Relationship between Drug Dreams, Affect and Craving during Early Recovery from Drug Dependence

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Relationship between Drug Dreams, Affect and Craving during Early Recovery from Drug Dependence

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This thesis is an investigation of the drug dreams (DD) phenomenon in relation to the affect and craving of individuals in withdrawal or early recovery from drug dependence. Dream journals were used by 86 participants over the course of their five weeks treatment program to record their daily affect, craving, dreaming occurrences as well as drug dream content. The data were analysed using mostly mixed modelling methods, and a dream content analysis was also performed. DD were associated with higher levels of negative affect ($p < .001$) and craving ($p < .001$) while positive affect showed only little variations in relation to the type of dream experienced (drug dream, regular dream, no dream) during the night. These significant associations between craving, affect and DD were replicated in the female only analysis but not in the male one. The incidence of drug dreams did not decrease in the 5 weeks of the study ($p = 7.06$). Cocaine/crack users reported a higher incidence of DD ($p = .03$) than the other drug groups (opiates and alcohol). Nicotine patch users for their part experienced more DD than non-users during treatment ($p = .03$). DD content that involved active drug use had a larger impact on affect than DD with passive content ($p < .05$). The presence of fear ($p < .001$), distress ($p < .05$) and nervousness ($p < .001$) in DD moreover produced higher levels of negative affect when compared to DD without such content.
These results support the hypothesis that DD can act similarly to drug conditioned stimuli to elevate craving and negative affect in abstaining individuals. Given the role of negative affect and craving on continued drug use and relapse, these results support the implementation of psychological and pharmacological interventions aimed at altering the impact of DD on individuals in recovery.
To those wonderful people who always believed in me

my research

and my ability to carry it out...

and to those who never did

for the motivation to prove them wrong.

To Emile
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General Introduction

Individuals going through drug withdrawal or in early recovery from drug addiction often report vivid and distressing dreams in which drug themes are present, such as seeking or using drugs, being in the presence of drug paraphernalia or looking at other people handle drugs. These dreaming occurrences involving drug themes will be referred to in this thesis as “drug dreams” (DD).

Despite their frequent occurrences and reports of their impact on recovery from drug use, drug dreams have not been the object of many in-depth studies in the field of addiction. This fact is intriguing given that exposure and re-exposure to drug cues as well as stress have been confirmed to play a prominent role in relapse, and that drug dreams can create an environment where all three factors are present. The objective of this thesis, therefore, is to investigate the relationship between DD, affect and craving during withdrawal and early recovery from drug dependence. Based on research findings providing evidence that different types of encounters with drugs (for example seeing drugs, as opposed to manipulating it or hearing about it) can produce different intensities of cravings, this research will also investigate whether these findings can be replicated when the exposure to drugs occur during dreaming, and whether negative affect scores are impacted by the different exposures to drug cues.

Eighty-six participants (males and females) 18 years of age and older, were recruited from two residential addiction programs in Ontario (Homewood Health Centre in Guelph and Womankind Addiction Treatment Centre in Hamilton) offering 5-week treatment programs. Participants were asked to fill out an Initial Questionnaire and a daily Dream Journal for the duration of their program. The initial questionnaire gathered information related to
demographics, history of drug use and past treatment. It also inquired about craving and affect prior to, and since admission to treatment, as well as dreaming patterns and drug dream occurrences. The dream journal collected daily data on the craving and affect of the participants each morning upon awakening. It also monitored regular and drug dream occurrences as well as drug dreams content.

The data was analyzed using the mixed modeling method (SPSS-20). The mixed modeling was selected as it offers many advantages over the multivariate approach for repeated measures analysis. Hence, by using a long rather than a wide format for data entry, the method allows the unit of observation to become time points as opposed to a participant’s identification number. In the context of this research, it means that the data can be analyzed on a “nightly basis” or even by categorizing the nights by types of dreams reported by the participants (DD, regular dream, or no dream). Consequently, missing data (which can take the form of missing dream journals or missing information throughout the dream journals) in this case does not exclude a participant from the final analysis (no list-wise deletion) as only the missing data points are dropped from the analysis. Other benefits of the mixed modeling approach are the ability to treat time as continuous and to conduct post-hoc tests.

Overall, DD were associated with higher levels of negative affect (p < .001) and craving (p < .001) in the morning. Hence, the analysis confirmed that the scores for negative affect reported in the morning were associated with the type of dream experienced by participants during the night (drug dream, regular dream or no dream), drug dreams being associated with higher negative affect scores in week 2 to 5 of the study than RD or ND (all p < .001 except for the ND and DD relationship for week 5 where p < .05). This kind of effect was not noted for the positive affect scores. Hence, of the five weeks studied, only week 1 and 2 revealed significant
variations between dream types and positive affect. In week 1, a significant difference in mean score was found between ND and the experiencing of a DD \((p < .05)\) and an RD \((p < .001)\). Only in week 2 did the experiencing of a DD result in a significant difference with the experiencing of an RD or ND \((p < .01\) in both cases).

Craving scores were for their part significantly more elevated following a night with DD than when a RD was experienced in weeks 2 to 5 \((all\ p < .001)\). The correlation between craving and frequency of DD was also significant \((r = .37, p < .05)\).

The incidence of DD did not decrease significantly from week 1 to 5 \([F(4, 48)= 0.84, p = .51]\). However DD occurrence varied according to the type of drug used as the main drug of abuse, with a higher percentage of DD experienced by cocaine/crack users than alcohol or opiates users \((p < .001)\).

Each of the 227 drug dream reports was analyzed for emotional and action content to evaluate whether specific emotions were associated with the affect and craving scores reported by the participants in the morning or with specific emotions experienced during DD. It was found that DD content that involved active drug use had a larger impact on affect than DD with passive content \((p < .05)\). The presence of fear \((p < .001)\), distress \((p < .05)\) and nervousness \((p < .001)\) in DD moreover produced higher levels of negative affect when compared to DD without such content.

Overall, the findings support the idea that DD may impact on the recovery of drug abstinent users by being associated with higher levels of negative affect and craving upon awakening, mimicking the effects of drug-cue exposures experienced by recovering individuals during the day (when awake). To alleviate or eliminate the impact of DD on negative affect and craving, it is suggested that therapies and pharmacological modalities used for the treatment of
disturbed dreaming in other psychological disorders involving negative affect (such as PTSD, anxiety and depression) be adapted to the specific phenomena of DD. Those modalities may include Imagery Rehearsal Therapy (IRT), the use of Prazosin and mindfulness therapy, as stand-alone or as complements to other forms of addiction treatment.
CHAPTER 1 – Literature Review.
1.0 Drug addiction

Drug addiction is a complex condition that affects many of the biological, psychological and social aspects of human functioning (McCrady & Epstein, 1999) and consequently requires a multitude of interventions related to those domains for the affected individuals to attain and maintain recovery. Hence, according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5, 2013), a diagnosis of alcohol or drug use disorder (AUD or DUD respectively) is made when a minimum number of criteria related to those biopsychosocial areas impair the normal functioning of an individual. The criteria are: 1) use of larger amount of drugs, or for a longer period of time than intended, 2) sustained desire or unsuccessful attempts at cutting down or controlling the drug use, 3) important amount of time seeking, using or recovering from drug use, 4) craving, 5) inability to fulfill work, social or recreational activities, 6) tolerance, 7) continued use despite negative consequences, 8) use in situations where safety is compromised, 9) use despite physical or psychological problems caused by, or amplified by the drugs, 10) withdrawal upon cessation of use, and 11) loss of control over use. Meeting 2 to 3 of the 11 criteria indicates a mild AUD or DUD; moderate and severe forms of these disorders are diagnosed when 4 to 5, and 6 or more criteria are met, respectively (DSM-5, 2013).

It is well known that addictive disorders evolved as a cyclic pattern that involves periods of use interspersed with phases of abstinence (Nordfjærn, 2011). Four main models have been developed in an attempt to explain the roots of drug addiction, and offer an explanation of the cyclic nature (remission-relapse) of the condition. The biological model considers addiction a disease, stipulating that it alters the proper functioning of the mesolimbic-cortical pathway (McCrady & Epstein, 1999). Proponents of this model agree
that the disease may also have genetics and environmental components. Relapse, from the perspective of this model, is attributed to cravings as well as dysfunctions in the frontal cortex that affect decision-making and judgment (McCrady & Epstein, 1999). The learning model argues that drug addiction is a “learned behavior” acquired through the individuals’ interactions with their environment (Hogarth, 2013). In this model, cue exposure is seen as an important factor in relapse following a period of abstinence (Hogarth, 2013). The cognitive model stipulates that faulty thinking as well as inadequate decision-making processes are at the root of drug addiction (Skinner, 2010). Relapses, in this model, are viewed as the result of an individual’s inability to correct their dysfunctional beliefs and thoughts which in turn may lead the individuals to experience the “abstinence violation effect” (AVE), further amplifying the belief that cognitive control cannot be achieved, thus perpetuating the cycle of addiction (Kirchner, 2012). Finally, the bio-psycho-social model formulates that drug addiction results from the complex dynamic between biological, psychological and social factors that influence on an individual’s predisposition to addictive behaviors, or increase the propensity of such individuals to develop the condition (el-Guebaly & Hodgins, 1998). In this model, relapse is believed to be the result of an exposure to triggering factors from the individual’s bio-psycho-social environment.

It is interesting to note that in the two most commonly used models (biological and bio-psycho-social), relapses are related, either explicitly or implicitly, to some forms of cue exposure following a period of abstinence. For example, the biological model infers that relapses are the results of cravings, which are in essence responses to drug cues (McCrady & Epstein, 1999) while the bio-psycho-social model considers relapses as a response to various internal or external cues (such as stress, depressive symptoms, etc.) that over time have
become associated (conditioned) with drug use (el-Guebaly & Hodgins, 1998).

To better understand how addictive behaviors are reinstated during a period of abstinence, it is important to review in more details the different models of relapse as they relate to the above-mentioned concepts of conditioned drug responses and drug cues, as well as affective states and stress. These concepts are particularly important in the context of this study as the occurrence and content of drug dreams (DD) may have many common psychological and neural mechanisms with those experienced by individuals when awake.

Two models of drug dependence hold diametrically opposite views as to the factors underlying relapses. Hence, the physical dependence model is based on the premise that the aversive symptoms of withdrawal are responsible for the resumption of drug use of a dependent individual (Koob & Le Moal, 1997), while the hedonic model suggests that it is the positive reinforcement properties (i.e., the hedonic effects) of the drug that serve to maintain the addiction cycle (Stewart, de Wit, & Eikelboom, 1984). More specifically, the physical dependence model stipulates that when withdrawal symptoms (Unconditioned responses - UR) are repeatedly paired with the same environmental stimuli (Conditioned stimuli - CS) during periods of withdrawal, over time the CS comes to being associated - or conditioned -, with the unpleasant symptoms of withdrawal (Wikler, 1984). This leads a dependent individual to experience symptoms of drug withdrawal when encountering a CS, even after the acute withdrawal symptoms have abated. In turn, the CS in turn may produce a number of responses (conditioned responses – CR) to be experienced, one of the most important ones in the context of relapse to drug being craving (which in many instances may be a factor in relapse). In the hedonic model, it is the positive reinforcing properties of the drug that act as the US, and are thought to ultimately drive subsequent drug taking behavior (Stewart et al., 1984). Despite their
differences, the two models support the idea that conditioned responses to drug cues are important elements to consider in the treatment of drug addiction due to their important role in the relapse process.

Some factors have been proposed to explain the opposite direction of the CRs to drug cues in the physical and hedonic models discussed above, one being the specific site(s) of action of the drug taken (Eikelboom & Stewart, 1982), and another the timing and strength of the antagonist response to the cues (Solomon & Corbit, 1978). The Eikelboom and Stewart study (1982) suggests that drugs that exert their effects on efferent limbs produce antagonistic responses to drug cues, while those acting mainly on afferent limbs result in agonistic responses to the cues encountered.

From another perspective that adopts the idea that agonist and antagonists responses to drug cues can both be present in the same individual, it is suggested that that the two processes may in fact be working together to maintain homeostasis (Solomon & Corbit, 1978). Consequently, the direction of the CR to drug cues is, in this model, related to the temporal relationship between the specific drug cues and the agonistic and antagonist processes.

