8.5 years (Group3).

All of the children were from a middle class, educated environment, with at least one of the parents holding a degree in higher education. All the children were healthy; any diagnosis of mental or physical illness caused an exclusion from the study. Written consent forms were obtained from the parents. Ethical approval of the study was received from the Semmelweis University Ethical Review Board.

DOI:10.14753/SE.2016.1935

3.2 Measures and Procedures

3.2.1 Study Procedure

An initial interview with both the recruited parents and the children was carried out, where they were informed about the details and schedule of the study: the children could express willingness to participate and the parents could sign the written consent forms. The parents were trained how to use the structured dream interview developed for this study, how to avoid suggestive questioning, and how to obtain the dream reports every morning upon awakening through a 6-week time period.

During the 6 weeks of dream collection period the children and their parents visited our laboratory 3 times for the different testing sessions. The first session included the test of intelligence (see section: 3.2.4), the second session included the computerized neuropsychological test (see section: 3.2.5), and on the third occasion the attachment test took place (see section: 3.2.6). Each of these occasions started with a short warm-up game (Hungry Hippos) with the researchers in order to eliminate any possible tensions induced by the environment (although, since the initial interview also took place in the lab, for most children the environment, the lab assistants and the games were already familiar) or the tasks ahead. Each of the testing sessions included optional breaks between the subtasks when children could relax, draw or drink. After each of the sessions the children were allowed choose a small reward from a present-box in the room. The games, the friendly environment, continuous reinforcements, and the little presents kept the children motivated and enthusiastic throughout the study. Those families who stayed in the program for a 2-night sleep session including polysomnographic recordings (this part of the study will be reported elsewhere) also received a 10,000 HUF compensation (sponsored by the 2010 Research Grant of the BIAL Foundation (55/10)).

The author of this dissertation organized (and took part in) every stage of the study, including study design, subject collection and subject management, data collection, data processing and analysis (including the development of a new system of dream content analysis, coding of the dream reports and developing the technical support for automatic formation of a data table from raw counts of dream content).

DOI:10.14753/SE.2016.1935

3.2.2 Methods of Dream Collection and Control

Dreams were obtained from the children upon morning awakenings over a 6 week period of time during a structured dream interview conducted by the pre-trained parents. The 6 week-period was considered to be long enough to provide a representative sample of the children's dreams. In order to meet the children's possible need for extra attention in the morning we asked the parents to carry out a 5 minute conversation after waking about the night or any other topic that the child showed interest in, even if no dream was recollected. In that way the possible need for attention did not pressure children to invent dream stories.

Interviews were carried out within the first 20 minutes of the waking state each morning, and were tape recorded in order to allow retrospective control over the conversation.

In order to rule out parental suggestions and waking fantasy penetrations from entering the reports we introduced a 3 step control system on the dream collection and evaluation process which included control of the child's narrative by the parent and the researcher, and control of parental influence by the researcher. The steps are:

1. The parents were asked to rate the dream reports on a 0-10 scale in order to estimate the extent to which the report is a dream (10) or a product of waking fantasy (0). Dreams rated below 5 points were excluded from the research. Parents were also encouraged to name a point (if recognized) where the dream becomes a fantasy, and thus we were able to exclude the products of waking fantasy from the analysis.
2. A research assistant, blind to the parent's ratings, rated the dreams independently on a similar scale using the guidelines of Colace (Colace, 1998, 2010) on dream report credibility. Those dreams, where the two ratings diverged significantly, were excluded from the analysis.
3. Answers to suggestive questions were eliminated from the dream narrative: mentioning any concrete character or event in the parent's question that the child had not mentioned before were considered suggestive (for example: *"Was your father there in the dream?"* instead of the general *"Was there anyone else in your dream?"* or *"Did anything happen in your dream?"*).

DOI:10.14753/SE.2016.1935

3.2.3 Measures of Dream Content

After the 6 weeks of data collection, assistants, blind to the purpose of the study, typed the conversations into written documents. During the word-count process two independent researchers counted relevant words of the dream reports, based on the word-count rules described by Foulkes and Shepherd (Foulkes & Shepherd, 1971).

To form the basis of our system we considered two popular content analysis systems, which we augmented with some of our own categories. One of these existing content analysis methods for children's dreams was developed by Foulkes and Shepherd (Foulkes & Shepherd, 1971) and the other one was the widely used system of Hall and Van de Castle (Hall & Van de Castle, 1966), which we simplified to fit the characteristics of the often short and simple dream reports of children. We also modified the Foulkes-system to be comparable with the other. (For a description of our content analysis system, see Appendix 3).

Here, I focus on those dream characteristics that diverge most prominently between different dream collection methods and that could be important in clearing up inconsistencies in the literature. Dream characteristics that change significantly through development (in both laboratory and home studies; Foulkes, 1982, 1999; Sándor, Szakadát, Kertész, & Bódizs, 2015), and those that proved to be significant in adult studies in connection with cognitive and affective regulation (Blagrove et al., 2010; Simor, Pajkossy, et al., 2012) were considered as well.

Dream characters (variable used: the average number of characters per dream)

a. *Human character*: a character is someone physically present in the dream, or whom the dreamer interacts with in the dream. The dreamers themselves were not counted as human characters; they were only coded as self-representation.
b. *Family character:* characters belonging to the dreamer's family.
c. *Animal character*: any kind of non-imaginary animal physically present in the dream. (Variable used with character subcategories: number per all characters.)

Settings (the average number of settings per dream)

a. *Home setting:* any kind of building where people live. E.g.: a castle, an igloo, a hut, etc. A kennel can also be a "home", and any part of a home is scored as

"home". (Variable used: the percentage of all settings and dreams with a home setting, for all dream with a setting).

b. *School setting:* any building or area set aside for educational purposes, including physical education or sports. Includes education spaces for young children i.e. preschool, kindergarten, daycare etc. (Variable used: the percentage of all settings.)

c. *Undefined/ unclear setting*: a setting that is mentioned in the dream report but cannot be clearly defined by the dreamer. Blurry and unsure location. (Variable used: the percent of all settings and dreams with unclear setting, for all dreams with setting.)

Kinematic nature of dreams

a. *Kinematic imagery*: children were asked if their dream contained motion *("Did you see your dream as a motion picture was it rather like a photo?"*). (Variable used: the ratio of dreams with kinematic imagery.)

b. *Self-initiated actions*: any activity actively performed by a character is scored here. For example: "*I reached for the cup…"* or *"I went to my grandma's place".* (Variable used: the average number of actions per dream.)

   a. *Gross-motor activities*: gross motor activities are those that involve the movement of whole body or a significant part of the character's body. (Variable used: the average number of gross-motor activities per dream).

   b. *Verbal activities*:

c. *Exploratory activities:* Any unusual or fantastic activity which the Dreamer probably would not perform in real life. Exploratory activities are driven by curiosity or adventurousness. E.g.: *"to go treasure hunting, diving etc."* (Variable used: the percentage of dreams with exploratory activities.)

Social interactions

(Variables used: the average number per dream, and the ratio of dreams with interactions.)

a. *Aggressive interactions*: any hostile or offensive act towards a character, when it is a consequence of a deliberate, intentional act on the part of one character to

harm or annoy some other character. For example: *"I was playing with E. and she hit me on the head…"* or *"…the sharks hit each other with the iron rods…"*

b. *Friendly interactions*: any friendly or helpful overture towards another character, which involve a deliberate, purposeful attempt on the part of one character to express friendliness toward or cooperate with another. For example: *"…she stroked the pony…"* or *"The natives were took the polar bear to their hut to cure it…"*.

(Variables used: the ratio of all interactions, and the percentage of dreams with aggressive or friendly interactions.)

Indices of self- effectiveness:

a. *Active self-representation*: coded if the dreamer is present and actively takes part in the dream mentation (e.g.: *"I was on a ship"* or *"I made a cake"*). Passive self-representation is scored if the dreamer merely views the scene and no self-representation is coded if the dreamer is not mentioned at all. (Variable used: ratio of dreams with an active self.)
b. *Self-negativity percent:* calculated by adding up the incidences of dreamer as a victim plus dreamer involved misfortune plus dreamer involved failure divided by all the above plus dreamer as befriended plus dreamer involved good fortune and dreamer involved success (Domhoff, 1999).
c. *Dreamer involved strivings and success:* calculated by adding up the dreamer involved strivings (failures and successes) and successes respectively and dividing them by the number of dreams for each of the children.

(Success is scored when a character achieves a positive outcome by actively contributing to the achievement through their own efforts and skills, and a failure is when a character fails to achieve an important goal due to their own faults or flaw in her character. Similarly to success, failure can only be the consequence of character initiated actions (Hall & Van de Castle, 1966).

Cognition in dreams: mental or intellectual activity of any sort. For example thinking, planning, counting, decision making, imagination, forgetting, remembering, dreaming, learning, knowing, comparing, longing for, expectation, will, or interest. Negative examples are also scored. For example: *"I did not remember the way home…"*.

(Variable used: average number of cognitions per dream and percentage of dreams with cognition.)

Emotional aspects of dreams

a. *Dream emotions*: the children were asked if they had any feelings during the dream and they were given examples of feelings by the interviewer. *("Did you have any feelings during the dream? Did you feel for example angry, sad, happy, surprised or scared or were just calm?"*). Positive emotions were happy, calm, and good (sometimes the participants spontaneously said they felt good). Negative emotions were sad, scared, angry and bad. (Variables used: average number of emotions per dream, the percentage of dreams with emotions and the ratio of specific emotions compared to all emotions.)
b. *Emotional dream quality*: is also based on the children's self-report. *("How was this dream? Was it good, bad or neutral?"*). (Variable used: the ratio of dreams with positive/negative quality.)
c. *Effect on daytime mood*: based on the self-report, the children dreams were categorized to have an emotional effect on the mood after awakening or not. (*"Do you still feel all of these feelings of your dream or did they go away as you woke up?"*). (Variable used: the percentage of dreams with a reported effect on daytime mood compared to those dream reports that contained mood data at all.)

Bizarreness: bizarre elements were coded according to the coding method of Revonsuo and Salmivalli (1995).

All of the above categories were coded by two independent raters. For measuring Inter-rater reliability we used Cohen's Kappa which varied between .7–.87 amongst the content analysis categories.

3.2.4 Measures of Intelligence

Three subtests from the *Wechsler Intelligence Scale for Children* (WISC-IV) (Wechsler, 2003) were used; the Vocabulary subtest for assessing verbal abilities, the Digit Span subtest for assessing working memory capacity and the Block Design subtest for estimating visuospatial abilities.

Raven's Coloured Progressive Matrices (CPM, Raven, Court, & Raven, 1995) were used to assess fluid intelligence based on non-verbal reasoning.

3.2.5 Measures of Executive Functioning

The relatively recent but well-studied *child Attention Network Test* (child ANT, Fan et al., 2002; Rueda et al., 2004) was used to measure reaction times and precision in different components of attention: the alerting, orienting, and conflict networks. It was built on the basis of the Flanker Test (Eriksen & Eriksen, 1974) but uses cues to measure alertness and orienting. In the child version the target is a fish, and the children are instructed to feed the hungry fish (by pressing a key corresponding to the direction of the target fish's mouth, as quickly as possible) which is either alone or in the company of distractors (in this case the target is always the central fish) (Rueda et al., 2004). Each trial begins with a central fixation cross. On congruent trials the central fish (target) face in the same direction, on incongruent trials in the opposite direction to the flanking fish, and on neutral trials the central fish appears alone. Each target is preceded by one of the four warning cue conditions: centre cue, a double cue, a special cue or no cue. In the centre cue condition an asterisk (cue) is presented in the location of the fixation cross. In the double cue condition an asterisk appears in the target location above and below the fixation cross. Spatial cues involve a single asterisk presented in the position of the upcoming target. An ANT session consists of a total of 24 practice trials and three experimental blocks of 48 trials in each. Each trial represented the 12 possible conditions in equal proportions: three target types (congruent, incongruent and neutral) × four cues (no cue, central cue, double cue and spatial cue). Children were provided with audio and visual feedback signals about their performance after each trial: for correct responses the target fish would blow bubbles followed by a happy sound, incorrect responses were followed by a single tone with no animation (Rueda et al., 2004). Participants indicated their responses via pressing the right or left arrow key on the keyboard. Children were verbally encouraged and supported if it was necessary during the practice trials. Accuracy and reaction time were also recorded.

Instructions and training of the children before the task happened exactly as described in the work of Rueda et al. (2004). The test usually lasted less than 30 minutes and

children could take a break after each block. Verbal encouragement was given to the children after each block.

The Alerting Network measure was calculated by subtracting the average reaction time of the double cue condition from the average reaction time with no cue conditions. The Orienting Network measure was calculated by subtracting the average reaction time of the spatial cue trials from that of the central cue trials. The Conflict Network measure was defined as the difference between reaction times for the incongruent and that of the congruent trials.

Modified Fruit Stroop and Emotional Stroop Tests for children were used to measure inhibitory control (Archibald & Kerns, 1999) and emotional interference control (Eschenbeck, Kohlmann, Heim-Dreger, Koller D., & Leser, 2004), dimensions of executive functioning in a situation of interfering stimuli. The Fruit Stroop Test is based on the same principles as the original adult version but the congruent and incongruent stimuli are non-verbal and better suited for children as they are represented by fruits in different colours consistent or inconsistent to the given fruit (Archibald & Kerns, 1999).

The Emotional Stroop task is a well-used tool in several variety to investigate attentional bias and emotional interference caused by emotionally salient stimuli (MacLeod, Mathews, & Tata, 1986). The task involves the presentation of neutral and emotionally loaded stimuli with different colours, and participants are asked to press the button corresponding to the colour of the stimulus as quickly as possible. Although the original version consists of neutral and emotionally charged words as stimuli, emotional facial expressions has been proven as ecologically valid stimuli (Honk, Tuiten, de Haan, vann de Hout, & Stam, 2001) and was used with children as well as with adults (Eschenbeck et al., 2004). Since the only relevant stimulus in this task is the colour information, subjects have to suppress other perceptual information about the face shown. This task might be more difficult in case of faces with emotional expressions, especially anger, because these emotional stimuli might attract attention more strongly than neutral faces thus causing cognitive interference. The shift of attention and the regulation of evoked emotions might demand extra cognitive effort from the subjects. This theory explains a slowdown in reaction time as a result of emotional stimuli especially for subjects with emotional processing difficulties (e.g. anxiety) (Eschenbeck

et al., 2004), results in this aspect however are inconsistent (Heim-Dreger, Kohlmann, Eschenbeck, & Burkhardt, 2006; Kindt, Bierman, & Brosschot, 1997) moreover the decrease of reaction time has been also observed (Hadwin, Donnelly, Richards, French, & Patel, 2009). One possible explanation for this inconsistency provided by Heim-Dreger et al. (2006) is that those subjects behave in the latter way, whose avoidance in connection to the emotional stimuli is stronger than their disturbance by them. Additionally it has been shown in children that, unlike in adults, error rates as well as reaction times could be predictive for emotional disturbances such as non-clinical anxiety (Eschenbeck et al., 2004). Brain imaging studies indicate that the Emotional Stroop task is associated with enhanced activation in the amygdala and the anterior cingulate cortex (Bremner et al., 2004; Etkin, Egner, Peraza, Kandel, & Hirsch, 2006; Whalen et al., 1998). Maintaining attentional set in the presence of salient distractors is attributed to the dorsolateral frontal lobe activity (Compton et al., 2003).

A computerized version of the Stroop Test was displayed on a 15-inch monitored laptop computer with coloured arrow buttons in the right hand corner. A session of the combined Stroop Test included a familiarization phase with the colours and the task (with 4 coloured squares as stimuli), a trial phase with the 4 kinds of fruits appearing in congruent colours, followed by the incongruent versions and with the 4 coloured schematic faces with neutral facial expression. Each trial starts with a central fixation cross appearing on screen for a randomly changing period between 1000-1600 ms. The test phase consists of four experimental blocks of stimuli. The first block contains 16 trials of congruent fruits followed by 16 trials of incongruent fruits in a fixed random order. The second block contains 16 happy faces and 16 angry faces (4 types of angry and happy faces in the 4 colours) in a fixed random order. And the third and fourth block repeated the first and the second blocks with trials arranged in fixed random orders. The stimuli were presented for 2000 ms on the screen before disappearing and giving way to a rest-screen for 1500 ms in case of no answer after which the fixation cross emerges. If no answer arrives to the stimulus before the time limit, the screen changes for the next fixation cross.

A block design for the stroop tasks was used in order to account for the slow effect of the negative emotional stimuli in the emotional part of the test (McKenna & Sharma, 2004). A second version of the test was also used which presented the blocks of

negative/incongruent stimuli before the positive/congruent, ones thus addressing the issue of possible reaction time differences due to exhaustion of the children. These two conditions were counterbalanced between the children.

Since according to our pilot study 4 year-olds had difficulties following the instructions of pressing the original colour of the incongruently coloured stimuli, we altered the usual instruction for the Stroop Test and the children were asked to press the colour that they actually see and try to suppress the stimulus (the incongruent fruit) which is interfering with it, thus making the exercise similar in nature to the Emotional Stroop task. The interference effect is proven to be present in the case of naming the presented colour of incongruent fruit stimuli (Ménard-Buteau & Cavanagh, 1984), and in the present study reaction times and accuracy rates were also found to be higher in the case of incongruent stimuli compared to congruently coloured fruits (paired t-test, $t= 6.4$, $p< .001$ and $t= 3$, $p< .01$).

A measure based on reaction times was calculated for both the Fruit Stroop and the Emotional Stroop conditions. The Incongruency Index (II) was calculated by subtracting the average reaction time of the congruent stimuli from that of the incongruent stimuli. The Emotional Interference Index (EII) was calculated by subtracting the average reaction times of happy faces from that of the angry faces. Overall, the bigger the difference is between the two kinds of stimuli, the more difficult it is to use inhibitory control in case of the Fruit Stroop Test and the slower the processing of negative emotional stimuli in the case of the Emotional Stroop Test. The accuracy measures of all conditions were recorded and used parallelly.

3.2.6 Measures of Attachment and Emotional Regulation

The *Manchester Child Attachment Story Task* (MCAST, Green et al., 2000) was used to assess the children's attachment representations in connection to the primary caregiver figure (in this research this is always the mother). This is a projective test that uses five story stems (the first of which is a practice story) intended to activate the children's attachment representations. The interviewer presents the story stems which introduce small stress situations to be continued by the child. Administration of the test involves a doll house and dolls, from which the child chooses one for representing themselves and one for the mother. The trained administrator introduces each story in a way designed to

induce a level of arousal and distress, prompting the child to resolve the stress situation during the story completion. Non-leading prompts facilitate story completion, followed by probes about both the child and mother doll's thoughts and feelings (mentalizing abilities). The four story stems are: 1) the child having a nightmare, while mother seeping in the adjacent room, 2) the child hurting their knee playing in the garden, while mother doll is near busy, 3) stomach ache while watching TV, mother doll is the adjacent room, 4) the child gets lost in a mall while shopping with the mother. The test takes around 30-45 minutes to complete, the administration is videotaped and the taped sessions are used for coding. The coding procedure uses a variety of attachment related scales that rate content (e.g. proximity seeking, parental sensitivity, self-care of the child) and process features (e.g. narrative coherence, arousal) to arrive at a formal classification of attachment using standard categories in the literature. The overall attachment category of each child is assigned based on the predominant attachment strategy represented throughout the four test vignettes. Besides the attachment categories we used the narrative coherence scores (based on the quality of the stories represented) and the disorganization scale (episodic disorganized or disoriented behavior) both indicated on a 9 point scale, as well as indicated mentalizing abilities as binary categories of mentalizers and non-mentalizers.

The *Strengths and Difficulties Questionnaire* (SDQ, R. Goodman, 2001) is a 25-question questionnaire completed by the parents, suitable for screening childhood behavioral problems and emotional coping. The Hungarian version was adapted and validated, finding an acceptable internal consistency amongst the scales (Birkás, Lakatos, Tóth, & Gervai, 2008). Both the original English version and the Hungarian version used in this study show a good correlation with the corresponding scales of the Child Behavior Checklist (Birkás et al., 2008; R. Goodman & Scott, 1999). The questionnaire consists of 5 scales each containing 5 items: 1) emotional symptoms, 2) conduct problems, 3) hyperactivity/inattention, 4) peer relationship problems, 5) prosocial behavior. The first 4 are used to calculate the total problem score while the fifth is a positive index for social coping. Each item can be rated in 3 ways: "not true" (=0), "somewhat true" (=1), "definitely true" (=2). The sum of the values of the individual items forms the scale values thus ranging from 0-10. The sum of all 4 problem scales form the total difficulty scores, and the positive scale of prosocial

behavior represents the extent to which the child, in spite of the difficulties, is still able to maintain positive behavior with others.

The authors suggest that in the general population it may be more useful to use a condensed form of the problem scales consisting of "internalizing problems" (emotional problems + peer problems) and "externalizing problems" (hyperactivity/ inattention + conduct problems) (A. Goodman, Lamping, & Ploubidis, 2010). Emotional problems scale was also included on its own right, given its possible importance in relation to attachment and emotional aspects of dream reports.

3.2.7 A Measure of Sleep Quality

The *Child Sleep Habits Questionnaire* (CSHQ; Owens, Spirito, McGuinn, & Nobile, 2000) is a retrospective, 45-item parent-report questionnaire with an overall internal consistency of .68 (alpha coefficient), and an acceptable test-retest reliability of the subscales ranging from .62-.79 (Pearson's correlation). The test-retest reliability was measured on a community sample of 60 parents who repeatedly completed the questionnaire at 2-week intervals (Owens, Spirito, & McGuinn, 2000).

The CSHQ includes items relating to a number of key sleep domains that encompass the major presenting clinical sleep complaints amongst school-aged children. Subscales: 1) bedtime resistance, 2) sleep onset delay, 3) sleep duration, 4) sleep anxiety, 5) night wakings, 6) parasomnias, 7) sleep disordered breathing, 8) daytime sleepiness. Parents were asked to recall sleep behaviors occurring over a "typical" recent week. Items are rated on a three-point scale: "usually" if the sleep behavior occurred five to seven times per week; "sometimes" for two to four times per week; and "rarely" for zero to one time per week. Higher scores indicate more problems on each of these scales. The scales of the CSHQ are calculated by taking the mean value of the consisting items which vary from only 1 item (sleep onset delay) to 8 items (daytime sleepiness). Due to the variability in the scale lengths in the present study I only considered the total sleep problem scores for correlations.

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3.3 Data Analysis

Since the number of observations (dreams) per child varied greatly across the sample, dream content characteristics were relativized (average item/dream) for each child. These are the units of the statistical analyses unless defined otherwise in the methods section. Since the dream related variables did not meet the conditions for parametric testing, I used non-parametric statistics through the main data analysis sections. To analyze sample characteristics I used the Student's t test for children's ages and the chi-squared test for frequency data (for example: the distribution of children with siblings or with both parents throughout the age groups).

Statistical analysis of the age-dependency of dream report features was performed by calculating the Kendall tau rank correlation coefficient. Between-group comparisons, including age categories and gender differences in children's dream content were tested with the Kruskal-Wallis test, and the Mann-Whitney U test serving as post hoc analysis.

To explore the correlations between the dream characteristics of the children and their intelligence and executive measures the Kendall tau (τ) method was used.

To examine associations between the scale measures of the MCAST and the questionnaires the Kendall tau rank correlation test was applied and with categorical measures of the MCAST (attachment and mentalization categories) I used the Mann-Whitney U test. Age was held constant at all of the correlations with the cognitive, emotional and sleep-related measures, and the degree of freedom equals to 38 in all correlations unless stated otherwise in the text.

In case of the Mann-Whitney test used to determine the differences between the categories of MCAST variables (attachment: secure vs insecure and mentalization: mentalizers vs non-mentalizers) a multiple-step method was used in order to control for age:

1. the hypotheses were tested with the Mann-Whitey U test,
2. values of the significantly differing dream variables were ranked,
3. linear models were fitted, with the dream variables in question (ranked) as the dependent variable and age ranked as the independent variable,
4. residuals were extracted from these linear models,

5. the residuals were tested with the Mann-Whitney U test, this time accounting for the effect of age as well.

With the Mann-Whitney U tests effect sizes are also reported as advised by Field ($r = Z/\sqrt{N}$) (Field, 2013).

In order to control for Type I errors in case of multiple correlations (Kendall tau), the Benjamini-Hochberg (B-H) correction method was used to adjust p values, using a 10% false discovery rate as recommended by McDonald (2014).

Statistical analyses were carried out and all figures were produced by the R statistical program (version 3.0.2, RCoreTeam, 2013).

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4 Results

4.1 Sample Characteristics

The socio-economic background of the participants was reasonably homogenous. All of the recruited participants were from middle class families with mid-range income and at least one of the parents holding a degree in higher education. All of the families (with one exception, also living in a city) were from the capital city of Hungary. Major differences amongst the children could be naturally their age and the family structure they were living in. Regarding age, 3 age groups (Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years) were formed for a better illustration of developmental changes in the dream characteristics (Table 2). To gain an insight into the participants' family structure I analyzed if they were living with both parents or with only one of them and also the number of siblings in the household. None of these variables differed significantly amongst the 3 age groups. In order to check on gender differences I also compared the mean age of males and females within the age groups. Boys in Group3 turned out to be significantly older than girls which circumstance should be considered when interpreting gender data (Table 2).

