MEASURING EMOTIONS IN DREAMS: METHODOLOGICAL CHALLENGES
Abstract

Although emotions are a natural component of dream experiences, a lack of consensus prevails in research literature concerning the specific characteristics of emotional dream experiences. The aim of this study was to investigate if and to what extent this lack of convergence among studies stems from whether dream emotions are self- or externally rated. Forty-four healthy participants (16 males and 28 females; mean age = 26.93, range = 19 - 40) kept a home dream diary for three consecutive weeks, and daily rated their emotional experiences in dreams with the Swedish modified Differential Emotions Scale (smDES; Fredrickson, 2013). Two external judges rated emotions in the same 552 home dream reports using the same scale. Results obtained with the two methods differed in that the self-ratings, compared to external ratings, revealed: (a) more emotional dreams; (b) more positive than negative emotions per dream (with the ratio being relatively balanced); (c) a relatively more balanced proportion of positive and negative emotions, while the external ratings revealed more negative than positive emotions per dream. The results suggest that this is mostly due to the underrepresentation of positive emotions with external ratings. Thus, the results continue to question the extent of convergence between self- and external ratings when investigating emotional dream contents, and bring to attention the importance of methodological aspects when investigating dream emotions.

Keywords: dream emotions, positive and negative emotions, content analysis, modified Differential Emotions Scale
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Introduction

The nature of dreaming has interested mankind since the earliest civilizations (i.e., the Mesopotamians; the Egyptians). Dreaming is seen as a universal phenomenon that occurs in all humans every night. Contrasting the more current belief that dreams are a result of the mind, in the ancient times (i.e., Ancient Greece) people believed that dreams were divine messages sent to humans (Barbera, 2008).

According to Schwartz (2000) modern dream research has had three main specific investigation periods. The first period (1855) was characterized by “neurocognitive-like” (p. 4) theories of the time, where studies used questionnaires and introspective observations to conduct experiments. The second period (1900) was characterized by both a behavioristic denial of mental phenomena, such as dreams, and by a psychoanalytic approach approaching dreams as a subconscious symbolic language to be interpreted in order to reveal their meaning. The third period (1950) was characterized by systematic investigations integrating physiological measurements and phenomenological dream descriptions. The term “phenomenological” in this context, refers to phenomenological dream research which aims to systematically investigate and quantify the qualitative features of mental experiences (Galin, 1999).

During the third period an objective indicator of the dreaming state was discovered. It was found that dreaming was related to recurrent periods of high cortical activity while sleeping (resembling cortical activity during wakefulness), accompanied by rapid eye movements (REMs), increased heart rate and respiratory activity (Aserinsky & Kleitman, 1953; Nir & Tononi, 2010). The REM sleep period was eventually associated with dreaming (although controversially so, see also 1.1.3 Relationship between sleep, dreaming and dreams.) and stimulated the revitalization of experimental dream research. The focus shifted
to the content analysis of introspective dream reports using various coding systems (with the purpose to quantify aspects of phenomenological dream contents) (Schwartz, 2000; Strauch & Meier, 1996).

Dream research is important in order to advance the understanding of dream functions, sleep functions, and consciousness in general. When investigating subjective dream experiences it is important to know which methods are best to use depending on what aspect is being investigated (Domhoff, 2005; Kahneman & Riis, 2005; Nir & Tononi, 2010; Sikka, Valli, Virta, & Revonsuo, 2014; Schredl & Doll, 1998; Schredl, 2010b; Strauch & Meier, 1996; Wamsley, 2013). Thus, research on methodological issues of dream research is needed. Moreover, it is of great value for future research investigating neural correlates of dream content as the latter essentially depends on the validity of dream reports (Desseilles, Dang-Vu, Sterpenich, & Schwartz, 2011; Nir & Tononi, 2010; Sikka et al., 2014).

**Dreaming and Sleep**

**Definition of dreaming, dreams, and dream reports.** Although dreams and dreaming have been the topic of scientific inquiry since the middle of the 19th century there is no single clear definition for dreams or dreaming (Pagel et al., 2001). However, the various definitions agree upon that dreams are mental activity or subjective conscious experiences occurring during sleep (Revonsuo, 2000; Sikka et al., 2014). Dreaming refers to a state or process of having dreams (Pagel et al., 2001). Often these two terms, dreams and dreaming, are used interchangeably.

This mental subjective experience can range from simple repetitive images or thoughts (i.e., sleep mentation) experienced through one sensory modality, to complex sensory-motor imagery extended in time (i.e., dreaming), experienced through several sensory modalities (Nir & Tononi, 2010; Revonsuo, 2009). Dream research suggests that dream content is experienced through nearly all sensory modalities, yet most commonly
visually (e.g., circa 50-70% of dreams are colored). Auditory experiences (e.g., spoken language heard by the dream self) and tactile experiences also occur, followed by the least common modalities: smell, taste and pain (Revonsuo, 2009; Strauch & Meier, 1996).

Customarily, dreams are scientifically investigated using dream reports (either written or oral) which represent described recollections of subjective dream experiences, and/or people’s evaluations of their dreams (i.e., dream questionnaires). Often collected and investigated in studies concerning the perceptive, cognitive and emotional elements of dreaming, such dream reports represent a natural retrospective description of the dream experiences (Schwartz, 2000). As such, dream researchers rely on dream reports as a valid indicator of dream experiences (Schredl, 2002; Schredl & Wittmann, 2005; Hall & Van Der Castle, 1966) while acknowledging the inherent limitations (e.g., memory-experience gap; Domhoff, 2003; Strauch & Meier, 1996).

**Sleep stages.** Sleep is the behavioral state created as a result of the interacting circadian system (regulating the functioning of 24-hour cyclical biological rhythms) and the wake-dependent sleep pressure system that is homeostatically regulated (Franca, 2013). The circadian system reacts with the onset of darkness by elevating substances causing intense somnolence (state of drowsiness, sleepiness). This somnolence gradually diminishes as sleep duration progresses. Then the circadian system reacts again by diminishing the intensity of sleep until one awakens (Franca, 2013).

Using polysomnography researchers today can differentiate between four sleep stages. Polysomnography is an assembly of three electrophysiological instruments: electroencephalography (EEG) measuring electrical brain activity, electrooculography (EOG) measuring eye movements, and electromyography (EMG) measuring muscle tone. The four sleep stages together with the state of wakefulness (stage W) are characterized as follows.
Stage W with eyes closed presents low amplitude mixed-frequency waves (LAMF) with alpha activity (8-13 Hz), voluntary eye blinks, and with the highest EMG readings under voluntary control. There are three Non-Rapid Eye Movement (NREM) sleep stages (i.e., N1, N2, N3), and the Rapid Eye Movement (REM) sleep stage (Iber, Ancoli-Israel, Chesson, & Quan, 2007; Marshall, Marshall, Robertson, & Carno, 2013).

REM sleep is represented by LAMF, and sawtooth waves, accompanied by typical readings of phasic rapid eye movement readings in the EOG on the background of tonic REM, and very low levels of chin EMG. Conversely, NREM sleep is characterized by high voltage and low frequency synchronized brain activity (Iber et al., 2007; Marshall et al., 2013). More specifically, during stage N1 (sleep onset) the EEG usually displays readings intermediary between wakefulness and deep sleep (presence of theta activity of 4-7 Hz, LAMF, and vertex sharp waves), slow eye movements (SEMs) in the EOG, and high chin EMG. During stage N2 (NREM 2) the EEG readings display sleep spindles (oscillations of thalamic origin; 12 -14 Hz), K-complexes on the background of LAMF, with occasional SEMs in the EOG, and the chin EMG activity is lower than during N1. Throughout the stage N3 (NREM3) the EEG readings display an abundance of large slow waves with a progressive decrease in spindles accompanied by an increase in delta activity (0.5 - 2 Hz), the EMG shows chin tone readings usually lower than in stage N2, and the EOG eye activity is usually absent. These sleep stages are usually scored in periods of 30 seconds, called epochs, and the scoring is determined by the waveform readings recorded during the sleep period. Altogether these four sleep stages form a cycle of about 90-100 minutes that repeats itself several times during the night (Iber et al., 2007; Nir & Tononi, 2010; Marshall et al., 2013).

**Relationship between sleep, dreaming and dreams.** Even though dreaming occurs during sleep, the physiological state of sleep should not be equated with dreaming, as sleep can also occur without dreaming (Nofzinger, Mintun, Wiseman, Kupfer, & Moore, 1997).
Since 1953, dream researchers have analyzed dream contents and characterized dream experiences depending on the corresponding sleep stage - such research has suggested disparity between the phenomenological dream contents contingent on the specific sleep stage (Aserinsky & Kleitman, 1953; Schredl & Wittmann, 2005). Although dreaming was first found to occur during REM sleep (Aserinsky & Kleitman, 1953), it is now well recognized that dreaming is not exclusive to REM sleep but can occur in all sleep stages (Desseilles et al., 2011; Nir & Tononi, 2010).

Ideally, dreams occur while the dreamer is in a typical state of muscle tone loss which allows the internalization of the experienced dream events without any corresponding behavioral output. In laboratory dream studies, participants sleep under researchers’ supervision. They are then woken up during (or directly after) the sleep stage of interest and asked to recollect their subjective dream experiences by reporting them orally or in written form (Hobson, Pace-Schott, & Stickgold, 2000; Nir & Tononi, 2010).

REM sleep dream reports have been described as being more common, longer, more bizarre, more visually animated, and hyperemotional (Fosse, Stickgold, & Hobson, 2001; Merritt, Stickgold, Pace-Schott, Williams, & Hobson, 1994; Nielsen, 2000; Sikka et al., 2014; St-Onge, Lortie-Lussier, Mercier, Grenier, & De Koninck, 2005). On the other hand, NREM sleep dream reports have often been described as thought-like and of transient nature, concerned with current issues, less emotional and less pleasant when compared to REM sleep dream reports (i.e., short, less vivid, less visual, more conceptual, under greater volitional control yet less motorically animated) (Hobson et al., 2000; Nir & Tononi, 2010).

**Neural correlates of dreaming and dreams.** Clinico-anatomical (Solms, 1997) and functional imagery studies (Braun, 1997, 1998; Nofzinger et al., 1997) suggest that dreaming is controlled by dopaminergic forebrain mechanisms (while REM sleep is controlled by
cholinergic brainstem mechanisms). Forebrain mechanisms refer to the involvement of a highly specific group of forebrain structures that eventually shape dream content (Domhoff, 2003; Solms, 2000). It has been demonstrated that dreaming usually ceases after unilateral lesions in or near the region of the parieto-temporo-occipital (PTO) junction, and after bilateral lesions in the ventro-mesial quadrant of the frontal lobe, while REM sleep is preserved. The other way around, REM sleep cessation results from extensive lesions in the pontine brainstem, while dreaming is preserved (Solms, 2000). These double dissociations between REM sleep and dreaming suggest that these two states can occur independently of one another (see also Hobson, 1988; Hobson, 1992; Solms, 2000).

Dream research has mainly attempted to characterize the dream form (e.g., emotionality) by investigating how dream contents correlate with certain neurophysiological activity during sleep (Desseilles et al., 2011; Hobson et al., 2000; Nir & Tononi, 2010; Schwartz, 2000). As dreams are more often reported after REM sleep awakenings (Nir & Tononi, 2010) and these dream reports tend to be more vivid and richer in contents than those from NREM sleep – current knowledge concerning the neural correlates of dreaming and dreams mainly derives from studies of REM sleep and its underlying neurophysiology (Desseilles et al., 2011; Hobson et al., 2000; Nir & Tononi, 2010; Schwartz, 2000).

Dream research has often focused on the investigation of differences and similarities between wakefulness and dreaming (or more often REM sleep) in order to characterize the neurophysiological characteristics of dreaming. This is usually done using EEG and neuroimaging techniques that contrast the brain activity observed during quiet wakefulness with the activity observed during REM sleep (Hobson et al., 2000; Nir & Tononi, 2010).