Whereas agonist and antagonist effects following drug use may occur in the same individual, they reflect the function of distinct appetitive and withdrawal relief networks (Hobbs, 2005) whose activation depends on both the stage of intoxication and withdrawal of the user (Drummond, Cooper, & Glautier, 1990). Consequently, whereas for occasional or non-dependent users, it is the appetitive network that is primarily activated, as the addictive disorder progresses, the withdrawal relief network becomes preferentially activated (Donovan & Chaney, 1985). The incentive-sensitization model developed by Robinson and Berridge (1993) also proposes that two distinct brain mechanisms may be responsible for drug “liking” and drug “wanting”,

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respectively. In this case, the researchers argue that as drug use progresses to become an addiction, the wanting system is sensitized whereas the functioning of the liking system is not altered significantly (Robinson & Berridge, 1993). These two separate processes thus result over time and frequent drug use in increased cravings (wanting) for the drugs by the dependent individuals, despite unchanged, or in many instances decreased, “liking” (produced by the hedonic effects) of the drugs. In this model, it is suggested that the dependent individuals’ attention becomes gradually focused on particular drug cues that, over time, become overwhelmingly salient (Field & Cox, 2008; Franken, 2003; Lubman, Peters, Mogg, Bradley, & Deakin, 2000) and in turn produce powerful incentive (motivation) for the individuals to attend to those cues, to the detriment of other important but non-drug related ones (Moeller et al., 2009).

1.1 Stress and exposure to drug cues

Stress can be defined as a physiological response generated by exposure to social, psychological or physiological stimuli perceived as dangerous or threatening by an individual, resulting in a disruption of the homeostatic state (Seo & Sinha, 2011). Consequently, for newly abstinent drug users, stress may follow an exposure to stimuli such as drugs or drug cues (Sinha, 2008). Physiological markers of stress include cortisol increase (Fatseas et al., 2011; Sinha, 2009) and dopamine release (Franken, Booij, & van den Brink, 2005): both have been shown to fluctuate in response to exposure to emotionally salient visual cues in drug dependent individuals (Sinha et al., 2005). Negative affect can be viewed as one of the psychological manifestations of stress.
The relationship between visual cues and stress responses has been studied from both a behavioral (Bergquist, Fox, & Sinha, 2010) and physiological (Hyman, Fox, Hong, Doebrick, & Sinha, 2007; Sinha et al., 2009) perspective in addiction research. The findings that have transpired from this body of research have revealed that presentation to participants of visual cues relating to their past drug experiences could reliably and consistently trigger the activation of neural areas related to stress and craving (Childress et al., 1999; Sinha et al., 2005; Volkow & al., 2006; Volkow et al., 2008), and by the same token increase the propensity of those individuals to resume drug use (Dagher, Tannenbaum, Hayashi, Pruessner, & McBride, 2009).

But whereas visual cues have been given a lot of attention in addiction, exposure to other types of stimuli, such as listening to recording of drug-related scenes or handling of drug paraphernalia, have also been found to elicit different levels of stress responses in research study participants (Childress, McLellan, Ehrman, & O’Brien, 1988; Ehrman, Robbins, Childress, & O’Brien, 1992; O’ Brien, Childress, McLellan, & Ehrman, 1992) . For example, it has been observed that tactile drug cues (handling drugs or drug paraphernalia) are followed by higher levels of self-reported craving than visual or audio-recorded drug use scenarios (Childress et al., 1988; Robbins, Ehrman, Childress, & O’Brien, 1997) . Research involving the monitoring of skin temperature fluctuation (which is well known to be a reliable marker of craving) in response to the manipulation of drug paraphernalia by abstinent users has also demonstrated that such activity also triggered self-reported levels of craving that were higher than those reported after viewing a video containing drug-related cues (Ehrman et al., 1992; O’ Brien et al., 1992).

1.2. Dopamine and addiction

Whereas many neurotransmitters can be linked to drug addiction, one of them is common to both drug addiction and dreaming, that is, dopamine (Colace, 2004; Perogamvros
& Schwartz, 2012). For this reason, this section of the literature review focuses on the role of this particular neurotransmitter as an important component of the neurobiological mechanism connecting both phenomena.

Although eight dopaminergic pathways have been identified in the brain, two of them play a central role in addiction, that is, the mesolimbic and mesocortical pathway (Bossert, Ghitza, Lu, Epstein, & Shaham, 2005; Heyne, May, Goll, & Wolffgramm, 2000; Ross & Peselow, 2009). While both of those pathways originate in the ventral tegmental area, the mesolimbic one extends to the nucleus accumben and further to the limbic system, while the mesocortical pathway ends in the frontal lobes. Over the years, strong evidence has been gathered by researchers confirming the association between those two pathways and the reward system (Bossert, Ghitza, Lu, Epstein, & Shaham, 2005; Heyne et al., 2000; Ross & Peselow, 2009). It has also been suggested that the mesocortical dopamine pathway mediates drug seeking behaviour (wanting) - but not the drug liking by a dependent drug user (Berridge & Robinson, 1995; Hobbs, 2005; Saunders & Robinson, 2010).

The relationship between DA receptors’ occupancy and stress, particularly when related to craving, has also been researched thoroughly in clinical population (Adinoff, 2011; Breeze et al., 2005) through many neuroimaging studies of individuals with addictive disorders (Lataster et al., 2011; Mizrahi et al., 2012; Suridjan et al., 2012). Since glucocorticoids hormones are involved in the neurobiological mechanism that triggers the release of DA in striatal regions following exposure to stress, some researchers have suggested that sensitization of the reward system through chronic stress exposure could be an important factor in the perpetuation of drug taking behaviors (Marinelli & Piazza, 2002).
1.3. Drugs, relapses and sleep disturbances

It is intriguing that the relationship between sleep disturbances and relapse has only recently gained the attention of addiction researchers given that: 1) sleep is vitally important to cognitive processes such as learning and memory consolidation (Smith, 2005), both of which are necessary for the learning of alternative coping skills to drug use; 2) sleep disruptions such as insomnia and interrupted sleep have long ago been reported to increase the propensity to relapse (Berro, Frussa-Filho, Tufik, & Andersen, 2014) and: 3) disturbed sleep is a universal symptom of acute (Brower & Perron, 2010) and protracted withdrawal (Mahfoud, Talih, Streem, & Budur, 2009).

Many drugs of abuse also impact the sleep architecture of dependent users by disrupting the intensity and/or length of specific sleep stages during active drug use (Ogeil, Rajaratnam, & Broadbear, 2013; Sharkey, 2011) and withdrawal (Angarita et al., 2014; Matuskey, Pittman, Forselius, Malison, & Morgan, 2011; Okun, Levine, Houck, Perkins, & Marcus, 2011). Hence, it has been found that the majority of drug users experience sleep disturbances, either during active use or withdrawal from drugs (Brower & Perron, 2010; Jones, Knutson, & Haines, 2003). For example, ethanol, benzodiazepines morphine and alcohol have all been found to decrease rapid eye movement (REM) sleep stage’s length during active use (Ebrahim, Shapiro, Williams, & Fenwick, 2013; Kay, 1973; Kay, 1975; Pagel, 2010). Delayed REM sleep onset and increase slow wave sleep (SWS) in the first half of the night were observed for active alcohol users (Ebrahim et al., 2013).

During withdrawal, cocaine users showed a significant deterioration of their total sleep time with an increased time for sleep and REM onset and increased SWS (Matuskey et al., 2011). In heroin users on the other hand, sleep time was increased upon withdrawal while a 26%
reduction in SWS was noted (Howe, 1980) whereas another study by the same group revealed that REM sleep time and number of REM sleep cycles throughout the night were also reduced during withdrawal from heroin (Howe, 1980). For marijuana users, withdrawal was accompanied by an increase in both REM length and SWS and a decreased latency of REM (Bolla, 2010).

1.4. Dreams and dreaming

The study of dreams has for a long time been compartmentalized, each specialty working almost in isolation from each other, and research findings lacking integration across the span of those specialties (Domhoff, 2003; Hobson, Pace-Schott, & Stickgold, 2000). Hence, the origins of dreams are still disputed and differ greatly depending on the approach used to research the matter. The Freudian model of the origins of dreams was based heavily on a psychiatric perspective and posited that dreams were the result of repressed sexual desires and unfulfilled wishes by the conscious mind during waking hours that resurfaced during sleep due to the less inhibited unconscious mind (Freud, 1913; Van De Castle, 1994). Dreams were moreover hypothesized by Freud to result from a conflict between the unconscious mind’s desire to fulfill a wish during sleep and the conscious ego’s disapproving and repressive functions during waking. Dream-thoughts distortions for their part were regarded as resulting from these opposing unconscious and conscious ego forces experienced during the dreaming stage (Freud, 1913). Freud introduced the concepts of the ‘drive’ and the ‘wanting system’ to explain the persistent needs for an individual to fulfill desires or wishes through the dreaming process, stating that these systems operated mostly at a subconscious level (Freud, 1913).

The popularity of Freud’s theory declined sharply following the discovery of REM sleep by Arisenski and Kleitman in 1953, as the research on sleep became associated with dreaming (Hobson et al., 2000) and hypotheses as to the origins of dreams adopted a more
neurophysiological and/or neurobiological perspective. The findings from the work of Aserinsky and Kleitman on REM sleep initially suggested that dreams are a characteristic of the REM cycles and the result of neurophysiological processes occurring for the most part during that stage (Hobson et al., 2000). The activation-synthesis model presented by Hobson and McCarley later concurred with the idea of dreaming being mostly associated with REM sleep (Hobson & McCarley, 1977). More specifically, it suggested that dreams result from a release of acetylcholine by REM-on cells and originate from the pons area of the brain (Hobson, 1988). This model furthermore dismissed the idea that dreams can have any meaningful purposes, advocating instead that they are “random noises” resulting from biochemical processes at play during REM sleep (Hobson, 1988). The assumptions underlying this model were later revised as a result of other research studies findings related to the dissociation of REM sleep from the dreaming process. The current Activation-Input-Modulation (AIM) model suggests a greater implication of the limbic structures and forebrain in the dreaming process but still advocates for the primary role of the pontine tegmentum as the main brain area involved in the production of dreams (Hobson et al., 2000).

Solms’ perspective on the origins of dreams were based on a group of over 300 patients with injuries to the pons or the motivation centre of the brain (Solms, 2000). He observed that the patients suffering from injuries to the pons experienced disruptions of their REM sleep but that their dreaming ability remained unaffected (Solms, 2000). Damages to the motivation centre of the brain on the other hand was found by Solms to produce a loss of dreaming for the patient, but no REM disturbances. Therefore, he concluded that dreams are generated by mechanisms emanating from the forebrain, suggesting also that the REM and dreams periods could be disassociated since dreaming also occurred during NREM sleep (Solms, 2000).
The finding that dreams are in fact not the sole action of REM sleep has given rise to two different models of dream generation. The first model (1-gen) advocates that all dreams are generated by one system of memory processes, notwithstanding in which stage of sleep they occur (Nielsen, 2000). This model gained some momentum when researchers successfully developed and applied methods to remove the quantitative effects of the longer REM dreams, leading to a more reliable comparison of the REM versus NREM mentation in terms of their respective content (Nielsen, 2000). It was concluded that it is not the difference in neural systems that accounts for REM and NREM dream generation but rather the levels of brain activity required to meet their respective dream generation threshold. In both REM and NREM sleep, dreams are thus believed to be generated by one process that includes three main elements, that is, 1) memory activation, 2) organization of the information, and 3) the interpretation by the brain of this information (Nielsen, 2000).

The 2-gen model posits that major qualitative differences between REM and NREM mentation serve as evidence that dreams generation in those two states cannot be from the same source or neural process (Nielsen, 2000). Hence, sleep mentation in this model is believed to depend on different neurophysiological systems in which interactions between mind and brain is essential for dream generation (Nielsen, 2000).

It was moreover suggested that the 1-gen and 2-gen models could be reconciled by a model he coined “covert REM sleep” (Nielsen, 2000). This model suggests that the mechanisms associated with dream generation in REM cycle are replicated in a covert manner in NREM periods (especially NREM1) and account for the occurrence and similarities of NREM dreams to REM mentation. Hence, according to that model, NREM dreaming is not a distinct phenomena from REM dreams, as both originate from the same neurophysiological mechanisms.
The origin and neural mechanisms responsible for the occurrence of dreaming in general, or disturbed dreaming episodes in particular, are still debated today amongst the dream researchers’ community. In the early 1900s, Freud attributed general dreaming occurrences to uncensored subconscious messages during sleep in response to a frustration of the needs of the individuals during daytime, when the EGO is at play. In the same vein, Jung concluded that dreaming occurs in order to provide the dreamer with information about daily life from a different perspective than that experienced while awake. This approach shares common ground with the perspective of more contemporary researchers who advocate for the role of dreams as problem solving mechanisms (Revonsuo, 2000) or as a process that enables the dreamer to better adapt emotionally to situations encountered during daily life (Cartwright, 1991; Hartmann, 2000).