Table 2. Age and family background data of the subjects broken down by age groups and gender in case of age. *= p < .05, Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

Age groups:	**G1**		**G2**		**G3**		**Total**		**X^2**
Number of participants	14		12		14		40		-
Age in years (SD)	4.6 (0.56)		6.1 (0.36)		8.1 (0.52)		6.3 (1.6)		-
Number of children with separated parents	5		3		3		11		0.77 (df=2)
Average number of siblings (SD)	1 (0.39)		1.42 (0.5)		1.36 (0.93)		1.25 (0.67)		10.4 (df=6)
Gender differences:	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	-
Number of participants	7	7	7	5	7	7	21	19	-
Age in years	4.4	4.7	6.1	6.0	7.8	8.4	6.1	6.4	-
t-test	0.8 (df=12)		0.5 (df=10)		2.9* (df=7)		0.36 (df=36)		-

4.2 Descriptive Analysis of Dream Content throughout the Age Groups

4.2.1 Dream Report Frequency and Length

Over the 1680 attempts (42 mornings for each of the 40 children) 349 dreams were collected, with an overall mean of 8.7 dreams per child (ranging from 1 to 25 dreams). Group1 accounted for 112 dreams with an average of 8 dreams per child. Children in Group2 reported 129 dreams with an average of 10.8 dreams per child, and Group3 subjects collected 108 with an average of 7.7 dreams per child. There was no significant correlation between dream report rate and age, nor significant difference amongst the three groups (Kruskal-Wallis $H = 1.09$, $p = .58$).

Gender differences were found in the overall number of reported dreams (Mann–Whitney $U = 298$, $p = .008$, $r = .42$, $df = 38$), which also appeared in the oldest age group where girls reported more dreams than boys ($U = 44$, $p = .010$, $r = .67$,$df = 12$; Figure 3). Dream recall frequency seems to be very similar in the youngest age group, but while the girls' relative dream recall shows a clear rising tendency towards the oldest age group, the boys' relative report rate declines (from 46% to 25%).

I also tested for the possible changes in dream recall rate throughout the 6 weeks of data collection. I divided the 6 weeks into 3 two-week periods and found that children reported significantly more dreams during the first 2 weeks (mean dream recall: 5) of the dream collection period than either of the second ($U = 345$, $p = .000$) or third 2-week periods ($U = 50.5$, $p = .002$) which latter two showed no difference (3 dream reports on average).

Dream length was measured by the number of words in the dream report (Foulkes & Shepherd, 1971). The median of the number of words across the dreams was calculated for each child. The overall mean of the median lengths of all children's dreams was 51.3 words (median: 39.5, ranging from 12 to 143 median words per child, see Figure 3). The mean length was 38.1 words in Group1 (median: 32.2), 58.4 words in Group2 (median: 60.8), and 58.5 words in Group3 (median: 43.5). Significant differences between the dream lengths of the age groups (Kruskal-Wallis $H = 6.04$, $p = .048$) were found, with the significant difference observed between Group1 and Group2 (Mann-Whitney $U = 31$, $p = .007$, $r = .53$, $df = 24$; Figure 3), but there was no significant correlation with age as a continuous variable. No significant gender-difference were

found across the 3 age groups, only that in the youngest age group a tendency emerged with girls reporting longer dreams (U = 267, p = .069, df = 38) than boys.

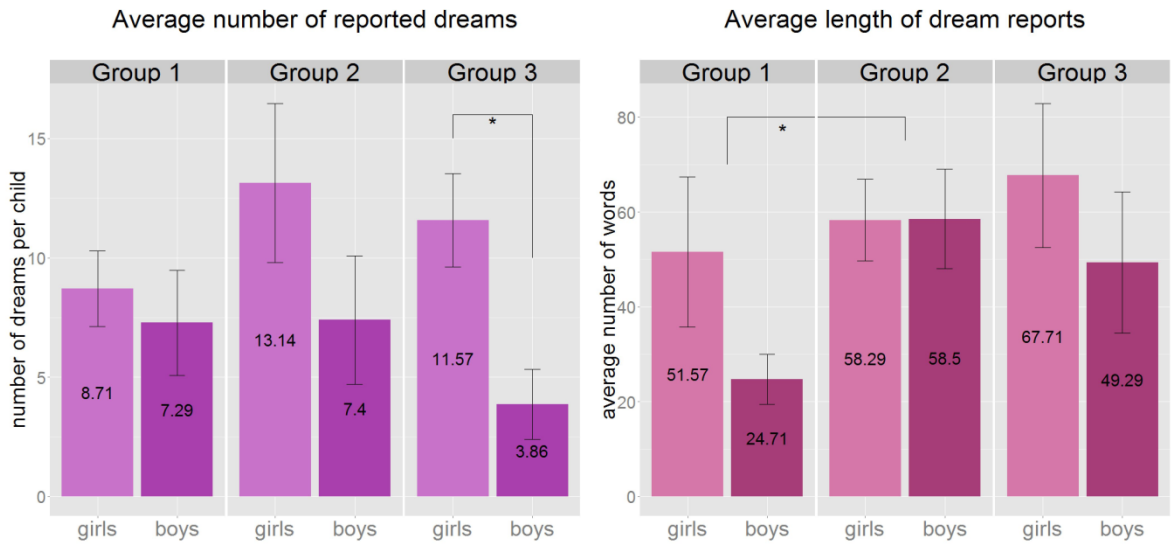

Figure 3. Left: the average number of reported dreams by gender and age group. A significant difference in the number of dreams between the two genders in the oldest age group (U = 44, p = .01, r = .67) is observable. This gender difference was also present in the overall population. Right: the average length of dream reports by gender and age group. A significant increase was present between Group1 and Group2 in the length of dream reports (U = 31, p = .007, r = .53) when genders were tested together. *= p < .05, Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

4.2.2 Dream Characters

Altogether 1092 characters in the 349 dreams were counted, an average of 3.13 characters per dream (not including the self, Figure 4). The most frequent characters in the dreams were human characters, with an average of 2.15 per dream (749 altogether) accounting for 68.6% of all characters (Figure 5). Only 7.9% of the characters were animals. The average number of characters did not show a significant change across the age groups (3.3; 2.8; 3.5 respectively), nor did the percentage of human (71%, 68%, 68% respectively), or animal characters (9%, 6%, 14% respectively) to all reported characters. No significant gender difference in dream characters were found, but boys showed a declining pattern of the relative number of human characters between Groups 1 and 3 (U = 40.5, p = .047, r = .39, df = 12; Figure 5). The expected gender differences in the distribution of male and female characters were found: girls dreamed about more female characters (U = 279, p= .01, r = .40, df = 38), and boys dreamed about more male characters (U = 114, p = .035, r = .33, df = 38). The male per

female character percent was also calculated from the Hall/Van de Castle system (Domhoff, 1999) and found a significant gender difference appearing even in the preschool age group (U = 76, p = .004).

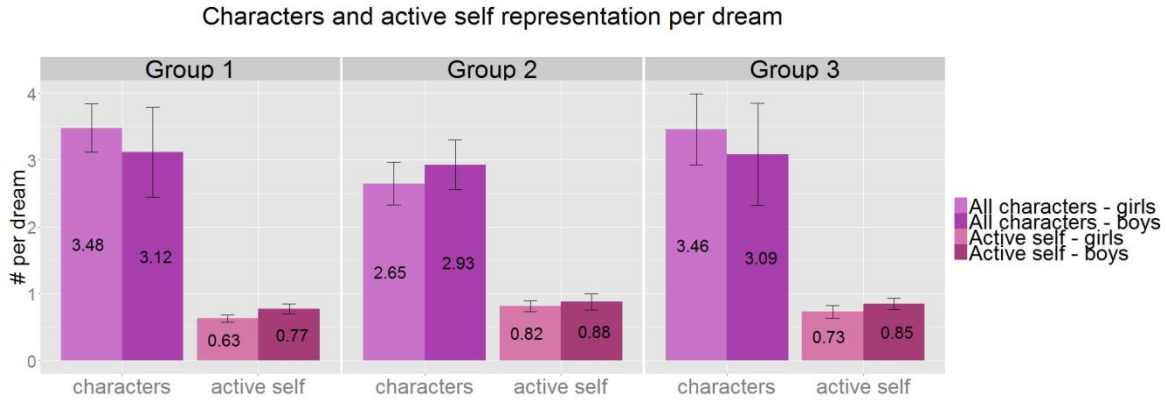

Figure 4. The average number of characters per dream by gender and age group (purple). The ratio of dreams with active self- representation compared to all dreams (pink). Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

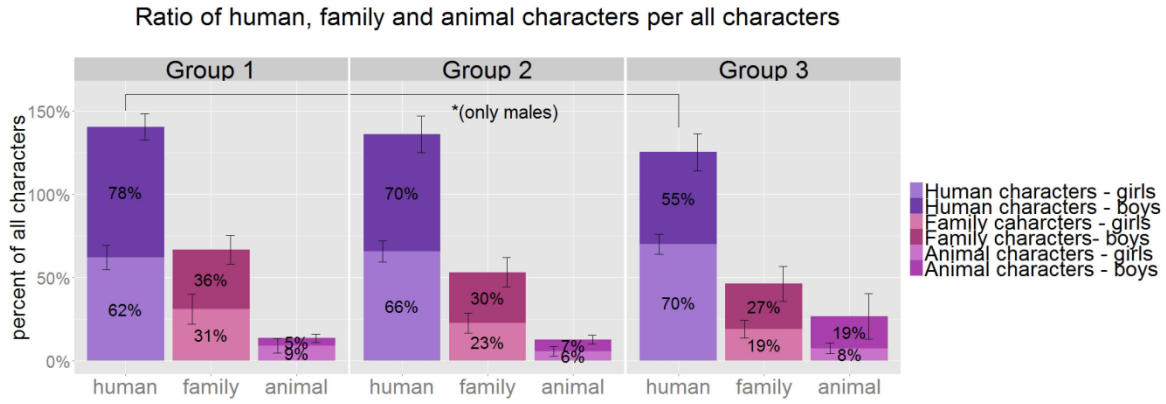

Figure 5. The relative percentage of human, family and animal characters of all characters appearing in the dreams by gender and age group. Although there is no significant age or gender difference in any of the above variables, boys show a significant decrease in the percentage of human characters in their dream reports between Group1 and Group3 (W = 40.5, p = .047, r = .39). * p < .05, Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

An example of a typical dream depicting various characters from a 5.7 year old girl: *"We went to the city park, papa and you [mom] and Lili and Bende [siblings] we went for a walk and we arrived at a garage…".*

4.2.3 Dream Setting

Children mentioned on average 1 setting per dream overall which showed a slight tendency to increase throughout the age groups (G1: 0.88, G2: 1.09, G3: 1.11, Kruskall-

Wallis H = 5.14, p = .076, df = 2). These settings appeared in 83% of all the dream reports, moving from 75% (G1) through 86% (G2) to 89% (G3), but this tendency did not reach significance. Home settings and school settings turned out to be most frequently occurring in the age range of the study, thus I will analyze these two settings, together with the ratio of unclear or undefined settings further. Interestingly a decrease was found in the ratio of home settings (39%, 34%, 15% of all settings) and an increase of the relative amount of school settings (8%, 16%, 26% of all setting) in dream reports throughout the age groups (Kruskall-Wallis H = 7.81, p = .020, df = 2; H = 5.5, p = .061, df = 2, Figure 6). The ratio of unclear settings did not show significant changes throughout the age groups. Sex difference was found only in case of the ratio of school setting (Mann-Whitney U = 124, p = .033), where girls experienced a higher ratio of school settings than boys (21% and 12% respectively). This difference was interestingly the highest in the youngest age group (G1, boys: 1%, girls: 14%) and arrived at the same level by the oldest age group (G3, both sexes: 26%).

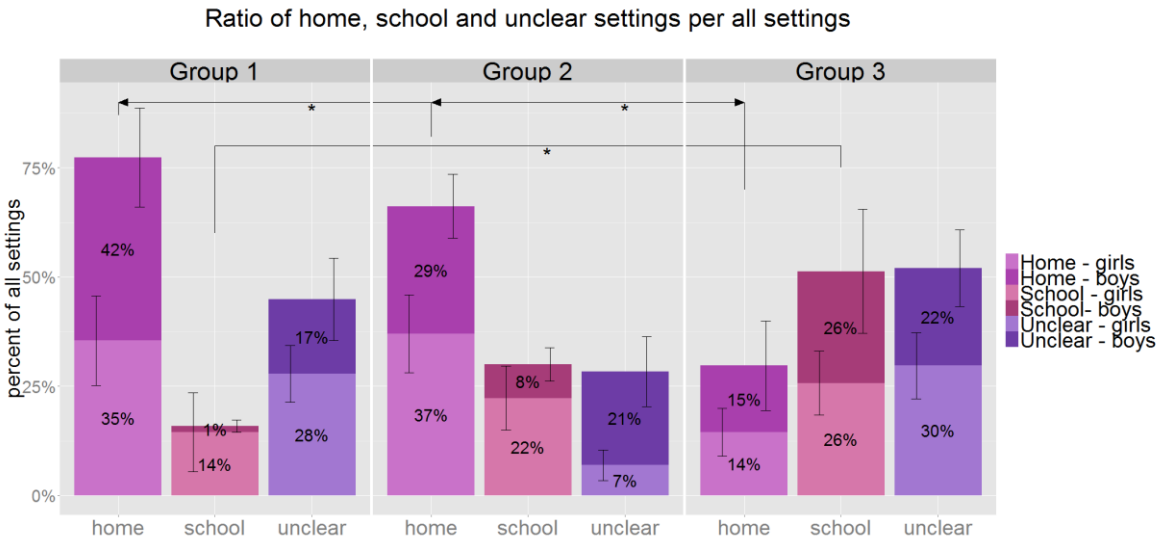

Figure 6. The percentage of home (purple), school (pink), and unclear (blue) settings compared to all settings appearing in children's dreams. While the percentage of home setting decrease, the ratio of school/preschool/ kindergarten settings increase with age. The ratio of settings reported to be unclear stay relatively stable throughout the age groups. * p < .05, Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

Dreams taking place at home were typical for the youngest age group (girl, 5.1 y): *"The dream started at home, we were here, sitting on the couch downstairs, and the door was not locked with key….."*, in contrast unclear settings were present in every age group

(girl, 7.8 y): *"I dreamed that I, Flora [sibling] and Mama were at a place…I don't know what kind of place…"*

4.2.4 Kinematic Imagery and Dream Activities

The kinematic or static nature of the dreams was reported in 84% of all dream reports (293 dreams), and this ratio did not differ significantly between the age groups (82%, 81%, 89% respectively). The percentage of kinematic dreams itself did not differ significantly but stayed relatively high across the age groups (80%, 93%, 85% respectively). Out of those dreams where a kinematic or static nature was explicitly reported by the dreamer 86% were kinematic. No gender differences were detected in connection with kinematic imagery in the dream reports (Figure 7).

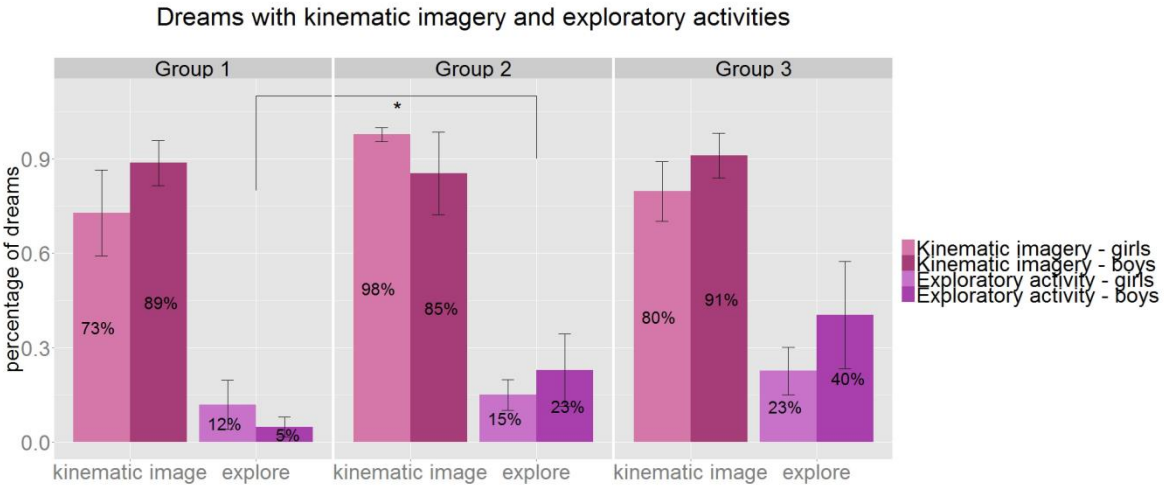

Figure 7. The ratio of dreams with kinematic imagery (pink) is stable and stays high throughout the age groups (ranging from73-91%). The ratio of dreams with exploratory activities (purple), though not reaching high levels, show a significant increase between Groups 1 and 2 (U = 162, p = .044, r = .32). * p < .05, Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

4.2.4.1 Self-initiated Activities

As further evidence adding to the self-reported kinematic nature of the dreams, self-initiated actions in the dream reports were counted. I counted 1651 activities in the 349 dreams altogether, which on average is 4.73 activities per dream. 90.2% of all dreams contained at least one activity (Figure 8).

Thus, a typical dream report of 4 to 5 year-olds is likely to be kinematic and contain more than one self-initiated actions: *"…then the ship started to sink and Bius [sibling] and papa swam over to me and then deep-sea divers found us and they carried us to the*

dry land…" (boy, 4.9 y) or "We ate some cookies and then we went to the playground at Mammut [shopping mall]…" (boy, 4.7 y).

The number of all activities tended to increase across the age groups (3.8, 4.8, 5.8 activities per dream respectively) (Kruskal-Wallis, H = 5.51, p = .063). This increase was significant between Groups 1 and 2 (U = 42, p = .033, r = .34, df = 24; Figure 8). The ratio of dreams containing activities is similarly high and stable across the age groups.

Girls reported slightly more dream activities than boys, which remained a tendency (U = 268, p = .065, r = .29, df = 38).

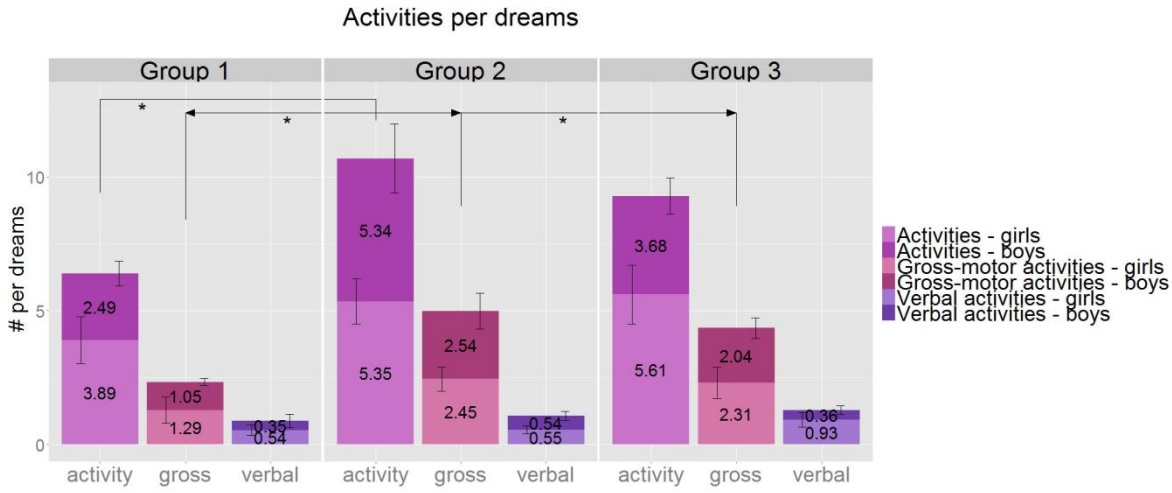

Figure 8. The average number of self-initiated activities per dream (purple), show a significant increase between Group1 and Group2 (U = 42, p = .033, r = .34). Gross-motor activities per dreams (pink) also show significant growth throughout the age groups. The number of verbal activities per dreams stays stable with age. * p < .05, Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

Amongst dream activities the number of gross-motor activities and verbal activities per dream were analyzed. Children's dream reports showed a significant increase in the number of gross-motor activities with age (Kruskal-Wallis, H = 8.13, p = .017), mostly between Groups 1 and 2 (U = 140, p = .013, r = .40, df = 24) and Groups 1 and 3 (U = 152, p = .020, r = .037, df = 26). The number of verbal activities in the dreams stays relatively low and stable across the age groups (from 0.4 (G1) to 0.6 (G3) per dream). Girls reported slightly more verbal actions than boys (0.67 and 0.40 per dream respectively) in their dreams, which remains a tendency (U = 264, p = .083, r = .28, df = 38, Figure 8) in all groups.

4.2.5 Social Interactions

Altogether 321 interactions in the 349 dreams were counted which make up an average of 0.92 interactions per dream (Figure 9). 57.1% of all dreams contained at least one interaction. Aggression accounted for 38.3%, friendliness for 45.8% of all interactions (Figure 10). Out of all the dreams 27.7% contained some kind of aggression and 35% involved friendly interactions.

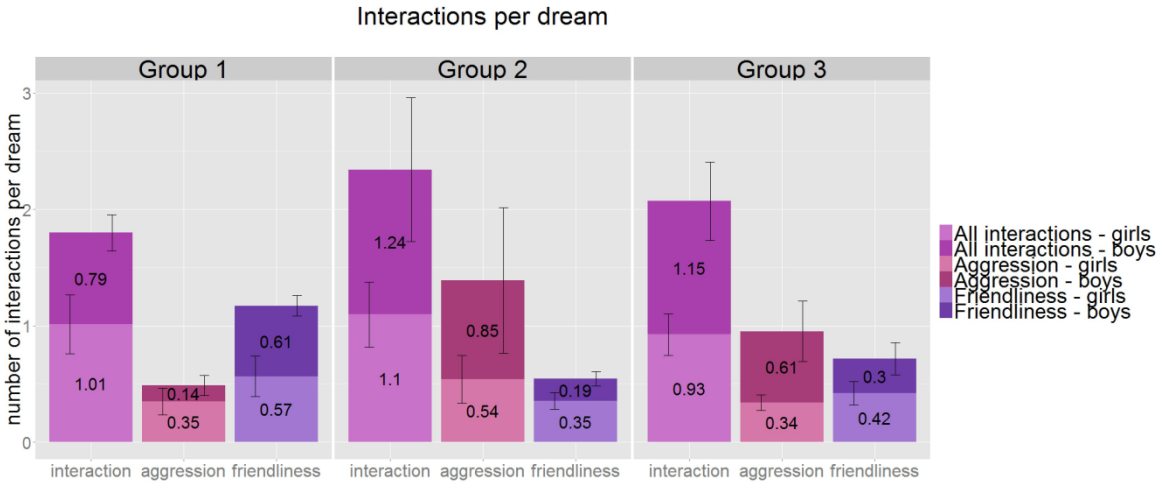

Figure 9. The average number of interactions (purple), aggressive interactions (pink) and friendly interactions (blue) per dream by gender and age group. All of these variables stay relatively stable across the age groups. Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

The number of interactions per dream (0.9, 1.2, 1; Figure 9) and the percentage of dreams with at least one interaction (55%, 54%, 62%) remained stable across the age groups. Within the stable interaction rate an increasing tendency was observed of the relative number of aggressive acts per all interactions with age ($\tau = .21$, $p = .06$, $df = 38$). The percentage of aggressive interactions relative to all interactions was characterized by an intergroup increase (Kruskal-Wallis, $H = 6.39$, $p = .04$) from Group1 to Group2, as well as from Group1 to Group3 values ($U = 41$, $p = .029$, $r = .43$, $df = 24$ and $U = 52$, $p = .034$, $r = .40$, $df = 26$, respectively). The number of dreams with at least one aggressive interaction per dream also showed an increase between Group1 and 3, supporting the above results ($W = 54$, $p = .043$, $r = .39$, $df = 26$; Figure 10).

Examples of aggressive interactions typically varied on a wide scale from mild sibling arguments: *"I took the hammer from her hand and she started crying…"* (girl, 4.2 y) to

deadly actions: *"the car ran over me […] the man bent me and the car went over me"* (girl, 3.8 y).

A decrease in friendliness per all interactions (Kruskal-Wallis, H = 10.4, p = .005) was also detected, which is significant between Group1 and 2 and Group1 and 3 (Mann-Whitney U = 29, p = .005, r = .55, df = 24 and U = 41, p = .009, r = .50, df = 26 respectively), yielding a tendentious negative correlation with age (τ = .21, p = .059, df = 3; Figure 10).

Friendly interactions usually included giving or accepting help or playing /doing mischief together: *"…we found out that we will escape from school together … and we climbed over the fence and … went to the amusement park"* (girl, 7.6 y) or *" I dreamed that mother was telling me a good night tale"* (girl, 5.2 y).