Research has shown that while dreaming, volition and voluntary control seem to be significantly diminished in comparison to wakefulness (i.e., the dream self has no control
Evidence suggests that the brain area responsible for waking volition (the right inferior parietal cortex; Brodmann’s Area 40) is deactivated during REM sleep (Desmurget et al., 2009; Goldberg, Ullman, & Malach, 2008). Deactivation of the dorsolateral prefrontal cortex (DLPFC) during REM sleep has also been associated with poor control over the dream experience progression, and with the dream self lacking critical thinking (Desseilles et al., 2011).

Besides, while dreaming, self-awareness and reflective thinking abilities seem to be reduced. Namely, dreaming is accompanied by uncertainty for places, time, and personal identities, and lacks the contextual awareness which would normally aid the dream self realize that it is in bed sleeping. Reflective thinking is also altered so that conflicting beliefs and events (such as flying or abrupt scenery changes) that would normally be detected in wakefulness are often accepted as common (Desseilles et al., 2011). Evidence suggests that the reduction in self-awareness might be due to the deactivation of brain regions such as the posterior cingulate cortex, inferior parietal cortex, orbitofrontal cortex (OFC), and the DLPFC during REM sleep dreaming (Maquet et al., 1996) (e.g., deactivated DLPFC during NREM sleep dreaming; Braun, 1997).

However, reflective thought can occur while dreaming, as demonstrated by the phenomenon of lucid dreaming (i.e., where the dream self achieves self-awareness while sleeping and can influence dream progression or pursue goals) (Voss, Holzmann, Tuin, & Hobson, 2009). Voss and colleagues (2009) investigated the physiological correlates of lucid dreaming and suggested that brain activity specific of lucid dreaming shared characteristics with wakefulness and REM sleep brain activity (i.e., that lucidity seems to be attained when wake-like frontal lobe activation is associated with REM-like activity in posterior structures). A recent study tried to induce self-awareness in dreams by using lower gamma band fronto-
temporal transcranial alternating current stimulation (tACS) at various frequencies on participants during monitored REM sleep (Voss et al., 2014). The results suggested that self-awareness in dreams (i.e., higher order consciousness) could be induced with tACS stimulation of synchronous oscillations of respectively 25- and 40-Hz (Voss et al., 2014).

Moreover, studies have also identified a specific pattern of brain hypoactivity during REM sleep, in the regions in charge of executive and attentional functions during wakefulness. This specific pattern of activity consists of the DLPFC, OFC, posterior cingulate gyrus, precuneus, and the inferior parietal cortex (Braun, 1997; Desseilles et al., 2011; Maquet, 2000; Maquet et al., 2005; Maquet et al., 1996). Besides, it has been shown that DLPFC is involved in decision-making processes which require associations with internal, past events, and contextual signals, which could explain why during REM sleep external stimuli are often ignored (or sometimes incorporated in the dream experience) without interrupting dream progression. However, this can also be related to the activation of the hippocampus, limbic structures, and the posterior cortical areas in REM sleep. (Desseilles et al., 2011; Schredl & Hofmann, 2003).

Another aspect differentiating wakefulness from dreaming is the typical dream amnesia. Dreams are generally forgotten after awakening if the dream self does not intentionally report or think upon the dream experiences. Neuroimaging studies suggest that this might be due to the hypoactive lateral and inferior prefrontal cortex (PFC) which is involved in memory processes. In contrast, neuroimaging studies also reveal that other brain regions involved in memory processing, such as the limbic circuits in the medial temporal lobe, are highly active during REM sleep (Desseilles et al., 2011; Braun, 1998; Maquet et al., 1996) which seems to suggest enhanced emotional memory processing (see also Walker, 2009).
Additionally, REM sleep neuroimaging studies have also displayed state dependent changes in the activity (i.e., deactivations during slow wave sleep and reactivations during REM sleep) in several motor brain regions such as the primary motor and premotor cortices, the brainstem, the cerebellum, the thalamus, and basal ganglia (Braun, 1997; Maquet, 2000) suggesting that these regions are part of brain mechanisms mediating the sleep-wake cycle (arousal).

One more dream specific characteristic is that of the disconnection from the environment that the dream self usually experiences while dreaming. Studies suggest that typically external stimuli neither elicit behavioural responses, nor manage to be incorporated in the dream contents. One of the explanations research has offered is related to the corresponding default-network activity (neural network mainly in charge of self-related introspective processes). Possibly due to the highly active medial prefrontal cortex, part of the default-network, intrinsic activity seems to dominate while dreaming (Buckner, Andrews-Hanna, & Schacter, 2008; I.I. Goldberg, Harel, & Malach, 2006; Gusnard, Akbudak, Shulman, & Raichle, 2001).

Interestingly, the medial prefrontal cortex is also highly active during a resting wakefulness state. Besides, other regions of the default-network such at the posterior cingulate and the inferior parietal cortices are deactivated during REM sleep. Conversely, these same regions are highly active during highly-engaging waking tasks. Thus, the default networks’ partial deactivation during both REM sleep (and mental imagery) might explain the filtering away of any cognitive states that are not self-oriented while dreaming (Mason et al., 2007). It is also possible for the dream self to participate in dream events both from a first person perspective and from a third person perspective without realizing this shift. This has been related to the decreased activity in the inferior parietal regions - thought to be in charge of constructing a unified self perspective and make possible to differentiate between the self
and others (Ruby & Decety, 2004). REM sleep specific brain activity has also been shown to occur in the form of a functional dissociation in the temporo-occipital regions. More precisely, the dissociation was displayed in the extrastriate cortex activity (visual association area) which significantly correlated with deactivation in the striate cortex (primary visual cortex) (Braun, 1998). The comparison between this REM sleep specific functional dissociation with these area’s connectivity during wakefulness where it is usually reflected through a positively correlated activity, suggests that this might be an indication of visual information being intrinsically processed in a manner disconnected from external stimuli influence (Braun, 1998; Desseilles et al., 2011).

Another approach in studying the neural basis of dreaming is to focus on the properties of individual dreams. The idea is to relate neuronal activity to the underlying dream experiences in a retrospective manner in order to eventually predict contents from the underlying neural activity alone (Horikawa, Tamaki, Miyawaki, & Kamitani, 2013). Horikawa and colleagues (2013) were the first to have tried relating neural activity to specific dream contents within individuals by investigating visual imagery (hallucination) from the sleep-onset period (sleep stage N1 or N2), with the aim to investigate the correlation between sleep-onset visual imagery and underlying neural correlates. First, the 3 participants were monitored with functional magnetic resonance imaging (fMRI) as they were sleeping and were awoken from sleep-onset until approximately 200 oral dream reports were collected from each participant. Second, the fMRI patterns and their corresponding visual images with the relevant words describing visual experiences extracted from the previously collected dream reports were programmed in a computer program (i.e., systematically paired together) as the participants were watching certain visual images while in the fMRI scanner. This process called stimulus representation programming aimed to create decoding models in order to predict the contents of certain brain activity patterns. Then as the participants were
once again sleeping in the fMRI, the researchers woke the participants up during sleep-onset and asked them to report their visual experiences a second time and used the previously programmed neural patterns decoding program to predict with circa 60% accuracy the visual objects described in their dream reports. The results suggested that specific spontaneously generated visual experience during sleep was reflected in, and could be decoded from, the underlying visual cortical activity patterns programmed during stimulus representation training (Horikawa et al., 2013).

**Neural correlates of emotional dream contents.** Concerning the emotionality of dreaming, studies have showed that the majority of dreams display a high degree of emotionality (i.e., joy, surprise, anger, fear, and anxiety) (Fosse et al., 2001; Foulkes, Sullivan, Kerr, & Brown, 1988; Sikka et al., 2014). Neuroimaging studies support an association between REM sleep and increased activation of limbic and paralimbic structures like the amygdala, the anterior cingulate cortex, and the insula which might explain the respective dream emotionality (Maquet et al., 1996; Nofzinger et al., 1997).

In fact, neuroimaging studies reveal a more specific brain activity pattern associated with regional activity increases in REM sleep through activity in the pontine tegmentum, the thalamus, the basal forebrain, and the limbic and paralimbic structures; specifically, in the: amygdaloid complexes, hippocampal formation, and the anterior cingulate cortex (Braun, 1997; Maquet et al., 1996; Vandekerckhove & Cluydts, 2010). This specific brain activity pattern associated with REM sleep has been related to memory consolidation processes, especially to the processing of emotional memories (Walker, 2009). During wakefulness amygdala activity is usually related to stressful or threatening situations, and novelty. It has thus been suggested that the highly active amygdala in REM sleep might also be in charge of the intense emotional reprocessing occurring in dreams (Maquet et al., 1996; Maquet & Phillips, 1998).
Several EEG studies have likewise investigated the electrophysiological markers of emotional processing while dreaming (mainly during REM sleep) (Benca et al., 1999; Daoust, Lusignan, Braun, Mottron, & Godbout, 2008; Nielsen & Chénier, 1999). The first study to explore the relationship between waking and sleeping frontal activation asymmetry (i.e., frontal alpha power asymmetry in EEG activity previously correlated in the literature with emotional reactivity during waking) found that the strongest correlations for the alpha EEG asymmetry were observed between waking and REM sleep (i.e., in both eyes-closed and eyes-open conditions), compared to the lower correlations between waking and NREM sleep (i.e., only eyes-closed condition). The findings suggested that the patterns of frontal EEG alpha asymmetry seemed to be stable across waking and sleep, possibly linking it to emotional reactivity while dreaming (Benca et al., 1999).

Nielsen and Chénier (1999) investigated interhemispheric EEG coherence as an index for emotional REM sleep dream content integration (i.e., a measure of social-emotional interaction in dreams; the explicit facial representation of a dream character). The results indicated that coherence levels increased as the degree of facial representation predominated in the REM dream experiences, proposing that higher coherence might reflect the process of emotional character imagery integration (occurring usually in the right hemisphere) into the narrative dreaming process (occurring usually in left hemisphere).

As alpha EEG activity (asymmetric activation between hemispheres) has previously been linked to emotional processing both in waking and during REM sleep (e.g., Benca et al., 1999), Daoust et al., (2008) - investigated alpha and beta REM sleep EEG activity in two groups of participants, healthy and those diagnosed with autistic spectrum disorders (ASD). The findings showed that decreased slow alpha activity in centro-posterior regions during REM sleep reflected the decreased occurrence of emotions in the dreams of ASD.
participants, compared to the healthy controls. The authors suggested that alpha EEG activity might be a neurophysiological marker associated with emotional dream content.

As can be seen most studies investigating dreaming have actually studied REM sleep. As dreaming is not the same as REM sleep, it is important to investigate the neurophysiology of REM sleep with dreams and without dreams. Additionally, it is important to investigate the neural basis of dreaming during other, NREM, sleep stages. This could shed light on the differences and/or similarities between the neural basis of dreaming and the underlying sleep stages. Additionally, more studies are needed that would investigate the neural correlates of specific contents of dreams such as dream emotionality across and within subjects (Hobson et al., 2000; Desseilles et al., 2011; Domhoff, 2005; Nir & Tononi, 2010; Schwartz, 2000).

**Dream Emotions: The Effect of Methodological Variables**

**Definition of emotions.** The umbrella term to cover all valenced states (i.e. positive and negative) such as emotion, mood, and feelings is called affect (Juslin & Västfjäll, 2008). An emotion can be described as an affective reaction (brief and intense) to possibly important events or changes in the external or internal environment. Emotions consist of several sub-components which are relatively synchronized, such as: subjective feeling which can reflect all other emotions components (how the emotion is felt, e.g., you feel afraid), cognitive appraisal (how the felt emotion is labeled, “I was afraid”), physiological arousal (activation of the autonomic nervous system), expression (how the felt emotion is expressed, “I screamed”), action tendency (how one acts on the felt emotion, “I ran away”), and regulation (how the felt emotion is regulated, “I calmed myself down”). Besides, emotions can last from a few minutes to a few hours and usually have a focus on specific objects. Distinctively, mood can be defined as an affective state with a lower intensity compared to emotions. Mood
does not usually have a clear object, and can last from several hours to several days (Juslin & Västfjäll, 2008).