The work of Crick and Mitchison was based on the assumption that the purpose of dreaming is to allow the brain to discard un-necessary information through a process of ‘active un-learning’ during sleep cycles (Crick & Mitchison, 1983). According to the model, not remembering dreams is an intrinsic and imperative part of the process of discarding the unnecessary information, even suggesting that the recall of all of our dreams would result in a state of psychosis! Moreover, without this ‘housecleaning’ activity, it has been suggested that the excess information would in the long term impair the proper functioning of the cortex (Crick & Mitchison, 1983). Adopting a different perspective, Hartmann (2010) proposes that dreaming may help create new associations of ideas that can be useful in getting a different perspectives on issues and find different solutions to resolve them. This idea of dreaming as a means to finding creative ways to problem-solve during sleep is also endorsed by Barrett (1996).
From an evolutionary perspective, Jouvet posits that dreams are essential to the survival of species, dreaming enabling the rehearsal of those behaviours necessary for survival (Van De Castle, 1994). Jouvet’s model is based on his experimental research with cats whose brains have been surgically altered to suppress paralysis during REM sleep. By observing the cats’ activity and movements during their REM cycles, he concluded that a rehearsal of behaviors unique to the species was taking place during the dream cycles, reinforcing his assumption that dreams have a specific purpose that is biologically driven but also involves brain areas responsible for cognitive functioning, especially memory and learning (Jouvet, 1991; Van De Castle, 1994).

Revonsuo’s threat rehearsal model to explain the function of dreaming also advocated for the idea of an evolutionary perspective (Zadra, Desjardins, & Marcotte, 2006), suggesting that dreams were initially essential to the survival of our ancestors, providing them with the opportunity to rehearse threatening situations encountered on a daily basis (Desjardins & Zadra, 2006; Revonsuo, 2000). According to this model, dreams would still today serve this purpose although the model stipulates that the threats encountered in today’s society do not warrant the constant triggering of this adaptive mechanism anymore. Moreover, the author emphasizes that not all dreams necessarily served this function, even in ancient times, which would help explain why some of our dreams are in fact not related to survival threats (Revonsuo, 2000).

Other researchers embrace the idea that dreaming serves some adaptive functions such as emotion regulation (Levin, 2010; Zadra & Donderi, 2000) or the processing of traumatic events and life concerns (Barrett, 1996; Cartwright, Young, Mercer, & Bears, 1998). Those ideas about the psychological functions of dreaming are not farfetched from that of Jung who posited long ago that dreams were essential to the maintenance of our psychological balance.
Continuity between dreaming and daily events

Dreaming consists of a subjective experience associated with a different brain state than that of waking, albeit with many similarities and uniqueness from the waking experience (Hobson, 2009). There seems to be general agreement amongst researchers, however, that no matter how subjective the experience of dreaming is for each of us, it nonetheless reflects a continuity with our waking state experiences and emotions (Domhoff, 2010; Hobson & Stickgold, 1994; Kramer, Roth, Arand, & Bonnet, 1981). There is also substantial evidence that dreams and waking affect interact (Duval and Zadra, 2010; Grenell, 2011; Lara-Carasco, Nielsen, Solomonova, Levrier, & Popova, 2009; Roberts, Lennings, & Heard, 2009; Schredl, Funkhouser, & Arn, 2006; Schredl, 2006; Schwartz, 2003). That is, sleep disturbances (including vivid dreams and nightmares) have been found to be both the precursors and the results of negative affect states (Blagrove, Farmer, & Williams, 2004; Levin, 2010; Levin, 2011; Levin & Nielsen, 2007; Zadra & Donderi, 2000). For example, vivid dreams and nightmares are recognized as valid and important indicators of stress in post-traumatic stress disorders (PTSD) and other anxiety-related disorders (American Psychiatric Association, 2013; Levin, 2007). Levin and Nielsen (2007) also reported that waking psychological impairments are strongly correlated to nightmare distress, implying the occurrence of a transfer of affective states between waking and sleeping periods, which they described as ‘cross-state continuity’. Several researchers concur with this cross-state continuity concept (Hartmann, 2000; Schredl & Hofmann, 2003; Schwartz, 2010), positing that emotions and concerns experienced during the day may be reflected into the dreaming process (Levin, 2007; Schredl, 2006b). Disturbed dreaming is also associated with somatic distress and negative affect (Blagrove et al., 2004;
Levin & Fireman, 2002; Pesant & Zadra, 2006), and intensity of nightmares has even been found to be predictive of level of emotional distress (Levin, 2007).

Even much older discussions on the nature of dreams have consistently suggested that dreams reflect some experiences or feelings that are able to transcend the waking state consciousness and affect our dreaming experiences (Van De Castle, 1994). However, one of the debates at this time seems to be about whether dream mentation is significantly different from waking thoughts. According to Stickgold et al. (Stickgold, Pace-Schott, & Hobson, 1994), a number of approaches have been utilized in order to better understand the nature of the dreaming process and the level of similarity and differences between dream mentation and waking thoughts. In a nutshell, those studies have either tried to fragment the dreams into several elements (Van De Castle content analysis system, for example) or instead attempted to evaluate the nature of the dream by adopting an overall perspective on the mentation experience, such as looking at the main imagery (Bulkeley & Hartmann, 2011) or at the loose associations of waking elements into the overall dream content (Hartmann, 2010a).

However, if the dreaming mind comes short of replaying episodic memories as they occurred in the waking state, it may be due to the selective and differential activation of brain areas during the various sleep stages (Schwartz & Maquet, 2002). For example, some of the features of dream content including bizarreness, juxtaposition of elements and characters, discontinuities, loose associations or lack of episodic and temporal references can be related to the specificities of the neuromodulatory systems activated during REM as opposed to waking as well as to the reduction of activity and transmission of information from the hippocampus area to the neocortex (Nielsen & Stenstrom, 2005).
1.5. Disturbed dreaming

Under the disturbed dreaming umbrella fall two broadly encompassing categories of dreams: nightmares, and bad dreams. Disturbed dreaming (or also sometimes called “dysphoric dreaming”) consists of intense and vivid mentation producing a negative affective state upon awakening (Duval & Zadra, 2010; Zadra & Donderi, 2000). These episodes are generally classified as nightmares if they wake up the individual during the night, or bad dreams if they do not (Zadra & Donderi, 2000). The main characteristics of this type of disturbed dreaming are their dysphoric emotions and terrifying nature, propensity to awake the dreamer from sleep when they occur, and their impact on the social and emotional functioning of the individuals experiencing them (DSM-5, 2013). The second broad category of disturbed dreaming consists of the bad dreams, which have been defined in the literature as dreaming that contains dysphoric emotions but does not awaken the individuals abruptly during the night (Duval & Zadra, 2010; Levin, 2010).

Two other factors, namely affect load and intensity of affect distress, also provide subjective markers that delineate bad dreams from the idiopathic and posttraumatic nightmares (Duval & Zadra, 2010; Levin & Nielsen, 2007). Hence, in addition to the nature of the disturbed dreaming, as described above, Levin and Nielsen (2007) have developed an intensity of distress scale to help in the classification of the disturbed dreaming experience based on the two main criteria of affect load and affect distress. According to this model, affect load represents the subjective weight of the accumulated stressors, whereas affect distress relates to the degree to which the individual’s functioning is affected by the dream. This conceptual model of disturbed dreaming provides a relevant way to classify the intensity of the dream and resulting impact on the waking affect of the individuals experiencing them.
The relationship between disturbed dreaming and waking events.

Waking and dreaming events are interrelated on two fronts: 1) there is a frequent carryover of affective states between waking and dreaming episodes (Domhoff, 2010; Pesant & Zadra, 2006; Zadra & Donderi, 2000), and 2) the visual imagery experienced in dreams is often a replay of waking events (Duval and Zadra, 2010), although this replay is never an exact replica of the actual happenings but rather an intricate assembly of related cognitive associations based on those waking events (Hartmann, 2010a, 2010b). The waking-dreaming continuity hypothesis for affect states is supported by research findings confirming the high prevalence of disturbed dreaming in a wide range of mental health conditions such as depression (Besiroglu, Agargun, & Inci, 2005), borderline personality (Semiz, Basoglu, Ebrinc, & Cetin, 2008) and post-traumatic stress disorders (Krakow & Zadra, 2006) (PTSD) which all involve negative affect during both dreaming and waking. Studies exploring the dream mentation of nightmare sufferers and individuals affected by PTSD confirm for their part that visualization of emotionally salient elements from waking events (visual cues) during disturbed dreaming is in fact a frequent phenomena for many individuals (Duval and Zadra, 2010).

The relationship between disturbed dreaming and psychopathologic conditions impacting on affect has been studied fairly extensively in the scientific literature (Berquier, 1992; Chivers & Blagrove, 1999; Hartmann, Russ, Van der Kolk, Falke, & Oldfield, 1981) . Hence, a link between negative affective states in conditions such as depression, anxiety and PTSD and disturbed dreaming occurrences has been established and points to the idea that negative affect can be both a precursor or a result of the disturbed dreaming (Levin & Fireman, 2002; Levin & Nielsen, 2007; Zadra & Donderi, 2000). It has been found that this negative affect carry-over
phenomena between sleep and awakening periods involves the contribution of specific neurophysiological and cognitive mechanisms at play during both the acquisition (experiencing) and recall of the emotional memory in both states (Levin & Nielsen, 2007).

A disturbed dreaming model developed by Levin and Nielsen offers a good example of such a complex neurophysiological/cognitive network interaction (Levin & Nielsen, 2009). It stipulates that posttraumatic nightmares and the emotional processing associated with it is the result of two neural networks working in tandem, one neurophysiological, and the other cognitive. Those two networks together are said to be responsible for the processing of the traumatic events experienced during the day through dreaming. Hence, the authors suggest that the AMPHAC/AND systems, composed of the amygdala, the medial-prefrontal cortex, the hippocampus and the anterior cingulate (AMPHAC) and the Affect Network Dysfunction (AND), are essential components of the neurophysiological and cognitive mechanisms responsible for the activation of the dreaming process and the resulting nature of the dreams content following a highly emotional event triggering PTSD (Levin & Nielsen, 2009). Moreover, according to those researchers, recurrent posttraumatic dreams would then result from a failure of those neural networks to process the emotional information due to a dysfunction of the affect network and a consequent abrupt awakening of the individuals during the process. Recurrent nightmares such as those experienced in PTSD would consequently be the result of a failure of this AMPHAC/AND system to process and extinguish the emotional memories of the traumatic experience, thus keeping the nightmares intensity at a peak without a gradual decrease, as would occur in the cases of non-traumatic nightmares (Levin & Nielsen, 2009). Whether in this model the dysphoric emotional state is a precursor or a result of the disturbed dreaming process is still a debate amongst researchers and is beyond the scope of this review. However, Levin and
Nielsen’s research provides some evidence that heightened arousal during encoding may help in replaying the events as experienced during waking.

Other mental health conditions involving negative affective states and disturbed dreaming have been mentioned in the literature, including depression and anxiety disorders, although theoretical models have not been specifically developed to explain this relationship. However, the fact that conditions involving negative affect are linked to disturbed dreaming point to the idea that the neurophysiological correlates of the two phenomena must have many similarities and be active during both sleep and awakening periods.

1.6. Sleep, dreams and memory consolidation

An impressive amount of evidence has been gathered over the years pointing to the idea that sleeping involves the complex interactions of different neurochemical and neurophysiological mechanisms that fluctuate and transition in a structured manner throughout the night, making sleep a succession of unique stages rather than an homogenous event (Stickgold, 2009). Whereas there is general agreement amongst researchers over the division of those stages, their respective function in the memory consolidation processes is still being addressed (Peigneux & Smith, 2010; Stickgold et al., 2001). Furthermore, albeit more recently, studies on sleep including the potential role of dreaming in memory consolidation processes have been published (De Koninck, Lorrain, Christ, Proulx, & Coulombe, 1989; Stickgold et al., 2001), raising additional debates amongst sleep, memory and dream researchers as to the role of sleep mentation in memory processing.