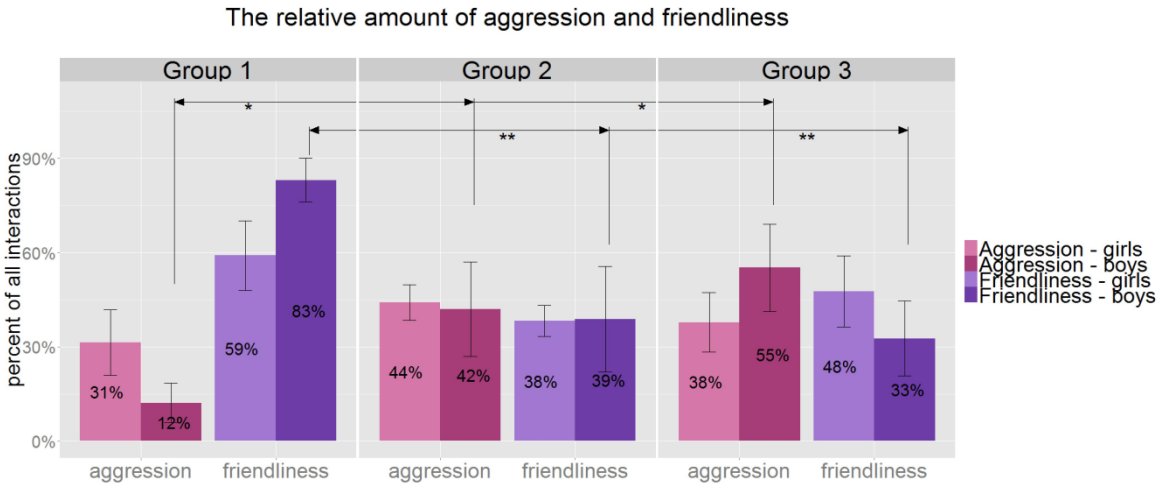

Figure 10. The relative percentage of aggressive and friendly interactions in all interactions, by gender and age group. There is a significant increase in aggression from Group1 to Group2 and from Group1 to Group3, which is only significant amongst the boys and not the girls (although it stays significant without the gender split). Friendliness shows a significant decrease in the same pattern: from Group1 to 2 and from Group1 to 3. * p < .05, ** p < .01, Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

Neither the number of interactions per dream nor the relative number of aggression or friendliness did show any gender related differences. However, when I paid more attention to the individual patterns of girls and boys across the age groups I discovered that both the increasing tendency of aggression and the decreasing pattern of friendliness was caused by a change only in the boys' group (Kruskal-Wallis, H = 5.9, p = .052 and H = 8.2, p = .016, respectively), while girls' relative aggression and friendliness stayed stable (Figure 10).

4.2.6 Self –agency

The ratio of dreams with an active self, the number of dreamer involved successes and strivings per dream and self-negativity index were considered to be measures of self-agency. The dreamer's own self appeared in an active role in 77.6% of the dreams, which did not differ significantly between the age groups, only a tendency of growth is observable between Groups 1 and 2 (U = 52, p = .097, df = 24, Figure 11). No gender differences were present in connection with the self in the dreams. The number of dreamer involved successes was 0.22 per dream on average, which did not change significantly throughout the age groups nor between genders, but showed a slight increasing tendency with age which became obvious when the wider category of strivings (0.33 per dream were examined, growing from 0.19 (Group1) to 0.35 (Group3)). Dreamer involved strivings showed an overall tendentious increase with age (Kruskal-Wallis H = 5.6, p = .06, df. = 2) which reached significance in between Group1 and 2 (Mann Whitney U = 163, p = .018, r = .37, df = 24, Figure 11).

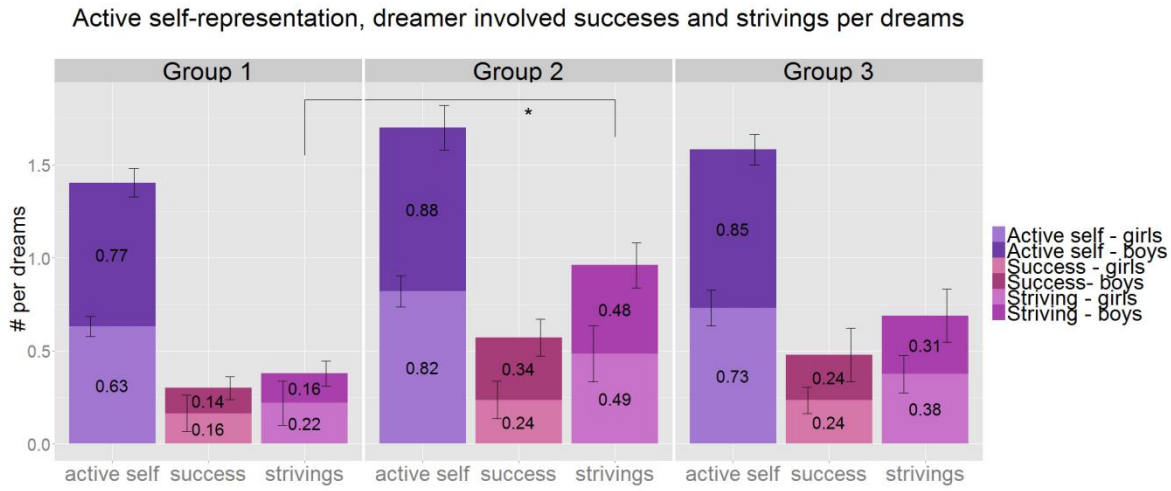

Figure 11. The ratio of dreams with the dreamer's active self (blue), the average number of dreamer involved successes (pink) and strivings (purple) per dream by gender and age group. Only the number of dreamer involved strivings per dream showed a significant change (increase) with age. * p < .05, Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

Self-negativity depicted a similar pattern; with an overall increasing tendency (Kruskal-Wallis, H = 5.3, p = .07) and a significant increase between Groups 1 and 2 (Mann Whitney U = 127, p = .023, r = .36, df = 23; Figure 12). Gender differences were observed in Group1 with girls showing significantly higher self-negativity than boys (U = 37, p = .019, r = .62, df = 12), and which difference disappeared with age.

An example of a typical dream depicting an active self and dreamer involved success from a 5.7 year old boy: *"The T-Rex was looking in through the window […] I was yelling […] and then I turned around and then I hit the T-Rex with a whip …"*

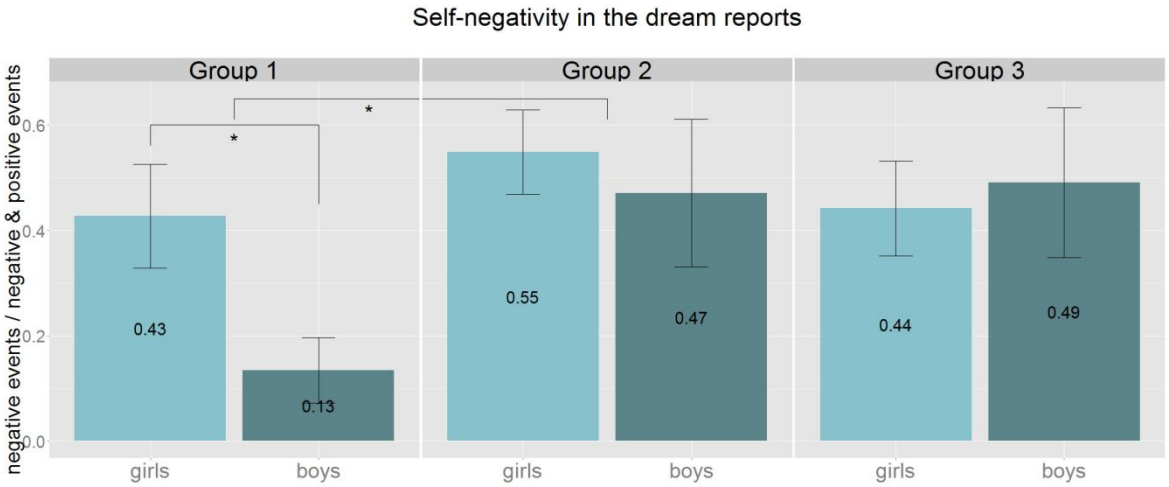

Figure 12. Self-negativity index by age and gender, which showed a significant increase between age groups 1 and 2. Gender differences were only detected in the youngest age group, with girls experiencing more signs of a negative self in their dreams. * p < .05, ** p < .01, Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

4.2.7 Cognition

Verbs reflecting cognitive activities were counted throughout the dream reports in order to test the parallelism of wakeful cognitive skills and dream narratives. The overall frequency of cognitive verbs in the dream reports was .37 and 28% of the dreams contained at least one cognitive verb. A significant increase of cognitions between Groups 1 and 3 (Mann Whitney U = 50, p = .028, r = .42, df = 26), and a tendency between Groups 1 and 2 (Mann Whitney U = 50.5, p = .086, df = 24, Figure 13) were found.

No gender related difference was found in the number of cognitions appearing in dream reports.

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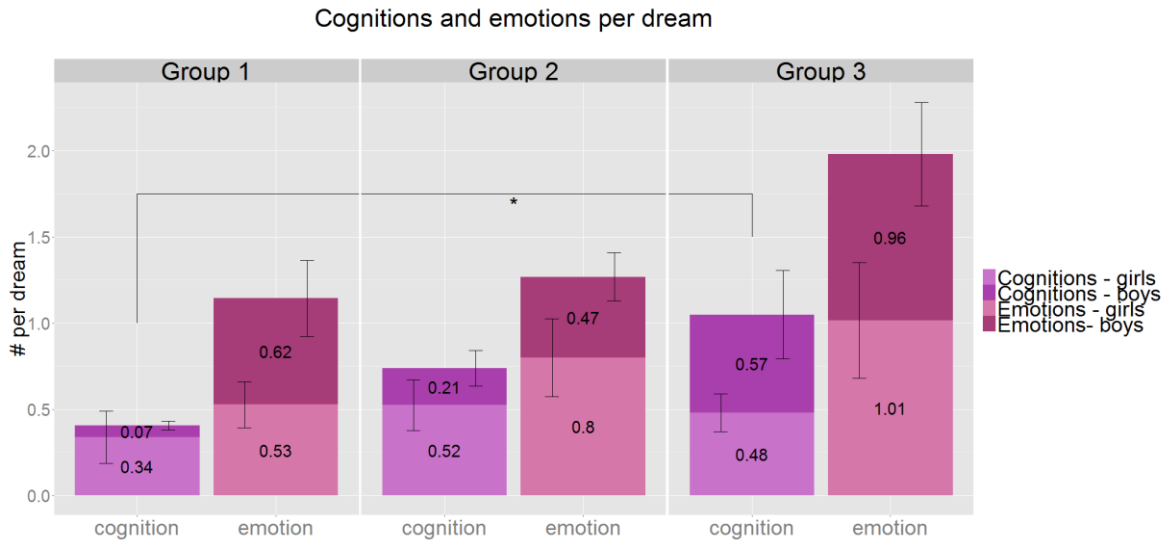

Figure 13. The average number of cognitive verbs and emotions per dream by gender and age group. There is a significant increase of cognitions appearing in the dream narratives between Groups 1 and 3 (U = 50, p = .028, r = .42). * p < .05, Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

Typical examples for cognitions in the dreams: *"... my tooth fell into my hand and I told the teacher about it but she did not know where to put it..."* or *"... a bad person came into our house ... and she pretended to be our mother ... and we really thought she was the real mother..."* (girl, 5.7 y).

4.2.8 Emotions in the Dreams

The assessment of emotions in the dreams was based on the self-report of the children given as an answer to the standard interview question asked by the parent. Unfortunately, this question was not evenly asked by all of the parents. Here I only analyze those children's dreams whose parents reliably asked this interview question. Here our sample consists of 33 children 10 (female= 6) from Group1, 9 (female= 6) from Group2 and 14 (female= 7) from Group3, whose mean age by group does not differ significantly from the original sample.

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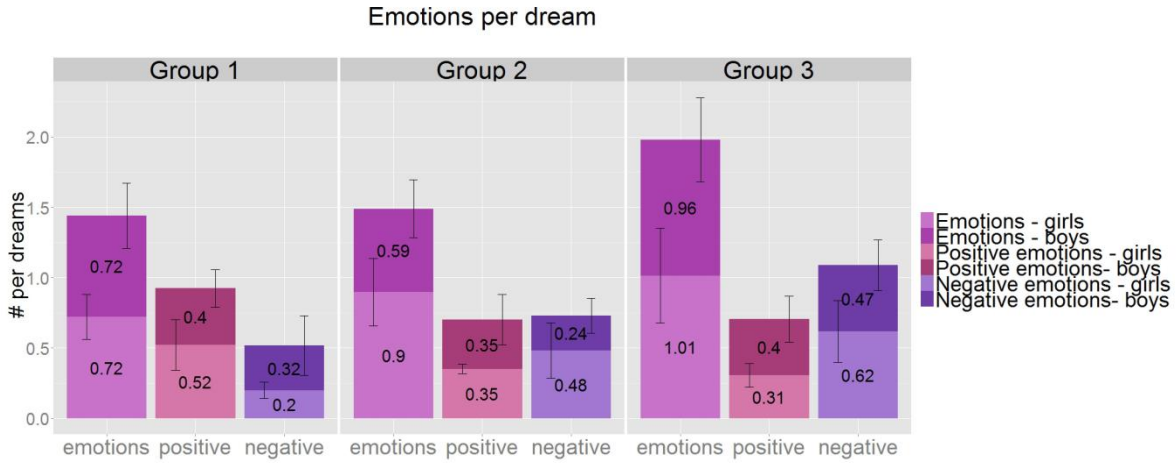

Figure 14. Average number of positive, negative, and all emotions per dream. Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

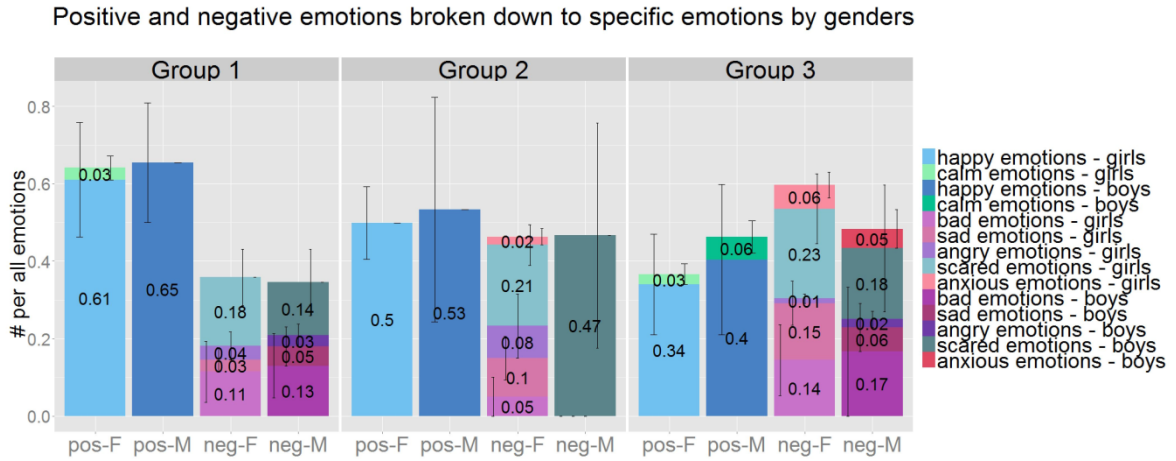

Figure 15. Percentage of different kinds of emotions compared to all emotions broken down by positive and negative categories, and genders. Colors and legend read from left to right from the bottom of the columns to the top. Positive emotions include happy and calm emotions and negative motions include bad, sad, angry, scared and anxious emotions. (pos-F/ pos-M: positive emotions-females / ~ males; neg-F /neg-M: negative emotions-females / ~ males) Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

The overall frequency of emotions appearing in dream reports is 0.85 (Figure 14), which means almost one emotion per dream on average, and these emotions appear in 64% of the dreams (ratio of dreams with at least one emotion). Amongst positive emotions (0.38 per dream), children reported happy/good (49% of all emotions) and calm (2% of all emotions) feelings. As negative emotions (0.42 per dream) generally bad (11% of emotions), sad (8% of emotions), angry (0.3% of emotions), scared (22% of emotions) and anxious (2% of emotions) feelings were reported (Figure 15). Importantly, the number of emotions in dreams, the number of dreams with emotions, as

well as the relative number of specific emotions are stable across the age groups and between the genders.

Emotions were assessed as part of the dream interview by the parents. Sometimes children reported dream feelings without questions: *"I do not remember much…there were lots of people and I felt really good"* [boy, 8.4 y]. Children could also specify their emotions along questions. For example a 7.8-year-old girl dreamt about going to prison. Mother: *"Did you have any feelings in the dream?"* Girl: "Yes*…."* *Mother: "Did you feel anxious?"* Girl: *"No".* Mother: *"Were you scared?"* Girl: *"Yes"*.

4.2.8.1 Emotional Dream Quality

More than half (59%) of the dreams were reported as positive, 27% as negative and 13.5% as neutral. Although there is a slight increase in the number of negative quality dreams (24%, 20%, 38%) and a decrease in the number of positive quality dreams (72%, 59%, 47%) across the age groups, these remain non-significant. There was no gender related difference in affective dream quality (Figure 16).

Finally, the intercorrelations of positive feelings in dreams, positive dream quality, and friendly interactions in the dream reports were tested, since they showed a similar decreasing tendency when compared to negative feelings, negative dream quality, and aggressive interactions respectively. Reported positive emotions correlate significantly with positive affective quality ($\tau = .67$, $p = 6.2*10^{-8}$, $df = 32$) and negative emotions with negative affective quality of the dreams ($\tau = .69$, $p = 6.5*10^{-8}$, $df = 32$), but the relative amount of aggressive or friendly interactions did not correlate either with reported feelings nor with affective dream quality.

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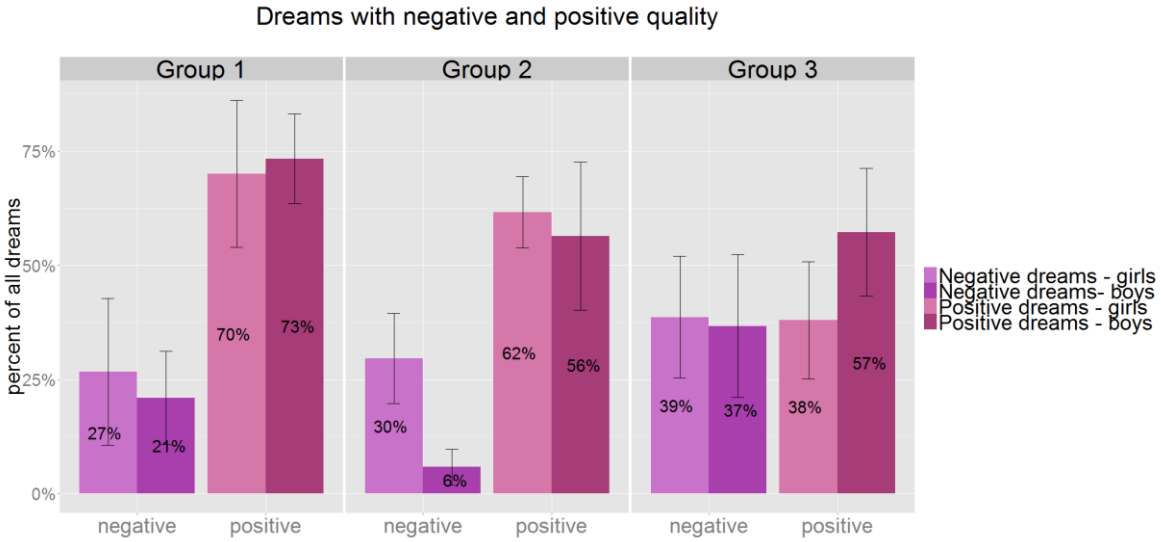

Figure 16. The ratio of dreams with negative (purple) and positive (pink) dream quality, by gender and age group. There is no significant change between the age groups, although a tendency of increase of dreams with negative dream quality and a relative decrease of positive dreams with age can be observed. Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

4.2.8.2 The Dream's Effect on Daytime Mood

Children reported that 51% of their dreams had an effect on their daytime mood as assessed in the morning during the dream interview. Unfortunately effect on daytime mood was not evenly assessed by the parents, thus the above percentage was calculated relative to the sum of those dreams that included any data on daytime mood (173, 50% of all reported dreams). The percentage of dream reports with daytime mood assessed varied greatly between the groups with significant differences between G1 (34%) and G3 (65%) ($U = 145$, $p = .008$, $r = .42$).

The dream's effect on daytime mood is relatively stable except for a sudden drop from Group1 to 2 that only reaches significance in case of the girls (drop from 79% to 44%, $U = 55.5$, $p = .050$, $r = .43$, $df = 11$, Figure 17). There is also a tendency for girls to report more dreams that affect their daytime mood than boys ($U = 224$, $p = .096$, $r = .27$, $df = 38$, Figure 17).

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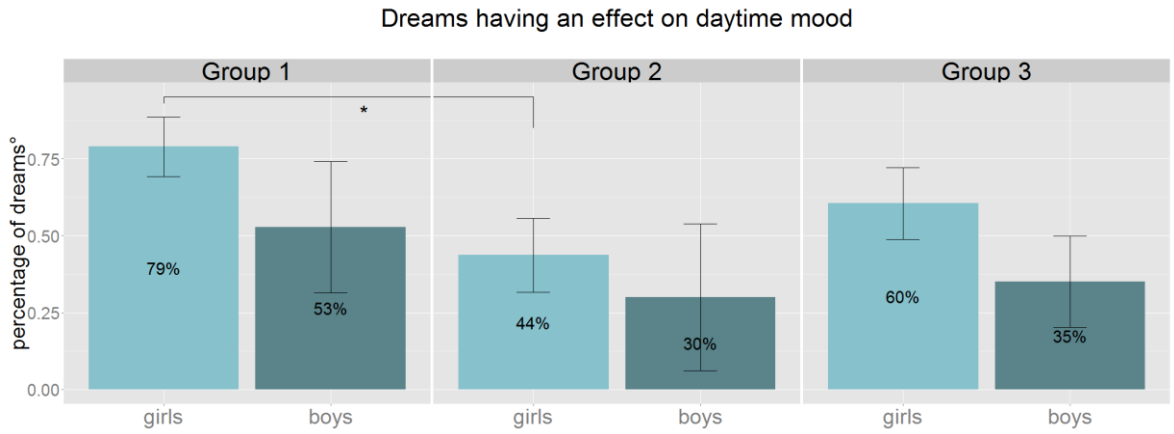

Figure 17. Percentage of dreams that had an effect on the children's daytime mood, as reported on the morning of the dream interview, relative to the sum of those dreams that included any data on daytime mood. Dreams affecting daytime mood show a visual decrease from G1 to G2 but only reaches significance in case of girls. ° = percentage of those dreams that included data on daytime mood, * p < .05, Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

4.2.9 Bizarreness

Bizarreness appeared in 75% of children's dream reports ranging from 65% (G1) to 85% (G3), which means an increasing tendency (Kruskal-Wallis, $H = 4.9$, $p = .084$) throughout the age groups, with a significant gain from Group1 to Group3 (Mann Whitney $U = 158$, $p = .038$, $r = .33$, $df = 26$, Figure 18). The majority of bizarre elements derived from incongruency with reality (instances of incongruency: 0.55 per dream), while uncertainty and discontinuity (0.32 and 0.18 per dream respectively) appeared to play a less significant role in bizarre dreams. None of the bizarreness subtypes changed with age in the present sample, and no gender differences in relation to bizarreness were found (Figure 18).

Bizarreness was present even in the preschoolers' dreams: *"…and there were you [parents] …and you had wings, and I was holding Blanka [little sister] and I had wings too"* [girl, 3.8 y].

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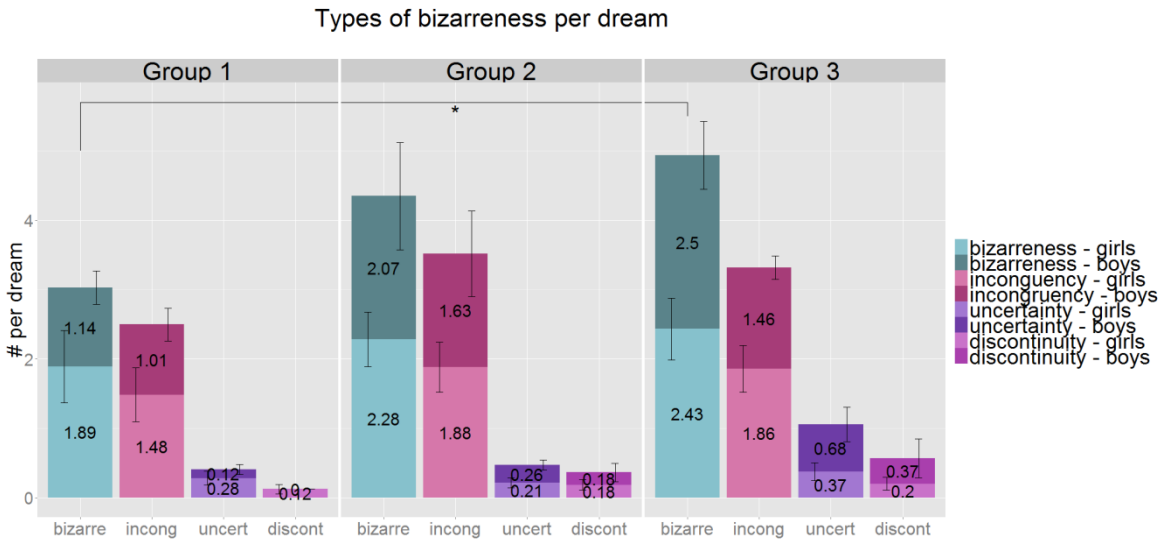

Figure 18. The average number of bizarre elements (turquoise) and its 3 subtypes: incongruences (pink), uncertainties (blue), discontinuities (purple) per dream. Bizarreness shows an overall increase with age that is significant between Groups 1 and 3. *= p < .05, Group1: 3.8-5.5 years, Group2: 5.51-7 years, Group3: 7.01-8.5 years.