Nevertheless, in dream research the term emotion has not been consistently and clearly defined. Researchers seem to refer to and measure either one or a few sub-components of emotion. Often, moods are measured without offering a clear distinction between emotion and mood. Despite existing terminological inconsistencies it is generally agreed that emotions are an essential part of dream experiences. Emotions are even a central part of certain dream theories (e.g., threat-simulation theory, TST; Revonsuo, 2000; mood-regulation theory; Cartwright, Luten, Young, Mercer, & Bears, 1998). A wealth of studies have investigated dream emotions but, surprisingly, instead of consensus these studies have led to more inconsistencies and disagreements. The issue seems to lie in methodological aspects that differ between studies (Domhoff, 2003, 2005; Fosse et al., 2001; Izard, 2007; Schredl & Doll, 1998; Sikka et al., 2014; Solms, 2000).

**Emotion rating methods: self- and external ratings.** Findings on dream emotionality depend on many methodological aspects. One of these is who rates the dream emotions (Foulkes et al., 1988; Hall, 1951; Kahan & LaBerge, 1996; Sikka et al., 2014; Schredl & Doll, 1998; Schredl, 2010b; Strauch & Meier, 1996).

Two different emotion rating methods used in dream research are the self-rating (SR) and the external rating methods (ER) (Domhoff, 2003; Sikka et al., 2014). With SR an individual is typically asked to rate and describe his/her dream experiences (e.g., the emotions and moods experienced in the dream or described in the dream report) using a scale or a questionnaire. Customarily, ER are conducted by at least two independent raters who evaluate and classify emotions expressed in dream reports using relevant scales and coding systems (Schredl, 2010b; Smith, 2000). It is important to note that SR measure mostly
subjective feelings and moods, whereas ER measure sub-components of emotion, such as: cognitive appraisal, expression, action tendency, and regulation.

Dream content analysis studies have generally shown a preponderance of negative (NE) over positive emotions (PE) in dream reports (e.g., Hall & Van de Castle, 1966; Revonsuo, 2000). For example, Hall and Van de Castle (1966) conducted ER on 1000 home dreams of 200 participants and the results indicated that external raters detected a preponderance of NE. Out of 702 emotions detected in all dreams, 137 (19.5 %) were PE, while the remaining 565 (80.5 %) were NE (i.e., 114 represented happiness, 67 sadness, 62 anger, 124 confusion, and 225 apprehension). Kramer, Winget, and Whitman (1971) similarly showed that in 182 home dreams from 300 adults the external raters evaluated 54 % of dream emotions as unpleasant, 26 % as pleasant, and 20 % as neutral, and that only 29 (16%) dream reports were emotional (i.e., 153 or 84 % non-emotional dream reports).

Moreover, studies have also showed that ER irrespective of environmental setting (i.e., home or laboratory dream reports) show a predominance of NE (Domhoff, 2005; Sikka et al., 2014). For example, Snyder (1970) showed that from 635 laboratory dream reports external raters evaluated unpleasant emotions to predominate over pleasant ones with more than two to one (i.e., fear/anxiety most frequent followed by anger; while the most frequent pleasant feeling was friendliness). Merritt and colleagues (1994) likewise showed that in 189 home dream reports, external raters detected 809 emotions out of which 68.1 % were NE, and 31.9 % were PE.

On the other hand, results of studies using SR of dream emotions have generally either shown a balanced prevalence of PE and NE, or a preponderance of PE over NE. For example, Fosse et al. (2001) collected 88 home dreams from 9 participants in home settings with the help of ambulatory polysomnography, to supervise the sleep stage from which the participants were awakened. With SR 65 (74%) home dreams were rated as emotional (i.e.,
23 non-emotional dreams). The self-raters reported 157 instances of emotion out of which, 33% (52) were PE, 44% (69) were NE, and 23% (36) were neutral (i.e., the distributed prevalence of emotions was joy/elation 36%, surprise 24%, anger 17%, anxiety/fear 11%, and sadness 10%). The authors interpreted the results as a relatively balanced occurrence of NE (42%) and PE (49%) in the home dreams, when the dreams were collected from the same REM sleep stage for all participants (see also Strauch & Meier, 1996). Contrariwise, Merritt and colleagues (1994) used SR of dream emotions in home dreams with the same scale as the one used in the Fosse and colleagues (2001) study, and found 809 emotions in 189 (95%) emotional dreams (i.e., 5% or 11 non-emotional dreams) out of which 68.1% were predominantly NE (i.e., anxiety most frequent), and only 31.9% were PE (i.e., joy/elation, affection/eroticism). The authors interpreted the prevalence of NE as a result of the highly active amygdala under REM sleep which leads to a preponderance of anxiety and fear emotions in dreams. Nielsen, Deslauriers and Baylor (1991) similarly showed that SR of dream emotions in 79 home dreams (100% emotional dreams) reported 599 emotions out of which 20% were predominantly negative (i.e., fear prevailed in 120 dreams). The authors suggest that emotion regulation is a function of dreaming – possibly revealed in a specific regulatory process inhibiting PE and facilitating fearful or anxious emotions.

Several laboratory studies have indicated a heightened dream emotionality with SR. For example, St-Onge and colleagues (2005) also showed that self-raters respectively rated nearly all (98.38%) of 247 home dreams, and 90.6% 149 laboratory dreams as emotional. In agreement with above mentioned home dream studies, a NE (i.e., anxiety) was ranked first in home dreams, whereas a PE (i.e., quietness) was ranked first in laboratory dreams.

In contrast, the Snyder (1970) study showed that when self-rated 201 (31%) reports from 635 laboratory dreams were rated as non-emotional, while less than 35% of dreams were rated as emotional. The author interpreted this low emotion prevalence as a sign that
emotions are not a typical feature of dream reports or dreaming. Supported by Strauch and Meier (1996) who likewise showed that from 500 self-rated laboratory dreams, 26.4% were non-emotional, 50.2% contained specific emotions, and 23.4% contained mood states (i.e., prevalence of emotions: joy a PE predominated with 12.0%, followed by anger 8.9%, fear 8.5%, interest 8.5%, stress 7.1%, confusion 4.7%, distress 4.5%, surprise 3.9%, shame 2.0%, contempt 1.4%, guilt 0.8% and disgust 0.4%). The authors also suggested that PE might be more often represented in moods, while NE as specific emotions. In agreement with the Snyder (1970) study dream emotions were generally infrequent (three out of 10 dreams were considered to be neutral), despite that a PE was the most frequent emotion.

Studies that directly compare SR and ER of dream emotions are scarce (Schredl & Doll, 1998; Sikka et al., 2014). For example, Schredl and Doll (1998) investigated dream emotions in 964 home dreams from 263 participants by using three different measurement approaches. More specifically, after spontaneous awakenings the self-raters rated the emotional tone of their dreams on two 4 point scales, for the PE and NE (i.e., 0= none, 1= mild, 2= moderate, and 3= strong feeling). Then external raters firstly used the same 4 point scales as the self-raters to evaluate the emotional tone of the dream reports. Secondly, external raters also content analyzed the dream reports using the Hall and Van de Castle (1966) scale to score all explicitly expressed emotions (see Emotion rating methods: scales and measures). A direct comparison of the three measurement approaches in the same set of dreams (n = 133) was conducted. The results showed that when self-rated for intensity of emotional tone, 0.8% dreams contained no emotions, 12.0% contained balanced emotions (balanced proportion of PE and NE), 50.4% contained more NE, and 38.8% contained more PE (i.e., 92.7% emotional dreams; 7.3% non-emotional dreams). Whereas, the external raters evaluated 13.5% dream reports to contain no emotions, 9.0% containing balanced emotions, 56.4% containing more NE, and 21.1% containing more PE. The third measurement
approach, the content analysis, showed 57.9% dream reports to be non-emotional, 6.8% contained balanced emotions, and that 26.3% contained more NE, while 9.0% contained more PE. The results suggest that with ER, as compared to SR, home dreams are evaluated as less emotional. Moreover, with ER, the NE predominate, while with SR the proportion of NE and PE is relatively more balanced in home dreams (Schredl & Doll, 1998).

However, Sikka and colleagues (2014) bring to attention that the difference shown in the Schredl and Doll (1998) study might also depend on the differences in scales used with SR compared to ER leading to a comparison between moods and emotions (i.e., first both methods used a scale measuring emotional tone; then external raters content analyzed specific emotions). In order to control for the limitations of the Schredl and Doll (1998) study, Sikka and colleagues (2014) used only one scale to measure the expression of specific dream emotions (Finish translation of the Modified Differential Emotions scale; fmDES; Fredrickson, 2013) with both external and SR in the same set of 115 laboratory dreams (from both early and late REM sleep) collected from 17 participants. The participants were invited to sleep in the laboratory for two nonconsecutive nights under which they were awakened every time they had been 5 minutes into phasic REM sleep, and asked to orally report their dreams (dreams were later on transcribed for the external raters). After that they also rated their dream emotions using fmDES. The results revealed that when self-rated all dreams contained at least one type of emotion (i.e., either PE or NE), while when externally rated only 33 of dream reports (28.7%) contained emotions. From those dreams that were rated as emotional with both rating methods (n = 33 dreams of 11 participants), with SR per subject the number of positive dreams (5.6) was much greater when compared with ER (1.0), the number of negative dreams was balanced between the SR (1.1) and ER (1.2), and the number of PE and NE per dream were much higher with SR (PE = 5.0; NE = 2.0) than with ER (PE = 0.2; NE = 0.3). Besides, with SR all of the 18 different emotion categories were reported in
the dreams (i.e., \( M = 7.24 \) per dream), while the external raters detected only 12 emotion categories in the same dream reports (i.e., \( M = 0.31 \) per dream). Moreover, SR also showed that the most frequently reported specific emotion was a PE (interested/alert/curious, \( M = 0.95 \)), while the most frequent externally rated specific emotions were equally a PE (amused/fun-loving/giggly, \( M = 0.19 \)) and a NE (angry/irritated/annoyed, \( M = 0.19 \)).

The authors (Sikka et al., 2014) suggest that the main difference between the two rating methods lies in the detection of emotions, especially PE (with external raters underestimating these), and that such a difference might have occurred due to the fact that external raters more easily detect explicitly expressed emotions. Explicitly expressed emotions are usually inhibited in laboratory settings but not in home settings (e.g., Schredl & Doll, 1998). Thus, it remains to be determined whether such differences as obtained in the Sikka et al. (2014) study between SR and ER, when keeping the rating scale constant, would also occur when dreams are collected in the home environment.

In sum, it seems that studies yield different results depending on who rates the dream emotions (i.e., self- or external raters), and also on the environment under which dream reports were collected. The differences can concern the overall number of emotional dreams, the number of specific emotions per dream report, and the proportion of PE and NE per dream report.

**Data collection environment: home or laboratory.** A second methodological aspect contributing to the inconsistency of results on dream emotions is the data collection environment, that is, whether dreams are reported or collected in home or laboratory environment (Domhoff & Kamiya, 1964a; Domhoff & Schneider, 1999; Sikka et al., 2014; St-Onge et al., 2005; Weisz & Foulkes, 1970). Previous studies have generally showed that laboratory dreams seem to be less emotional than diary dreams collected in home settings (Schredl & Reinhard, 2008), and that the laboratory setting may have an inhibitory effect on
dream contents, especially emotional dream contents (i.e., participants feeling more safe in a supervised laboratory environment) (Domhoff & Kamiya, 1964b; Domhoff, 2005; Strauch & Meier, 1996). For example, the St-Onge et al. (2005) study showed that SR of laboratory and home dreams reported PE to predominate in laboratory dreams compared to home dreams, which contained an equally balanced incidence of PE and NE. The results also indicated an inhibitory effect of the laboratory settings as the home dreams generally contained more emotions than the laboratory dreams (St-Onge et al., 2005). The Sikka et al. (2014) study similarly found that with SR, PE prevailed in laboratory settings, and all dreams were rated emotional. Whereas, with ER the NE prevailed, and only 28.7% of dream reports were rated to be emotional. Besides, in contrast to other studies investigating externally rated home dream reports where NE have found to predominate, and around 30-40% of the dream reports rated as emotional (e.g., Hall & Van de Castle, 1966; Merritt et al., 1994; Schredl & Doll, 1998), the Fosse et al. (2001) study found that 74% of the self-rated home dreams were rated as emotional, and that the SR showed a relatively balanced proportion of PE and NE. Due to the above mentioned methodological discrepancies studies investigating emotional dream contents seem to have mostly produced incongruent results, especially concerning dream emotionality, and the number of emotions per dream (Domhoff, 2003, 2005; Schredl, 2002; Sikka et al., 2014).