Whereas the role of sleep is certainly not limited to memory processing, mounting evidence from both animal and human studies supports the idea that it nonetheless enhances the brain plasticity processes underlying memory consolidation (Peigneux & Smith, 2010). Hence, it
is widely agreed that most sleep states play a role in facilitating memory consolidation (Smith et al., 2004). Like sleep, memory is comprised of several distinct systems and sub-systems, and specific pairings of sleep stages and memory types are required for an impact to be produced on memory consolidation processes (Diekelmann, Wilhelm, & Born, 2009; Peigneux & Smith, 2010; Smith & Peters, 2011).

Declarative and non-declarative memory use different neural mechanisms and different stages of sleep in order to process information. Whereas, in general, declarative memory relies in great part on NREM stages, non-declarative memory seems to engage mostly the REM stage, and to a lesser extent SWS and stage 2 (Diekelmann et al., 2009; Smith et al., 2004; Smith, 2005). Hence, while implicit learning with new cognitive content requires REM sleep for consolidation, learning explicit tasks requiring the use of already acquired skills seems to involve stage 2 (Diekelmann et al., 2009; Peigneux & Smith, 2010). Episodic memory consolidation for its part engages SWS processes (Walker, 2009) while emotional memory appears to do better following REM than NREM periods of sleep (Smith, 2012; Stickgold et al., 2001).

Two main hypotheses have been brought forward in order to explain the role of sleep states in memory consolidation processes. The dual-process hypothesis posits that the involvement of specific sleep stages in memory consolidation is dependent on the specific type of memory to be consolidated. The competing hypothesis to the dual-process is the sequential hypothesis, which proposes that memory consolidation is best achieved through uninterrupted cycling of sleep stages throughout the night. Recent study findings have revealed that both hypotheses have value and their respective appropriateness depends on whether the learning or task acquisition requires the involvement of only one or both memory types. Declarative memory tasks such as the well-known word-paired recall task as well as some recognition tasks for
example, have revealed to be mainly dependent on SWS for consolidation (Walker, 2009). Non-declarative learning involving visuo-motor abilities or requiring complex cognitive processes on the other hand has been found to rely heavily on REM sleep periods for consolidation (Smith, 2012). Such conclusions for the involvement of only one sleep stage in memory consolidation processes was probably due in part to methodological considerations in study design or feasibility reasons. Hence, whereas in general the work involving post-training manipulations or enhancement studies targeted either REM or NREM periods, deprivation methods, for obvious feasibility reasons, could only focus on REM sleep.

Some mixed results between different studies looking at the impact of memory consolidation for cognitively demanding tasks motivated researchers to take a closer look at the relationship between sleep stages and memory consolidation from a more encompassing perspective of different stages being potentially involved in the processing and consolidation mechanisms of a task. Smith (2012) suggested that those mixed results were likely rather complementary and could be attributed to the skill level of the participants in the task at the onset of the study. In scenarios using a mirror-tracing task or the Alpine skiing virtual video games play, while REM was found essential in the processing of learning for low skills or novice players, stage 2 sleep involvement (increased spindles) was heavily used for participants with prior task or game experience (Smith et al., 2004). This reconciliation of two initially competing hypotheses demonstrates the complexity of the mechanisms involved in the sleep memory consolidation process. Learning new tasks therefore often requires the involvement of both declarative and procedural system (Smith et al., 2004) and thus relies on the activation of different neural structures and sleep states (Diekelmann et al., 2009), adding to the complexity of delineating which system is primarily involved in the memory consolidation for that particular
task. Different types of memory, moreover, seem to rely on different neural systems, declarative memory depending on the hippocampal area and procedural memory using the striatal-cerebellar structures (Diekelmann et al., 2009).

Studies involving the use of declarative memory associated abilities have focused mainly on the use of verbal-paired associative tasks to explore the role of sleep on memory consolidation (Diekelmann et al., 2009). The subjects in these studies were asked to recall the paired words either following a normal sleep period or after a period of time awake. Performance in this kind of studies was found to be better when sleep was involved between acquisition and retest, giving strength to the general hypothesis that sleep is beneficial to memory consolidation. While SWS has been suggested to be the main sleep stage involved in the processing of this type of learning, stage 2 has also been reported, through increase in spindle activity, to facilitate the consolidation process (Smith, 2012). Moreover, sleep spindles increases following tasks acquisitions have been associated in many studies with the consolidation of procedural and declarative memory (Peigneux & Smith, 2010; Smith et al., 2004), and more recently, to IQ scores (Fogel & Smith, 2011).

While a fair amount of research has been conducted exploring the dreams of the adult populations, the interest and publications on the dreams of children are much more limited. Such information would however be most useful in providing a longitudinal picture of dream development that could be compared to our knowledge about memory processes across the lifespan and provide us with more information on the correlation between the two phenomena. Short of having a wealth of such information, the work of Foulkes on the dreams of children provides a starting point to initiate the debate on the topic (Foulkes, Hollifield, Sullivan, Bradley, & Terry, 1990). In one of the few pieces of extensive research on children’s dreaming, the
authors concluded that while children do report dreams at a fairly young age (less than 5 years old), those dreams tend to be static in nature rather than animated and do not seem to relate to the events or situations encountered in their daily life (Foulkes et al., 1990). Moreover, only limited reporting is generated from REM sleep awakening in that young population and even less from the NREM periods, in no ways close to matching the reporting rates of adults in either REM or NREM sleep. Interestingly, Foulkes et al. suggest that the development of dreams and the complexity of their content may well be related to the parallel development of visuo-spatial abilities in children (Foulkes et al., 1990). This is most interesting to this debate as it can be extrapolated that while much learning and neural development is completed in the earlier years of our lives, they both occur without a fully active dreaming brain (Foulkes et al., 1990), thus suggesting that dreaming may not be essential to the consolidation of memories, or even help in facilitating it (Smith, 2012).

The study of the relationship between sleep and memory consolidation has not yet expanded much into the specific role of dreaming as a major player in the efficient processing of recent learning, focusing instead on the role of sleep stages to account for the consolidation of different types of memory. Relying on those studies to assess dreaming in relation to memory processing is at once insightful and deceiving. Since evidence has been provided that some task acquisitions require the involvement of more than one memory consolidation process and therefore potentially more than one stage of sleep (Peigneux & Smith, 2010), looking solely at dream content from REM sleep periods may not adequately reflect the role of dreaming in the overall memory consolidation process (if such a role exists).

One of the studies that has focused on REM dreams in relation to learning is that of De Koninck et al. (De Koninck et al., 1989) which has explored the incorporation of French material
into the dream content of students attending an intensive French immersion course. It concluded that there is a significant relationship between the latency of incorporation of French into REM dreams and the development of French speaking skills. Hence, the authors found that performance in learning the language was positively correlated with the level of incorporation of the language into dreams (De Koninck et al., 1989).

Only a handful of studies on task performance improvement following sleep periods have looked at the incorporation of task-related dream content during NREM periods. Moreover, those that did have focused on the content of hypnagogic dreaming (Stickgold, Malia, Maguire, Roddenberry, & O’Connor, 2000). Due to the different neurophysiological and neurochemical mechanisms at play between the different NREM stages, again, generalization of the findings based on those studies should be done with caution. Nonetheless, two experiments offer a starting point to elaborate onto the question of whether dreams have a function in memory consolidation. Both have studied the impact of intensive sessions of computer games (Tetris and Alpine Skiing) on the incorporation into dreams of game elements (Stickgold, 2005). For the Tetris experiment, participants were awakened numerous times during the first hour of sleep, each time within about 3 minutes of sleep onset (Stickgold et al., 2000). Dream content incorporation of game task-related elements was observed in 75% of the novice and 50% of the expert players and was of similar nature, that is, pieces falling into place on the Tetris board. Interestingly however, some of the expert players also reported the incorporation of older game-related memories in their hypnagogic dreams, as opposed to memories only directly related to their most recent play session (Stickgold et al., 2000). This points to the strong propensity of dreaming imagery to involve associative content rather than replaying the situations in an episodic fashion. A similar study conducted using the arcade game alpine skiing also supports
this idea, reporting that 50% of participants with prior skiing experience had also elements of previous skiing situations incorporated into their dreams when awakened at sleep onset (Stickgold, 2005; Stickgold et al., 2001). A further study using the same virtual game but with hypnagogic awakenings occurring 2 hours following sleep onset confirmed that as time elapses from the first sleep onset of the night, dream content becomes less directly associated with the recent events (Stickgold, 2005).

Although these examples offer some evidence that a relationship exists between the intensive involvement in a task and the occurrence of dreams content-related to that task, the argument for a role of dreaming in the consolidation of the memory associated with the task is still at best a weak one. Hence, while these studies may provide some evidence that dreams associated with a specific task acquisition may change as the consolidation of the memory is occurring, they do not, however, provide strong indication that the content of the dreams itself plays a significant role in the memory consolidation process. Rather, as in the cases of the children’s dreams and the incorporation of French material into dreams during French immersion, it may only confirm that dream content varies in part as a function of 1) the sleep stages in which they are generated, 2) the emotional involvement of the dreamer into the task and 3) the level of processing achieved. Furthermore, since REM and NREM sleep are used differentially but are often complementary in memory consolidation processes - depending on the complexity of the task and the individuals’ command of the task (Smith et al., 2004) – it would probably be beneficial to study dreaming on a continuum of REM – NREM periods so as to assess the changes in dream content in relation to the processing stage of the tasks.
1.7. Neurophysiological correlates of disturbed dreaming

Neuroimaging studies (fMRI and PET) conducted during periods of REM sleep, when vivid dreaming is most often experienced, have provided evidence of high levels of brain activity in the regions associated with the processing of emotional information (Dang-Vu et al., 2007; Desseilles, Dang-Vu, Sterpenich, & Schwartz, 2011; Maquet et al., 1996). Three main types of findings have emerged from this literature. First, a comparative pattern of neural activation has been established between REM sleep and waking periods (Nir & Tononi, 2010) based on the assumption that the anatomical division of the neural areas responsible for cognitive processing of perceptual information during waking is preserved during REMs. Moreover, different levels of activation in many neural areas during REM sleep, compared to waking, have been confirmed (Nir & Tononi, 2010). Hence, hemodynamic changes have shown increased levels of activity during REM periods in the pontine tegmentum (PT), thalamic nuclei, limbic and para-limbic areas, amygdaloid complexes, hippocampus, anterior cingulate cortex and the posterior cortices of the temporo-occipital areas (Desseilles et al., 2011; Nir & Tononi, 2010). Deactivation, or lower levels of activation compared to waking or non-REM sleep stages were for their part noted in the dorso-lateral prefrontal cortex region, parietal cortices, posterior cingulate cortex and precuneus (Desseilles et al., 2011).

Second, an outline of the neural network involved in the processing of the emotional information often times experienced in dreams has been delineated (Levin, 2010). As in waking, albeit at an increased level, this network involves the activity of the limbic and paralimbic system, the amygdala, anterior cingulate cortex and insula (Nir & Tononi, 2010). Third, many of the phenomenological characteristics of dream content such as bizarreness, temporal and visual distortion, lack of volitional control, and emotional valence have been related to the
neurophysiological activation in the neural areas mentioned above (Dang-Vu et al., 2007; Desseilles et al., 2011). Adding to these findings the fact that the hippocampal area is also active during REM sleep (Dang-Vu et al., 2007), it is plausible to assume that while the brain in REM sleep is not privy to external input, stored information is nonetheless available and processed, and emotionally salient information is the object of such processing during disturbed dreaming episodes.

However, the specific neural activation patterns occurring during disturbed dreaming episodes have not been thoroughly studied or related extensively to the dream content and affect of the individuals upon awakening.

Whereas a number of neurochemicals are activated (or become more active) during REM sleep, only dopamine (DA) has been associated with the occurrence of disturbed dreaming. Of particular interest to the study of disturbed dreaming, some of these research findings have related DA increases in the dorsal-striatal region to the experiencing of aversive, stressful or painful stimuli during waking (Dagher et al., 2009), providing an indication that during disturbed dreaming, this specific neural area may be particularly active. DA increases in the striatal area during waking periods have also been associated to the visualization of emotionally salient cues (Badgaiyan, 2010). Volkow et al. has confirmed, however, that the DA release in itself did not trigger craving unless associated with emotionally salient cues (Volkow et al., 2008) such as drug-related ones in the context of addiction.