4.3 Dream Characteristics in Association with Cognitive Development

4.3.1 Distribution of the Cognitive Measures across the Sample

The distribution of test scores and gender differences were analyzed regarding the neuropsychological tests (Modified Fruit and Emotional Stroop Test and Attention Network Test) and the intelligence tests (Wechsler Intelligence Scale for Children and Raven Colored Matrices). Significant differences between boys and girls were found in case of the Emotional Interference Index of the Stroop Test (U = 110, p = .014, r = .38), with girls achieving shorter reaction times in case of emotionally disturbing stimuli and the block design test of the WISC IV (U = 106, p = .012, r = .40), and boys providing a better visuospatial performance (Table 3). It is important to note that boys are also a little bit older than girls reaching a significant level in Group3 (see Table 2).

Table 3. Mean scores on tests of neuropsychology (STROOP Test, ANT) and intelligence (WISC IV, RAVEN) broken down by gender. Gender differences were analyzed using the Mann-Whitney U test. Degrees of freedom are 38. *p≤ .05.

	Total	Females	Males	Mann-Whitney U test
	Mean scores (SD)			*≤ .05, (df =38)
STROOP				
Incongruency Index	80.3 (78.9)	72.4 (70.5)	89.0 (88.3)	179
Accuracy in incongruent stimuli	0.72 (0.22)	0.72 (0.24)	0.72 (0.20)	215
Emotional Interference Index	-24.0 (86.3)	-48.5 (95.5)	3.2 (67.1)	110*
Accuracy in angry faces	0.80 (0.17)	0.79 (0.18)	0.81 (0.16)	188
ANT				
Alerting network	32.4 (55.7)	29.1 (60.6)	36.1 (51.2)	197
Orienting Network	37.8 (59.4)	29.2 (72.5)	47.3 (40.2)	152
Conflict network	47.8 (75.5)	33.8 (66.0)	63.3 (83.9)	139
WISC IV				
Vocabulary	35.9 (10.1)	35.3 (9.8)	36.6 (10.6)	192
Digit span	12.8 (3.7)	12.2 (3.7)	13.4 (3.7)	174
Block Design	24.1 (10.6)	20 (6.6)	28.6 (12.5)	106*
RAVEN	25.9 (6.6)	25.0(6.5)	26.9 (6.8)	164

4.3.2 Dream Recall Frequency and Report Length

The number of recalled dreams per child did not show any significant associations with visuospatial abilities. Similarly, report length did not show associations with either measure of verbal or memory performance. On the contrary, report length was associated with the increased accuracy of the Stroop Test in case of incongruent stimuli ($\tau = .25$, $p = .026$, see Table 4. for a summary of all correlations).

4.3.3 Human Characters, Actions, and Interactions in the Dreams

The number of human characters per dream showed no correlations with the executive measures of neither of the neuropsychological tests. On the contrary, a positive association with the effectiveness of the Orienting Network ($\tau = .23$, $p = .04$) was found, which is an essential measure of the ability to select the relevant stimuli in a distracting environment, thus is interpreted as part of the human attention network supporting the executive system (Figure 20). However the B-H correction did not confirm the reliability of this result.

The number of self-initiated actions per all actions, as well as the ratio of gross motor activities in dreams, were significantly associated with the Incongruency Index of the Stroop Test ($\tau = .26$, $p = .02$ and $\tau = .24$, $p = .03$, respectively), indicating a more efficient behavioural inhibitory control associated with more dreamer involved actions

(Figure 19). In addition, gross-motor activities were associated with higher accuracy under the condition of incongruent stimuli in the Stroop Test ($\tau = .28$, $p = .01$) indicating better inhibitory control functions (Figure 19).

The number of verbal actions per dream correlated positively with the Vocabulary subtest of the WISC test ($\tau = .24$, $p = .03$, Figure 20).

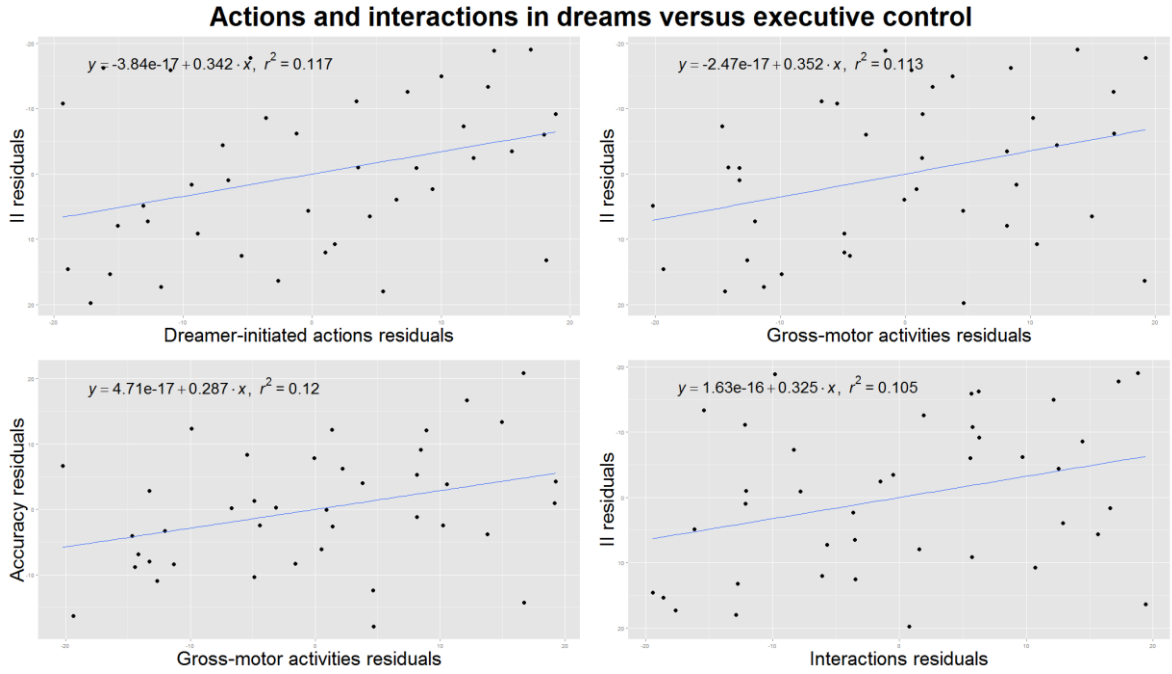

Figure 19. Actions and interactions in the dreams plotted against executive control measured by the modified Fruit Stroop Test. All plots are controlled for age by running linear regressions with x and y variables as dependent and age as independent variable and plotting the residuals from both regressions against each other. Upper left: association of dreamer initiated actions per all actions and executive control measured by the Incongruency Index (II) of the Stroop Test. Upper right: Correlation of gross-motor activities per dream and Stroop Test Incongruency Index. Lower left: the number of gross-motor activities per dream also correlates with accuracy in the Stroop Test in case of incongruent stimuli. Lower right: Association between the number of interactions per dream and Incongruency Index of the Stroop Test.

Interactions and specifically dreamer-initiated interactions per dream were also associated with the behavioural inhibitory control functions measured by the Incongruency Index of the Stroop Test ($\tau = .23$, $p = .03$, and $\tau = .22$, $p = .04$, respectively, Figure 19). Friendly interactions per dream showed association with the Emotional Interference Index of the Stroop Test ($\tau = .24$, $p = .03$) being positively correlated with a more efficient control of emotional interference (Figure 20). This latter result did not remain significant after the B-H correction procedure.

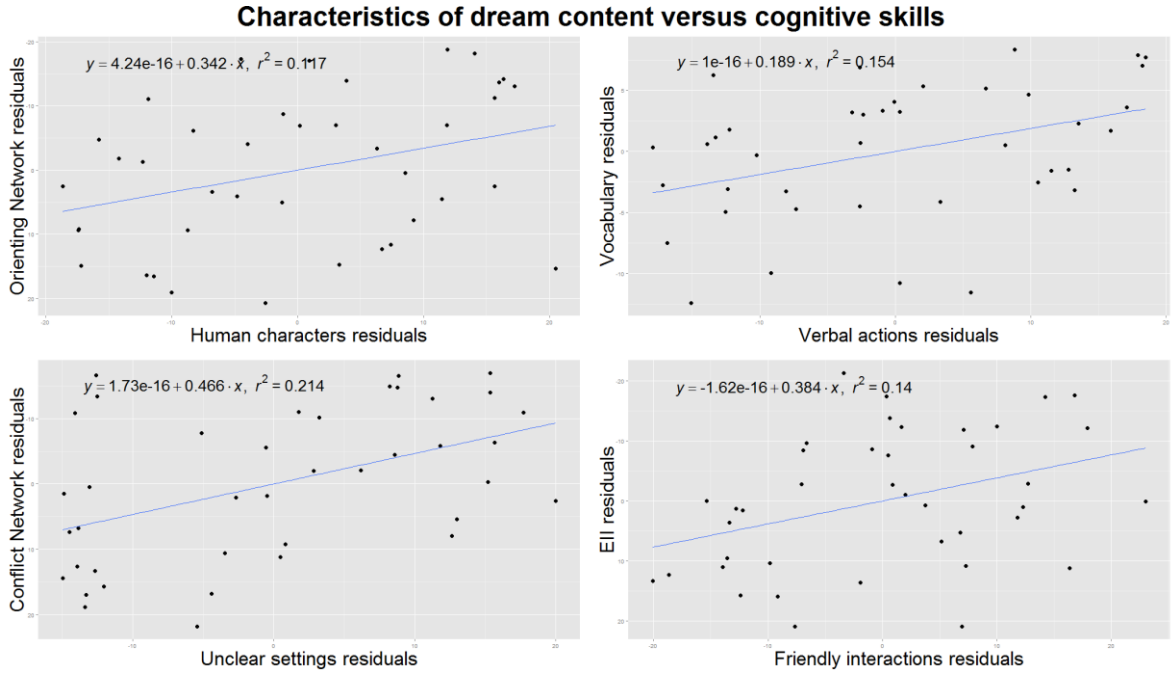

Figure 20. Characteristics of dream content and wakeful cognitive skills. All plots are controlled for age. Upper left: associations between the number of human characters per dream and the ability to select the relevant stimuli in a distracting environment measured by the Orienting Network of the Attention network test (ANT). Upper right: the number of verbal actions per dream correlates with the vocabulary subtest of the Wechsler intelligence test for children (WISC IV). Lower left: associations between the ratio of dreams with unclear settings (compared to dreams with any kind of setting mentioned) and executive control, measured by the conflict network of the ANT. Lower right: the number of friendly interactions per dream, associated with the ability to control emotional interference measured by the Emotional Interference Index (EII) of the Emotional Stroop Test.

4.3.4 Dream Bizarreness

No significant association between bizarre elements in the dreams and measures of intelligence and executive functions were found. However when the above relationships were analysed without controlling for the effects of age, comparable results were found with previous studies (Colace, 2010). The number of dreams with bizarreness showed a significant positive correlation with general nonverbal intelligence measured by the CPM (τ = .27, p = .018) and verbal abilities measured by the vocabulary subtest of the WISC IV (τ = .26, p = .021). A positive tendency also appeared with visuospatial abilities measured by the block design subtest of the WISC IV (τ = .22, p = .059).

Although it is worth mentioning that the number of unclear settings (a self-defined version of a subscale of dream bizarreness measure) correlated significantly with the Conflict Network of the ANT (τ = .30, p = .00) pointing towards better executive attention skills (Figure 20).

Table 4. Correlations (Kendall τ) between dream report characteristics and waking measures of neuropsychological and intelligence scores of 4-8 year-old children. Bold values are statistical results that stayed significant after the Benjamini-Hochberg correction for type I error.

Dream characteristics		STROOP TEST				ANT			WISC IV			CPM
		Incongruency Index	Accuracy of incongruent fruits	Emotional Interference Index	Accuracy of angry stimuli	Alerting network	Orienting Network	Conflict network	Vocabulary	Block Design	Digit Span	RAVEN
Kendall-τ with $^{+}p< .1$; *p≤ .05; **p≤ .01												
	Number of dreams									−.16		
	Dream-length								.11		−.10	
characters	Human characters	−.16	.03			.03	−.23*	−.06				
	Self-initiated actions	**−.26***	.03			−.03	−.01	.07				
actions	Gross-motor activities	**−.24***	**.28****			.10	−.03	.06				
	Verbal actions	.04	.00			−.02	−.13	.05	**.24***			
	Interactions	**−.24***	.12			.08	−.10	−.05				
Interactions	Dreamer initiated interactions	**−.23***	.12			.12	−.13	−.05				
	Friendliness	−.06	−.01	-.24*	−.15	−.08	−.13	.02				
Bizarreness	Bizarreness	−.06	.09			−.04	−.07	−.14				.16
	Unclear setting	−.08	−.13			.18	−.08	**-.33****				.11
Self-agency	Active self-representation	$-.21^{+}$	**.27***	-.01	.24*	−.07	-.01	.20				
	Dreamer involved strivings	**−.25***	**.24***	−.16	.13	−.06	−.08	−.05				
	Dreamer involved success	**−.29****	.14	−.10	.05	−.05	.07	−.08				
	Self-negativity Index	−.08	.05	−.10	.05	−.04	−.17	−.00				
Cognition	Cognition	$-.20^{+}$	**.25***			−.06	−.02	.00	.16	−.04	.08	.09
	Emotions per dream			.06	.04	−.25*	−.15	.20				
	Positive emotions			−.02	.01	−.07	−.25*	.07				
Emotion	Negative emotions			−.00	.01	−.25*	−.05	.10	**.24***			
	Dreams effecting daytime mood			**−.33****	−.07	−.07	−.19	−.27*				

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4.3.5 Self-agency and Cognition in Dreams

I considered the effectiveness of the self and cognitive/metacognitive verbs in the dreams as measures of awareness during dreaming in children. Interestingly, both the ratio of dreams with active self-representation ($\tau = .27$, $p = .03$) and cognitive/metacognitive verbs ($\tau = .25$, $p = .02$) together with the ratio of dreamer involved strivings ($\tau = .24$, $p = .03$) were associated with increased accuracy in the Stroop Test in case of incongruent stimuli (Figure 21). Additionally, dreamer involved success and dreamer involved strivings per dream were correlated also with the Incongruency Index of the Stroop Test ($\tau = .29$, $p = .01$ and $\tau = .25$, $p = .02$ respectively), confirming that self-effectiveness in children's dreams is a correlate of better attentional and behavioural control (Figure 21).

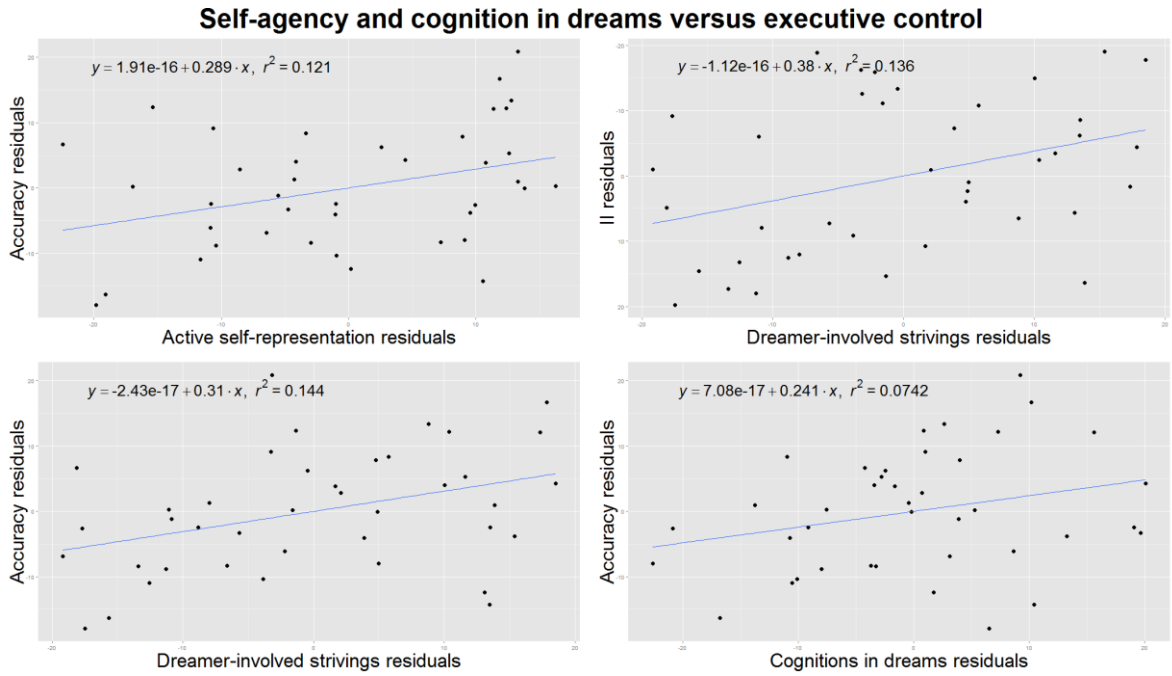

Figure 21. Self-agency and cognitive control in the dreams versus executive functioning measured by the Modified Fruit Stroop Test. All plots are controlled for age. Upper left: the ratio of dreams with active self-representation correlated with executive functioning measured by the accuracy in the Stroop Test in case of incongruent stimuli. Upper right: the number of dreamer involved strivings (dreamer's voluntary efforts) per dream correlated with the executive functioning measured by the Incongruency Index (II) of the Stroop Test. Lower left: dreamer involved strivings are also correlated with accuracy in the Stroop Test in case of incongruent stimuli. Lower right: the number of cognitively reflective verbs in the dreams correlated with executive efficiency measured by the accuracy in the Stroop Test in case of incongruent stimuli.

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4.3.6 Emotional Quality and Daytime Effect of the Dreams

Children reporting more emotions per dream tended to perform better on the alerting network of the ANT ($\tau = -.25$, $p = .042$, $df = 31$, Figure 22), indicating a better ability to achieve and maintain an alert state in case of a cognitive task. Moreover specifically positive emotions reported in dreams positively correlated with the ability to select the relevant stimuli in a distracting environment, measured by the Orienting Network of the ANT ($\tau = -.25$, $p = .043$, $df = 31$, Figure 22). Children with more dreams reportedly having an effect on their daytime mood performed better on the conflict network of the ANT ($\tau = -.27$, $p = .022$, $df = 35$) indicating better executive attention. None of these results were confirmed by the B-H procedure.

On the other hand, children with more dreams affecting their daytime mood showed a more efficient control of emotional interference measured by the Emotional Interference Index of the Stroop Test ($\tau = -.33$, $p = .004$, $df = 35$, Figure 22), which has been confirmed by the B-H control.

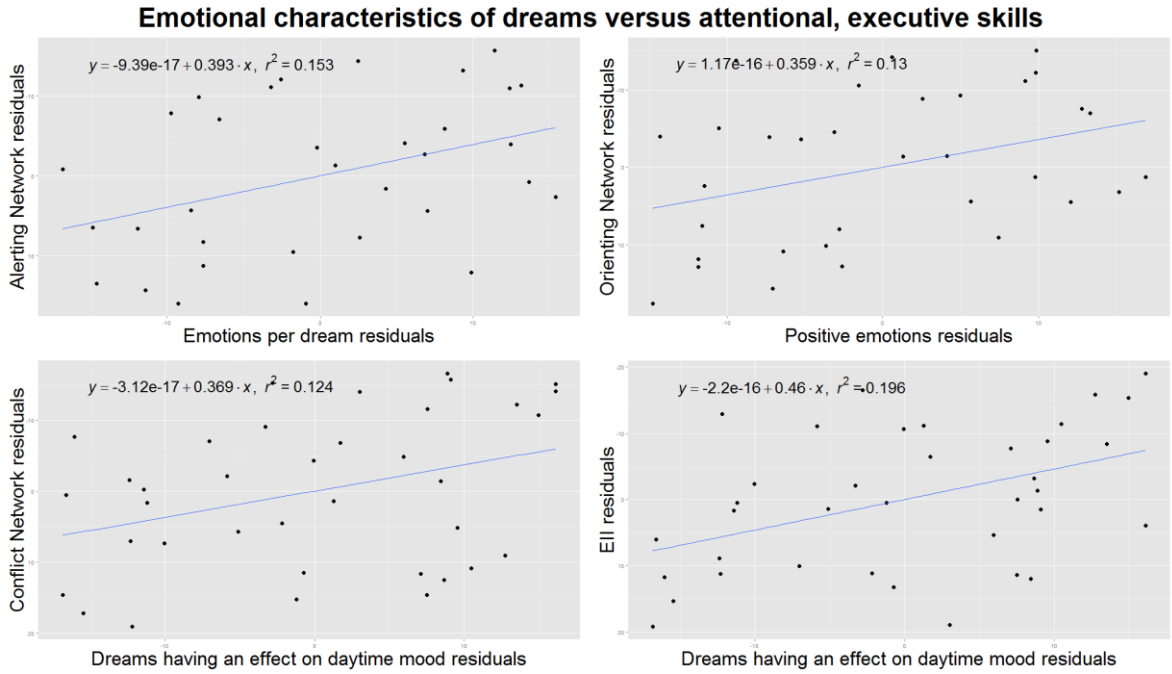

Figure 22. Emotions in the dreams and the dreams' effect on daytime mood versus executive functioning measured by the modified Fruit Stroop Test and attentional skill measured by the Attention Network Test (ANT). All plots are controlled for age. Upper left: average number of emotions per dream correlated with the ability to achieve and maintain an alert state suitable for cognitive tasks measured by the alerting network of the ANT. Upper right: the average number of positive emotions per dream correlated with the ability of selecting relevant stimuli in a distracting environment measured by the Orienting Network of the ANT. Lower left: the ratio of dreams reported to have an effect on the dreamer's daytime mood correlated with executive attention measured by the conflict network of the **ANT. Lower right: the ratio of dreams reported to have an**

effect on the dreamer's daytime mood correlated with the ability of processing negative emotional stimuli measured by the Emotional Interference Index (EII) of the Emotional Stroop Test.

Additionally children with a more extensive vocabulary (measured by the vocabulary subtest of the WISC) also reported more negative emotions per dream ($\tau = .24$, $p = .049$, $df = 31$), which could be important in terms of discussing the possible motivations behind reporting or not reporting emotional tones in dream narratives in case of children.

4.4 Dream Characteristics in Relation to Attachment, Emotional Processing, and Sleep Quality

4.4.1 Distribution and Interrelations of Test Scores across the Sample

Distribution of test scores and gender differences were analyzed regarding the three measurement tools used in this section (MCAST, SDQ, CSHQ). Significant differences between boys and girls were found only in case of the Children's Sleep Habits Questionnaire (CSHQ) and its subscale on daytime sleepiness, revealing that girls exhibit more sleep related problems in general and they also show more signs of daytime sleepiness compared to boys (Table 5).

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Table 5. Mean scores on the questionnaires of emotional functioning (SDQ) and sleep habits (CHSQ) and on the MCAST Narrative Coherence and Disorganization scales broken down by gender. Gender differences were analyzed using the Mann-Whitney U test. *In case of categorical variables, such as MCAST attachment categories and mentalization, frequency data were reported and differences were analyzed by Pearson's X^2 test.* Degrees of freedom are 38 in cases of Mann-Whitney U test and 1 in cases of *X^2 test (unless stated otherwise in the table).* $^{+}$ p < .1; * p ≤ .05; ** p ≤ .01.