Another factor that can explain the differences between home and laboratory dreams is which procedure is best to use: spontaneous awakenings in home settings most often from early morning late REM sleep (Schulz & Bes, 1998), or planned laboratory awakenings which can be from any sleep stage depending on when the subjects are awaken (Weisz & Foulkes, 1970; Domhoff & Schneider, 1999; Hobson et al., 2000). Studies that have investigated dream emotionality from early compared to late REM have suggested late REM sleep dreams to be more vivid, emotional and longer (Agargun & Cartwright, 2003;
Nevertheless, several studies have shown that when the awakening procedure is kept constant the differences can be minimized (see also Domhoff & Schneider, 1999; Domhoff, 2005; Strauch & Meier, 1996; Weisz & Foulkes, 1970). For example, in a study by Weisz and Foulkes (1970) the influence of experimental settings was thoroughly controlled for by keeping the reporting instructions for awakenings constant in both experimental settings. More specifically, 12 male participants were awakened by an alarm clock at 6.30 a.m. both in the laboratory (two nights; 20 laboratory dreams) and at home (two nights; 18 home dreams) and orally recorded their dreams with a provided tape recorder. The externally rated dream reports did not reveal any significant differences between laboratory and home dream reports in their length (mean word count: laboratory = 147; home = 120), and unpleasantness (hedonic tone: laboratory dreams = 5; home dreams = 5.25; 1 = very pleasant and 7 = very unpleasant). The results did however reveal a difference concerning the expression of aggression, leading the authors to conclude that home dreams are more aggressive than laboratory dreams. Factors such as the tendency of selectively recalling the most salient dreams after spontaneous awakening at home, might explain why the difference in emotionality between dreams collected at home or in the laboratory (Domhoff, 2005; Kahneman & Riis, 2005).

Differences in aggressive or hostile features of home dreams, as compared to laboratory dreams, have received further support (Domhoff & Kamiya, 1964a; Domhoff & Schneider, 1999; Domhoff, 2005; Weisz & Foulkes, 1970). A comprehensive study (Domhoff & Schneider, 1999) which compared the effects of experimental settings on dream content in 272 laboratory and 120 home dreams showed that home dreams had a higher percentage of dreams containing at least one aggression event, that they had a higher
aggressive interaction rate per character, and a higher rate of physical aggressions (e.g.,
physical attacks, murders). However, 44% of home dream reports did not contain any
aggression at all, and up to 72% of the home dream reports did not contain any physical
aggressions. These results are supported by another study which showed that 53% of the
home dream reports did not contain any form of aggression, while 74% did not contain any
physical aggressions (Hall & Van de Castle, 1966). Concerning laboratory dream reports the
Snyder (1970) study has showed a level of 4% of aggressiveness detected in 635 externally
rated laboratory dream reports.

Another methodological aspect that might explain the differences between dream
emotional content collected at home versus laboratory setting is whether dreams are reported
in an oral or written format. Generally, oral and written dream reports are a major
information source through which dream contents are investigated (Casagrande & Cortini,
2008; Domhoff, 2005; Schredl, 2002; Klösch & Holzinger, 2014).

Studies have demonstrated differences in dream features and content depending on
whether dreams are orally reported or written down (Domhoff, 2005). For example,
Casagrande and Cortini (2008) showed that the written versions of home dream reports when
compared to the oral versions (i.e., the same home dream reports were first orally recorded
and later transcribed) tend to be of shorter length, contain more substantives rather than
verbs, and that such text loss might also reflect a corresponding loss of dream specific
contents. The average total word count for written and oral dream reports was respectively 75
and 140 words. The results also indicated that the content of written and oral dream reports
respectively, might be more planned and implicit and more spontaneous and explicit in
nature. The authors suggested that oral dream reports represent a more optimal dream
reporting procedure that best reflects dream contents, as orally reported dreams are longer
therefore richer in contents which might give a more accurate representation of dream
contents. Besides, other studies have shown that the number of emotions per dream is moderately positively correlated with dream report length (Domhoff, 2003; p. 81).

In sum, it seems probable that the results of studies investigating the differences between SR and ER of dream emotions, differ depending on the environmental settings in which the dreams are collected, and also if spontaneous or controlled awakenings are conducted. Results might also differ depending on whether the dreams are reported orally or written.

**Emotion rating methods: scales and measures.** A third aspect contributing to the inconsistency in findings on dream emotions concerns the scales used for rating and measuring dream emotions (Domhoff, 2003; Sikka et al., 2014). Generally, the methods most commonly used with SR are emotion rating scales, while content analysis scales are used with ER (Domhoff, 2005; Schredl, 2010b). Content analysis scales typically detect explicitly expressed emotions and categorize them into specific emotion categories. The most commonly used content analysis scale is the one developed by Hall and Van de Castle (1966). With SR people use emotion rating scales to evaluate either the occurrence or intensity of specific emotions or overall emotional tone (Domhoff, 2003, 2005; Schredl, 2010a, 2010b).

Interestingly, as previously discussed (*see Emotion rating methods: self- and external ratings of dream emotions*) the Schredl and Doll (1998) study showed that investigating SR of home dream reports using two 4-point scales for measuring the intensity of both positive and negative emotional dream tone reported a relatively balanced ratio of rated NE and PE. In contrast, the external raters who used the Hall and Van de Castle content analysis scale evaluated the majority of dream reports to contain more NE than PE. This suggests that general scales most likely measure mood (or overall emotional tone), whereas the content
analysis scale measures specific emotions. Hence, the difference in results might be due to the fact that mood versus emotions have been measured (Sikka et al., 2014; Domhoff, 2003).

Another issue with scales is what type of emotions these measure and what is the number of different emotions categories in the scales used (Domhoff, 2003). In the most commonly used content analysis scale, the Hall and van de Castle scale (1966), the emotions are categorized into 5 categories (i.e., anger, apprehension, happiness, sadness, and confusion), out of which four are negatively and one positively valenced. When specific emotions have been investigated, studies have usually used the Hall and Van de Castle scale (1966) and have typically yielded results showing a preponderance of NE over PE (e.g., Domhoff & Schneider, 1999; Domhoff, 2005; Hall & Van de Castle, 1966; Kramer et al., 1971; Schredl & Doll, 1998; Schredl, 2010a; Merritt et al., 1994). More specifically, the Merritt et al. (1994) study showed, for example, that in home dreams 68.1% out of 809 detected emotions were negative, while only 31.9% of them were positive. The Schredl and Doll (1998) study likewise showed that when 180 home dream reports were externally rated using the Hall and Van de Castle scale the results showed 24.4% of detected emotions were NE, and only 9.4% PE. It may be that the unequal number of positive and negative emotion categories may contribute to the increased negative ratings of emotions in externally rated dream reports.

Studies that have used scales with a balanced number of PE and NE items have generally shown a different pattern of results. For example, Sikka and colleagues (2014) used the fmDES (see Appendix A) which has an equal number of PE (10) and NE (10) items, and found a preponderance of PE with SR and a balanced ration of PE and NE with ER. These results are in agreement with results of the St-Onge et al. (2005) study which also used a scale consisting of an equal number of positive (4) and negative (4) items, with SR.
Nevertheless, as discussed above, these differences could also be due to the dissimilarities in rating method (i.e., SR versus ER), not only due to the scale used.

The Present Study: Aim and Hypotheses

As reviewed above, results on dream emotionality are contingent on who rates the dream emotions (i.e., SR or ER), which environment the dreams are collected in (i.e., home versus laboratory settings), which procedure is used when collecting the dreams (i.e., spontaneous or predetermined awakenings; written or oral dream reports), and which measurement scale is used when rating the dream emotions (i.e., scale measuring overall emotional tone versus specific emotions; scale with equal or unequal number of positive and negative items). Thus, in order to accurately advance the knowledge on dream emotionality it is important to control for the above mentioned methodological variables.

This is the intention of the current study which is based on and serves as an extension to the previous study by Sikka et al. (2014) which held the environment, procedure, and scale constant while investigating SR and ER of dream emotions (see 1.2.2. Emotion rating methods: self- and external ratings). However, the Sikka and colleagues (2014) study was conducted in a laboratory setting, which, as discussed above, might have influenced the results concerning dream emotionality. Hence, the aim of the present study is to investigate the degree of convergence between the self- and external ratings of dream emotions in home dream reports. In order to keep the methodological variables constant, this study uses the same scale for the emotion ratings as the one used in the Sikka et al.’s (2014) study. Therefore, comparing the results of the current study with that of Sikka et al. (2014) would hopefully enable us to clarify the differences between SR and ER of dream emotions and additionally shed light on how the data collection environment might influence emotional dream contents.
Based on the previous findings reviewed above it is hypothesized that: (1) SR will reveal a greater number of emotional dreams than ER; (2) SR will reveal a greater number of emotions per dream than the ER; (3) SR will reveal a relatively more balanced ratio of PE and NE per dream, while ER will reveal a greater number of NE than PE per dream.

**Method**

**Participants**

47 healthy Swedish speaking individuals (17 male, 30 female) from the Västra Götaland region in Sweden volunteered to participate in the study and provided daily home dream reports. Those with less than 5 dream reports over the three week period were excluded (i.e., 3 participants; 2 female and 1 male) from further analyses. The final sample consisted of 44 individuals (16 male, 28 female). The average age for the final sample was 26.93 (SD = 5.09, age range = 19 – 40).

Eight participants were recruited from another study: those who reported being interested in participating in the dream study, who reported having dreams at least 1-2 times per week, who showed no depressive symptoms according to the Beck Depression Inventory II (BDI - II; Beck, Steer, & Brown, 1996) and reported having no neurological or psychiatric disorders. The second set of 39 participants was recruited through a specific dream study ad that was emailed to the students at the University of Skövde (also posted in an online newspaper). Individuals interested in participating in such a study and who fulfilled the following criteria were asked to contact the researchers: having no psychiatric and neurological disorders, Swedish speaking, and within an age range of 18 to 40. All participants were consequently contacted by the researcher through email.

**Procedure**

The individuals who showed an interest in participating in the study were first given a description of the study (see Appendix D). They were encouraged to contact the researcher
by phone or by email should they have any questions about any aspect of the study. After having read through the study description form and having received answers to their questions, individuals interested in participating were provided with an informed consent form (see Appendix B) to sign, detailed instructions on how to keep a dream diary (see Appendix C), together with a link to the online dream diary. The participants also filled in an extensive well-being questionnaire (WBQ) which consisted of several psychological and physical well-being scales, and several demographic scales. The WBQ is part of another study and is hence not included in the present study. After having filled in the WBQ, the participants were asked to keep the dream diary daily for the following three weeks. Namely, the participants were supposed to log on to the online diary every morning, and first answer the question – “Do you remember having any dreams?” (i.e., “Kommer du ihåg om du har drömt något i natt?”). In case of having had a dream, they were supposed to write down the dream number and as thoroughly as possible write down all the details they remembered about their dream experience. After having written down the dream report, the participants had to rate their dream emotions using the emotion rating scale on the same online dream diary (see Appendix C, for link to the online dream diary). In the event of not having received any dream reports from a participant the researcher emailed the respective participant to ask if they had forgotten to report their dream. After the data collection ended, all dream reports were given to the external raters for rating emotions in dream reports. Participants with less than five dream reports were excluded from further analyses, thus the analyses are based on 44 participants and 552 dream reports.

In addition, the study was conducted in accordance with the Declaration of Helsinki guidelines. As all the participants signed an informed consent form before their participation, they were fully aware of the possibility to cease their participation in the study at any time. The participants did not receive any monetary rewards for their participation.
Measures

Self-ratings. In accordance to the measures used in the previous study by Sikka et al., (2014) the participants used the smDES to report the PE and NE experienced in their dreams. The smDES contains 20 items (three adjectives describing each item) out of which 10 items depict PE and 10 items depict NE. The scale does not measure the duration of emotions, however it measures both the occurrence and the intensity of emotions. The emotions were rated on a Likert scale from 0 (“I did not experience any of these feelings at all”) to 4 (“I experienced one or more of these feelings extremely much”). A detailed report of the smDES items is given in the Results section (see Appendix A, for both English and Swedish versions of scale).