Solms theoretical model of the neurophysiological processes underlying dream formation advocates for the important role of DA in triggering dreaming during REM periods, suggesting that while the cholinergic activity responsible for the activation of the pons is necessary to trigger REM periods, is not in itself sufficient to initiate the dreaming process (Solms, 2000).
Hence, Solms suggests that it is the concomitant activation of the mesolimbic system through dopaminergic mechanisms that is responsible for the occurrence of dreaming episodes (Solms, 2000). A link between DA and dreaming has also been established through a Positron Emission Tomography study that revealed that regular bursts of DA are in fact common occurrences during REM periods (Dahan et al., 2007). Since disturbed dreaming episodes occur mostly during REM sleep, this finding strengthens the connection between DA and disturbed dreaming, at least from a theoretical perspective. Experimental studies pertaining to the role of DA in dreaming are still few, however, despite its known involvement in neuropsychological conditions involving severe disturbed dreaming episodes such as depression (Besiroglu et al., 2005) and schizophrenia (Limosani, D’Agostino, Manzone, & Scarone, 2011).

The relationship between disturbed dreaming and addiction is not surprising. Many of the neurotransmitters involved in the regulation of sleep and wake cycles also regulate the proper functioning of neural pathways heavily involved in addiction and affect regulation. Dopamine is the most important one and is strongly linked to both the initiation of REM sleep periods and the neural mechanisms underlying the activity of the reward system in addiction. Moreover, the great majority, if not all drugs of abuse exert an effect on dopaminergic activity in the brain, either through excitation or inhibitory activity of the dopamine neurons.

1.8. The drug dream (DD) phenomenon

Drug dreams (DD) can be defined as vivid subjective experiences during sleep which are reported upon awakening as containing drug themes, such as seeking or using drugs, being in the presence of drug or drug paraphernalia, or looking at other people using or handling drugs (Colace, 2014). Although DD have been mentioned in the scientific literature as far back as the 1960’s, their study as central to the phenomenon of drug withdrawal and craving has not gained
sustained attention from addiction researchers until the 1990’s. The reasons underlying this lack of attention to DD may be due in part to the mainstream theories on dreams which for a long time were stipulating that dreams were merely a by-product of brain activity during REM periods, and thus had no intrinsic meanings (Hobson & McCarley, 1977). At best, their association with daytime events was considered an artifact of the activity of certain brain regions related to memory and emotions during sleep. The limited technological capabilities available to help elucidate the neurochemical and neurophysiological commonalities between dreams and drug addiction most likely also deterred from researching this topic. Moreover, cooperation between researchers in different fields of study (such as dreams, neuroscience and psychology) that would have been needed to carry out such research has, until recently, been very limited.

In the recent past, models that have attempted to explain the occurrence of DD during withdrawal and recovery from drug addiction have focused on two main areas of research, that is: 1) the relationship between DD, craving and treatment outcome (Christo & Franey, 1996; Colace, 2014; Hajek & Belcher, 1991; Reid & Simeon, 2001), and; 2) the common neurochemical/neurophysiological mechanisms underlying the relationship between craving and dreaming (Johnson, 2001). Hence, to date, most of the work associated with DD has been linked to the craving phenomenon in one way or another. For example, much evidence has been presented by researchers and clinicians confirming that the emergence of DD, from either a neurophysiological, psychoanalytical, or psychological perspective, is associated with some of the neural mechanisms underlying the activation of simultaneous cravings (or craving-related neural systems) in abstinent users (see: Colace, 2014 for a review of the work in this area).
From a neurophysiological perspective, the “biological drive frustration” leading to the occurrence of DD has been explored, relating previous work on the concept of “drive” to that of DD (Johnson, 2001). The main assumption forming the basis of this drive (craving) to DD association is that DD only occur in individuals affected by a drug or alcohol addiction (Colace, 2014). Hence, DD are considered to represent a direct expression of, or response to, an inability by the individual to satisfy a need (craving) for the substances. In this context, the unsatisfied craving result in the activation of the mesolimbic-mesocortical system responsible for DA release, which in turn provides the neurophysiological activity necessary to the initiation of the DD phenomena (Colace, 2014; Johnson, 2001).

Most of the neuroscience-oriented research on DD has concluded that DD and craving are linked, relying on the finding that both phenomena involve the activation of the meso-limbic dopaminergic neural pathways, which is involved in both dreaming and craving (Johnson, 2001). It has been widely agreed that the stimulation of one process (craving) implies the concurrent activation of the other (DD), making the two phenomenon in many cases joint experiences. Whereas such evidence is not contested in this thesis as being part of an explanation of the DD phenomena, it is important to remember, however, that not all individuals who experience cravings for drugs will necessarily experience DD. The DD-craving link therefore only partially uncovers the neural and psychological processes underlying the occurrence of DD during withdrawal and recovery.

*DD frequency during recovery from drug addiction*

DD have been found by many researchers to be frequent occurrences at different stages of the addiction recovery process (Christo & Franey, 1996; Colace, 2014; Flowers & Zweben, 1998; Hajek & Belcher, 1991; Reid & Simeon, 2001). For many drug users, the occurrence of
drug dreams start within the first week of abstinence (Colace, 2004) and may persist for weeks (Colace, 2004; Hajek & Belcher, 1991), months (Christo & Franey, 1996), and even years (Johnson, 2001) after cessation of drug use. Estimates of the number of recovering users experiencing drug dreams within a two month window from abstinence vary depending on the study but range from 33% (Hajek & Belcher, 1991) to 84% (Christo & Franey, 1996), and has even reached close to 100% in a study of drug dreams of heroin users conducted by Colace (2014). A decline in the number of drug dreams reported seems to be occurring as recovery time increases: hence, 6 months following the initiation of their study, about 50% of the Christo & Franey’s study participants were still experiencing drug dreams (Christo & Franey, 1996). Johnson’s psychoanalytic work with a recovering client also indicates that although dreams become less frequent as recovery progresses, they nonetheless remain disturbing for the recovering user (Johnson, 2001).

DD frequency during active drug use has not been the object of many studies but data collected as part of DD research during treatment for drug addiction indicated that 97% of the participants in a study of nicotine withdrawal had never experienced a drug dream prior to cessation of nicotine use (Hajek & Belcher, 1991). Colace (2004) on the other hand reported that many individuals participating in a study of DD during heroin withdrawal mentioned experiencing DD despite using methadone replacement therapy during treatment. These results point to the idea that DD may be the result of an array of biological, physiological or emotional factors occurring concurrently with, or following cessation of drug use, rather than a symptom of drug withdrawal or craving.
**DD and negative affect**

It is well known that negative affect experienced through stress, anxiety and depression, is an important factor in the propensity of recovering drug users to relapse (Breese & Knapp, 2005; Cleck & Blendy, 2008; Dagher et al., 2009; Koob, 2008; Sinha, 2008; Witkiewitz & Bowen, 2010). But whereas negative affect has been identified as having the potential to induce a state of craving and potentially relapse in recovering users (Cleck & Blendy, 2008; Breese and Knapp, 2005; Koob, 2008; Sinha, Garcia, Paliwal, Kreek, & Rounsaville, 2006), the specific role of DD in triggering or amplifying the negative affect of participants is not yet firmly established. However, some information pertaining to the emotional content of the dreams about drugs experienced by recovering users, which include panic and guilt (Hajek & Belcher, 1991) make it easy to contemplate the potential of those emotions to increase negative affect upon awakening. In this context, it is most surprising that the relationship between DD, affect and craving has not been given more attention by addiction researchers. Therefore, it is the main objective of this research to clarify the relationship between DD, craving and affect in the early stages of recovery from drug addiction.

1.9. Hypothesis

The main hypothesis of this research is that DD can act as drug conditioned stimuli that elevate negative affect and craving upon awakening. Related to this hypothesis, the following predictions were tested:

1) Negative affect and craving will be dynamically associated with DD occurrence during early recovery;

2) Active versus passive drug use in DD will impact the level of negative affect and craving reported by the participants in the morning.
In order to complement the main analysis, data were also gathered to explore the following DD-related matters;

1) The role of the main drug of abuse in the frequency of DD occurrence;

2) Gender differences in the association between DD, negative affect and craving;

3) The impact of nicotine replacement therapy on DD frequency;

4) The association between specific DD content (situations, emotions, etc.) and negative affect and craving upon awakening.
CHAPTER 2 (Manuscript). Relationship Between Drug Dreams, Affect and Craving During Treatment for Substance Dependence.
RELATIONSHIP BETWEEN DRUG DREAMS, AFFECT AND CRAVING, DURING TREATMENT FOR SUBSTANCE DEPENDENCE

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Abstract

Objectives

To explore the relationship between occurrence of drug dreams (DD) and daytime negative affect and drug craving during the course of a 5-week treatment program for substance dependence.

Methods

Using the dream journal methodology, 86 participants reported occurrence of dreams, dream content, as well as ratings of affect and drug craving. The relations between the experience of DD, dream content (“active” vs “passive”), affect and craving, were analyzed using mixed model methods.

Results

The experience of DD was associated with higher levels of negative affect ($p < .001$) and craving ($p < .001$). The occurrence of DD did not decrease significantly over the 5 weeks of the study. Cocaine/crack users reported a higher incidence of DD ($p = .03$) than the other drug groups (opiates and alcohol), and DD involving “active” drug use was associated with larger ($p < .05$) changes in negative affect.

Conclusions

These results are consistent with the hypothesis that DD can act as drug conditioned stimuli to elevate negative affect and craving in abstaining individuals. Although correlational, such findings support the implementation of psychological and pharmacological interventions aimed at minimizing the impact of DD on individuals in recovery from drug addiction.
2.1. Introduction

Drug dreams (DD) can be defined as dreams in which withdrawing or recovering drug users dream about situations where drugs, drug paraphernalia, drug use or other drug users are present. The content of the dreams has been reported to change as recovery progresses (Reid and Simeon, 2001), but common themes include using drugs, seeking or resisting use, or seeing other people using. DD are generally frequent during withdrawal and protracted abstinence (Christo and Franey, 1996; Flowers and Zweben, 1998; Colace, 2014), are mostly reported within the first week of abstinence (Colace, 2004) and can persist for weeks (Hajek and Belcher, 1991), months (Christo and Franey, 1996), and even years (Johnson, 2001) after the cessation of drug use. Although prevalence rates vary from study to study, it has been estimated that over 85% of individuals experience drug dreams within two months after cessation of drug use (see Colace, 2014 for review).

There appears to be an association between DD and the subsequent experience of drug cravings. This association is suggested by frequent anecdotal reports, and from studies that have explored the psychological and neurobiological bases of these two phenomena. For example, Colace (2004) argued that DD and drug cravings represent two different expressions of the same “motivational drive frustration” that is experienced when someone stops using drugs. More importantly, Johnson (2001) noted that the neural pathways involved in dreaming and drug craving overlap, and a recent review by Perogamvros and Schwartz (2012) indicated that the mesolimbic dopaminergic system, including the amygdala, the striatum and the anterior cingulate cortex, plays a role in both processes.

The main hypothesis underlying the present study is that DD can act as drug conditioned stimuli. Drug conditioned stimuli, which can be discrete (i.e., a syringe) and/or environmental
(i.e., a room), acquire the ability to activate drug-oriented behaviors because they are repeatedly perceived in conjunction with the unconditioned effects of drugs of abuse (Stewart et al., 1984). Hence, through Pavlovian conditioning, drug conditioned stimuli become “wanted” (Robinson and Berridge, 1993) and preferred (Moeller et al., 2009), “grab” attention (Field and Cox, 2008), and produce a variety of physiological and psychological responses (Carter and Tiffany, 1999; Volkow et al., 2006), including increased self-reports of drug craving. Therefore, if DD act as drug conditioned stimuli, they should be followed by a variety of conditioned responses including elevation in cravings. This prediction is consistent with the neurobiological concordance between conditioned craving responses and increased neural activity in the amygdala and the anterior cingulate cortex (Childress et al., 1999).

Within this framework, it is interesting to note that different types of drug conditioned stimuli can cause different physiological and psychological conditioned reactions. For example, Robbins et al. (1997) found that drug related actions (handling drug paraphernalia) triggered more pronounced physiological reactions (lowered skin temperature) than seeing these actions without active participation (watching a video with drug scenes). Therefore, if DD can act as drug conditioned stimuli, it is possible that the content of the dream can also have an impact on craving intensity.