	Total	Females	Males	Mann-Whitney U
	Mean scores (SD) or *N*			*≤ .05
SDQ total	**7.55 (4.8)**	**8.19 (5.6)**	**6.84 (3.7)**	**216**
Emotional problems	1.73 (1.8)	2.14 (1.9)	1.26 (1.6)	258
Conduct problems	1.77(1.6)	2.00 (1.9)	1.53 (1.1)	216
Hyperactivity	2.98 (2.5)	2.81 (2.7)	3.16 (2.3)	176
Peer problems	1.07 (1.1)	1.24 (1.1)	0.90 (1.2)	238
Prosocial behavior	7.88 (1.9)	8.24 (2.0)	7.47 (1.8)	266^{+}
Internalizing problems	2.80 (2.5)	3.38 (2.6)	2.16 (2.2)	262^{+}
Externalizing problems	4.75 (3.5)	4.81 (4.0)	4.68 (3.0)	196
CSHQ total	**45.89 (6.6)**	**48.4 (6.8)**	**43.2 (5.1)**	**258* (df = 36)**
Bedtime resistance	1.34 (0.4)	1.42 (0.5)	1.25 (0.3)	241
Sleep onset delay	1.42 (0.7)	1.57 (0.9)	1.26 (0.6)	230
Seep duration	1.27 (0.4)	1.38 (0.5)	1.16 (0.3)	240
Sleep anxiety	1.51 (0.5)	1.56 (0.6)	1.46 (0.5)	210
Night wakings	1.23 (0.4)	1.21 (0.4)	1.26 (0.3)	162
Parasomnias	1.23 (0.2)	1.27 (0.2)	1.19 (0.2)	254
Sleep disordered breathing	1.15 (0.3)	1.21 (0.3)	1.10 (0.2)	236
Daytime sleepiness	1.61 (0.4)	1.76 (0.4)	1.44 (0.3)	258* (df = 36)
MCAST categories secure/insecure (N)	***29/11***	***15/6***	***14/5***	***X^2 =0***
Mentalization mentalizers/non~ (N)	*23/17*	*12/9*	*11/8*	***X^2 =0***
Narrative coherence	5.8 (1.5)	5.6 (1.4)	5.9 (1.6)	174
Disorganization scale	3.0 (1.7)	3.1 (1.7)	2.9 (1.8)	221

It is important to mention that there were two children (1 boy and 1 girl from Group3) who had missing data on total CSHQ and daytime sleepiness scores. Interestingly, girls showed a tendency for both having more internalizing problems and also more social behavioral resources in forms of prosocial behavior than boys measured by the SDQ.

Age distribution within the categorical variables of the MCAST (attachment and mentalization) turned out to be uneven (see Table 6 and Figure 23), with the average age being higher in the groups of the securely attached children (in contrast to insecurely attached, U = 94, p = .046, r = − .31) and the mentalizers (in contrast to non-mentalizers, U = 79, p = .001, r = − .50). The age-dependency in the categorization of attachment (the older the subjects are the more likely that they will be categorized as secure) is an already established fact in the literature (Green et al., 2000).

DOI:10.14753/SE.2016.1935

Table 6. Distribution of age between the categories of attachment and mentalization. * p ≤ .05; ** p ≤ .01. r = effect size ($r = Z/\sqrt{N}$).

	MCAST attachment categories		MCAST mentalization skills		Chi^2 test
	Secure	Insecure	Mentalizers	Non-mentalizers	
Number of children	29	11	23	17	0.35
Mean age (SD)	6.55 (1.6)	5.48 (1.3)	6.92 (1.4)	5.36 (1.4)	
Mann-Whitney U test (r)	94* (.31)		79** (.50)		

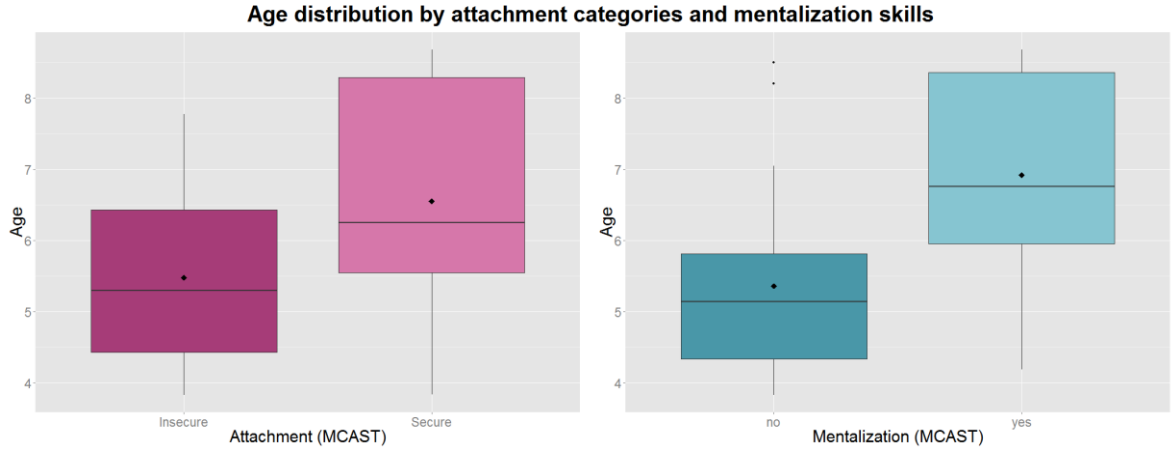

Figure 23. Distribution of age between categories of attachment and mentalization measured by the Manchester Child Attachment Task (MCAST).

Since, according to the literature, socio-emotional coping, attachment, and sleep quality are interrelated the possible relationships were analyzed between the tests used (MCAST, SDQ, CHSQ) amongst our sample of children (see Table 7). The MCAST insecure attachment category was related to higher levels of sleep parasomnias. Mentalization disability and lower levels of narrative coherence measured by the MCAST were both related to peer-related problems measured by the SDQ. Since there is available literature showing more sleep related problems in case of insecure attachment (McNamara, Belsky, & Fearon, 2003) and it has been also shown that mentalization skills facilitate social relationships (Fonagy et al., 2004), these concordances found here are not surprising. They are rather reassuring, showing that our tests provide valid information about the subjects despite the fact that the methods of measurement differed (the MCAST was assessed by the researchers, and the questionnaires were filled out by the parents). Emotional problems measured by the SDQ were related to various sleep difficulties including parasomnias, daytime

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sleepiness, and the total sleep problem-score. The total difficulty-score on the SDQ was related to sleep onset delay.

Table 7. Intercorrelations between measures of attachment (MCAST) and questionnaire data on emotional regulation and behavior (SDQ) and sleep (CSHQ) problems. Relationships between categorical and scale variables were tested with Mann-Whitney U test and difference between the two categorical variables was measured by Pearson's Chi-squared test (grey cell). $^{+}$ p< .1; * p ≤ .05; ** p ≤ .01; *** p < .001.

		MCAST				SDQ			
		Attachment	Mentalization	Narrative coherence	Disorganization scale	Total score	Emotio-nal problems	Exter na-lizing	Interna -lizing
		Mann-Whitney test							
MCAST	Attachment	–							
	Mentalization	.35	–						
	Narrative coherence	31***	55**	–					
	Disorganiza-tion	263*	322**	-.76**	–				
SDQ	Total score	193	240	-.12	.08	–			
	Emotional problems	178	178	.05	-.02	.41**	–		
	Externalizing	183	222	-.13	.10	.76***	.14*	–	
	Internalizing	170	236	-.05	.04	.53**	.75***	.22*	–
CSHQ	Total score	197	158	.05	.00	.04	.22*	-.05	.20^{+}

4.4.2 Measures and Dreaming

Higher rates of home setting per all settings were found (U = 224, p = .048, r = .31, df = 38) in the dreams of children categorized as insecurely attached by the MCAST procedure (Figure 24, see Table 8 for all relationships), which remained a tendency after controlling for age (U = 100, p = .072, r = .29, df = 38).

On the other hand, securely attached children displayed more exploratory activities (U = 90, p = .027, r = −.35, df = 38) and reported fewer sad emotions (U = 128, p = .01, r = .43, df = 29) than insecure children. After introducing age control, the relationship of attachment to sad emotions even improved (U = 26, p = .004, r = .49, df = 29) and the association to exploratory activities was also present although reduced to a tendency (U = 218, p = .078, r = −.27, df = 38, Figure 24).

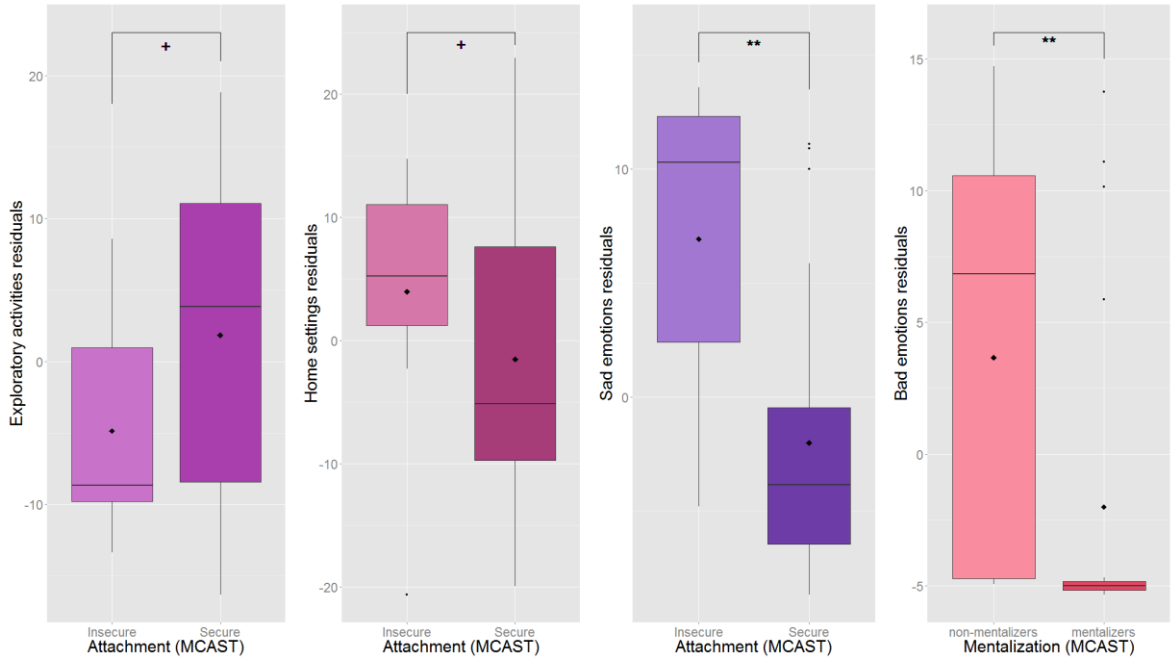

Figure 24. Dream characteristics significantly differing between attachment categories and mentalization abilities measured by the Manchester Child Attachment Story Task (MCAST). Dreams with exploratory activities (first boxplot), the ratio of dreams with home setting per all dreams with a setting (second boxplot), and the ratio of sad emotions in the dreams per all dream emotions (third boxplot) arranged by attachment (insecure and secure). The ratio of "bad" emotions in the dreams per all dream (fourth boxplot) emotions by mentalization skills (non-mentalizers, mentalizers). $^{+}$ p < .1; * p ≤ .05; ** p ≤ .01. All figures are controlled for age.

Children, who exhibited a more coherent narrative in an emotionally loaded situation during the MCAST procedure, experienced more exploratory activities (τ = .29, p = .009, df = 38) in their dreams and more dreams with aggressive interactions (τ = .26,

p = .02, df = 38, Figure 25), however the latter result was not confirmed by the B-H procedure. Children with less coherent narratives experienced more of their dreams taking place at home (τ = −.28, p = .009, df = 38). Similarly, children scoring higher on the disorganization scale of the MCAST tended to experience more dreams set at their homes (τ = .30, p = .007, df = 38, Figure 25), which did not remain significant after the statistical control.

Finally the children with good mentalizing skills also showed more exploratory activities (U = 137, p = .01, r = −.26, df = 38) in their dream narratives, which relationship completely disappeared after the age control. Interestingly, children with non-mature mentalizing abilities tended to report more "bad" emotions (U = 128, p = .01, r = .43, df = 29) in their dreams (compared to all reported emotions) while mentalizing children rather specified their feelings as sadness (U = 149, p = .06, r = .35, df = 29). In this case only the relationship of mentalizing abilities and "bad" emotions remained present after the age control (U = 183, p = .002, r = .54, df = 29, Figure 24).

Results in case of setting, exploratory activities and emotions reported in the dreams are salient, although such concordant results are not surprising since the scales of the MCAST are interdependent (Table 7).

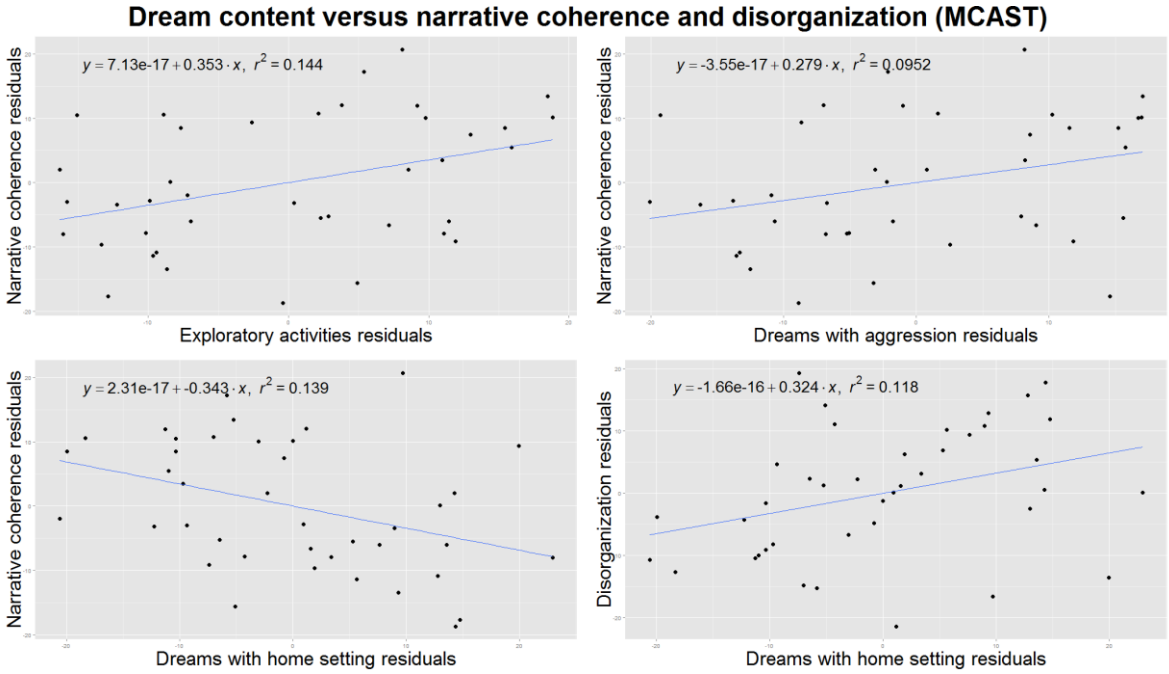

Figure 25. Dream content versus narrative coherence and disorganization measured by the Manchester Child Attachment Story Task (MCAST). All plots are controlled for age. Upper left: dreams with exploratory activities correlated with the ability to present a coherent narrative about

an emotionally loaded situation. Upper right: the ratio of dreams with aggressive interactions correlated with narrative coherence. Lower left: the ratio of dreams with home setting correlated with narrative coherence. Lower right: the ratio of dreams with home setting correlated with signs of disorganization in the MCAST.

4.4.3 Socio-emotional Coping (SDQ) and Dreaming

Children who scored low on the total behavioral difficulty scale of the SDQ expressed more dreams with active self-representation ($\tau = -.35$, $p = .002$, $df = 38$, Figure 26) and presented more dreamer involved success in their dreams ($\tau = -.23$, $p = .040$, $df = 38$) indicating a higher level of self-agency in their dreams. The latter result however was not confirmed by the statistical correction. Low problem scores were also associated with high number of active dreams (ratio of dreams with actions, $\tau = -.33$, $p = .003$, $df = 38$). In contrast, children with high problem scores more often had dreams affecting their daytime mood ($\tau = .25$, $p = .031$, $df = 35$).

Amongst the scales of the SDQ emotional difficulties, internalizing and externalizing symptoms were analyzed in terms of dream correlates. First of all, the frequency of dream reports was positively correlated with difficulties in emotional coping ($\tau = .32$, $p = .004$, $df = 38$, Figure 26) as well as internalizing problems ($\tau = .33$, $p = .003$, $df = 38$). Emotional problems were also correlated with negative dream quality ($\tau = .24$, $p = .041$, $df = 38$), although not confirmed by the B-H correction. Children who experienced more dreams with less active self-representation expressed both internalizing and externalizing symptoms ($\tau = -.32$, $p = .004$, $df = 38$; $\tau = -.28$, $p = .012$, $df = 38$ respectively), similarly to scoring lower on total problem scale of the SDQ.

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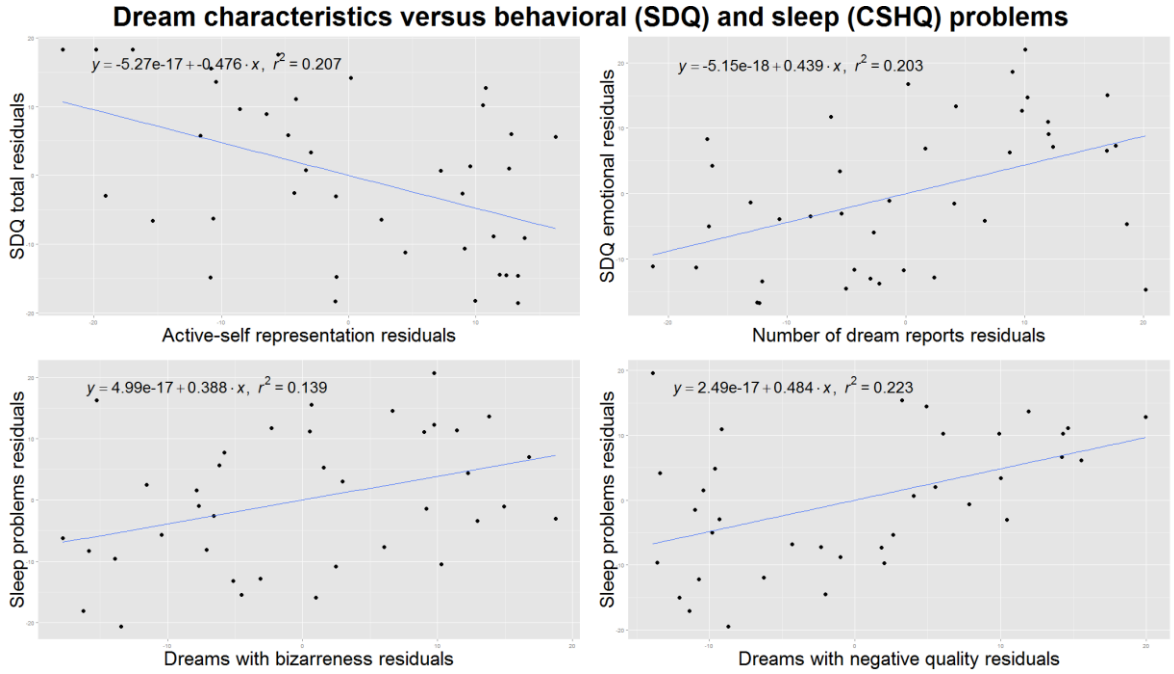

Figure 26. Characteristics of dream reports versus behavioural and emotional problems measured by the Strengths and Difficulties Questionnaire (SDQ) and sleep related problems measured by the Child Sleep Habits Questionnaire (CSHQ). All plots are controlled for age. Upper left: representation of an active self of the dreamer in the dreams negatively correlated with behavioural problems measured by the SDQ. Upper right: the number of reported dreams per child correlated with emotional problems measured by the SDQ. Lower left: the ratio of dreams with bizarreness correlated with total sleep problem score of the CSHQ. Lower right: the ratio of dreams with negative quality correlated with total sleep problem score of the CSHQ.

4.4.4 Dreaming and Sleep Quality

Children experiencing more sleep problems in general (CSHQ total) tended to have more bizarre dreams (τ = .25, p = .033, df = 36, Figure 26), more dreams with cognitive control (τ = .29, p = .012, df = 36), and with negative quality (τ = .36, p = .003, df = 34, Figure 26), together with more negative emotions in their dreams (τ = .25, p = .033, df = 29). The correlation with bizarre dreams did not remain significant after the B-H correction.

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Table 8. Relationships between dream report characteristics and attachment measures assessed by the Manchester Child Attachment Story Task (MCAST), behavioral and emotional problems measured by the Strength and Difficulties Questionnaire (SDQ) and sleep related problems measured by the Children's Sleep Habits Questionnaire (CSHQ). To explore relationships between continuous variables of dreaming and waking the Kendall tau rank correlation test was used. Bold values are statistical results that stayed significant after the Benjamini-Hochberg correction for type I error. In case of categorical variables (MCAST attachment and mentalization measures) Mann-Whitney U test was performed with effect sizes in brackets. $^{+}$p < .1; * p ≤ .05; ** p ≤ .01.

Dream contents and categories		MCAST				SDQ				CSHQ
		Attachment	Mentalization	Narrative coherence	Disorganization	Total score	Emotional problems	Internalizing	Externalizing	Total score
		Mann-Whitney U test (r)		Kendall tau test						
	Number of dreams	138 (.10)	183 (.05)	−.12	.11	.11	**.32****	**.33****	.00	
setting	Home setting	100^{+} (.29)	213 (.08)	**−.28***	.30**	−.03	.01	−.00	−.10	
activities	Exploratory activities	218^{+} (-.27)	219 (−.10)	**.29****	−.16	−.03	.12	.14	−.09	
	Gross-motor activities	179 (−.09)	226 (−.13)	.19^{+}	−.08	−.15	.10	.00	−.17	
	Dreams with actions	145 (.07)	163 (.14)	.04	−.17	**−.33****	−.20^{+}	**−.30****	**−.30****	
interactions	Dreams with aggressive Interactions	197 (−.18)	254 (−.25)	.26*	−.14	−.21^{+}	.07	−.05	−.22^{+}	.19
	Dreams with friendly interactions	163 (−.02)	135 (.26)	−.10	.10	.14	.13	.13	.12	.08
Self-agency	Dreamer involved success	171 (−.05)	212 (−.07)	.20^{+}	−.12	−.23*	−.04	−.09	−.19^{+}	
	Active self-representation	164 (.03)	212 (−.07)	.09	−.09	**−.35****	−.20^{+}	**−.32****	**−.28***	
emotions	Negative dream quality	103 (.20)	179 (−.01)			.02	.24*	.10	−.02	**.35****
	Negative emotions/emotions	86 (−.02)	121 (.08)	.09	−.05	.04	.10	.09	−.02	**.31***
	Sad emotions/emotions	26** (.49)	101 (−.07)	−.10	.01	−.03	.10	.02	−.04	.22^{+}
	Bad emotions	73 (.09)	183** (.54)	.06	.02	.06	.06	.16	.01	.25^{+}
	Effect on daytime mood	100 (.20)	163 (−.03)	−.20^{+}	.16	.25*	.23^{+}	.18	**.27***	.17
cognition	Dreams with cognition	159 (.00)	210 (−.06)	.09	.02	.07	.23^{+}	.16	−.00	**.29***
bizarreness	Dreams with bizarreness	156 (.02)	263 (−.16)	.16	.13	−.08	−.05	−.04	−.07	.25*

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5 Discussion

5.1 Discussion of the Descriptive Analysis of Dream Content

5.1.1 Report Rate and Length

The overall median recall rate in the present study (15.5%) is similar to the cross-sectional results of Foulkes (1990) where he found 20% median recall rate amongst the 5 to 8 year-olds. Pooled dream recall was 21% of the morning interviews, which is also similar to Foulkes' reports (1982, 1999) on 3-5-year-olds (27% from REM awakenings and 6% of NREM awakenings), but is considerably lower than the result of the home based study of Resnick et al. (1994), revealing a 65% report rate from morning awakenings (amongst 4 to 10-year-old children, n=14). However, it has to be mentioned that those authors used various awakening methods during the 13 days of dream recall, and the age range of their subjects was slightly different from this study.

The overall increase in dream recall frequency (which reaches 48% of dream recalls from REM awakening and 21% of NREM awakenings in the 7-9-year-olds group) was not replicated in our study (Figure 3). Obviously, direct and deliberate comparison of the studies is not possible because in the present work we do not know the sleep phase that the child woke from, and the length of the data collection period was significantly longer in terms of consecutive mornings of dream interviews. In fact the long period of data collection had a significant effect on the dream recall frequency. This could reflect the great enthusiasm children (and parents) were involved in the task from the beginning and also could reflect the fading away of the motivation after a number of mornings beginning with the same questions.

It is intriguing that the stagnating number of dream reports across the age groups masks a peculiar gender difference: while girls relative dream recall frequency shows a clear rising tendency from the youngest to the oldest age groups, boys' report rate drops (from 46% to 25% of the total number of reported dreams). Thus, in the oldest age group girls reported significantly more dreams than boys. This growing difference could be viewed as an early effect of society on genders (Schredl et al., 2013). The different socialization of the two genders affects their dream sharing habits resulting in different

attitudes towards dreaming which then directly affect their dream recall frequency as Schredl and colleagues speculated (2013).