The focus of the analysis for both the SR and ER was the frequency of occurrence, rather than intensity, of dream emotions. This way the collected SR data would be comparable to the data obtained with the ER. Therefore, the results obtained with smDES were dichotomously investigated by differentiating between emotion experienced “not at all”, and emotion experienced “a little bit”, respectively, between 0 and 1. A detailed report of the occurrence of the 20 different emotion categories is given in the Results section.

In addition to evaluating discrete emotions categories, two cumulative subscales were separately formed for both the PE and the NE. The two subscales consisted of 10 emotions each. Cronbach’s alpha (α) coefficient was calculated to measure the reliability of the two subscales (Cronbach, 1951). The PE subscale had a coefficient of $\alpha = .930$, and the NE subscale had a coefficient of $\alpha = .847$, and as the analysis revealed good item-to-total correlations, no items had to be excluded from the subscales in further analyses. The PE and NE subscales were used to calculate the total number of emotions, and of PE and NE per dream.
External ratings. Similarly to SR, the frequency of occurrence of each of the 20 emotion categories was calculated. As a result, when a specific emotion category was recurrently expressed in the same dream report then it would still be calculated as occurring just once. Similarly to SR, two cumulative subscales were formed for the PE and NE items. As with SR, these subscales were used to calculate the total number of emotions, and of PE and NE per dream.

Similarly to the study by Sikka et al. (2014), first, the two external raters independently rated the occurrence of emotions according to the following criteria: (a) if an emotions was explicitly expressed as experienced by the dream self (e.g., “I noticed that there were two shockingly big dogs and I was afraid of what was going to happen”); (b) if an emotion was explicitly expressed, even though its target was unclear, yet if the emotion could not be attributed to any particular person besides the dream self (e.g., “Three of the puppies jumped on me which was terribly funny as they began biting each other’s tails”); and (c) if the dream self exhibited behaviour that clearly reflected an emotional state, and which was explicitly inferable from the dreamer’s behaviour, thoughts or context (i.e., only one prominent emotion could be interpreted from the outside as underlying the behaviour; e.g., “He was quite a joker so we were laughing”). Emotions were not to be coded when: (a) the dream self exhibited a behaviour obviously related to an emotion, yet without explicitly expressing the exact emotion (i.e., several emotions could underlie the behaviour) (e.g., “I started to cry”; “I protested”; “I was in a bad mood”); (b) the emotion was mentioned and felt by the dream self twice within the same dream report, and also referred to the same situation, then it was coded only once (e.g., “I found her extremely attractive... (later) I told her that she was hot”); (c) a general compliment was detected then it was not coded as an emotion (e.g., “I said how nice of him to come”). Moreover, the external judges distinguished the
emotions expressed explicitly from emotions inferred or observed only from behaviour; or coded separately if these were observed simultaneously (both expressed and inferred; EI).

The percentage of agreement for the occurrence of emotions was 79% (462) out of a total of 585 emotion occurrences detected in a total of 559 dream reports; and the percentage of disagreement was 21% (123). After discussion, the raters agreed on 574 (98.1%) occurrences of emotions, and excluded 11 (1.9%) miscellaneous cases of emotion. Out of the 574 detected emotions: 461 (80.3%) were expressed, 67 (11.7%) were inferred, and 46 (8.0%) were EI emotions. The raters agreed on 84.6% (390) of the expressed emotions, 53.7% (36) of the inferred emotions, and on 73.9% (34) of the EI emotions. As the agreement for the 67 inferred emotions was low, they were excluded from any further analyses. Hence, further analyses were based on a total of 507 emotions (i.e., 461 expressed and 46 EI).

Next, the raters independently coded each of the identified emotions using the same emotions ratings scale as with SR, i.e., smDES. An additional category (number 21) was used for emotions (e.g., surprise, confusion) that the external raters were not able to classify under any of the existing 20 emotion categories. This category was, however, not used in further analyses. The external raters agreed on 475 (93.7%) out of the 507 emotions (expressed – 93.3%; EI – 97.8%). In order to evaluate the inter-rater reliability for the coding of specific emotions, Cohen’s Kappa was used and the evaluation revealed an excellent Kappa value ($\kappa = 0.925$).

The length of the dream reports, or the total recall frequency, (i.e., text without repetitions, fillers, and corrections; TRF) was also calculated (Antrobus, 1983).

**Statistical analyses**

The IBM SPSS statistics software (version 22) was used to conduct the relevant statistical analyses. Firstly, for each participant the total number of dreams, emotional
dreams, and the aggregate scores for the amount of emotions per dream, the amount of PE and NE as well as TRF per dream were calculated. Thus, to control for the possible differences between participants, all analyses, besides the analyses concerning the word count per emotional and non-emotional dreams which were dream level, were subject-level (not dream level) analyses.

Secondly, all analyses were conducted in two phases. In the first phase all dreams ($N = 552$) from all participants ($N = 44$) were aggregated. In the second phase the relevant analyses were conducted on only the emotional dreams (i.e., rated as emotional with both SR and ER) (participants $n = 40$; dream reports $n = 264$).

The Shapiro-Wilk test (Shapiro & Wilk, 1965) was used to test the normality assumption. The majority of the variables were not normally distributed therefore most comparisons were conducted with nonparametric tests. However, parametric tests were used when both variables that were compared were normally distributed. The differences between SR and ER with respect to variables of interest were calculated with either Wilcoxon signed-rank tests (nonparametric) or paired-samples t-test (parametric). Effect sizes were calculated with Pearson’s correlation ($r$) for Wilcoxon signed-rank tests, and with Cohen’s $d$ for $t$-tests.

Thirdly, preliminary analyses were conducted before hypothesis testing ($t$-test or Mann-Whitney $U$-tests were used depending on whether the variables were normally distributed or not) to analyze whether there were significant differences between genders, and groups with and without depressive symptoms in the number of emotional dreams, emotions per dream, or PE and NE per dream. This was done for both methods separately (i.e., SR and ER).

Correlations between the PE and NE subscales for each method separately and with the TRF were conducted with Spearman’s rank correlation coefficient.
Results

**Preliminary Analyses: Gender and Depressive Symptoms Groups**

Participants were divided into groups without (NS; n = 36) and with depressive symptoms (S; n = 8), according to the Beck Depression Inventory II (BDI - II; Beck et al., 1996) scores. According to BDI - II the score of 0-10 is considered normal and above 10 is considered symptomatic. The NS (BDI ≤ 10) and S (BDI > 10) groups did not significantly differ in any of the dependent variables with either measure (ps > .05). Thus, the data from individuals belonging to different groups based on BDI scores were pooled together in subsequent analyses.

With regards to gender, the only significant difference between males and females was that the females (M = 6.82, Mdn = 6.00; SD = 4.39) expressed more NE in dream reports as evaluated with ER than the males (M = 4.56, Mdn = 4.50; SD = 3.81) with a medium effect size, U = 135.000, Z = -2.162, p < .05, r = .32.

**Overall Dream Emotionality**

With SR the overall emotionality of dreams was calculated using the 20 items of the smDES. A dream was considered emotional if at least one of the 20 items received a self-rating score above 0. With ER the category 21 ("Other") was included when determining the emotionality of dreams to ensure that the dream reports in which emotions were identified (despite not being classified into any of the 20 categories) were still rated as emotional. Thus, with ER a dream was considered emotional if at least one of the 21 items were detected by the judges in the dream reports.

As measured with SR, 538 (97.4 %) dreams were rated as emotional, and 14 non-emotional (2.5 %), while with ER 264 (48 %) dreams were evaluated as emotional, and 288 (52 %) non-emotional. When comparing the two methods (N = 44) a significantly larger
number of dreams were rated as emotional with SR ($M = 12.23$; $Mdn = 11.00$; $SD = 5.60$) as compared to ER ($M = 6.00$; $Mdn = 5.00$; $SD = 4.29$), $Z = -5.71$, $p < .01$, $r = -.60$ (see Table 1).

With ER, emotional dream reports ($M = 169.14$, $Mdn = 125.20$) contained significantly more words than non-emotional dream reports ($M = 86.53$, $Mdn = 87.11$), $Z = -9.994$, $p < .01$, $r = -.43$. Similarly, with SR, emotional dreams ($M = 128.10$, $Mdn = 115.30$) contained significantly more words than non-emotional dreams ($M = 46.79$, $Mdn = 29.52$), $Z = -3.335$, $p > .01$, $r = -.14$.

Table 1

<table>
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<td>Negative emotions</td>
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**Emotions per Dream**

The overall number of PE and NE per dream was calculated by summing up the frequency of occurrence of items for each subscale separately, and the overall number of different emotions per dream was the sum of PE and NE items. This resulted in a maximum number of 20 different emotions per dream (i.e., PE = 10 items; NE = 10 items).
All dreams. With SR ($N = 44$), the mean number of different emotions reported per dream was $8.46$ ($Mdn = 8.59$; $SD = 3.08$) when rated with the PE ($M = 4.89$, $Mdn = 4.76$; $SD = 2.10$) and NE subscales ($M = 3.57$, $Mdn = 3.75$; $SD = 1.79$) of the smDES. Thus, there were significantly more PE than NE, $t(43) = 3.65, p < .01, d = .51$. With ER ($N = 44$), the mean number of different emotions per dream report was $0.76$ ($Mdn = 0.73$; $SD = 0.61$), when evaluated with the PE ($M = 0.27$, $Mdn = 0.20$; $SD = 0.26$) and NE subscales ($M = 0.49$, $Mdn = 0.38$; $SD = 0.42$). Thus, there were significantly more NE than PE, $Z = -3.637, p < .01, r = -.55$.

When directly comparing the two methods, significantly more PE were detected with SR than with ER (see Figure 1.), $Z = -5.777, p < .05, r = -.62$. Similarly, a significantly higher mean number of NE was detected with SR than with ER, $Z = -5.777, p < .05, r = -.62$.

*Figure 1.* Mean number of different categories of positive and negative emotions per dream per participant ($N = 44$) as measured with the positive emotion (PE) and negative emotion.
(NE) subscales of the smDES, for each method separately. Includes all the participants and both emotional and non-emotional dreams. **p < .01.

Additionally, when reported with SR, both PE ($r_s (44) = .33, p < .05$) and NE subscales ($r_s (44) = .41, p < .01$) were positively correlated with the length of the dream report. This suggests, that the longer the dream report provided by the participants, the more different types of emotion the participants also rated as having experienced during those particular dreams. When detected with ER, both PE ($r_s (44) = .37, p < .05$) and the NE subscales ($r_s (44) = .34, p < .05$) were positively correlated with the length of the dream report. This suggests, that the longer the dream report provided by the participants, the more different types of emotion the external judges also detected in those particular dream reports.

Due to the fact that males and females differed in the amount of NE as measured with ER (see chapter 3.1), separate analyses between genders were conducted to see whether there are different patterns of results with respect to ER NE. Among females ($n = 28$) significantly more NE were detected SR ($M = 3.76, Mdn = 3.88; SD = 1.80$) than with ER ($M = 0.56, Mdn = 0.59; SD = 0.37$), $t(27) = 10.487, p < .05, d = 2.46$. With ER significantly more NE ($M = 0.56, Mdn = 0.59; SD = 0.37$) than PE ($M = 0.26, Mdn = 0.21; SD = 0.25$) were detected, $Z = -2.464, p < .05, r = -.46$.

Within the male group ($n = 16$), significantly more NE were detected with SR ($M = 3.21, Mdn = 2.81; SD = 1.77$) than with ER ($M = 0.36, Mdn = 0.21; SD = 0.48$), $Z = -3.516, p < .05, r = -.62$. Besides, with ER significantly more NE ($M = 0.36, Mdn = 0.21; SD = 0.48$) than PE ($M = 0.27, Mdn = 0.18; SD = 0.30$) were detected, $Z = -1.020, p < .05, r = -.26$.