However, even if DD and drug craving share psychological and neurobiological processes, several issues remain unclear. First, although cravings are an inevitable component of withdrawal, as stated in the DSM-5 (American Psychiatric Association, 2013), DD are not (for a comprehensive review of the DD and craving issue, see Colace 2014). Second, disturbed dreaming in the form of “vivid unpleasant dreams” are reported in the DSM-5 as common occurrences during withdrawal from psychomotor stimulants (cocaine, methamphetamines), but
not withdrawal from opiates and alcohol. Therefore, it may be that the experience of DD is related to the primary drug of abuse prior to withdrawal. Third, exposure to drug conditioned stimuli is also associated with the experience of stress and negative affective states (Childress et al., 1988; Childress et al., 1994). DD are typically quite vivid, and bouts of disturbed dreaming (vivid dreams and nightmares) are well known to cause somatic and psychological distress (Zadra and Donderi, 2000; Levin and Fireman, 2002; Blagrove et al., 2004). Furthermore, sleep disturbances have been found to be both precursors and consequences of negative affective states (Zadra and Donderi, 2000), with intensity of nightmares being predictive of level of emotional distress during wakefulness (Levin and Nielsen, 2007). Therefore, DD may elevate craving as a consequence of disturbing sleep and/or by inducing negative affective states upon awakening.

The main objective of the current study was to investigate DD occurrence and dream content in subjects attending 5-week residential treatment programs. The overarching hypothesis was that DD act as drug conditioned stimuli and therefore can negatively impact daytime affect and cravings. Based on findings presented above, it was also predicted that occurrence of DD would change during treatment, that it would be related to the type of drug primarily abused, and that DD content (“active” vs “passive:” see below) would be associated with intensity of daytime negative affect and craving.

2.2. Methods

2.2.1. Subjects

Participants were recruited between January 2012 and March 2013 from two residential treatment centers in Ontario offering 5-week long abstinence-based programs consisting primarily of group and individual therapy. Males and females, 18 and over, were included in the study. Forty-five participants were recruited from a woman-only facility (Womankind St.
Joseph’s Healthcare, in Hamilton) and 41 were recruited from a mixed-gender treatment center (Homewood Health Centre, in Guelph). Demographic data, main drug of abuse, frequency of use in the month preceding admission, as well as mental health diagnosis, are presented in Table 1. Potential participants were informed that the experience of DD was not a requirement for inclusion in the study. Those suffering from active psychosis or untreated schizophrenia symptoms were excluded. The research protocol was approved by the University of Guelph Research Ethic Board, as well as Homewood Health Centre and St Joseph’s Healthcare Hamilton Research Ethic Boards.

The number of required participants was calculated with G-Power 3.1 using conservative estimates (medium effect size, alpha at 0.05 and predicted correlation amongst measures of 0.3; power = 0.95). This method was used as a general guideline because, as far as the authors know, this type of study has never been performed. A sample size of 63 participants was suggested, and to account for an anticipated drop out rate of 20%, the sample size was set to a minimum of 76 participants. The final sample size was subsequently increased to better balance male/female ratio, bringing the total number of participants to 86.

2.3. Measures
2.3.1. Questionnaires

Subjects provided informed consent following a description of study objectives and participation requirements, and they completed a questionnaire designed to gather demographic data, drug use and treatment history information.

During this initial session, they were also provided with the first week of dream journals. They were instructed to complete these journals, daily upon awakening, to report dreams and, if they were drug dreams, their content. The dream journal/diary method is considered a valid
approach to explore the association between psychological health and dream content (Pesant and Zadra, 2006) as well as relations between dream content and events experienced during the day (Schredl and Hofmann, 2003). Other methods, such as ecological momentary assessment, that would allow stricter control on when measurements are taken were not applicable to this study because it was impossible to estimate, on an individual basis, what was the most desirable time interval between awakening and explicit/accurate report of dreams and their content. This, of course, is an issue common to all studies of dreams.

The dream journal also included questions about drug cravings and affect. A single item visual-analog scale (0 to 10 cm) was used to self-report drug craving (Goddard et al., 2013). Affect was indexed by the PANAS scale - 10 items for each, scale: 1 to 5 (Watson, Clark & Tellegen, 1988), although only negative affect scores were analyzed in this manuscript.

The participants received a gift certificate for participation in the study regardless of the number of dream journals that were completed during the week.

2.3.2. Data analysis

Each participant reported whether they experienced a DD or a regular dream (RD) during the night. If neither was reported, the rater classified the night as a “no dream” (ND). Although it was not commonly observed, when a journal included both DD and RD in the same night, the rater classified the night as DD.

Linear mixed modeling (SPSS v21) was used to evaluate the relationship between dream type and self-reported scores of craving and negative affect. This particular method of data analysis was employed because it has the advantage of retaining participant’s data despite missing entries throughout the dataset (missing questionnaire entry, or drop out from the study).
Moreover, time (weeks of the study) is treated as continuous variable, and the method allows for post-hoc mean comparisons using the Bonferroni adjustment.

To assess whether occurrence of DD changed over time, the percentage of total dreams that involved drugs was compared across the 5 weeks of treatment using a repeated measures ANOVA. To assess the relationship between occurrence of DD and intensity negative affect and craving, Pearson correlations were performed for all weeks combined, and separately for each week of the study. To explore whether the type of primary drug of abuse was related to occurrence of DD, the three most commonly reported drug choices were compared (see Table 1): cocaine/crack, alcohol and opiates (oxycodone, heroin and morphine were merged).

Finally, the content of each DD was evaluated by two independent investigators for description of: 1) use of drugs - injecting, snorting, smoking or drinking; 2) searching drugs; 3) resisting use; 4) temptation to use; and 5) looking at, or seeing, drugs. However, because the self-reports of categories 2 to 5 was low, such dreams were merged and categorized as “passive” DD, and were compared to dreams in category 1 - “active” DD. The inter-rater reliability Cronbach’s alpha was 0.90.

2.4. Results

Information pertaining to the main characteristics of subjects is reported in Table 1. Fifty-two (60.5%) reported poly-drug use, while thirty-four (39.5%) reported using only one drug. Analysis of drug use prior to admission indicated that 65% of the participants had less than a week of abstinence prior to initiation of treatment. Over the entire study period, considering that the average stay in treatment was 2.2 weeks, a total of 1324 dream journals were collected (1 journal per night per participant). This average length of stay reflects a treatment drop out rate that is typical of many residential programs.
In these dream journals, 633 (74%) and 227 (26%) RD and DD were reported, respectively (mean RD per week/participant = 3.4; mean DD per week/participant = 1.3). Fourteen (21%) participants never reported a DD, and 8 (12%) reported no RD during their participation in the study. The proportion of participants who reported at least one DD during the study period was: week 1 = 49%; week 2 = 57%; week 3 = 61%; week 4 = 51%; and week 5 = 22%. Compliance rate for dream journals completion, defined as number of daily dream journals filled out in relation to the total number of days of participation in the study, was 88.6%. Drop out rate, defined as number of participants who enrolled in the study but for whom no dream journals were received, was 17.4%.

The linear mixed model analysis indicated that craving scores following DD were significantly higher than following ND and RD in weeks 2-4 (see Figure 1). The overall (all weeks included) correlation between DD occurrence and intensity of craving was significant ($r = 0.37, p < .05$), but the effect was primarily due to a significant correlation in week 3 ($r = 0.62, p < .001$), possibly because of smaller sample size in weeks 4 and 5.

Similarly, the linear mixed model analysis indicated that negative affect scores following DD were significantly higher than following ND and RD in weeks 2-4 (see Figure 2). The overall (all weeks included) correlation between DD occurrence and intensity of negative affect was significant ($r = 0.33, p = .02$), but the effect was primarily due to significant correlations in weeks 2 and 3 ($r = 0.47, p < .05$ and $r = 0.51, p < .05$, respectively), possibly because of smaller sample size in weeks 4 and 5.

The occurrence of DD, calculated as a mean frequency of DD in proportion to all dreams experienced by a participant during a given week (only participants who experienced at least 1
DD during each week of the study were included in this ANOVA) did not decrease significantly from week 1 to week 5 (Means = 43, 42, 42, 41 and 27, respectively; [F(4, 48)= 0.84, p = .51]).

The occurrence of DD was found to vary as a function of the primary drug of abuse. Hence, when all DD nights were pooled amongst participants, a higher percentage of DD was reported by cocaine/crack users (26.1%), in comparison to alcohol and opiate users (12.6% and 13.1%, respectively).

Finally, “active” DD were associated with significantly higher negative affect scores than “passive” DD (see Figure 3A; mixed linear model, p < .05). This relationship was also observed on the craving measure (see Figure 3B), but it was not statistically significant.

A final exploratory analysis investigated possible differences between females and males. A Chi-square analysis did not reveal a significant difference in overall dreaming frequency (drug dreams and regular dreams calculated as a percentage of all nights in the study; females = 52.5%, males = 53.3%, χ² = 0.06, p = .80), but females experienced more drug dreams (females = 18.3%, males = 13.5%, χ² = 4.56, p = .003). This said, the relationships between DD and craving and negative affect were similar in both females and males.

2.5. Discussion
This study explored the relationships between the experience and content of drug dreams (DD) and self-reported drug craving and negative affect in 86 volunteers enrolled in two residential addiction treatment programs. It was found that the experience of DD was associated with higher levels of both craving and negative affect. Also, the relationship between DD content and daytime negative affect was significantly greater for dreams involving drug use (i.e., “active”) than for dreams involving searching drugs, resisting use, temptations to use, and looking at/seeing drugs (i.e., “passive”). The same was observed for craving, but the result was not statistically significant. Finally, individuals in treatment for cocaine/crack addiction reported
a higher occurrence of DD than those in treatment for alcohol or opiate addiction. Taken together, these correlational data are consistent with the hypothesis that DD can act as drug conditioned stimuli to elevate craving and negative affect in abstaining individuals. Given the role of these subjective experiences in continued drug use (Sinha et al., 2000) and relapse (Sinha et al., 2006), it is concluded that interventions aimed at minimizing the emotional impact of DD may be clinically relevant.

In the current study, occurrence of DD did not decrease significantly over the 5 weeks of treatment. However, it has been observed that frequency of DD significantly abates over longer periods of time (i.e., months following treatment; Christo and Franey, 1996; Reid and Simeon, 2001; Yee et al., 2004). Hence, because almost half of the participants stopped using drugs only a few days prior to recruitment in the current study, it appears that DD may be particularly common during early withdrawal from drugs. This may also explain why there were no significant relationships between DD and cravings or negative affect in week 1: acute withdrawal may have interfered with the ability of the subjects to identify and/or self-report dreams and affective states.

There are at least three possible interpretations for the main findings of this study. First, as stated above, the hypothesis formulated on the basis of neurobiological evidence suggests that drug dreams function as drug conditioned stimuli and, therefore, can induce conditioned responses experienced either during sleep, or during subsequent waking. However, a second interpretation suggests that DD act as general stressful stimuli, rather than specific conditioned stimuli. Indeed, it is known that disturbed dreaming alters sleep (Simor et al., 2012), and that disturbed sleep can cause negative affective states (Zadra and Donderi, 2000; Levin et al., 2011). Here, it is important to note that 52% of participants in the present study reported being
awakened by their DD. Of course, these two interpretations are not mutually exclusive, and it is very likely that DD, craving and negative affect interact in complex ways. For example, there is evidence that hypnotically-induced negative mood states alter the intensity of craving precipitated by exposure to drug conditioned stimuli (Childress et al., 1994).

The third possibility is that withdrawal symptoms, negative affect, and craving experienced during the day induced dreams about drugs. This would be consistent with the observations that negative affect experienced during the day can promote disturbed dreaming during the night (Pesant and Zadra, 2006), and that dream content is frequently based upon the thoughts and activities of one's daily experience (Zadra and Donderi 2000). Unfortunately, this interpretation, which essentially reverses the direction of effect hypothesized in the current study, cannot be ruled out by empirical investigations. This said, it should be noted that: while dependent users experience craving during withdrawal, not all concurrently experience drug dreams; in this study, cocaine users reported more drug dreams than alcohol users, and there are no a priori reasons to believe that these two sub-groups would have different experiences during treatment; the participants were attending residential treatment centers, and consequently they were not using drugs, or manipulating drug paraphernalia, as part of their daily activities; and finally, thoughts about drugs, while inevitable during treatment, are also prominent during active drug use, and yet drug dreams during active use periods are quite infrequent.

To our knowledge, this is the first demonstration that DD involving use of drugs (i.e., “active”) are significantly associated with affect scores reported upon awakening. This is consistent with the observation of more pronounced cue-reactivity in subjects asked to actively manipulate drug paraphernalia (Childress et al., 1988; Robbins et al., 1997) and supports the possibility that drug stimuli experienced during dreaming may be similar to drug stimuli
perceived during waking. Furthermore, the current study also revealed that main drug of abuse may be related to the experience of DD during early withdrawal, with cocaine/crack being associated with the highest occurrence, followed by opiates and alcohol. This evidence, although preliminary, is in line with the inclusion in the DSM-5 of disturbed dreaming episodes as common symptoms of withdrawal for stimulant abusers. For the moment, neuropharmacological mechanisms underlying this observation remain unclear.