Regarding report length, children improved from 38 words (Group1) to 58 words (Group2 and 3) on average. This yielded a significant difference between the first and the second group (Figure 3). Although laboratory-based research reveals lower numbers of words (Foulkes, 1982), if we compare our findings on average report length with outcomes of the home study of Colace (2010) we see rather similar results (35 words for the 3 to 5-year-olds, and 41 for the 5 to 7-year-olds). Developmental psychologists conclude that narrative abilities are still immature in preschoolers (Pitcher & Prelinger, 1963), which is consistent with the age-related increase in dream report length found in both previous (Colace, 2010; Foulkes, 1982) and present findings. On the other hand, these results are clearly revealing that the method of dream collection can have serious impact on the formal characteristics of children's dream reports especially among young children, as we already described in our recent review of a wide range of empirical works (Sándor, Szakadát, & Bódizs, 2014). We speculate that the nighttime awakening protocol is most unsuitable for the youngest children, and this effect is observable in their dream reports in the form of shortness, infrequency and mundaneness.

5.1.2 Dream Characters

According to our results 4-8 year- old children already mention several characters (other than themselves) in their dream reports (3.13 characters/dream, Figure 4). This value stayed relatively stable across the age groups, indicating the predominance of human characters (69% of all characters), amongst which family members were relatively frequent (28% of all characters). Our findings on characters in children's dream reports are comparable with adult standards of Hall and Van de Castle (1966), who reported 2.6 characters per dream on average and 2.47 human characters per dream (95% of all characters). Other home-based studies on children's dreams reported similar results: 2.2 characters per dream on average (2.7 for the 4-5 year-olds and 1.8 for the 8-10 year-olds), of which 30% were family members (Resnick et al., 1994). Furthermore, Honig & Nealis (2012), found that 89% of the dreams contained human characters, and family members were the most common characters in the dream reports of 3-5 year-old children (30% of the dream reports). The adult standards indicate that 11% of all

characters are family members (Hall & Van de Castle, 1966). Although this percentage is lower than the 28% in our child sample, a trend for an age-dependent decrease of this ratio was also observed (34%, 27% and 23% in groups 1, 2 and 3, respectively). Thus, our findings cohere with other non-laboratory studies and contrast the laboratory reports indicating the infrequency of human characters in the dreams of preschoolers (Foulkes, 1982).

Authors of the laboratory studies considered animal characters to be especially frequent in preschoolers' dreams, and found them in 45% of the girls' and 33% of the boys' dreams (Foulkes, 1982; Foulkes, 1999). As a comparison 17% of the dreams contained at least one family member and *"other known persons appeared even less"* (Foulkes, 1982 p.48, 1999). Additionally, a reanalysis (Domhoff, 1996) of the laboratory results (Foulkes et al., 1990) found that in the dreams of 5 year-olds 23% of all characters were animals. According to our results only 14% of the dreams contained animals and 8% (0.25 animals per dream) of all characters were animals, which is only slightly higher than the 0.13 animals per dream (5% of all characters) of the adult standard (Hall & Van de Castle, 1966) and very similar to the results of the Resnick-study (1994) indicating 0.19 animals per dream (corresponding to a value of 8.7% animal characters per all characters).

On the whole significant changes in the number of dream characters between the ages of 3.8 to 8.5 years were not found. Instead, even 4-5 year-olds' dream reports are comparable to adult standards. Our home-based results, derived from a 6-week sampling procedure, rather confirm earlier home and school-based results. The age-dependent decrease in the number of family members in the dreams might parallel the increasing number of strangers in children's dreams (Resnick et al., 1994), reflecting the changing social exposure of the children at different ages.

5.1.3 Dream Setting

A decrease in the ratio of home settings and an increase of school settings in the children's dreams was observed with age. These findings are concordant with previously reported results by Resnick et al. (1994), who also noted a drop in the ratio of home settings (from 22% to 11% between groups of 4-5 year-olds and 8-9 year-olds) and growth in the ratio of school settings (15% to 27%). While the tendencies seem to

be similar, previous studies tend to report lower percentages of home settings in preschoolers' dreams (23.3% in Honig et al.'s study (2012), and 39% in the present research). Regarding the ratio of school settings in this study, it increases from a lower value (8%), and this is also lower in Honig et al.'s study (2012; 3.4%) than in Resnick et al.'s (1994) work. The ratio of unclear or uncertain settings did not show any significant change throughout the age span in the present study, unlike Foulkes's category of unclassifiable settings which appeared most often in preschoolers' dreams. The category of uncertain setting is similar to the uncertainty category of bizarreness in Revonsuo and Salmivalli's system, with the exception that it reflects the uncertainty of the dreamer themselves during the dream report and not the coder's retrospective opinion.

5.1.4 Social Interactions

Social interactions are present in almost every dream report, and the overall aggression and friendliness per character ratio is 0.14 and 0.16, respectively. Thus, our values are higher than the aggression per character and friendliness per character ratios (0.05 and 0.06) of the laboratory dream reports (G William Domhoff, 1996; Foulkes et al., 1990). Although the number of interactions is equally distributed across the age groups, the percentage of aggressive interactions shows a significant increase, and the ratio of friendly interactions a decrease (Figure 9). The number of dream reports with at least one aggression increases from 15% in Group1 through 32% (Group2) and reaches 36% amongst the 7-8.5 year-olds in our sample. Interestingly, in one Spanish study (where dreams were collected with the last remembered dream method) Oberst and her colleagues (2005) found that amongst the 7-8 year-olds 73% of the dreams contained aggressive interactions, which gradually decreased with age until adolescence. Adolescent values were similar to the normative data of adults (45.5%). Unfortunately, Oberst did not study children younger than 7 years old. The age group (7-8 years), when both studies found the highest ratio of aggressive content, is the age when the children start attending school. This significant event might cause substantial challenges for children and could affect their dream contents. Regarding the absolute difference in aggressive content of 7-8 year-old children's dream reports I have to mention the "last remembered dream" technique used by Oberst et al (2005) might favor the report of

emotionally salient and memorable dreams in comparison with mundane ones (Foulkes, 1999). As emotionally striking dreams often contain aggressive imagery, this could account for the observed difference in results.

On the whole, while a typical aggressive act in young children's dreams usually involves the dreamer or their close family, 7 to 8 year-olds are more likely to include a wider environment in their aggressive content. For example a typical aggressive dream from a 5.7 year-old boy: *"We went to a park with father and a dinosaur attacked us…"* and a 3.8 year old girl: *"…I climbed onto a sofa, the cat came and put its claws into it. I kicked the cat and I kicked it again when it came back. Then it climbed onto the sofa and ate my leg"*, another example from an 8.4 year-old boy: *"I dreamt that there was the third world war … and we opened the door and they were shooting on the street"*.

The percentage of dreams with friendly interactions was found to be 35% in the overall sample, which is close to the average adult standard (40%). Moreover, preschoolers (Group1) were found to have far the highest ratio of dreams with friendly interactions (45%), which is even slightly higher than that of the adult sample.

5.1.5 Kinematic Imagery Actions in the Dreams

86/80% of children/preschoolers reported motion in their dreams, which confirms Honig and Nealis' (2012) results derived from preschool interviews (they found actions in 81% of the dreams).

The above results on self-reported movements were further confirmed by counting explicit self-initiated actions in the dream reports. 4.7 actions per dream were found on average (3.8 for the youngest age group) and 90% of the dreams (87% in the youngest age group) contained at least one action (Figure 7).

Although dream activities have a tendency to become more frequent with increasing age, our results prove that, even young children's dreams are highly eventful and evidently non-static. This leads us to the conclusion that children's cognitive architecture is already functional in spontaneously constructing motion imagery. This latter phenomenon contradicts Foulkes' speculations who found young children's dreams to be static, and hypothesized that preschoolers are unable to imagine motion in space. In fact recent studies of children's waking spatial imagery indicate that preschool aged children have some ability to mentally represent movements and rotation, although

these skills undergo significant development and show important individual differences during the preschool ages (Frick, Ferrara, & Newcombe, 2013; Newcombe & Frick, 2010).

5.1.6 Self-agency

For describing self-agency, I used 4 measures: dreamer involved success and strivings per dream, Hall and Van de Castle's self-negativity percent and active self-representation in the dreams. The first three of these measures are scarcely studied, with normative data missing even for adults.

Active self-representation was relatively high in the dream reports of all age groups of our study, appearing in 78% of the dreams. Although the values showed an increasing trend across the age groups, the differences did not reach statistical significance (Figure 11). Other non-laboratory studies reported values ranging between 59% (Honig & Nealis, 2012) and 85% (Resnick et al., 1994) in preschoolers' dreams. These convergent findings cohere with our present results, and contradicts the statement claiming the inability of young children to depict themselves as active agents in their dreams (Foulkes, 1982). It has to be noted in Foulkes study the active self was defined as explicit report of any movement performed by the dreamer, which might be a stricter criterion than ours. For better comparability the ratio of dreams with self-movements was also calculated and found to be 75% amongst the preschoolers, which is still considerably higher than the 13% reported in laboratory studies (Foulkes, 1982).

The only comparative study on self-agency (researching the self-representations in child and adult dreams; McNamara, McLaren, & Durso, 2007) found self-negativity percent high (58%) and dreamer involved success percent low (32%) in case of 9-12 year-old girls. It was concluded that children present a kind of pre-reflective self in their dreams with low level of agency. However, our sample showed a higher agency of self with lower self-negativity percent (42%) and relatively high dreamer involved success percent (58%), which represents a good self-agency even compared to the adult findings (self-negativity: 64% and dreamer involved success: 63%, McNamara et al., 2007) . It should be noted that dreamer involved success percent here follows the rules of the Hall & Van der Castle system (dreamer involves success per all dreamer involved strivings; G. William Domhoff, 1999) and here this measure was calculated for the sake of

comparability. I deliberately use simpler measures of self-agency in this study (dreamer involved success and strivings per dream) which seem to be more sensitive indicators in the case of young children, since the number of different kinds of outcomes (success, failure, fortune and misfortune) are, on average, low in young children's dreams.

The high rate of dreams depicting an active self indicates that children are able to represent mental states and reflect on their own self in their dreams. Also their dream-self seems to be an effective agent in the narrative, a comparable measure to adult findings.

5.1.7 Cognitions in the Dreams

For investigating cognitive maturation the number of cognitive and self-reflective verbs appearing in the dream narratives was counted. This number increased steadily from 0.2 (Group1) to 0.52 (Group3) per dream. It suggests a significant age-related increase in cognitive activities in dreams (Figure 13). This finding could be explained by the general development of narrative skills involved in the dream production process, but we could also assume that it is a reflection of wakeful cognitive development modulating the dream report behavior and not dream production per se. Both hypotheses are supported by the analysis of the cognitive and reflective activities appearing in dream reports of adults: wakeful cognition parallels dreaming cognition, and the emerging differences between the two would be rather quantitative than qualitative in nature (Bradley, Hollifield, & Foulkes, 1992; Kahan et al., 1997).

Although only 15% of the dream reports of the youngest age group contained verbs reflecting cognitive effort and metacognitive activity, this value gradually grew to 39% amongst the 7-8.5-year-olds. It suggests that high-order cognition is present in children's dreams and it gets more prominent with increasing age. Although further investigations are needed to test how the development of this phenomenon follows waking cognitive actions and reflective abilities, baseline data could be of interest for theoretical models of reflective abilities and metacognitive functions.

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5.1.8 Emotional Aspect of the Dreams

5.1.8.1 Dream Emotions

An average of 0.85 emotions per dream report was found, which ranges from 0.72 in the youngest age group and reaches almost one emotion per dream (0.99) in the oldest (Figure 14). In fact, the average of 1.18 emotions per dream report in the adult standard sample of Hall and Van de Castle (1966) is close to the results of Group3 (0.99) in our study. Similarly to the above findings, the number of dreams containing at least one emotion ranges between 61% (Group1) and 66% (Group3), which is higher than the results of the laboratory studies (8-25%; Foulkes, 1982) but lower than the outcomes of home (85-89%) and school based studies (79%) of Resnick et al (1994) and Honig and Nealis (2012), respectively. Foulkes (1982) explains the scarce number of emotions in preschoolers' dreams by stating that *"feeling itself is a cognitive achievement",* which he bases on the work of Schachter & Singer (1962). It is obvious that cognitive development is necessary for emotional recognition and labeling, as it was indicated in the cited work of Schachter and Singer, but cognition is not indispensable for the subjective experience of emotional events. There are several criticisms raised with respect to the cognitive appraisal theory of emotions (Zajonc, 1984). As the labelling of dreamt emotions could cause difficulties for preschoolers, we provided a list of 6 emotions in the dream interview. Children were explicitly asked about these feelings in their dreams. More than 60% of the dreams were labelled with at least one of the emotions by our preschooler subjects, which could have also been caused by attempts to satisfy assumed parental expectations. The fact that preschoolers were proven to be highly effective in choosing the appropriate affects to the actual narrative structure (Camras & Allison, 1985) also allows the possibility that the process of emotion-matching is a result of waking interpretation of the dreams. This is unfortunately an inherent dilemma regarding dream emotions in adult samples as well.

It is worth mentioning that only 70-75% of laboratory dream reports of adult subjects contain any emotion (R. Fosse, Stickgold, & Hobson, 2001; Foulkes, Sullivan, Kerr, & Brown, 1988; Strauch & Meier, 1996). Moreover, adult volunteers tend to attribute many more emotions to their non-laboratory dreams than do blind judges when they are asked to recall the emotions that accompanied the report they have written down (Kahn,

Pace-Schott, & Hobson, 2002; Merritt, Stickgold, Pace-Schott, Williams, & Hobson, 1994). Thus, it could be that the results from self-ratings of home dream reports are due to two extrinsic factors: the demand characteristics of such a rating task, and the waking-life assumption that certain emotions would logically be present in many of the situations experienced in the dream. Although, this consideration might be relevant when interpreting our findings, it is important to note, that the striking children vs. adult difference in the laboratory dream emotions were not replicated in our home-setting investigation. In other words reporting of dream emotions in young children and adults seems to be similar when research is based on home-collected dreams. It should be mentioned that self-rating and direct questioning of emotional experiences might result in the overemphasis of emotions in dream reports, but blind judges might underrate such experiences, since they do not have direct access to them.

As regarding the emotional quality of dreams in children, our results cohere with the laboratory findings indicating the predominance of positive emotions in preschoolers' reports (Foulkes, 1982, p.50). This is consistent with the overall conclusion of those studies claiming that nightmares in both children and adults are highly overestimated because of exclusive or dominant reliance on retrospective questionnaires (Robert & Zadra, 2008; Zadra & Donderi, 2000).

On the whole, we consider our method as an appropriate and efficient aid for eliciting reports on the affective aspects of dreams in children who are not comfortable with labeling emotions by themselves or think that emotions are implicitly present in the dream narrative so it is not necessary to explicitly report them (Bauer, 1976). Moreover, we conclude that emotional load is an important aspect of children's dreams which means that developmental dream research could be a valid and important extension of adult dream theories which emphasize the emotional regulatory functions of dreaming.

5.1.8.2 Affective Dream Quality

Based on the self-report of the children the majority of the dreams were found to be positively toned (59%), surprisingly, with preschoolers having the highest rate of positive dreams (72%). As a comparison, in the school-based research of Honig & Nealis (2012) they found less (41.8%) of preschoolers' dreams to be positive, but approximately the same ratio of dreams (21.4% versus 24% in our study) to be negative,

and 23.7% to be neutral. In our study the high proportion of positively-rated dreams in preschoolers (72%) which then drops to 47% in the oldest age group, and the practical absence of neutrally-rated dreams in the youngest group (4%), seem to refer to a more simplistic world view described by less differentiated semantic categories in case of preschoolers (Bauer, 1976).

5.1.8.3 The Dream's Effect on Daytime Mood

In our sample, the ratio of dreams affecting daytime mood is highest in the youngest age group (66%). This might reflect the immaturity of emotional processing abilities of young children in order to modulate the emotional effect of their dreams in waking life.

5.1.9 Bizarreness

In the present study an overall of 2 bizarre elements per dream was found. In the youngest age group this measure was 1.5 per dream, which contradicts laboratory-based results with a lack of bizarreness in preschoolers' dreams (Foulkes, 1982). A direct comparison is not possible as Foulkes' method of measuring bizarreness through character and setting distortion is quite different from the system used here. On the other hand, Resnick et al.'s study (1994) provides a possibility for comparison: amongst 4-5 year-olds, they found an average of 0.4 bizarre elements per dream in contrast to our 1.5 items amongst preschoolers. When we look at the percentage of dreams with at least one element of bizarreness we also see an elevated ratio (65%) in the preschoolers' group compared to previous findings: 32% (Colace, 2010: home and school based studies), 55.5% (Colace, 2006) and 34% (Resnick et al., 1994). These results become more convergent with age: amongst 5-9 year-olds Colace (2010) found that 58% of dreams contained bizarreness compared to the 75-85% according to our data. Most of the studies agree that bizarreness appears in about 74% of adult dream reports, which means a high comparability with the children above 5 years of age in our sample.

Interestingly, out of the 1.5 bizarre elements per dream in the youngest age group, 83% incongruous, 13% uncertain and 4% discontinuous elements were found. These are somewhat similar to Resnick et al.'s study (1994) given that the vast majority of bizarre elements turned out to be incongruent in both studies, but in preschoolers' dreams they found no uncertain elements at all. They offer 4 possible explanations for the

phenomenon, two of which (the possibility that preschoolers lack the linguistic skills to report uncertainty and that they simply do not experience uncertainty in their dreams) seem not to be plausible according to our data. Just like them, we have no evidence of parental redirection or correction of uncertain elements. The last remaining possibility regarding the unbalanced appearance of bizarreness subcategories amongst young children is that they try to rectify uncertain events in their dreams (and perhaps the disconnected events), just as they seem to do with large number of uncertainties they experience in their waking life (Resnick et al., 1994). Other possible hints for the lower rate of bizarre elements and especially the relative absence of uncertainties in young children's dreams lie in Bauer's (1976) observation of undeveloped symbolization skills (see section 1.4.5: Credibility of children's dreams) and also, as DeMartino (1955) points out, in the possible failure to report material in their dreams that are contrary to the children's own experiences. All of the above mentioned studies agree that the amount of bizarreness increases and the ratios of the subcategories become more balanced with age. Moreover, direct (Colace, 2010) and indirect (Resnick et al., 1994) evidence suggest that cognitive development is also involved in the achievement of bizarreness in dreams.

5.1.10 Gender Differences

Interestingly, gender differences were found to be relatively scarce in the present sample. The most prominent differences were those already established in the literature, namely that female subjects report dreams more frequently than males, and that the majority of the characters tend to match the gender of the dreamer: this difference was present already in the preschooler's age group, similarly to what Domhoff reports from the age of 5 years (Domhoff, 1996; Hall & Van de Castle, 1966). Another difference that is most prominent in the youngest age group is the occurrence of school setting being significantly higher amongst girls, and which became balanced by the age of 7-8.5 years. This is a result unique to this sample since previous results only show gender differences in relation to indoor versus outdoor settings (with fewer outdoor settings appearing in girls' dream reports; G. William Domhoff, 1996; Trupin, 1976).

Both the increase in the relative amount of aggression and the decrease in friendliness are caused entirely by the age-effects in the dream reports of boys. Girls' relative

aggression and friendliness stay stable. In contrast to previous findings (Honig & Nealis, 2012; Oberst et al., 2005), boys and girls did not differ significantly in measures of aggressive interactions at any age (Figure 9). Given the findings showing that gender-related attitudes are becoming accentuated with increasing age (Foulkes, 1999), the dream socialization theory of Schredl (2013) may count as an explanation. Another possible explanation of gender-related differences in aggressive interactions in dream reports could be rooted in the reported delays in the emotional maturation of boys relative to girls (Brody & Hall, 2008; Brody, 1985).

5.1.11 Summary Discussion of the Descriptive Study on Children's Dreams

An important and unfortunately often neglected aspect of dream research is the indirect nature of the data; one can only have access to the verbal narrative and not the dream experience itself. We should always keep in mind that the verbal and narrative abilities and memory capacity of the children may shape, affect or even limit the dream reports. Since older children and girls tend to have more advanced cognitive skills, such as verbal and memory abilities (Halpern, 2011), the possible distorting effects of gender and age could be reflected in differences of dream reports. This could be a potential confounding factor in the case of improvements in dream report length with age, as well as for the tendency of girls to produce longer dream reports than boys. Besides dream report length, significant age-related increases in the number of school settings, self-initiated actions, explorative activities, self-involved strivings, cognitions and bizarreness were also found in children's dream reports. There was no gender difference in these latter measures.

Thus, our results support the basic concept of Foulkes' claiming that children's dream narratives follow a developmental pattern of some kind. The age-related increase in the above mentioned variables are the subject of maturation and growth during ontogenesis. At the same time, the results also suggest that even at a preschool age the level of most measures of dreams are significantly closer to adult standards than the laboratory based approach had concluded. Some researchers claim that visual imagery is underdeveloped in young children, preventing them to create complex dream images (Foulkes, 1999; Kerr & Domhoff, 2004; Kerr, 1993). Foulkes hypothesized that immature symbolization skills of pre-school aged children have a direct effect on the dream experience itself:

"The unique properties of dreams at 3-5-year-olds – their static quality, their representation of salient body states rather that symbolization of social interactions, their lack of motoric self-involvement and most often of any effective form of self-representation – are dictated not by the peculiarities in the child's waking experiences but by immaturity in the child's ability to recreate such experiences symbolically" (Foulkes 1982, p.54). Other authors conclude that indeed young children are not only able to create images with their mind's eye, but spontaneously use mental imagery to emulate real events and boost performance of difficult or unfamiliar tasks during wakefulness (Burnett Heyes, Lau, & Holmes, 2013). Moreover, Fonagy and his coworkers (Fonagy et al., 2004) have shown that children as young as 3 years old are able to understand and engage in pretense play, which requires the simultaneous symbolic representation of the outer and inner reality. Based on these studies as well as on our current findings I assume that even preschoolers are able to represent mental imagery such as vivid and eventful dream scenarios. On the other hand, it is plausible to hypothesize that the cognitive sub-processes that support the deliberate generation, manipulation, and maintenance of mental images undergo protracted development throughout childhood and adolescence, underpinned by the maturation of executive and processing capabilities (Burnett Heyes et al., 2013), and that this partial immaturity of visual imagery might influence dream production playing a role the rarity of dream recall in preschoolers.

According to the present results we conclude that although the developmental pattern is clear in some aspects of children's dreams, even preschoolers are able to represent active self-involvement, self-initiated motoric actions and kinematic imagery, various human characters and social interactions, emotional and cognitive involvement in their dream narratives. This is a significantly different picture of preschoolers dreaming than results of laboratory studies suggest, and which difference is presumably rooted in the setting and/or the method of awakening the children. Since this study was not aimed to find out the causes of the differences, further research is needed in this field.

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5.2 Discussion of the Correlational Analysis of Dream Characteristics and Cognitive Performance Measures

5.2.1 Dream Recall Frequency and Bizarreness

Based on previous laboratory studies (Foulkes, 1982, 1999) I hypothesized that dream recall frequency would be associated with cognitive skills, especially visuospatial abilities measured by the Block Design subtest of the WISC. Our results did not support this hypothesis; moreover dream recall frequency did not correlate with any of the cognitive measures. Similarly, in spite of direct supporting evidence in the literature (Colace, 2010; Resnick et al., 1994), I did not find significant correlation between bizarreness measured by the Revonsuo-Salmivalli system (Revonsuo & Salmivalli, 1995) and any of the cognitive measures. The reason for these differences may lie in a rather convenient explanation of the differences amongst the data collection methods and different settings. On-the-spot dream interviews during scheduled awakenings in case of the laboratory study are possibly less often affected by recall failures than the morning dream interviews, thus resulting in a possibly less biased sample of dreams and dream report rates.

The ratio of those dreams that were reported to have an undefined setting showed a significant correlation with the effectiveness of the executive attention measured by the ANT, contrary to those categories of bizarreness defined by Revonsuo and Salmivalli (1995). Undefined setting is similar to the uncertainty category of bizarreness defined by Hobson (1988) or Revonsuo and Salmivalli, with the distinction of being reported by the dreamer. This does not explain why the well-defined and control-coded categories of bizarreness did not correlate with any measures of cognitive performance, especially considering that previous results show a close relationship between cognitive and behavioural control development, and bizarreness measured by various bizarreness scales using dreams from school and home interviews (Colace, 2010). Since the correlations presented in the work of Colace (2010) were not controlled for age I performed such correlations on the present sample, which proved age-control to be responsible for much of the differences. In our opinion however, age control is necessary in order to obtain a clear view on the relationship between cognitive skills and dreaming without the obvious confounder of general developmental changes.

5.2.2 Dream Environment and the Dynamic Nature of the Dreams

Based on laboratory studies that showed specific dream content characteristics closely correlated with age (Foulkes, 1982, 1999), I hypothesized that human characters, activities, and interactions appearing in the dreams would be associated not only with chronological age but with mental age as well (measured by WISC IV, ANT, Stroop, Emotional Stroop). The number of human characters per dream correlated with better ability to select relevant information from the environment (Orienting Network of the ANT): an essential element of attentional skills. The number of gross-motor activities and interactions in the dreams, as well as the ratio of self-initiated activities, turned out to be positively associated with executive attention skills, measured by the Incongruency Index of the Stroop Test. This means that more self-initiated and gross-motor activities in the dreams and more interactions between dream characters predict better functioning of the frontal executive regulation of behaviour. Our convergent findings on the activities, interactions and active self-representation in children's dream reports (all the above features correlate with cognitive development) suggest that these content categories could be integrated in a single aspect of dynamic (instead of static) nature of dreaming. From this point of view we might consider that the richness of the dream environment (e.g. human characters) may be a correlate of information selection skills, and the busyness or dynamic nature of the dreams (e.g. activities, interactions), especially if it is connected to the effort of the dreamer's self, is possibly a correlate of executive attention skills.