Thus, despite females having expressed more NE in dream reports (as measured with ER), there were no differences in the overall pattern of results concerning the emotionality of dreams between the genders.
Only emotional dreams. When taking into account only those dreams that were rated emotional with both measures. The difference between the mean number of different emotions when comparing the two methods was statistically significant with a large effect size, \( Z = -5.511, p < .05, r = -.61 \). That is, with SR on average 9.56 different emotions (\( Mdn = 9.68; SD = 3.22 \)) were reported, while with ER on average 1.48 different emotions (\( Mdn = 1.50; SD = 0.48 \)) were identified. The difference between the average number of PE items when comparing the two methods was statistically significant with a large effect size, \( Z = -5.433, p < .05, r = -.60 \). Namely, with SR (\( M = 5.07, Mdn = 4.70; SD = 2.21 \)) a larger mean number of PE items were reported than rated with ER (\( M = 0.52, Mdn = 0.47; SD = 0.39 \)). The difference in the mean number of NE items when comparing the two methods was also statistically significant with a large effect size, \( Z = -5.433, p < .05, r = -.60 \). Namely, with SR on average 4.48 (\( Mdn = 4.33; SD = 1.96 \)) NE items were reported, while with ER on average 0.96 (\( Mdn = 1.00; SD = 0.40 \)) NE items were identified. Thus, the overall pattern of results is the same no matter whether all, or only emotional, dreams were analyzed.

Discrete Emotions in Dreams

The occurrence of all the different emotions per emotional dream (\( n = 264 \)) was calculated using the 20 items of the smDES according to whether a particular emotion category was rated to occur at least once with the SR (irrespective of the intensity ratings), and with ER (irrespective of how many times it was coded in one dream). The average occurrence of each of the discrete emotion categories per emotional dream with both SR and ER is depicted in Table 2, in the order of the most to least frequent emotions, separately for each of the subscales.

With SR, frequency of reported PE from most to least occurring was, joyful/glad/happy (\( M = 0.60 \)), interested/alert/curious (\( M = 0.58 \)), amused/fun-loving/giggly (\( M = 0.54 \)). The frequency of reported NE from most to least frequent was
stressed/nervous/overwhelmed ($M = 0.64$), angry/irritated/annoyed ($M = 0.56$), and scared/fearful/afraid ($M = 0.53$) (see Table 2). The least occurring emotions with SR were contemptuous/scornful/disdainful ($M = 0.18$), guilty/repentant/blameworthy ($M = 0.37$), grateful/appreciative/thankful ($M = 0.39$), and proud/confident/self-assured ($M = 0.45$).

Table 2.

<table>
<thead>
<tr>
<th>Positive emotions</th>
<th>Self-ratings</th>
<th>External ratings</th>
<th>Wilcoxon signed rank test (two-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joyful/Glad/Happy</td>
<td>.60</td>
<td>.26</td>
<td>.13</td>
</tr>
<tr>
<td>Interested/Alert/Curious</td>
<td>.58</td>
<td>.30</td>
<td>.09</td>
</tr>
<tr>
<td>Amused/Fun-loving/Giggly</td>
<td>.54</td>
<td>.29</td>
<td>.03</td>
</tr>
<tr>
<td>Hopeful/Optimistic/Encouraged</td>
<td>.53</td>
<td>.51</td>
<td>.01</td>
</tr>
<tr>
<td>Love/Closeness/Trust</td>
<td>.51</td>
<td>.30</td>
<td>.03</td>
</tr>
<tr>
<td>Serene/Content/Peaceful</td>
<td>.47</td>
<td>.25</td>
<td>.07</td>
</tr>
<tr>
<td>Inspired/Uplifted/Elevated</td>
<td>.47</td>
<td>.30</td>
<td>.01</td>
</tr>
<tr>
<td>Awe/Wonder/Amazement</td>
<td>.46</td>
<td>.33</td>
<td>.04</td>
</tr>
<tr>
<td>Proud/Confident/Self-assured</td>
<td>.45</td>
<td>.28</td>
<td>.04</td>
</tr>
<tr>
<td>Grateful/Appreciative/Thankful</td>
<td>.39</td>
<td>.33</td>
<td>.06</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Negative emotions</th>
<th>Self-ratings</th>
<th>External ratings</th>
<th>Wilcoxon signed rank test (two-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stressed/Nervous/Overwhelmed</td>
<td>.64</td>
<td>.30</td>
<td>.19</td>
</tr>
<tr>
<td>Angry/Irritated/Annoyed</td>
<td>.56</td>
<td>.35</td>
<td>.24</td>
</tr>
<tr>
<td>Scared/Fearful/Afraid</td>
<td>.53</td>
<td>.27</td>
<td>.18</td>
</tr>
<tr>
<td>Embarrassed/Self-conscious/Blushing</td>
<td>.46</td>
<td>.32</td>
<td>.05</td>
</tr>
<tr>
<td>Sad/Downhearted/Unhappy</td>
<td>.44</td>
<td>.33</td>
<td>.15</td>
</tr>
<tr>
<td>Ashamed/Humiliated/Disgraced</td>
<td>.43</td>
<td>.27</td>
<td>.01</td>
</tr>
<tr>
<td>Disgust/Disgust/Revulsion</td>
<td>.42</td>
<td>.30</td>
<td>.04</td>
</tr>
<tr>
<td>Hate/Distrust/Suspicion</td>
<td>.38</td>
<td>.28</td>
<td>.04</td>
</tr>
<tr>
<td>Guilty/Repentant/Blameworthy</td>
<td>.37</td>
<td>.26</td>
<td>.05</td>
</tr>
<tr>
<td>Contemptuous/Scornful/Disdainful</td>
<td>.18</td>
<td>.23</td>
<td>.01</td>
</tr>
</tbody>
</table>

With ER, frequency of reported PE from most to least occurring was, joyful/glad/happy ($M = 0.13$), interested/alert/curious ($M = 0.9$), and serene/content/peaceful ($M = 0.7$). The frequency of reported NE from most to least was angry/irritated/annoyed ($M =
0.24), stressed/nervous/overwhelmed ($M = 0.19$), scared/fearful/afraid ($M = 0.18$) (see Table 2). The least occurring emotions with ER were hopeful/optimistic/encouraged ($M = 0.1$), inspired/uplifted/elevated ($M = 0.1$), contemptuous/scornful/disdainful ($M = 0.1$), and ashamed/humiliated/disgraced ($M = 0.1$). When comparing SR and ER with regards to discrete emotions, all the discrete emotions were reported significantly more with SR than with ER, $ps < .05$.

**Correlation Between Positive and Negative Emotion Subscales**

When rated with SR, the PE and NE subscales were not significantly correlated, $r_s (44) = .28$, $p > .05$. When evaluated with ER, the PE and NE subscales were moderately positively correlated, $r_s (44) = .49$, $p < .01$. According to Schimmack (2008) the correlations between PE and NE subscales have been generally found to be close to zero or weakly negatively correlated suggesting that PE and NE scales are structurally independent. Hence, the current results obtained with SR correspond to previous studies, while the results obtained with ER do not. These results do, however, correspond to those obtained by Sikka et al., 2014.

**Discussion**

In the current study emotions experienced in dreams were rated by participants after the dreams were reported and these self-ratings were compared to those obtained after two external judges identified and classified the same dream reports using the same emotion rating scale. The aim was to find out whether and to what degree the results concerning the overall emotionality of dreams, the number of different types of emotions (positive and negative) per dream differs depending on who rates the emotions.
Overall Dream Emotionality

The results confirmed the first hypothesis that (1) \textit{SR will reveal a greater number of emotional dreams than ER}. With SR the majority (97.4 \%) of dreams were rated as emotional, whereas with ER only half (48 \%) of the dream reports were judged to contain emotions. Thus, with SR (12.23) more than twice as many dreams were rated as emotional, as compared to ER (6.00).

These results are in agreement with previous results concerning SR, such as those in the Sikka et al.’s (2014) study where all laboratory dreams (115) were rated as emotional; in the St-Onge et al.’s (2005) study where 90.6 \% laboratory and 98.4 \% home dreams were rated as emotional. Conversely, the current findings concerning SR of overall dream emotionality are also higher compared to the Snyder (1970) study where despite that the researchers specifically asked the participants to express their dream emotions while reporting their dreams - only 35 \% out of the 635 laboratory dreams were rated as emotional; to the Fosse et al. (2001) study where only 74 \% of 88 home REM dreams were rated as emotional; and to the Strauch and Meier (1996) laboratory study where SR found 50.2 \% of dreams to be emotional.

The results concerning ER are slightly higher than the results presented in previous laboratory studies in which 29 - 40 \% of the dreams were evaluated to be emotional (e.g., Schredl & Doll, 1998; Sikka et al., 2014; Snyder, 1970). The current results are however considerably higher than the results of the Kramer et al. (1971) where in externally rated home dreams only 16 \% were found to be emotional.

However, the results obtained with ER in the current study are much lower compared to the Schredl and Doll’s (1998) study, where an identical scale was used with both methods and the resulting frequency of emotional home dreams as measured with ER (85.6 \%) was relatively similar to that obtained with SR (92.7 \%). Still these differences might be the result
of using different scales that measure different aspects of dream emotionality, as in the Schredl and Doll’s (1998) study a scale measuring overall moods of the whole dream was used which might have led to the ER detecting moods rather than emotions (Sikka et al., 2014). The current results are however similar the results of the Schredl and Doll’s (1998) study where the external raters used the Hall and Van de Castle content analysis scale (1966), and evaluated 57.9 % dream reports as non-emotional, and 42.1 % emotional. Similarly in the current study with ER 48 % of the dreams were evaluated as emotional, and 52 % non-emotional.

Besides, current results are also in agreement with the results of Kahan and Laberge (1996) where an identical scale was used with both SR and ER to investigate the incidence of emotions in home dream reports and with SR 93 % of dreams were found to be emotional, while ER only 38 % of dream reports were evaluated as emotional.

Emotions per Dream

**Total number of different emotions.** The results further confirmed the second hypothesis (2) *SR will reveal a greater number of emotions per dream than the ER*. With SR (M = 8.45) almost 11 times more different emotions per dream were reported, as compared to ER (M = 0.76). This was also the case when only emotional dreams (with both SR and ER) were included, with SR producing more than six times as many different estimations of emotions per dream, as compared to ER. These findings are in agreement with several previous studies (e.g., Hall & Van de Castle, 1966; Merritt et al., 1994; Nielsen et al., 1991; Schredl & Doll, 1998; Sikka et al., 2014).

**Number of positive and negative emotions.** The third hypothesis (3) *SR will reveal a relatively more balanced ratio of PE and NE per dream, while ER will reveal a greater number of NE than PE per dream*, was also confirmed in that with SR a relatively more balanced ratio of PE and NE per dream was obtained, as compared to ER which detected
more NE than PE per dream. More specifically, with SR, the mean number of PE per dream was 4.89 and of NE 3.57, whereas with ER, the mean number of PE was 0.27 and of NE was 0.49. In fact, with SR, despite being more balanced, there were actually significantly more PE than NE. Furthermore, when comparing the two methods, with SR 18 times as many PE items and 7 times as many NE items than with ER were detected. This was also the case when only the emotional dreams (with both measures) were analyzed. In the latter case, with SR (5.07) nearly 10 times as many PE than with ER (0.52) were detected. Similarly, with SR (4.48) nearly 5 times as many NE were detected than with ER (0.96).

The results indicate an underrepresentation of both types of emotions in home dream reports with ER, with the number of PE being the most underrepresented. Thus, the current results are in line with previous results of the Sikka et al.’s (2014) study which obtained similar results in the laboratory setting. Moreover, given that with ER only directly expressed emotions in dream reports were included in the analyses, the underrepresentation of especially PE might be due to the way emotions are used in language. It has been suggested that PE are less differentiated and more diffuse than NE (e.g., Fredrickson, 1998), and hence, there may be more means to express negative rather than positive experiences which might be reflected in the written dream reports (Ben-Ze’ev, 2000; Casagrande & Cortini, 2008; Sikka et al., 2014; Schredl & Doll, 1998).