When interpreting the results of this study, it is necessary to consider additional limitations. First, all data were self-reported retrospectively, and although it is know that self-report measures of dreaming, drug use, craving and negative affect are generally valid (Pesant and Zadra, 2006; Rosenberg, 2009; Sinha et al., 2009; Perez and Arroyo, 2010), there is no empirical method to verify the accuracy of self-reported dreams and dream content. This, however, does not undermine the relevance of dreaming and dream content as relevant human subjective experiences, nor should deter investigations of the phenomenon. Second, it is possible that the correlations among the variables of interest were an artifact of them being collected all at the same time. This, however, is unlikely because the results changed over the 5 weeks of the study. Third, because the dream journals were collected once a week, it is possible that participants did not comply with the protocol of daily recordings. This, however, is also unlikely because no penalties were incurred for skipping journals, and it seems unlikley that dream content was fabricated just prior to the collection of the journals. Fourth, the statistical power of this study was not conceived to allow inclusion of mental health disorders (such as: depression, anxiety, post-traumatic stress disorder, schizophrenia) and level of dependence, as covariates in the analyses. Clearly, all of these factors could mediate the relationship between dreaming, craving and negative affect. Fifth, the clinical relevance of the findings could be questioned
because the averaged self-reported scores on the craving scale and on the PANAS were in the mid-low end of the range. This, however, could simply be the outcome of having studied subjects within a residential clinical setting. Many participants also reported a mental health diagnosis concurrent to their substance dependence. There is a possibility that the conditions themselves, or the medications used to treat them, could have impacted dreaming patterns during the study. However, since the diagnoses were reported as pre-existing, most of the participants were already stabilized on their medications, these confounding elements are unlikely to play a major role in the results. Finally, the analysis of DD occurrence in groups created on the basis “main drug used” is limited by the fact that most participants were poly-drug users.

Notwithstanding these limitations, the current results suggest the interesting possibility that DD may be associated with emotional responses considered central to the process of recovery from drug addiction. Within this context, it should be considered that the experience of DD, unlike exposure to environmental drug conditioned stimuli, cannot be readily controlled by an individual. Therefore, imagery rehearsal therapy, which is used to treat post-traumatic nightmares (Casement and Swanson, 2012) or chronic nightmares (Krakow and Zadra, 2006), may be beneficial for those who experience frequent and vivid DD. Also, drugs such as Prazosin, an alpha-1 adrenergic antagonist, may be considered as adjunct pharmacotherapy for individuals who are particularly troubled by DD. This drug is considered an effective treatment for post-traumatic stress disorder nightmares (Kung et al., 2012), and there is preliminary evidence that it can reduce craving precipitated by stress and exposure to drug cues (Fox et al., 2012). Incidentally, if DD are partly reflective of craving and negative affect experienced during the day as a result of withdrawal, then clinical approaches to reduce their impact could be conceived as a broader withdrawal management strategy.
2.6. Conclusion

Using a methodology based on retrospective self-reports, it was found that the occurrence of drug dreams was associated with higher levels of both negative affect and craving. These correlational data support the hypothesis that drug dreams can act as drug conditioned stimuli, and suggest that some individuals in acute withdrawal from drugs may profit from specialized psychological and pharmacological interventions.

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CHAPTER 3 - Additional Analysis/ Results.
3.0. Relationship between DD, affect and craving

The overall objective of the study was to explore the association between drug dreams (DD), affect and craving during early treatment for drug addiction. To measure affect, participants were asked to complete the PANAS scale short form (Watson, Clark & Tellegen, 1988) every morning upon awakening. The PANAS-SF instrument is composed of 10 negative and 10 positive emotions that are scored by the participants on a Likert scale of 1 (do not experience/ very little) to 5 (severe experiencing of this emotion). The craving score was also measured on a Likert scale from 0 (no craving at all) to 10 (extreme craving). A linear mixed modeling method was used to assess direction and significance of association between types of dreams experienced, affect and craving. To do so, each night was entered as belonging to one of three dream categories, that is, drug dream (DD), regular dream (RD) and no dream (ND). Those three levels (DD, RD and ND) of predictor variables were tabulated as a fixed effect in the model and each night was entered as a repeated effect, whereas the participants’ ID acted as the subject variable. When two types of dreams (DD and RD) were reported during the same night, a DD always took precedence over the report of a RD, and only the DD score was tabulated in the analysis (in order to have only one type of dream per participant per night). Pairwise comparisons of the mean affect/craving scores for each dream type were subsequently calculated, and an analysis of the mean difference of those scores was computed with Bonferroni corrections. In addition, Pearson correlation analyses were conducted to explore associations between mean affect (positive and negative) and mean craving scores, using data consolidated at the participant level.
As presented in Chapter 2, the linear mixed model analysis indicated that when all weeks were combined, negative affect scores following DD (means range 2.08 to 2.14) were significantly higher than following ND and RD (means range from 1.33 to 1.57) in weeks 2-4 (see Figure 2), all \( p \)-values < .001. The overall (all weeks combined) correlation between DD occurrence (percentage of nights when participant experienced a drug dream) and intensity of negative affect (average negative affect score per participant) was also significant \( (r = .33, p = .02, n = 54, 95\% CI .06 to .61) \), but the effect was primarily due to significant correlations in weeks 2 and 3 \( (r = .47, p < .05, n = 35, 95\% CI .17 to .86 \) and \( r = .51, p < .05, n = 31, 95\% CI .19 to .93 \), respectively). As already presented in Chapter 2 also, craving scores following DD \( (M = 3.07 to 3.68) \) were significantly higher than following ND and RD \( (M = 1.36 to 2.14) \), see Figure 1.

In the manuscript (Chapter 2), the focus was placed on the exploration of the impact of DD on the negative affect and craving scores reported by participants during treatment. However, the literature review revealed that dream content and positive affect during the day may also be correlated. Hence, studies on the association between dream content and wellbeing suggest that the continuity effect applies to both positive and negative events. Therefore, in this research study, a data analysis was also performed with the positive affect scores to test whether participants would also experience a fluctuation of their positive affect and craving depending on the type of dream experienced and to assess whether positive affect scores would fluctuate concurrently or independently of the negative affect ones. The positive affect was analyzed using the same methodology adopted for the negative affect (mixed linear modeling).

The results of the positive affect and dream analysis revealed very little variations overall in the 5 weeks of the study, both within and between weeks (Figure 4). Only week 1 and 2
revealed significant differences in mean positive affects between types of dreams experienced. In week 1, a significantly lower mean positive affect score was found for participants who reported a night with DD ($M = 2.43$) compared to a night with ND ($M = 2.76$), $p < .05$. Lower affect scores were also noted when RD ($M = 2.41$) were experienced compared to ND ($M = 2.76$) during that first week, $p < .001$. In week 2, the experiencing of a DD ($M = 2.38$) resulted in lower positive affect scores than the experiencing of RD ($M = 2.71$) or ND ($M = 2.76$), $p < .001$ in both cases.

In the literature on DD, it has been suggested that a direct relationship exists between craving and DD (see: Colace, 2014 for a review). However, it has also been established that cravings are not always associated with the occurrence of DD and that consequently, other factors may have an impact on their occurrence during early recovery. Whereas the dynamic between craving and negative affect has not been the object of much attention in the DD literature, craving implies the longing for an unmet need, which certainly underlines the experiencing of a negative affective state. To ascertain the relationship between the variables (craving, negative affect, positive affect) a mixed modeling analysis was performed. In the models the craving score was a dependent variable, and the affect score (positive or negative) was the independent variable. We found statistically significant positive medium association between craving and negative affect ($p < .001$, $r^2 = .13$) and inverse small significant association between craving and positive affect ($p < .001$, $r^2 = .06$). In addition, the average affect and craving scores were calculated for each participant for the entire period of their participation in the study and a correlation analysis was conducted with these data. When all participants for whom data was available were included in the analysis ($n = 68$), both negative and positive affect
scores showed a significant correlation to craving scores \( (r = .45, 95\% \ CI \ .24 \ to \ .72 \ for \ negative \ affect \ and \ r = -.37, 95\% \ CI \ -.15 \ to \ -.63 \ for \ positive \ affect, \ both \ p < .001) \).

The data pertaining to affect and craving was furthermore broken down into two separate categories for each week of the study, that is, one for the participants who experienced at least one DD during a given week and the other for those who did not. When only the group having experienced DD was selected, the results showed significant positive strong correlations between negative affect and craving for week 1 to 4 inclusively (\( r \) values varies .43 to .68, see Table 2). The same type of analysis relating positive affect with craving when DD were experienced revealed a significant negative strong correlation in weeks 3 and 4 only (\( r = -.48 \) and \( r = -.57 \) respectively, also in Table 2).

A correlational analysis between the same variables for participants who did not experience DD during a specific week revealed a significant positive strong relationship in week 5 only for negative affect and craving (\( r = .50, 95\% \ CI \ .15 \ to \ .96, \ n = 26, \ p < .05 \)) and negative strong significant relationship in week 3 only for positive affect and craving (\( r = -.54, 95\% \ CI \ -.10 \ to \ -1.00, \ n = 18, \ p < .05 \)), see Table 3.

Correlation coefficients for DD frequency in relation to negative affect and craving were also calculated using the following method: 1) for each participant, the percentage of DD in relation to total number of dreams (DD and RD) experienced during the study period was calculated as the DD frequency; 2) mean affect and craving scores for each participant for the duration of their participation in the study were also calculated; 3) Correlation coefficients were derived from the data resulting from step 1 and 2. Only participants who experienced at least one DD during their participation in the study were included in this analysis (\( n =54 \)). Significant positive moderate relationships were found between DD frequency and craving (\( r = .37, 95\% \ CI \).
.11 - .66, \( p < .001 \)) as well as DD frequency and negative affect (\( r = .33, 95\% CI .06 - .61, p < .001 \)).

When analyzed for each week of the study, it was noted that the above correlation coefficient for DD frequency and craving is the result of a significant strong correlation in week 3 of the study (\( r = .62, 95\% CI .36 \) to 1.00, \( p < .001 \)) whereas the DD frequency and negative affect coefficient is the result of significant correlations in week 2 and 3 (\( r = .47, 95\% CI .17 \) to .86 and \( r = .51, 95\% CI .19 \) to .93 respectively, both \( p < .001 \)) (Table 4).

Finally, the “craving yesterday” data reported in the Dream Journals were analyzed in order to assess whether the level of craving the day before the dreaming occurrence could be associated with the type of dream experienced during the night. A mixed model analysis was performed and it was found that craving scores for the day preceding the dreaming are not significantly different between those who had the drug dream (\( M = 2.95 \)), those who had regular dream (\( M = 2.71 \)) and those who had no dream of any kind (\( M = 2.62 \), \( p = .08 \)).

3.1. Nicotine patch and DD frequency

It has been well documented through clinical trials reports and research studies on nicotine replacement therapy (NRT) that such treatment results for many users in increased frequency of dreaming episodes and/or episodes of vivid dreaming. Since nineteen (22%) of the 86 participants in the current study were using NRT during their treatment program, it was important to assess whether a difference in dreaming frequency could be observed between nicotine patch users and non-users. By calculating the percentage of nights with DD for NRT versus non-NRT users, it was found that NRT participants reported a higher percentage of nights with DD than their non-NRT users counterparts (32.1\%, \( CI 26.3\% - 37.9\% \) for NRT users, versus 20.8 \%, \( CI 17.5\% - 24.1\% \) for non-NRT users). To confirm these results, a Mann-
Whitney test was performed with the hypothesis that NRT users would dream more during the study than non-NRT participants, as stipulated in the literature. A significant difference was in fact found between the two groups (Mann-Whitney, \( p = .03 \), 1-tailed) supporting the values obtained by comparing DD nights as a percentage of all nights in the study for NRT users and non-users.