5.2.3 Interactions, Cognitions, and Mentalization

Although theory of mind skills were not measured in this part of the study, the presence of interactions in these children's dreams may refer to an access to theory of mind capacities during dreaming (McNamara et al., 2007), which is related to managing relationships in general. Interestingly, both the number of interactions in the dreams and theory of mind performance are connected to frontal inhibitory control (Carlson & Moses, 2001), which functions dynamically develop during the preschool and early school years (Friedman & Leslie, 2004; Magrabi, 2010). In the present study indirect evidence was found to support the possible reflection of theory of mind functions in the dream narratives: executive inhibition was correlated with the amount of cognitive and

metacognitive verbs in the dreams: this variable (indicating self-reflectiveness) could also be viewed as an indicator of developing theory of mind functions. Another example that could be interpreted as an indirect support for the theory of mind skills in dreams is the presence of friendly interactions which activity possibly involves an understanding of the inner motifs, wishes and goals of the self and the other. In this study, the number of friendly interactions per dream was associated with quicker and more efficient processing of negative emotional stimuli, which implies the association of fronto-limbic performance with attitude-related dream content. Future studies should consider exploring possible connections of mentalization skills with dream characteristics especially cognitive presence, interaction types, and possibly variables of emotional presence in the dreams.

5.2.4 Self-agency and Cognitive Presence

An interesting aspect of self-awareness and cognitive/metacognitive presence in the dreams is that these variables can be measured as a content of the dream reports while they are also defining factors of lucid dreaming, referring to which provides us a greater variety of considerable literature. Lucid dreaming by definition involves higher order cognitive skills (Kahan & LaBerge, 1994) and reflective self-awareness (Voss et al., 2009) during REM sleep and is also associated with the development of cognitive functions, like abstract thinking and cognitive insight (Voss et al., 2012). Although one study found that the occurrence of lucid dreaming is higher during childhood and decreases after reaching young adulthood (Voss et al., 2012) differences in cognitive functioning were only assessed and found between lucid dreamers and controls in adulthood; showing lucid dreamers to have better attentional skills and perform with shorter reaction times in the Stroop Test (Blagrove & Hartnell, 2000). Our hypotheses were confirmed as both cognitive verbs in the dreams and different measures of self-agency were found to be correlated with a more efficient executive control and attention skills measured by accuracy in the Stroop Test in case of incongruent stimuli. These results strongly support the notion that the cognitive and self-reflective features of lucid dreaming, that can also be traced in varying extent in normal non-lucid dreams, show a continuity with waking measures of frontal executive functioning (Blagrove et al., 2010; Schredl, 2003a).

5.2.5 Emotional Aspects of Dream Reports

The number of emotions appearing on average per dream report showed a positive relationship with the ability of achieving and maintaining an alert state during task completing (measured by the alerting network of the ANT). If we think about the possible relationship between physiological arousal and the appearance and labelling of emotions (Schachter & Singer, 1962), this result confirms the validity of self-reported emotions by the children during dream interview. Generally the ability to interpret physical arousal and verbalize the emotions seems to parallel the abilities of emotional processing in a positive way.

Regarding emotional quality, the amount of positive emotions per dream was associated with the ability of information selection in a distracting environment (measured by the Orienting Network of the ANT), possibly through a positive kind of alert state, with emotional space to freely pay attention to the task. On the other hand, negative emotions per dream were associated only with verbal abilities in a positive way. This raises the question of willingness or ability to verbalize or interpret negative emotions especially in the youngest age group, where the report rate of negative emotions was low (Figure 14).

Here the ratio of dreams affecting daytime mood was found to be positively associated with effective emotional processing. This means that children whose dreams affected their daytime mood were able to react to stimuli of negative affect in a very effective way, thus it is assumed that they also processed the presented negative emotions efficiently. This result might be surprising since our previous assumption about dreams affecting daytime mood was that this characteristic might be a sign of less effective emotional regulation, in a way that negative affects in dreams are still able to influence waking emotional status. A previous study (Punamäki, 1999) provides further basis for this assumption, where authors explored how dream content affected morning mood amongst children living under traumatizing environmental conditions, compared to controls. They found that the dreams' effect on the children's daytime mood was stronger and more general in the traumatized group (in both positive and negative ways) than the control group. Unfortunately they did not report data regarding the emotional coping skills of the children with the environmental challenges, but being traumatized in itself suggests a challenge or even damage for the emotional coping system.

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5.2.6 Summary Discussion of the Correlational Analysis of Dreams and Cognitive Measures

Evidence was found that the the busyness or dynamic nature of the dreams (dreamer involved activities, interactions, gross-motor activities), especially if that is connected to the effort of the dreamer's self, is a correlate of executive attention skills measured by the Incongruency Index (a reaction-time based measure) of the modified Fruit Stroop Test. At the same time measures of self-agency and cognitive presence in the dreams were also associated with executive functions measured by the accuracy of the reactions to the incongruent stimuli and also the reaction-time based Incongruency Index in the modified Fruit Stroop Test. Our results so far let us infer that the more effective the executive control of the child in waking life is, the stronger the dreamer's presence is in the dreams (manifested in activities, interactions, self-effectiveness, wilful effort and cognitive reflections).

Emotions appearing in the dreams seemed to parallel a wider concept of attentional skills in the children, which are part of the executive attentional system but seem to be controlled by slightly different parts of the brain. Emotions in the dreams parallel the ability of achieving and maintaining an alert state and effective information selection. Executive capacities themselves were more effective in those children who reported more dreams having an effect on their daytime mood.

On the other hand, emotional processing was more efficient with those children who displayed more friendly interactions, more often represented an active self, and had more dreams affecting their morning mood. These results would lead us to conclude that emotional processing could have something to do rather with the quality and content of the above mentioned activities and interactions, but this hypothesis certainly needs more systematic testing.

On the whole, while some results of this study are contributing to the mapping of the connections between brain development and its behavioural correlates during sleep and wakefulness, others raise questions about the reliability and generalizability. Interestingly, the two kinds of measures for executive functioning (Incongruency Index of the Stoop and conflict network of the ANT) did not overlap in terms of dream correlates (see Table 4), contrary to what was predicted based to the literature,

suggesting that the two measures are indexing the same kind of frontal executive control functions located in similar brain areas (see introduction). Perhaps the changes in the assessment rules of the Fruit Stroop Test we made had an effect on the outcome. However because the incongruency was still present (just like in the emotional version), the stroop effect was still measurable (see methods section) and the hypothesized associations between executive functions and dreaming were usually found in terms of the Stroop Test and not the ANT, we consider this a reasonable alteration. In any case, the issue of the correlation between dreaming and the different measures of executive functions in children highlights the importance of more specific research in this field.

5.3 Discussion of the Correlational Analysis of Dream Characteristics and Measures of Attachment, Emotional Development and Sleep Quality

5.3.1 Attachment and Dreaming

Within the interdependent subscales of MCAST three distinct categories of dream content showed consistent association: exploratory activities, home settings, and sad emotions. The first and most interesting of these is exploratory activities: both the categories of secure attachment and mature mentalization, and the scale measure of narrative coherence positively associated with the number of exploratory dreams. After age-control, the associations with secure attachment and narrative coherence still remained. This association is of particular importance because in waking life exploratory activity and the attachment system are viewed to work together in a complementary fashion (Bowlby, 1988): a child uses an attachment-figure as a *"secure base from which to explore"* the environment. This means that when the attachment system is active (absence of the caregiver or the insecurity of the attachment relationship) exploratory activity declines (Cassidy, 2008). Our results seem to reflect this association between attachment security and exploratory activity appearing in the dreams of preschool and school aged children. In this context narrative coherence seems to reflect a very similar concept to attachment security, since in the AAI (where the concept of narrative coherence derived from) coherence (in the context of emotionally loaded attachment narratives) is a core indicator of attachment security (Hesse, 2008). In our interpretation exploratory activity in dreams takes place when the child stretches

the boundaries of their comfort zone and explores territories unknown to their waking self. In this sense staying at home could be interpreted as the opposite of exploratory activity: it is the safe harbor from which exploration begins. Interestingly, home setting also showed association but of a negative nature with attachment security and narrative coherence and correlated positively with the disorganization scale of the MCAST. Since the home setting and its correlates all show dynamic changes with age, the presence of a large proportion of home settings in the dreams might as well be interpreted as a regressive index.

Based on previous results, it is not surprising that dream emotions were associated with attachment measures and that they also distinguished between mentalization categories. Self-reported sadness appeared significantly more frequently amongst insecurely attached children, which is in line with the findings of McNamara et al. (2001), who found more intense dream emotions in case of insecurely attached university students. Since previous findings tell us about differences in the intensity of any emotions, the specific nature of sad emotions in this study is interesting, especially if we consider how sad emotions were also found more frequently in the well-mentalizing children's dreams. This lets us suspect that mentalizing skills are essential for the ability to recognize and verbalize subtle emotional tones such as sadness, as opposed to non-mentalizing children, who rather used the more general category of "bad" emotion to describe their state of negative affectivity (independently of age).

On the whole our findings tend to support McNamara et al.'s attachment theory of dreaming and REM sleep (McNamara et al., 2002; McNamara, 1996) and as a support it is an interesting start, but it is also an exploratory work, which lacks a specific focus. Further research is necessary to refine the picture with perhaps specific foci on attachment related dream content, for example attachment figures, self-portrayal and/or more details of the secure base script.

5.3.2 Socio-emotional Coping and Dreaming

Self-agency and especially active-self representation in the dreams turned out to be negative correlates of behavioral-emotional problems measured by the SDQ. Children with high ratio of dreams with activity scored lower on the total problem score of the SDQ. Thus, high level of activity and self-presence in the dreams might be signals of

more mature dreaming, reflecting a more mature wakeful control over the behavior. To support this hypothesis prior concordant results can be found: in a study eliciting the most recent dreams of hyperactive children, the authors found (contrary to their expectations) no correlation in the hyperactive group and negative correlation in the control group between the severity of hyperactivity symptoms and the number of movements in the children's dreams (Schredl & Sartorius, 2010). They concluded that activities in the dreams are not only a continuation of waking behavior (for a critique of the continuity hypothesis see: Schredl & Hofmann, 2003).

Interestingly, those children who reported more dreams affecting their daytime mood and who previously were shown to be better in the processing of negative emotions measured by the Emotional Stroop Test (see section 5.2.5), tended to exhibit more emotional-behavioral problems, reported by the parents. The resolution of this apparently conflictual finding about dreams affecting daytime mood may lie in the observation that sometimes anxious children perform on Emotional Stroop with even shorter reaction time than the control group, which can happen with those children whose avoidance in connection to the emotional stimuli is stronger than their disturbance by them (Heim-Dreger et al., 2006). Thus, it is possible, that the emotional effect of dreams on daytime mood is (as shown in the correlation with parental report) a sign of emotional vulnerability and emotionally vulnerable children in this case tend to avoid negatively-toned stimuli. Results suggest that the effects of dream emotions on daytime mood could be important indicators of emotional regulatory capacities, but more research is needed to clarify the connection between the two phenomena.

The emotional behaviors measured by the SDQ correlated significantly with dream recall frequency of the children during the 6 weeks of dream collection period. Earlier findings showed that stress such as interpersonal conflicts and anxiety may be associated with elevated dream recall frequency in adults and in children (Pagel, Vann, & Altomare, 1995; Schredl & Montasser, 1996; Schredl, 1999), although results are somewhat inconsistent (Brand et al., 2011; Foulkes, 1969). These findings may support the salience hypothesis, since according to numerous studies stress also increases the emotional intensity of the dreams (for example: Hartmann, 2010). Nevertheless, we cannot exclude other explanations. For example it is plausible to assume that stress

increases the occurrence of nocturnal awakenings and therefore dream recall frequency increases (Schredl, Schafer, Weber, & Heuser, 1998; Schredl, 1999).

Children exhibiting more emotional problems on the SDQ also reported more dreams with negative quality, which parallels previous results of both adult (Michael Schredl & Engelhardt, 2001) and child (Foulkes et al., 1969; Punamäki et al., 2005; Schredl & Sartorius, 2010) research. This convergence suggests that waking life's emotional difficulties and struggles leave their impression on the human cognitive activity during sleeping and are reflected in our dreams. In an earlier review we suggested that the supposed fear-extinction and emotion regulation role of dreaming and REM sleep proposed by the neuro-cognitive theory of Levin and Nielsen (Levin & Nielsen, 2007; Nielsen & Levin, 2007) could be plausible for developmental dreams as well. The AND model assumes the ineffectiveness of the ventro-medial prefrontal, as well as dorsal and rostral anterior cingulated cortices in dampening the strong affective reactions induced by the amygdale and the lack of fear extinction, lead to nightmare experiences. Nightmares result from affect load (caused by acute stress) and affect distress (dispositional negative affectivity). The same mechanism could function during child development, given that the linkage between negative dream quality and daytime emotional problems is present in children as well. Similarly to adults, correlations between emotional disturbances, trauma and nightmare frequency are also present in children, moreover there are studies showing that children exhibit even more frequent nightmares than adults (Levin & Nielsen, 2007). This phenomenon could result from the late maturation of the frontal cortex during development (Thompson-Schill, Ramscar, & Chrysikou, 2009), being therefore still ineffective or immature in childhood, so that its tasks in carrying out the regulation of intense emotions arriving from the subcortical areas are affected too.

5.3.3 Dreaming and Sleep Quality

Contrary to previous findings (Schredl & Montasser, 1996; Schredl et al., 1998; Schredl, 1999) and our expectations, poor sleep quality did not associate with higher dream recall frequency in this sample. Parents might have simply overrated sleep problems in the children, or since the assumptions are all based on adult studies, it could be that poorer sleep quality does not correlate with dream recall frequency in young

children. For the first suggestion, it would be worth analyzing the objective measures of sleep quality in those children who slept in our laboratory, although that might not be a true representation of sleep quality at home.

The heightened ratio of bizarreness related to sleep problems supports the cognitive activation hypothesis, that suggests that bizarreness in dreams is a result of an overall increase in cortical and cognitive activation during sleep (Antrobus, 1991). This theory explains the heightened frequency of bizarreness in REM dreams contrary to NREM dreams, and, assuming that troubled sleeping is associated with higher level of arousal during sleep, could explain the correlation between sleep problems and bizarreness in children as well. Moreover, increased cognitive activation could also explain the found elevation of cognitive and metacognitive verbs found in children's dreams with sleep problems.

Disturbed and altered sleep is demonstrated to be related to nightmares in adult (Schredl, 2003b; Simor, Horváth, Gombos, Takács, & Bódizs, 2012; Simor, Horváth, Ujma, Gombos, & Bódizs, 2013) and child populations (Li et al., 2011; Schredl et al., 2000). In the present study we did not distinguish between nightmares and dysphoric dreams but found that negative dream quality and negative dream emotions are both correlated with problem scores on the CSHQ reported by the parents. Nightmares and vivid negatively toned dreams could cause frequent awakenings in themselves, but, as nightmares are associated with emotional and behavioral problems in children (Li et al., 2011), they could be affecting sleep through these emotional-behavioral symptoms. This latter explanation is rather plausible since in this study emotional difficulties assessed by the parents showed an association with negative dream quality as well as sleep problems. Further research is needed to map the possible causal associations between emotional problems, negative dream affect/ nightmares and sleep difficulties in childhood.

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6 Overall Discussion and Conclusions

The present work aims to contribute to the few attempts in the scientific literature that deal with cognitive correlates of dreaming and discuss the results in existing theoretical frameworks that consider neuro-cognitive and emotional functioning closely related to REM sleep and dreaming. Although the majority of the theoretical frameworks (see introduction) are based on adult dream research I conclude that examining the developmental aspects of both dreaming and cognitive functioning is a fertile direction to get closer to a wider multilevel perspective of dreaming (including levels of neuro-anatomic findings, cognitive and emotional functioning and behavioural aspects).

Contrary to previous laboratory-based research, our descriptive analysis of dreaming between 4 and 8 years of age showed young children, especially preschoolers, to be more accomplished dreamers than it was previously assumed in the scientific literature. The ratio of active self-representation, kinematic imagery, human characters, actions, interactions, and emotions appearing in their dreams were shown to be comparable to those of the adults. On the other hand, our results support previous findings claiming that the formal and content related characteristics of children's dreams (dream length, settings, activities, interactions, self-related strivings, cognitions and bizarreness) show a strong parallel development with age. Preceding research also showed specific dream report characteristics to be related to cognitive development which were not only confirmed by this study but we also extended the range of studied attributes of dream reports.

In this study longer and more eventful dreams (higher number of actions and interactions per dream) as well as an active role of the dreamer's self in the dream plot (self-initiated actions and active self-representation) were found to indicate a better attentional and frontal executive performance. Character-richness of the dream environment correlated with information selection skills and the emotion-related aspects of the dreams seemed to relate to all the aspects of the attentional network in a positive way.

According to recent findings, patterns of emotional development especially behavioural symptoms and attachment styles are reflected in dreams. These statements were confirmed here by finding that both insecure attachment and emotional difficulties were

associated with negative dream emotions (sadness) and negative dream quality, respectively. According to Nielsen and Levin's neurocognitive theory, emotionally loaded dreams especially nightmares can be a consequence of prefrontal-cortical areas being unable to down-regulate emotions presented by subcortical areas, resulting in ineffective emotional regulation. Our results support this theory, and show that although this theory is often portrayed through the mechanism of nightmare formation, it could be just as relevant as a model in case of dysphoric dreams and in a developmental context.

Finally, an association was found between various aspects of attachment styles and specific attachment related dream content (such as exploratory activity and home settings). Since these findings seem to be reasonably consistent amongst the measured attachment scales of the MCAST, I consider it as evidence supporting the hypothesis of McNamara et al. (Zborowski & McNamara, 1998) suggesting that REM sleep and dreams in part may selectively influence and even promote attachment especially in developing humans.

Importantly, some characteristics of dreams, such as activities and self-agency, emerge as important features, possibly reflecting a general positive adaptation and high level of wakeful functioning being correlates of both cognitive and emotional measures of development. Emotional and cognitive functioning are not separable in real life; they are interdependently contributing to a general successful adaptation or a balanced development. This balance could be an important contributor of school performance in this early age, which would be an interesting topic for further research in connection with dreaming.

Our findings provide further support to various theories suggesting a role of dreaming in state-like emotional processing from one day to another and trait-like characteristics of emotional coping and attachment styles. Considering these findings it is suggested that working with dreams could be useful in child therapies as well as adult therapies, especially in case of children with emotional difficulties, or who have difficulties talking about their life events.

Since developmental dream research studies are incredibly scarce and most of the modern theories about the possible functions of dreaming are developed and tested to fit

adult populations, this study is an important step to provide tests of these theories in connection with child development, thus forming a bridge between the isolated areas of adult and child research. The developmental perspective however can also provide us with useful information about how the levels of cognitive and affective maturation are connected to the development of dreaming as a behavioural output. This might take us closer to understand the role and function of dreaming in cognitive-emotional performance and how dreaming as a phenomenon fits into neural functioning and development.

6.1 Limitations

The difficulty of investigating dream experiences in children is probably due to the inherent methodological problems of the field. Although we aimed to overcome some of these problems (for example those caused by the unfamiliar research environment, an incomplete arousal from sleep, suggestive questioning, and confabulation; see section 3.2), several limitations and doubts have to be mentioned. There may be bias in recruiting parents who are interested in scientific achievements and/or motivated to get feedback about their child's development. The credibility of dream reports remains a major issue, although it is an untestable issue present with any extant dream collection method. Another limitation could be the coding system, which was aimed to integrate the advantages of two different well-used coding systems, but ultimately is a slightly different from both of its precursors, making it difficult to make direct comparisons between studies. Our method of eliciting dream emotions from the children might be prone to bias from waking interpretation or social pressure. For these reasons we consider it essential for further studies on this material to start with a control for emotions by independent coders.

In addition there are several other aspects which have to be considered as limitations of this study. For example it is still unclear to what extent dream reports collected upon morning interviews would be representative of the general dream life of the children. Also, because of the morning recalls, we have no means of knowing whether a dream was experienced during REM or NREM sleep, which could be important regarding

content issues. For example McNamara et al. (2007) found that interaction-types and the role of self could be significantly different in REM versus NREM dream reports.

Another issue of this study is that in spite of the efforts to provide specific hypotheses, it is still an explorative study in nature performing a relatively large number of correlational analyses. In order to control for the numerous correlations in this study, I used the Benjamini-Hochberg procedure. However correction of false positives with smaller sample sizes might be problematic because it may eliminate valid statistical results. Given that dream research is a field that is still at a descriptive stage, it could stifle the exploration of new, unexpected findings (G William Domhoff & Schneider, 2015). Instead of correction formulas some authors advocate follow up and replication studies. Considering the above reasons I presented the results with and without the Benjamini-Hochberg control throughout the article. Regarding the correlational results, it is considered to be supportive that on several occasions the correlations in this study tended to point at the same direction and repeatedly associated specific groups of dream features, such as measures of self-agency, activities and emotionality with both cognitive and emotional functioning.

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7 Summary

REM sleep plays an important role in neural development, and together with dreaming is closely connected to daytime cognitive and emotional functioning. The well cited developmental dream studies consider dreaming a cognitive achievement, ignoring the recent dream theories emphasizing the emotional processing functions of dreaming. The aim of this study is to describe the development of dreaming and to explore connections between cognitive and emotional maturation and dream characteristics of 4-8-year-olds.

Dreams of 40 children were collected upon awakening during a 6-week period. Content analysis was performed on the dream narratives focusing on formal and content related dream characteristics. Children's intelligence, executive functioning, emotional processing and emotional-behavioral symptoms were measured.

Contrary to previous findings, we found preschoolers to be already accomplished dreamers, exhibiting kinematic imagery, self-representation, interactions, activities, cognitions, bizarreness, and emotions in their dreams. According to our findings, although age related developmental patterns are also obvious, the dreams of 4-8-year-old children are in many ways comparable to those of adult standards. In association with emotional and executive functioning, specific categories of dream contents emerge as prominent correlates, such as activities and self-efficiency. We suggest that these content categories are indices of good emotional/cognitive functioning and positive behavioral adaptation. Associations between emotional adaptation and emotional dream content were found that support adult-based results showing the role of dreaming in emotional regulation. Specifically, attachment related contents were found to be associated with attachment security, thus supporting the role of REM sleep and dreaming in attachment promotion.

As a result, we developed a well-controlled methodology of home-based developmental dream research that could be useful in the future studies. We confirmed the relationship of various dream characteristics with waking cognitive and emotional functioning already established in the adult literature in developmental context. This is an important step towards bridging the gap between adult and developmental research and draws attention to the importance of dreaming in everyday emotional adaptation.

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8 Összefoglalás

Számos kutatás bizonyítja, hogy a REM alvás fontos szerepet játszik a neurális fejlődésben és hogy az álmodással együtt szorosan kapcsolódik a kognitív és affektív szabályozáshoz. Laboratóriumi vizsgálatok az álmodást kognitív teljesítményként értékelik, ezzel figyelmen kívül hagyva újabb elméleteket, melyek hangsúlyozzák az álmok érzelemszabályozásban betöltött szerepét. A jelen dolgozat célja, hogy feltérképezze a 4-8 évesek álmodási mintázatait és azok potenciális kapcsolatát a kognitív és affektív szabályozással.

Összesen 40 gyerek álmait gyűjtöttük össze otthonukban reggeli álominterjúk segítségével egy 6 hetes periódus során. Az álombeszámolók formai és tartalmi (karakterek, helyszín, aktivitások, interakciók) jellegzetességeit kódoltuk. Mértük a gyerekek intelligenciáját, neuropszichológiai működését, érzelemszabályozását és érzelmi-viselkedéses nehézségeit.

Megelőző vizsgálatokkal ellentétben már az óvodások álmaira is jellemzőnek találtuk az aktív szelf-reprezentációt, a kinetikus álmokat, az aktivitást, interakciókat, kognitív jelenlétet, érzelmeket és bizarrságot. Azzal együtt, hogy a korral egyes álomjellemzők gazdagodása egyértelmű, a 4 és 8 év közötti gyerekek sok esetben mégis a felnőtt standard értékekkel összevethető álommutatókkal bírnak. Az álmok egyes specifikus tartalmi kategóriái, mint az aktivitás és a szelf-hatékonyság kiemelkednek, mint a kognitív/ affektív fejlődés stabil korrelátumai. Amellett érvelünk, hogy ezek a visszatérő tartalmi kategóriák pozitív alkalmazkodást és magas szintű kognitív-érzelmi funkcionalitást jeleznek. Kapcsolatot találtunk az érzelmi fejlődés és az álmok érzelmi jellemzői között, ami támogatja az álmodás érzelemszabályozásban betöltött szerepét hangsúlyozó elméleteket. A nappal mért biztonságos kötődés összefüggést mutatott kötődési álomtartalmakkal, ami alátámasztja a REM alvás kötődési rendszert támogató elméletét.