Furthermore, the so-called general positivity offset (i.e., the tendency of people to be in a state of mild positivity) and negativity bias (i.e., the tendency to give more importance to negative, as opposed to positive, events) that we have preserved through evolution as a species (e.g., Cacioppo, Gardner, & Berntson, 1999), might make it easier for external raters to detect NE in dream reports and lead self-raters to report more PE, than NE. Thus, these findings suggest that the SR and ER indeed diverge as methods when rating and detecting dream emotions.
Even though in this study the dream reports were collected in the home environment, the results agree with those of Sikka et al. (2014) which was carried out in the laboratory environment. Even though dreams from home environment have been shown to be more emotional and more negative (e.g., Hall & Van de Castle, 1966; Domhoff, 2005; Merritt et al., 1994; Schredl & Doll, 1998), the difference between SR and ER obtained was similar to the results obtained using laboratory dreams in Sikka et al.’s (2014) study. There were still more PE than NE with SR although the difference between these was more balanced than in the previous study. Concerning ER, there were more NE than PE whereas in Sikka et al.’s (2014) study there was no significant difference between these. Thus, this study not only points to the differences between the rating methods (SR and ER) but also indicates to the differences between home and laboratory environment with the former being related to more emotional and negative dreams.

Concerning the differences between genders, interestingly, women ($M = 3.76$) expressed more NE than men ($M = 3.21$) in their dream reports but there were no differences in SR of dreams. This suggests that women tend to use more words denoting NE than men. This stands in contrast to the literature which indicates that males usually have more aggressive dreams, compared to females, despite the fact that females tend to report more explicitly expressed emotions and longer dream reports (e.g., Schredl & Piel, 2005; Schredl, Ciric, Götz, & Wittmann, 2004; Schredl & Reinhard, 2008; Domhoff, 2005), or that there is no significant difference in the emotional profiles of men and women concerning dream emotions (Merritt et al., 1994).

However, despite these dissimilarities, the differences between the SR and ER discussed above prevailed within gender groups. That is, both females and males rated their dreams to contain more PE than the external coders were able to detect in the same dream reports.
**Relationship Between Dream Length and Emotionality**

Correlation analyses further indicated that as reported with SR, the longer the dream report provided by the participants, the more different types of emotions the participants also rated as having experienced during those particular dreams. The same correlation was revealed for ER, i.e., the longer the dream report the more different emotions detected by the coders.

Moreover, the 264 emotional dream reports (128.10) contained on average nearly three times as many more words than the 14 non-emotional ones (46.79). This is in agreement with the results of the Sikka et al.’s (2014) study where the emotionality of dream reports was positively correlated with the length of the dream report, suggesting that longer dream reports might contain more emotions than shorter dream reports. Besides, in the Sikka et al.’s (2014) study the mean number of words per emotional dream report from late REM sleep was of 141.28, a number that resembles the mean number of words per emotional dream report in this current study (128.10). Correspondingly, according to Antrobus (1983) this could be an indication that the emotional dream reports in the current study might be representative of dreams from late REM sleep stage (i.e., dreams from early morning REM periods), while the non-emotional dream report sample might be representative of dreams from either NREM or early REM (i.e., dreams from early night REM period) sleep stage. Indeed, as reviewed before, research literature demonstrates an association between active limbic and paralimbic structures and REM sleep which suggests increased emotional processing during REM sleep, and as such, may account for the heightened dream emotionality in REM sleep compared to that of NREM sleep (Maquet et al., 1996; Maquet & Phillips, 1998; Nofzinger et al., 1997; Hobson et al., 2000). However, not all researchers agree that greater emotionality of dreams is due to the longer length of the dream (report) or that dream length reflects dreams from different sleep stages (Hobson et al., 2000).
Discrete Emotions in Dreams

Results revealed that with both SR and ER all of the 20 possible emotion categories were reported and detected. These findings are in agreement with the numbers reported in the Sikka et al. (2014) as in that study with SR all of the emotion categories were also reported. However, the findings differ that in the Sikka et al.’s (2014) study with ER only 12 emotion categories (i.e., five positive and seven negative) out of the 20 possible were identified by external judges. These incongruences between the two studies could be due to the generally heightened emotional nature of home dreams as compared to laboratory dreams (Domhoff & Kamiya, 1964a; Domhoff, 2005; Hobson et al., 2000; Strauch & Meier, 1996; Weisz & Foulkes, 1970), or the inhibitory effect of the laboratory environment (Schredl & Reinhard, 2008; Strauch & Meier, 1996).

The current results are also in disagreement with those of the Sikka et al.’s (2014) study in that, as measured with SR, the most frequently reported emotion was a PE, interested/alert/curious (0.95), followed by other two PE (i.e., joyful/glad/happy, 0.79; serene/content/peaceful, (0.64). In the current study one of the most frequently reported emotion with SR was a NE, stressed/nervous/overwhelmed (0.64), followed by two PE (joyful/glad/happy, 0.60; interested/alert/curious, 0.58). Besides, the current results are in agreement with other studies that used SR of emotional dream contents where mainly NE have dominated over the PE in frequency, such as in the Merritt et al.’s (1994) study where anxiety was found to be the most frequent dream emotion; in the Snyder (1970) study where in laboratory dreams fear and anxiety were the most frequently reported emotions; in the Nielsen et al. (1991) study where in home dreams fear was the most frequently occurring emotion in 20% of dreams; and in the St-Onge et al.’s (2005) study where in home dreams anxiety (57.7%) was rated as the most frequent NE. The current results as reported with SR are also in agreement with the Fosse et al. (2001) study where with SR the most frequently
reported NE was anxiety/fear, and that both PE and NE were reported in a relatively balanced manner in the home dream reports.

The current results as evaluated with ER are also in disagreement with the Sikka et al. (2014) where the most frequently reported emotions were in an equal manner a negative emotion, angry/irritated/annoyed (0.19), and a positive one, amused/fun-loving giggly (0.19) (awe/wonder/amazement, 0.28, was actually the most frequently reported emotion but the category in that study measured surprise with a neutral valence). In the current study the most frequently detected emotions with ER were however predominantly negative, such as, angry/irritated/annoyed (0.24), stressed/nervous/overwhelmed (0.19), and scared/fearful/afraid (0.18). Besides, the results of the current study are also in disagreement with the Sikka et al. (2014) study in the most frequent category of PE with ER was awe/wonder/amazement, while in this study the two most frequent categories of PE detected with ER were joyful/glad/happy, and interested/alert/curious.

Another difference between this study and the Sikka et al. (2014) study is that anxiety (stressed/nervous/overwhelmed) and fear (scared/fearful/afraid) were the least frequently rated emotions with both methods, while in the current study anxiety and fear were among the most frequently reported NE categories with ER. Thus, the current results with high prevalence of fear and anxiety in dream reports as measured with ER are in agreement with previous studies that used ER and showed fear, stress (Strauch & Meier, 1996) and apprehension (Hall, 1951; Hall & Van De Castle, 1966) to be the dominating emotions in dream reports.

Limitations of Present Study and Suggestions for Future Research

The current study has several limitations. The main limitation is that whereas the participants rated their dream experiences, the external judges rated the dream reports. It
could, of course, be argued that as the participants always rated the dream emotions after having reported the dream, they also rated the reports. However, to control for this, it would be best in the future studies to ask the participants also rate their dream reports after the same amount of delay as when the judges rate the same dream reports.

The second limitation is that order of reporting the dream and rating dream emotions was always the same and not counter-balanced. However, due to the fact that dream experiences fade from memory very quickly (Domhoff, 2003; Hobson et al., 2000; Nir & Tononi, 2010), it is difficult to ask the participants to report their dreams after some delay, that is, after having rated dream emotions.

The third limitation lies in how the dream emotions were rated. Whereas the external raters only rated directly expressed emotions or emotions inferred from underlying behavior, the participants rated their dream experiences and/or reports as a whole. Moreover, in the analyses inferred emotions were excluded due to low interrater agreement. As such, it might be that, despite having rated specific emotions, SR also reflect the overall emotional tone of the dream. Similarly, the exclusion of inferred emotions might be reflected in the diminished detection of emotions with ER. In future studies it might be a good idea to ask external raters rate the dream as a whole using the same scale (instead of identifying specific emotions within the dream report).

The fourth limitation lies in that there is no actual certainty that the participants reported their dreams exactly after they woke up which might have contaminated the dream reports with experiences from the waking state.

In future studies it would be beneficial to replicate this study and to extend it by monitoring sleep stages from which dreams are reported from with a nightcap (Hobson et al., 2000; Fosse et al., 2001). Another extension could also be to first use a tape recorder to report
the dream reports and to later transcribe the reports so to avoid loss of dream contents (Casagrande & Cortini, 2008).

Moreover, as our understanding of the neural basis of dream emotions is scarce, this study is important for future studies investigating the neural correlates of emotional dream contents. For the latter we need to have valid psychological measures. We should know what is the best method for measuring emotions (e.g., subjective self-reports or content analysis of written material evaluated using external ratings), the neural correlates of which we are interested in. Also we should carefully consider the procedure used when collecting the dream reports, the scale for rating the dream emotions, and the environment in which the dream reports are collected (Domhoff, 2005; Schredl & Doll, 1998; Sikka et al., 2014; Nir & Tononi, 2010). Furthermore, in addition to the investigation of the neural correlates of specific dream contents (e.g., emotional dream contents) it is important to explore the neural correlates of dreaming in general. As most studies have so far mainly investigated the neural correlates of REM sleep, the neural correlates of dreaming per se (i.e., dreaming vs dreamless sleep) are still unknown (Domhoff, 2005; Nir & Tononi, 2010). Thus, future research should specifically focus on the neural correlates of dreaming as well as the neural correlates of specific dream contents as they occur during different sleep stages.

Conclusion

The current study demonstrates that by keeping the procedure constant and using an identical scale for measuring emotions the results concerning emotional dream contents were considerably contingent on whether the emotions were self-rated by the participants themselves or whether external raters evaluated the participant’s dream reports.

With SR, as compared to ER, there is (a) a higher proportion of emotional dreams; (b) a higher number of different emotions per dream; (c) more PE than NE per dream, whereas
with ER there are more NE than PE per dream (with the ratio being relatively balanced). These findings, obtained in the home setting, corroborate findings obtained in the laboratory setting and thus point to the differences in the emotion rating methods irrespective of the data collection environment. Thus, the results continue to question the extent of convergence between self- and external ratings when investigating emotional dream contents, and bring to attention the importance of considering methodological aspects both when investigating dream emotions, and the neural correlates of emotional dream contents.
References


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Solms, M. (2000). Dreaming and REM sleep are controlled by different brain mechanisms. *Behavioral Brain Science, 23*(6), 843–850. doi:10.1017/s0140525x00003988


## Appendix A

The Original and Swedish Version of the mDES (Fredrickson, 2013) as Used in the Study.