Eredményeink fontos eleme egy jól kontrollált módszertan kialakítása, amely használható lehet későbbi álomkutatások során. Megerősítést nyert több, a felnőtt álomkutatás területén már ismert összefüggés az egyes álomtartalmak és érzelemszabályozás között, alátámasztva a neuro-kognitív álomelméletet. A munka fontos lépés a felnőtt és fejlődési álomkutatás közötti szakadék áthidalásához és felhívja a figyelmet az álmodás szerepére a mindennapi érzelmi alkalmazkodásban.

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10 Publication list

10.1 Publications Related to the Present Work:

Sándor P., Szakadát, S, Bódizs R. (2016). The development of cognitive and emotional processing as reflected in children's dreams: active self in an eventful dream signals better neuropsychological skills. *Dreaming* 26(1) pp. 58-78. (2016). $IF_{(2014)}$: 0.6.

Sándor P., Szakadát, S, Kertész, K. and Bódizs R. (2015). Content analysis of 4 to 8 year-old children's dream reports, *Frontiers in Psychology* 6: Paper 534. $IF_{(2014)}$: 2.56.

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Sándor, P., Bódizs, R. (2014). „Gyerekek álmai: módszerek és eredmények a gyerekálmodás kutatásában Freudtól napjainkig – kritikai áttekintés" *Psychiatria Hungarica* 29:(3) pp. 257-272.

10.2 Publications Unrelated to the Present Work:

Simor, P., Gombos, F., Szakadát, S., Sándor, P., Bódizs, R.. (2016) EEG spectral power in phasic and tonic REM: Different patterns in young adults and children. *Journal of Sleep Research* .25(3) pp. 269-77. $IF_{(2014)}$: 3.3.

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Ruggeri, K., Banasik, N., Bock, L., Cosma, A., Romila, C. I., Sándor, P., & Üzümcüoğlu, Y. (2011). An Exploratory Study of Multicultural Education Development in Eastern Europe, *Research in Social Change*, 3(2): 183-222.

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12 Appendices

12.1 Appendix 1

Képességek és nehézségek kérdőív (SDQ-Magy)

Mindegyik állítás esetében arra kérjük, hogy jelölje meg, mennyire igaz gyermekére: "Nem igaz", "Valamennyire igaz" vagy "Határozottan igaz". Kérjük, hogy a lehető legpontosabban válaszolja meg a kérdéseket, akkor is, ha nem teljesen biztos a válaszban, vagy a kérdés ostobának tűnik! Kérjük, hogy a kérdőívet az elmúlt 6 hónap vagy az idei iskolaév alapján töltse ki.

A gyermek neve: ..... Fiú / lány

Született: .....

	Nem igaz	Valamennyire igaz	Határozottan igaz
Mások érzéseit figyelembe veszi	☐	☐	☐
Nyughatatlan, túlságosan mozgékony, nem tud sokáig nyugton maradni	☐	☐	☐
Gyakran fáj a feje, a hasa, van hányingere	☐	☐	☐
Szívesen megoszt dolgokat más gyerekekkel (nyalánkságokat, játékot, ceruzát, stb.)	☐	☐	☐
Gyakran hisztizik, könnyen dühbe gurul	☐	☐	☐
Többnyire elvonul, inkább egyedül játszik	☐	☐	☐
Rendszerint szófogadó, teljesíti, amit a felnőttek kérnek	☐	☐	☐
Gyakran, sok minden miatt aggódik, szorong	☐	☐	☐
Segít, ha valakit bántottak, szomorú, feldúlt vagy beteg	☐	☐	☐
Állandóan izeg-mozog, fészkelődik	☐	☐	☐
Van legalább egy jó barátja	☐	☐	☐
Gyakran verekszik, vagy komolyan fenyeget más gyerekeket	☐	☐	☐
Gyakran boldogtalan, lehangolt vagy sír	☐	☐	☐
Más gyerekek általában kedvelik	☐	☐	☐
Könnyen elterelődik a figyelme, elkalandozik	☐	☐	☐
Új helyzetekben feszült és kapaszkodó, könnyen elbizonytalanodik	☐	☐	☐
Kisebb gyerekekhez kedves	☐	☐	☐
Gyakran hazudik vagy csal	☐	☐	☐
A többi gyerek beleköt, fenyegeti	☐	☐	☐
Sokszor segít önként is (szülőknek, tanároknak, gyerekeknek)	☐	☐	☐
Végiggondolja a dolgokat, mielőtt cselekszik	☐	☐	☐
Lop otthonról, az iskolából vagy máshonnan	☐	☐	☐
Jobban kijön felnőttekkel, mint gyerekekkel	☐	☐	☐
Sok mindentől fél, könnyen megijed	☐	☐	☐
A feladatokat teljesíti, figyelme kitartó	☐	☐	☐

Aláírás ..... Dátum .....

Anya/Apa/Egyéb (kérjük részletezze):

Közreműködését nagyon köszönjük

DOI:10.14753/SE.2016.1935

12.2 Appendix 2

Gyerek Alvási Szokások Kérdőív

Child's Sleep Habits Questionnaire, CSHQ

A következő kérdések gyermeke alvási szokásairól és az ezzel kapcsolatos lehetséges nehézségekről szól. Kérjük, gondoljon az elmúlt hét eseményeire gyermeke életében, mikor a kérdésekre válaszol. Ha a múlt hét valamilyen szempontból rendhagyó volt (pl. a gyermek beteg volt, és nem aludt jól, vagy elromlott a TV stb.), válassza ki a legutóbbi átlagos hetet emlékezetében. Válassza az ÁLTALÁBAN választ, ha valami 5 vagy több alkalommal történt a héten, a NÉHA választ, ha valami 2-4 alkalommal fordult elő a héten, és a RITKÁN választ, ha valami soha vagy csak egyszer fordul elő egy átlagos héten. Kérjük azt is jelölje, hogy az adott szokás jelent –e problémát Önöknél, úgy hogy bekarikázza az „igen"/"nem"/"nem értelmezhető" (NÉ) válaszok valamelyikét.

Lefekvés ideje

Általában hány órakor fekszik le a gyermek: _____

	Általában (5-7)	Néha (2-4)	Ritkán (0-1)	Probléma?		
A gyermek esténként ugyanabban az időben fekszik le.				Igen	Nem	NÉ
Ágyba kerülés után 20 percen belül elalszik.						
A gyermek egyedül, a saját ágyában alszik el.						
A gyermek a szülők vagy testvér ágyában alszik el.						
A gyermek elalváshoz hintázó, ritmikus mozgást végez.						
Szüksége van egy különleges tárgyra elalváshoz (baba, külön takaró stb.).						
A gyermeknek szüksége van a szülő jelenlétére elalváshoz.						
A gyermek kész lefeküdni a lefekvés idejében.						
A lefekvés idejében a gyerek nem akar lefeküdni.						
A lefekvés idejében a gyerek küzd a lefekvés ellen (sír, nem marad az ágyban stb.).						
A gyermek fél sötétben elaludni.						
A gyermek fél egyedül aludni.						

Alvási viselkedés

A gyermek átlagos alvásideje egy nap: _____ óra és _____ perc
(az éjszakai és a délutáni alvást együttvéve)

DOI:10.14753/SE.2016.1935

	Általában (5-7)	Néha (2-4)	Ritkán (0-1)	Probléma?		
A gyermek túl keveset alszik.				Igen	Nem	NÉ
Túl sokat alszik.						
Épp a megfelelő mennyiséget alussza.						
Körülbelül minden nap egyenlő mennyiséget alszik.						
Előfordul, hogy éjjel bepisil.						
Előfordul, hogy álmában beszél.						
A gyermek nyughatatlan, sokat mozog alvás közben.						
A gyermek alvajáró éjszaka.						
Az éjszaka során a gyermek átmegy valaki más ágyába (szülő, testvér stb.)						
A gyermek testi fájdalmakról panaszkodik alvás közben. Ha igen, hol? _____						
A gyermek csikorgatja a fogát álmában (A fogorvos említhette ezt Önnek).						
A gyermek hangosan horkol.						
Időnként úgy tűnik, mintha abbahagyná a lélegzést.						
A gyermek időnként horkant és/vagy zihálva lélegzik alvás közben.						
Problémát jelent a gyermeknek, ha nem otthon alszik (pl.: rokonlátogatás, nyaralás).						
A gyermek panaszkodik, hogy nem jól alszik.						
A gyermek éjszaka kiabálva, izzadva felriad és vigasztalhatatlan egy ideig.						
Ijesztő álom ébreszti fel éjjel.						

Éjszakai ébredések

	Általában (5-7)	Néha (2-4)	Ritkán (0-1)	Probléma?		
A gyermek felébred egyszer az éjszaka folyamán.				Igen	Nem	NÉ
A gyermek egynél többször ébred fel az éjszaka folyamán.						
A gyermek ébredés után segítség nélkül visszaalszik.						

Körülbelül hány percig tart egy- egy éjszakai felébredés: _____---------_____

DOI:10.14753/SE.2016.1935

Reggeli ébredés

Gyermek általában mikor kel reggel: _____

	Általában (5-7)	Néha (2-4)	Ritkán (0-1)	Probléma?		
A gyermek magától ébred reggel.				Igen	Nem	NÉ
Ébresztőórára ébred.						
Rossz hangulatban ébred.						
A szülők vagy testvér ébreszti a gyermeket.						
Nehezére esik felkelni reggel.						
Sok időbe telik, míg reggel éberré válik a gyermek.						
Reggel nagyon korán felébred.						
Jó étvágya van reggelente.						

Nappali álmosság

	Általában (5-7)	Néha (2-4)	Ritkán (0-1)	Probléma?		
A gyerek alszik délután.				Igen	Nem	NÉ
Hirtelen elalszik valamely aktív cselekvés közben						
A gyermek fáradtnak tűnik.						

Az utóbbi héten az alábbi cselekvések közül valamelyik közben tűnt-e nagyon álmosnak, vagy aludt –e el a gyermek (kérjük, jelölje meg):

	Nem álmos	Nagyon álmos	Elaludt
Egyedüli játék.			
TV nézés.			
Autóban utazás			
Étkezés.			

DOI:10.14753/SE.2016.1935

12.3 Appendix 3

CONTENT ANALYSIS
SCORING GUIDE

Content analysis table: in our content analysis table 3 columns account for each dream. The function of the columns change with the quality of dream feature we address. For example: when we address dream characters the score in the first column indicates male characters, but when we address activities it accounts for dreamer involved activities. Similarly the second column can account for female characters or "others" (characters different from the dreamer) involved activities, depending on the actual dream feature we are looking at. The third column is usually used for miscellaneous cases. The excel content analysis raw table and the R code that calculates the statistics are available from the author.

Our system of dream content analysis is based on the works of Foulkes and Shepherd (Foulkes & Shepherd, 1971) and Hall and Van de Castle (Hall & Van de Castle, 1966).

Cumulative variables: Dream features scored in an additive manner. All the appearances of a certain feature are added up and the total is scored in the content analysis table.

Dichotom variables: Dream features scored in a binary manner. We only indicate in the content analysis table with 0 or 1 that the specific feature we count for appears in the text or not.

Verb Count: Our concept was to gain a better insight on what actually happens in the dream, hypnotizing that this measure (the number of verbs) would be a more accurate index of the dream itself (regarding its length and the complexity of activities) than the total number of words.

Every verb in the narrative is scored. If an action is described twice by the Dreamer, i.e.: She repeats the same action in a different context, the verb is not scored again, given that it is absolutely sure the Dreamer talks about the same activity. (E.g.: " …then we jumped off the wall…" […] "… but it was only me jumping off the wall..."). Excluded are substantive verbs (the forms of the verb *to be)* e.g.: "We were on a ship", and verbs describing the dream itself. E.g.: It all happened in the school". If the verb is mentioned in a form describing a "possibility" of an action – e.g.: "we would see a shadow" - it is still scored assuming that the character actually preformed the activity. (E.g.: Saw the shadow.). The same principle is applied for statements in the passive voice. In case of a complex action (e.g.:" He *had to stop",* or "He *wanted to steal* it, or "I *thought I should have looked into* it") only one verb is scored.

I. Characters

Type of variable: cumulative
Definition: A character is someone actually appearing in the dream, or someone with whom the Dreamer interacts in the dream. (E.g.: In case of a phone call: if the dreamer mentions someone she talked to on the phone)

In case someone appears in the dream, but she is not visible, she is still scored as a character E.g.: "We were in the living room, so I could not see her, but I knew Mum was in the kitchen cooking."
If a person is mentioned but she is not present in the dream, the Dreamer only thinks about her, she is not scored as a character. (E.g.: "I was alone thinking about Mum". In this case "Mum" is not scored as a character.) If the Dreamer has a non-narrative dream, she only thinks about

certain person there is no character to score. If a person is mentioned only because she is linked to a certain object in the dream, she is not scored as a character. E.g.: "Tom's car was parked in front of the house".) If the Dreamer says "I was dreaming about "X", then "X" automatically becomes a character. The same criterion applies to the Dreamer herself. E.g.:"I was in the dream")
If the Dreamer mentions a group of characters – without naming each of the group members specifically -, two categories are scored: The "group" category gets a score, along with the specific category where the members of the group belong. E.g.: "and there were all my classmates". In this case one point is scored for the "group" category and one for known children in the 3rd column.)

Scoring

1. **Family:** characters are coded according to their position in the family relative to the dreamer. Unclear family relations are scored under the "other" category.

2. **Known person:** If the character is named by the dreamer or described in a context supposing familiarity. (E.g: classmates, schoolmates). From the age of 18 years characters are scored as "adults". If not specified otherwise "playmates" are automatically scored as children.

3. **Strangers:** Characters not named, or otherwise described to be known by the Dreamer.

4. **Celebrities:** Identifiable, real person known by the Dreamer but not personally.

5. **Fairy tale and cartoon characters:** Specific characters identifiable from tales, cartoons, myths.

6. **Group:** A collective of characters. (E.g.: "people", ""crowd" etc.). A group could consist of any sort of characters, so besides being scored for "group" we also score for the kind of characters forming the group. The size of the group is not important; even if it consists of a large (but unspecified) number of characters the group is only scored once. Based on these principles the sentence "I was flying with (the) fairies" is scored as follows: one score is given to the "group" category, and another to the "supernatural, fantastic creatures" category. If the characters in the collective are named or we know the exact number of them, they are coded accordingly in their specific categories and no "group" is scored.

7. **Supernatural and fantastic creatures:** Mythological or other characters with supernatural abilities or without them, non-existent in real life. (E.g.: Fairies, monsters, unicorns etc.) Characters in this category are not identifiable as a concrete character from a tale, cartoon etc. (E.g.: In the case "We saw a hobbit", "hobbit" is scored here, but if the dreamer says "We saw Frodo", "Frodo" is scored in the 5th category and no fantastic creature is scored even though Frodo is a hobbit.

9. **Animals:** Any kind of animal existent in the real world (if non-existent, or extinct, it belongs to the previous category)

8. **Toys, dolls:** Any inanimate object intended primary for play specifically mentioned by the Dreamer.

9. **Significant objects:** Objects different from those intended primary for play significant in the narrative. (E.g.: Landscape objects are not significant.) Significant objects are scored here but

they are not considered as characters later in the scoring process. E.g.: object movement does not count as action later in the analysis.

II. Settings

Definition: Any place where any dream event occurs or where any dream character is located. If the dreamer only thinks of Island, then Island is not a setting. Whereas, if she dreams about her friend, who is on vacations in Iceland, then Iceland is a setting. All settings are scored. If multiple settings are mentioned all of them are scored. If no setting is mentioned no setting is scored. Settings are always scored in the third column.

Scoring

1. **Conveyance:** Any enclosed vehicle where a dream event takes place. E.g: A car is scored as a setting (if any dream event takes place in the car), while a bicycle, or tricycle is not a setting. If the dreamer only mentions a car, but no event takes place inside the car it is not a setting.

2. **Home or residential:** Any kind of building where people live. E.g.: a castle, an igloo, a hut, etc. A dog house can be a "home", and any part of a home is scored as "home". (e.g.: the kitchen, a room, the living room etc.)

3. **School, educational:** Any building or area set aside for educational purposes, including physical education or sports.

4. **Urban:** Any urban area different from the "educational"-, "home"-, or "vehicle" settings. (E.g.: in the street, in a shop.)

5. **Outdoors:** Any outdoors *not* urban setting, including both rural and natural settings.

6. **Undefined, unclear:** If a setting is mentioned but cannot be named or described either because the Dreamer cannot remember it or cannot report it adequately; the setting remains unclear.

III. Activities

Type of variable: cumulative (except for exploratory activities)

Definition: Only activities explicitly mentioned by the Dreamer are scored. Activities ascribed to the Dreamer are scored in the first column. Activities ascribed to other dream characters are scored in the second column. Every activity is scored only once even if it is performed by multiple characters. In case the dreamer does something together with other dream characters, the dreamer is given priority at scoring. E.g.: "We were flying together with the fairies": The activity is scored for the dreamer in the first column, and no activity is scored in the second column for "other characters". Only activities ascribed to characters are scored, movements of objects are not.

1. All activities: Any activity actively performed by a character is scored here. Activities not initiated by a character are not scored. (E.g.: …"He fall off"…). Only those activities are scored which actually take place in the dream. Activities in a conditional form, or in a sentence expressing the possibility of something to happen, are not scored. E.g.: "It was possible to exit the building", "He could jump up the wall", "He was able to fish in the lake". In these cases no activity is scored unless it becomes obvious from the narrative that a character actually exits the

building, went fishing, or jumped up the wall etc. Verbal and Gross Motor activities are subsets of this category.

2. Verbal: Any activity involving verbal communication. E.g.: to say, to speak to, to call, to teach, to phone (someone). If the dreamer is involved in a conversation it is only scored for her.

3. Gross-motor activities: Gross motor activities are those that involve the movement of whole body or a significant part of the character's body (generally: more than half of the body). Locomotor activities usually belong here, unless they are performed with a vehicle which does not require the character to move her body. Several manipulative movements are also scored here e.g.: playing sports, climbing a tree, swinging etc.)

4. Exploratory activity: (Dichotom variable!) Any unusual or fantastic activity, which the dreamer probably would not perform in real life. Exploratory activities are driven by curiosity or adventurousness. E.g.: "to go treasure hunting, diving etc.". Activities containing aggressive elements like "fighting the dragon" or "to go shark hunting" where the emphasis is on the unusual nature of the activity, and not on aggression or impulsivity, are also scored here. The idea is that the Dreamer leaves the everyday limits of her life and gathers new experiences. This category is only scored for the Dreamer, and only in case the dreamer herself actively takes part in the activity, she actively shapes the flow of events. "We flew with the airship to a strange new place", "We built a hut in the jungle", or "we were fish and we tricked the sharks" are scored here, whereas: "…I was chased by…" or "I had to run from the snake" are not. This category is connected to Zuckerman's "sensation seeking"-, (the level of inclination to the search for experiences and feelings, that are varied, novel, complex and intense, and the readiness to take risks for the sake of such experiences) and Cloninger's "novelty seeking" personality traits. (Low sensation seekers at one end of the scale prefer to stay in their usual environment where they are rarely exposed to novel stimuli. On the other end are "high sensation seekers", who always seek novel sensory experiences that often increase their level of arousal.)

IV Interactions
Type of variable: cumulative

Definition: Any form of action towards another character, i.e.: any form of aggression, threat, or social approach towards another character. Here scoring is divided between the dreamer and others. The third column is used if the dreamer is not part of the interaction at all, or if the situation is not clear.

Scoring

1. Aggression: Any hostile or offensive act towards another character. The dreamer is given priority upon scoring, meaning that all activities are scored only once, and they are scored from the dreamer's point of view. E.g.: If the dreamer is already scored as the victim of an aggressive interaction the other character (or group of characters) who initiated the aggression will not be scored (as aggressor) for the same event. If the aggression is totally mutual between the dreamer and another character it will be scored in the dreamer's column. If the aggressive interaction takes place between two characters different from the dreamer it is scored in the third column.

Aggressor: the character who initiates the aggression. This is the default category so aggressions in the third column (those not involving the dreamer) are automatically scored here.
Verbal: aggression by words
Physical: aggression by deeds

Victim: The character who suffers the aggression. As "aggression" is scored from the dreamer's point of view, this category is used only if the dreamer is the victim.

2. Friendliness / social approach: Any friendly or helpful overture towards another character. The same principle is applied here as before, that a single event is scored only once, but the columns are used depending on how the Dreamer takes part in the interaction. If the Dreamer is the initiator it is scored in the first column, if she is the passive recipient party it is scored in the second column. If the dreamer is not part of the interaction the third column is used. Any kind of cooperation is scored as social approach but simply the state of two characters being together is not. If a character asks or offers cooperation to another one it is always scored as "friendliness" just like helping or supporting another character. In case a character only asks for something purely material which would not induce cooperation it is not scored here. E.g.: Asking for money is not "friendliness" while asking someone to help with the homework is "friendliness".

Verbal: verbalized instances of social approach E.g.: asked for, said
Physical: any nonverbalized example of social approach

3. Avoidance

The non-hostile avoidance of an interaction or a reference to a character's will to do so. E.g.: "I did not want to meet him". Running or hiding from someone or something, or leaving a setting while something is happening there are also scored as cases of "avoidance".

V. Outcomes

Type of variable: cumulative

Definition: The effect of an act or event on a character. Outcomes are the consequences of a character driven action (success or failure) or of an event or force independent from the characters where they do not influence the outcome (fortune or misfortune). The Dreamer and other characters are differentiated and the Dreamer's point of view is given priority upon scoring.

Scoring

Strivings:
1. Success: In contrast to "fortune", "success" is scored when a character achieves a positive outcome by actively contributing to the achievement through her own efforts and skills.

2. Failure: A character fails to achieve an important goal due to her own faults or flaw in her character. Similarly to "success" failure can only be the consequence of character initiated actions.

Fortune/Misfortune:
3. Fortune: A positive outcome that arise independently of the characters' will or acts. Positive outcomes due to mere chance or to an event no character can control. Being in a fortunate or highly rewarding environment or state without no apparent effort from any of the characters is scored here. E.g.: "Living in a beautiful castle" or "being in candyland".

4. Misfortune: Bad outcomes that arise through no obvious fault attributable to a character. Examples include: the inability to move, the threat of danger or of a frustrating event due to environmental obstacles, a sudden fall, the occurrence of a frightening phenomenon, an

accident, damage or loss of valuables, illness, death, etc. An event of death can be scored as "misfortune" but murder belongs to aggression.

VI. Cognitions

Definition: Mental or intellectual activity of any sort. E.g.: Thinking, planning, counting, decision making, imagination, forgetting, remembrance, dreaming, learning, knowing, comparing, longing for, expectation, will, interest. Negative examples are also scored. E.g.: "I did not remember where I had put my car keys" or "I did not know the way". As an example case: in "The dog wanted to bite me" the "dog" is scored as a "malevolent character", while his will to bite as "cognition". Although no "aggression" is scored until no actual biting takes place.

VII. Dream Assessment

Questions intended to assess the dream as a whole present in the dream interview, based on self –report of the children. In this category answers are scored in the third column.

1. Self-representation

It indicates whether the Dreamer's self is represented in the dream, and in what form. If the Dreamer is present but in a different bodily form, as someone else, or at a different age (categories 4-6), categories 1-3 are still considered.

Not represented: The Dreamer's self was not present in the dream
Passive self: The Dreamer's real self is present in the dream but only as a passive character (E.g.: I saw my mom in my dream).
Active self: The Dreamer's real self is present in the dream and takes an active role
As someone/something else: The Dreamer is present in the dream in someone or something else's skin. This category is used when the Dreamer is represented as an identifiable character or as a non-human character. E.g.: "I was Winnie-the-Pooh", "I was Colombo", or "I was a wild boar".
In a different role: The Dreamer is present as a human character but in a role different from her real life role. This category is used if professions are mentioned or if the Dreamer is represented as an unidentifiable character. (E.g.: "I was a doctor", "I was a pirate", etc.)
At a different age: The Dreamer is present in the dream and she keeps her real self, but sees herself at a younger or older age.

2. Kinematic or static imagery

Scored primarily based on the Dreamer's testimonial, but if they do not mention it (or was not asked about it) it can still be scored based on the narrative. If more than one verb referring to active movement in the dream is present we score kinematic. If no verb referring to movement is present in the narrative it is scored as static, otherwise it is not scored.

Kinematic: a dream similar to motion picture.
Static: a dream similar to a still image or a series of (a few) still images

3. Affective Dream Quality:

Scored primarily based on self-report.
Negative
Neutral

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Positive

4. **Feelings**

Scored based on self-report. A list of predefined feelings is enumerated and questioned to find out whether a specific feeling was present or not. These feelings are categorized as follows:
Positive feelings: happy, cheerful, good
Negative feelings: scared, angry, nervous, worried, sad, disappointed, and embarrassed
Neutral feelings: calm, surprised

5. **The dream's effect on the Dreamer's mood after waking up**

This category is only scored if mentioned by the Dreamer.

Yes: The Dreamer feels that the dream is affecting her mood after waking up.
No effect: The Dreamer feels that the dream is not affecting her mood after waking up.