<table>
<thead>
<tr>
<th>Code</th>
<th>Items in English</th>
<th>Items in Swedish</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Amused, fun-loving, or giggly</td>
<td>Road, lättrodd, eller fnitrig</td>
<td>PE1</td>
</tr>
<tr>
<td>4.</td>
<td>Awe, wonder, or amazement</td>
<td>Vördnad, förundran, eller häpnad</td>
<td>PE2</td>
</tr>
<tr>
<td>8.</td>
<td>Grateful, appreciative, or thankful</td>
<td>Erkännansam, uppskattande, eller tacksam</td>
<td>PE3</td>
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<tr>
<td>11.</td>
<td>Hopeful, optimistic, or encouraged</td>
<td>Hoppfull, optimistisk, eller uppmuntrad</td>
<td>PE4</td>
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<tr>
<td>12.</td>
<td>Inspired, uplifted, or elevated</td>
<td>Inspirerad, upplyft, eller upprymd</td>
<td>PE5</td>
</tr>
<tr>
<td>13.</td>
<td>Interested, alert, or curious</td>
<td>Intresserad, alert, eller nyfiken</td>
<td>PE6</td>
</tr>
<tr>
<td>14.</td>
<td>Joyful, glad, or happy</td>
<td>Glädjefull, glad, eller lycklig</td>
<td>PE7</td>
</tr>
<tr>
<td>15.</td>
<td>Hopeful, optimistic, or encouraged</td>
<td>Hoppfull, optimistisk, eller uppmuntrad</td>
<td>PE8</td>
</tr>
<tr>
<td>16.</td>
<td>Proud, confident, or self-assured</td>
<td>Stolt, trygg, eller självsäker</td>
<td>PE9</td>
</tr>
<tr>
<td>19.</td>
<td>Serene, content, or peaceful</td>
<td>Lugen, tillfreds, eller fridfull</td>
<td>PE10</td>
</tr>
<tr>
<td>2.</td>
<td>Angry, irritated, or annoyed</td>
<td>Arg, irriterad, eller förargad</td>
<td>NE1</td>
</tr>
<tr>
<td>3.</td>
<td>Ashamed, humiliated or disgraced</td>
<td>Skamfull, förödmjukad, eller utskämd</td>
<td>NE2</td>
</tr>
<tr>
<td>5.</td>
<td>Contemptuous, scornful or disdainful</td>
<td>Föraktfull, hänfull, eller nedlätande</td>
<td>NE3</td>
</tr>
<tr>
<td>6.</td>
<td>Disgust, distaste, or revulsion</td>
<td>Avsmak, avsky, eller motvilja</td>
<td>NE4</td>
</tr>
<tr>
<td>7.</td>
<td>Embarrassed, self-conscious, or blushing</td>
<td>Generad, självmedveten, eller rodnad</td>
<td>NE5</td>
</tr>
<tr>
<td>9.</td>
<td>Guilty, repentant, or blameworthy</td>
<td>Skyldig, ängerfull, eller klandervård</td>
<td>NE6</td>
</tr>
<tr>
<td>10.</td>
<td>Hate, distrust, or suspicion</td>
<td>Hat, misstro, eller misstanke</td>
<td>NE7</td>
</tr>
<tr>
<td>17.</td>
<td>Sad, downhearted, or unhappy</td>
<td>Ledsen, nedstämd, eller olycklig</td>
<td>NE8</td>
</tr>
<tr>
<td>18.</td>
<td>Scared, fearful, or afraid</td>
<td>Uppskråmd, förskräckt, eller rådd</td>
<td>NE9</td>
</tr>
<tr>
<td>20.</td>
<td>Stressed, nervous, or overwhelmed</td>
<td>Stressad, nervös, eller överväldigad</td>
<td>NE10</td>
</tr>
<tr>
<td>21.</td>
<td>Other (what?) (e.g., surprised; confused)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Jag har blivit tillfrågad att delta i en studie som heter ”Drömmar och välbefinnande”.


Jag är medveten om att endast medlemmar av denna forskningsgrupp kan hantera information rörande mig. All insamlad data i denna studie är konfidentiell. Data i studien används endast av denna forskargrupp och resultatet publiceras i en forskningsrapport på ett sätt att ingen enskild deltagares identitet kan identifieras.

Jag förstår att mitt deltagande i studien är helt frivilligt. Jag är medveten om att jag i vilket skede eller fas som helst under studien kan avbryta mitt deltagande. Jag är medveten om att även om jag avbryter mitt deltagande, kan insamlad data ändå komma att användas i studien.

Med min namnteckning intygar jag mitt deltagande i denna studie, samt att jag samtycker frivilligt till att vara studiedeltagare.

_____________________________                                   ____________________________
Deltagarens namnteckning                                                  Datum

_____________________________                                   ____________________________
Deltagarens namn                                                  Deltagarens födelsedatum och år

_____________________________                                   ____________________________
Deltagarens adress                                                  Deltagarens telefonnummer

_____________________________
Deltagarens e-post

Forskarens ansvar: informerat samtycke mottaget.
Härmed intygar jag att jag givit deltagaren tillräckligt med information om studien och om deltagarens rättigheter. Jag intygar att all insamlad data i studien hanteras konfidentiellt och att information som visas för andra utanför forskningsgruppen (t.ex. forskningspublicering) inte kan leda till identifiering av enskilda deltagare. Deltagaren har rätt av avbryta sitt deltagande under vilket skede eller fas av studien som denne vill.

_____________________________                                   ____________________________
Forskarens namnteckning                                                  Datum

_____________________________
Forskarens namn

Forskaren behåller ett undertecknad informerat samtyckesblankett och deltagaren ges kopia på undertecknad informerat samtyckesblankett.
Appendix C

INSTRUKTIONER FÖR SKRIVANDE AV DRÖMDAGBOK

Syftet med den här studien är att samla in dina drömmar (drömrappor) under de kommande tre veckorna. Därför ber vi dig att föra en drömdagbok där du systematiskt registrerar alla drömmar som du kommer ihåg under dessa tre veckor.

Vad kommer du att göra?

Varje morgon, precis efter uppvaknande, går du till online-frågeformuläret: https://www.webropol.com/S/981DDFF77813287F.par

I frågeformuläret kommer du att: fylla i ditt namn, aktuellt datum, och besvara frågan “Kommer du ihåg om du har drömt något i natt?” genom att välja ett av följande alternativ: (a) “Ja, och jag minns (åtminstone delvis) innehållet.”, (b) “Ja, jag tror att jag har drömt men jag minns ingenting av drömmen”. (c) “Nej, jag tror inte att jag drömt i natt”.

Om du INTE KOMMER IHÅG att du har drömt eller inte kommer ihåg drömmens/drömmarnas innehåll (dvs., om du ovan valde alternativ b eller c), vänligen gå till slutet av sidan och klicka på ”Skicka” knappen. I det här fallet behöver du inte svara på någon av frågorna nedan, de uppgifter du har gett hittills sparar i databasen och du kommer att lämna enkäten.

Om du KOMMER IHÅG att du har drömt en eller flera drömmar (dvs., om du ovan valde alternativ a), vänligen besvara frågorna nedan (drömmnummer, detaljerad beskrivning av drömmen och fyll sedan i skalorna för drömkänslor). Vänligen observera om du kommer ihåg flera drömmar, fyll i detta frågeformulär flera gånger separat för varje dröm (dvs., första gången för dröm nummer 1, efter att du har svarat på alla frågor, lämna in dina svar genom att klicka på ”Skicka” knappen och öppna sedan enkätlänken återigen för att kunna fylla i den en andra gång, för dröm nummer 2; osv.). Om du bara hade en dröm, fyller du i frågeformuläret endast en gång (för dröm nummer 1).

OBS! Var alltid uppmärksam på att klicka på “Skicka” knappen innan du lämnar frågeformuläret, annars kommer all data/information som du har uppgiven inte att sparas i databasen och gå förlorad.

Efter att du har fyllt i frågeformuläret, kommer forskaren ansvarig för studien att gå igenom dina svar och kommer att kontakta dig om något behöver specificeras.

Hur du kan förbereda dig för att föra drömdagboken:

Avvara 10 minuter på morgonen för att rapportera dina drömmar under följande tre veckor. Ta tillräckligt med tid för att vakna upp, för att kunna komma ihåg och skriva ned drömmen/drömmarna som du drömdes under natten.

Efter att du vaknat, gå inte upp ur sängen direkt, utan ligg kvar i sängen i några minuter och försök minnas allting som du upplevde i din dröm. Det har visat sig att plötsliga rörelser (som att gå ur sängen) direkt efter att man har vaknat från drömmen kan försämra ditt minne av drömmen dramatiskt.

Slappna av, blunda och fråga dig själv: ”Vad har jag just drömt om?” Gå igenom de viktigaste händelserna i din dröm ett par gånger och försök komma ihåg så många detaljer som möjligt om dem.

Skriv ned dessa drömhändelser kortfattat (i punktform) först.
Skriv sedan ned drömmen så detaljerat som du kan komma ihåg (vad det var som hände, var, när, vem var närvarande, vad du kände och tänkte).


**Hur ska du göra för att rapportera drömmen på det sättet som du hade/upplevde den?**
Ingen detalj är för oviktig eller obetydlig för att skriva ned. Skriv ned allt!
Vi dömer inte dig eller dina drömmar så skriv även ned de drömmar och drömdetaljer som du kanske vill censurera på grund av deras innehåll. Även dessa är viktiga för vår forskning.

Om du senare vill lägga till ytterligare detaljer om dina drömmar, ändra inte på den ursprungliga drömrapparten, utan skriv den ytterligare informationen separat efter respektive drömrappart.

Om du råkar vakna upp mitt i natten, bör du försöka att memorera och skriva ned drömmen på en gång eftersom du troligen inte kommer att minnas denna dröm/dessa drömmar på morgonen längre.

☐ Försök att vara så specifik, detaljerad och ärlig du kan när du skriver ned drömrapparten.
Dock, försök inte få din dröm att låta rimligare, mer logisk eller perfektare än hur du kommer ihåg den. Drömmar är oftast bisarra och liknar inte alltid det vakna tillståndet.

Försök inte att ändra din ursprungliga drömrappart senare genom att göra tolkningar av, eller elaborera den.

Om drömmen får dig att associera kring eller tänka på faktiska minnen, eller om du skulle vilja kommentera dina drömmar på något sätt, skriv ned alla sådana kommentarer inom parantes på ett sätt som gör det lätt att urskilja dessa från den egentliga drömmen (rapparten).

**Ytterliggare kommentarer:**
Vi ser helst att minst 10 drömrapparter inlämnas under denna tidsperiod. Fortsätt föra drömdagbok under hela treveckorsperioden även om du redan har rapporterat 10 drömmar. Alla rapporter är värdefulla för oss.

Om du glömmer att rapportera din dröm(mar) från en av nätterna, oroa dig inte över det och fortsätt att föra drömdagboken för följdande nätter. All data vi får är väldigt värdefull för oss, så även om data från några av nätterna skulle utebli, är vi extremt tacksamma om du fortsätter att delta i studien.

Om du undrar över någonting relaterat till studien, är du varmt välkommen att kontakta en av forskarna ansvariga för studien när som helst under studiens gång: Diana Feilhauer (a12diafe@student.his.se), Linnéa Stenström (a10linst@student.his.se), eller Pillerin Sikka (pillerin.sikka@his.se).

**DRÖM SÖTT ☐**
Appendix D

BESKRIVNING AV STUDIEN
STUDIENS NAMN Drömmar och välbefinnande

STUDIENS AVSEENDE OCH SYFTE

Studien undersöker dröminnehåll och mentalt välbefinnande. Syftet är att undersöka (a) innehållet i drömmar drömda hemma (ej i laboratoriemiljö); (b) relationen mellan innehållet i drömmar drömda hemma och olika sorters mentalt välbefinnande. Denna undersökning är viktig av den anledningen att den hjälper till att öka förståelsen för drömmars och välbefinnandets natur och funktion, samt deras interrelation.

STUDIENS TILLVÄGAGÅNGSSÄTT


HUR OCH VAR KOMMER STUDIENS RESULTAT ATT ANVÄNDAS

All insamlad data kommer att hållas strikt konfidentiell. Alla svar som givits av deltagarna samt all annan information rörande deltagarna kommer endast att vara tillgängliga för medlemmar av forskningsgruppen och kommer att publiceras i en kommande forskningsrapport som omöjliggör identifiering av individuella deltagare. För att säkra anonymiteten kommer all personlig information (som namn och kontaktuppgifter) att lagras separat från all annan insamlad data från deltagaren.

DELTAGARENS RÄTTIGHETER

Deltagandet i studien är helt frivilligt. Deltagaren har rätt att avsluta sitt deltagande i vilket skede av studien som helst. Deltagaren har rätt att få ytterligare information om studien via medlemmar i forskningsgruppen när som helst under studiens gång.

MEDLEMMAR I FORSKNINGSGRUPPENS KONTAKTUPPGIFTER

Denna studie är ledd av Pilleriin Sikka, adjunkt i kognitiv neurovetenskap vid avdelningen för neurovetenskap och filosofi, Institutionen för biovetenskap, Högskolan i Skövde och doktorand vid Åbo Universitet, Finland. Datainsamlingen utförs av kandidatstudenterna Linnéa Stenström och Diana Feilhauer. Om du har några frågor var god kontakta Diana Feilhauer (a12diafe@student.his.se), Linnéa Stenström (a10linst@student.his.se) eller Pilleriin Sikka (pilleriin.sikka@his.se).