**A role for the primary drug of abuse in DD**

DD frequency has been reported in various studies as a function of time in recovery but not in terms of its variability in relation to the primary drug of abuse. This lack of differentiation between primary drug use and DD frequency may reflect the difficulty in making a distinction between primary and secondary drug of abuse in the case of polydrug use or may also be due to the generally small sample sizes of participants in DD studies that preclude this type of comparative analysis. Exploring the variability of DD frequency in relation to primary drug used, however, may provide some valuable information as to the role of different drugs on DD. In the current study, 21 (25\%) participants reported crack/cocaine as their primary drug of abuse, compared to 36 (43\%) participants for alcohol and 14 (16\%) for opiates (heroin, Oxycontin and morphine). A percentage of nights with DD was performed in relation to the total number of night in the study for the three groups mentioned above. The results revealed that the occurrence of DD, in fact, varies as a function of the primary drug of abuse. Hence, when all DD nights were combined amongst male and female participants, a higher percentage of DD was reported by cocaine/crack users (26.1\%, \( CI 21.8\% - 30.3\% \)), in comparison to alcohol (12.6\%, \( CI 9.8\% - 12.4\% \)) and opiate users (13.1\%, \( CI 8.1\% - 18\% \)). To confirm these results, a Kruskal-Wallis test (equivalent to one-way ANOVA) was conducted and confirmed that a significant group difference exists between the drug categories (\( p = .03 \)). It was found that users of crack/cocaine
experienced a significantly higher proportion of drug dreams than users of other drugs (alcohol, opiates).

3.2. Gender analysis

Since it has been found in the literature on dreaming that both dream frequency and dream content vary between males and females (Schredl & Reinhard, 2008), a breakdown of the data by gender was done in order to assess whether specificities would also emerge in terms of the affect and craving scores reported by males versus females following DD, RD and ND. Moreover, the data was broken down by primary drug of abuse for the female participants group in order to gain some insight as to the impact of specific drugs of abuse on the relationship DD and affect and DD-craving. Due to the relatively small number of male participants in the study (n=25), a similar breakdown by primary drug used could not be performed for that group. The methodology used to analyze the gender specific data is the same as the one used for the mixed gender analysis, that is, linear mixed modeling method with pairwise comparisons.

Males only

The results of the male only analysis (n=25) revealed a significantly higher level of negative affect following nights with DD (M=1.79) compared to nights with RD (M=1.45), but only in week 4 of the study (Figure 5), p = .01. The mean positive affect score was only significantly lower for participants that had experienced a DD (M=2.43) than for those that had experienced a RD (M=2.93) in week 2 (see Figure 6), p = .04.

For the craving scores, an intriguing result in week 1 revealed that RD occurrences were followed by higher craving scores (M=3.46) than DD nights (M=1.21), p = .01. However, this result may be an artifact of the small sample size for the male group overall which resulted, when
the data were broken down by dream types, in inadequate sample sizes for comparison purposes. For the remainder of the study period, only in week 4 were statistically significant mean differences observed between ND \( (M = 1.71) \) and RD \( (M = 1.57) \), as well as DD \( (M = 1.98) \) and RD \( (M = 1.57) \), \( p < .01 \) in both cases (Figure 7).

**Females only**

When affect scores per dream type were analyzed with the mixed modeling methods for the women only group \( (n = 61) \), the mean negative affect score was significantly higher after the experiencing of a DD night (means range from 2.15 to 2.71) than RD or ND night (means range from 1.22 to 1.57) in weeks 2 to 5 inclusively \( (p < .001 \) for all weeks and comparisons) - Figure 8.

Positive affect scores in relation to the type of dreams experienced showed significant statistical differences between DD \( (M = 2.28 \) for week 1, \( M = 2.35 \) for week 2) and ND \( (M = 2.68 \) for week 1, \( M = 2.76 \) for week 2) but only in week 1 and 2 \( (p = .02 \) for week 1 and \( p = .02 \) for week 2). As expected, in both weeks the occurrence of ND resulted in a higher positive affect upon awakening than the experiencing of a DD (Figure 9).

In terms of the craving scores relationship to the type of dreams experienced for week 1 to 5, the analysis revealed that for week 1 to 4 inclusively, DD nights were followed by higher craving scores (means range 3.32 to 4.07) than ND or RD nights (means range 1.58 to 2.63), \( p < .05 \) in week 1 and \( p < .001 \) for all other weeks and comparisons (Figure 10).

Based on the chi-square analysis results indicating significant differences in the frequency of DD per primary drug of abuse, a subsequent analysis was carried out to assess whether the main drug of abuse could also impact on the level of craving reported in the
morning. A mixed model analysis was performed with the data from the female participants group for each of the two primary drugs of abuse (21 participants for cocaine, and 19 participants for alcohol). We looked at craving score as dependent variable and dream category as a factor.

The results of the analysis for female participants recovering from cocaine addiction revealed a pattern of craving following a DD similar to that found in the analysis performed in the mixed gender analysis. In weeks 2 and 4 DD nights were followed by a significantly higher level of craving ($M = 3.87$, $M = 3.25$) than reported when ND nights were experienced ($M = 1.86$, $M = .87$), $p < .001$ for both weeks. In weeks 2 to 4 DD nights also had significantly higher craving scores (means range 3.25 to 3.87) when compared to RD nights (means range 1.45 to 2.46), $p < .05$ for all 3 weeks (Figure 11).

The alcohol only analysis showed no clear pattern between levels of craving reported following DD, RD and ND nights. Significant differences were observed only in week 2 for DD ($M = 3.66$) versus RD ($M = 1.73$) and DD ($M = 3.66$) versus ND ($M = 1.15$), $p < .001$ in both cases (Figure 12).

3.3. Dream content analysis

In order to explore whether DD content could be related to the level of craving and negative affect reported by participants in the morning, the DD content of each dream was assigned to one of five DD categories specific to drug themes commonly encountered by participants. Those categories were as follows: 1) using drugs, 2) seeing drugs, 3) searching for drugs, 4) seeing other people use and 5) resisting use. Two independent investigators reviewed the dreams to evaluate their respective drug content and assign them to one of the five categories mentioned above. When both passive and active drug scene content was found in the same dream, it was categorized as a “using dream”. The inter-reliability Cronbach’s alpha was .90 for
the two independent investigators. The categories were partly based on research findings related to cue-craving in addiction that found a difference between the type of cues experienced by the participants and the craving response believed to be associated with those drug cues (as presented in the literature review). However, because the sample sizes of categories 2 to 5 were very small, they were merged and categorized as “passive drug scenes” and compared to category 1 (active use of drugs). A mixed model analysis revealed that DD in which active drug use was reported were followed by significantly higher negative affect scores than DDs in which drugs were involved, but not used by the participant ($p < .05$) – Figure 3. This relationship was also observed on the craving measure, but it was not significant.

An in-depth analysis of specific dream content was also performed in order to explore whether dream content can be related to the affect and craving scores reported by the participants in the morning. In this analysis, categories related to social interactions, drug paraphernalia, characters, emotions and places were developed (Table 5) and each of the 227 drug dreams was subsequently scored, reporting the occurrence of each item on a dichotomous scale. The inter-reliability Cronbach’s alpha was .90 for the two independent investigators. A linear mixed analysis was then performed to explore whether the presence of those specific content items in DD (independent variable) could be associated with higher affect and craving scores (dependent variable) than when such content was not identified in the DD. Given the relatively small samples of dreams containing the specific content, the dreams of male and female participants were analyzed together for the five weeks of the study, rather than for each week separately.

The results of the analysis revealed that when dream content related to fear (Afraid), distress (Distress) and nervousness (Nervous) was present in the DD, the negative affect score reported on the PANAS scale in the morning was significantly higher ($M = 2.70$ for fear, $M = $
2.43 for distress, and $M = 2.76$ for nervousness) than when no such content was reported ($M = 2.06$ for fear, $M = 2.06$ for distress, $M = 2.06$ for nervousness), $p < .001$, $p < .05$ and $p < .001$ for the three variables, respectively. Only one content category (Happy) was significantly associated with all three variables (negative affect, positive affect and craving scores). Hence, when happiness was reported in a DD, the mean negative affect score reported by participants in the morning ($M = 2.84$) was more elevated than when no such content was present in the dream ($M = 2.07$), $p < .001$. The opposite trend was noted for positive affect, that is, no report of happiness during a DD was associated with a higher mean positive affect scores in the morning ($M = 2.38$) than the presence of happiness ($M = 1.93$), $p < .05$. Happiness in DD also proved to be significantly associated with higher mean craving scores in the morning ($M = 5.55$) than the absence of such emotion in a DD ($M = 3.33$), $p < .001$. 
CHAPTER 4 – Participants Follow up
4.0. Methodology

Participants who agreed to the phone follow up during the initial interview session were contacted 3 months following the end of their treatment program. Since participants discharging themselves from treatment before the end of their program did not automatically end their participation in the study, follow up data were also collected from those participants. As per the research ethics agreement with the treatment centres for the conduct of this study, all participants reached for the phone follow up were reminded that they could decline to participate and were free to skip any follow up questions they did not feel comfortable answering. Also, to minimize the disturbances that may be caused by too many attempts to reach participants on the phone and to preserve confidentiality of the process, it was agreed that voice mail would not be left and only 3 attempts would be made to contact each participant via phone.

The phone follow up was designed to assess the occurrence of DD since discharge from treatment and to inquire whether participants had experienced a lapse, relapse, or maintained their abstinence during that time period. A questionnaire consisting of 7 questions pertaining to the occurrence of DD as well as lapse and relapses was followed in order to ensure consistency with both the order in which the questions were asked and the semantic used by the investigators (see Appendix). The follow up calls were conducted by either the main investigator (Hélène Tanguay) or her research assistant, and were completed within a few days from the 3-month end of program period. Each follow up took about 5 minutes to complete and consisted of multiple-choice questions.

4.1. Follow up process challenges and limitations

Unfortunately, and for many reasons that are beyond the control of the investigators, the number of participants who could be reached for the follow up was very limited, which impeded
the ability to carry out follow up analysis with reliable power. One of the main hurdles that was faced by the investigators was related to the transience of many individuals who participated in the study, meaning that by the time the follow up took place, many phone lines had been disconnected, or participants had changed phone number. This is not surprising as it is well known that drug addiction often times results in economic and social difficulties that may translate in a fairly high transience rate for individuals affected by the condition. Finally, many participants could not be reached within the 3 phone calls limit agreed to during the initial interview, while a few others simply declined to participate.

4.2. Results

Due to the hurdles described above, follow up data could be collected for only 19 (22%) of the 86 participants in the study. This, of course, precluded the finding of significant results in the analysis performed. Moreover, breakdown of the data by gender or main drug use in relation to DD frequency and relapse at follow up could not be performed due to those challenges. Therefore, the presentation of the follow up data is intended to portray a descriptive snapshot of relevant participants’ data during treatment and at follow up rather than the presentation of in-depth statistical analysis results on the obtained data.

Demographic data for follow up participants

Fourteen females (73.6%) and five males (26.3%) participated in the phone follow up. The main drug used by the participants prior to treatment was alcohol for 10 participants (58.8%), followed by opiates (26.4%) for 5 participants, cocaine (5.3%) and cannabis (5.3%) for 1 participant respectively. Two follow up participants (10.5%) did not report main drug use information at the onset of the study.
**DD occurrence and vividness following treatment**

At follow up, 15 (78.9%) participants indicated that they experienced at least one DD since the end of their residential treatment whereas 4 (21.1%) indicated that they had not experienced any. The frequency of DD occurrence since the end of the treatment period was reported as follows: 6 (40%) participants experienced 1-2 DD, 4 (26.7%) had 3 to 4 DD, and 5 participants (33.3%) experienced more than 4.

The follow up questionnaire also inquired about the vividness of the DD experienced during the 3 months following end of treatment. Of the 15 participants who experienced DD in that time period, 9 (69.2%) reported that those DD were more vivid than their regular dreams, 4 (26.7%) stated that they were not, and 2 (13.3%) responded that they did not know.

**Lapse, Relapse and DD at follow up**

Of the 19 follow up participants, 6 (31.6%) reported a relapse since the end of their residential treatment program while the other 13 (68.4%) reported that they maintained their recovery. Only 1 (5.3%) participant reported a lapse without a full relapse during that time period.

**Frequency of DD during treatment and relapse at follow up**

A Mann-Whitney test was performed to explore whether the number of DD experienced during treatment could be associated with relapse at follow-up. Sixteen of the nineteen follow up participants (84.2%) experienced DD during treatment and were therefore entered into the analysis. Of those, 5 (31.3%) reported a relapse at follow up and 11 (68.7%) did not. Although
the Mann-Whitney test was not significant, it showed a higher frequency of DD during treatment for those who had relapsed at follow up ($Mdn = 11.30$) compared to participants who had remained abstinent ($Mdn = 7.23$), $U = 13.50$, $p = .107$.

**Frequency of DD since end of treatment and relapse**

A Chi-square analysis was performed to assess whether the frequency of DD experienced during the 3 month following treatment had a relationship with the occurrence of relapse. To perform the analysis, two categories of DD frequency were created, i.e. 1-2 DD, and 3 or more DD respectively. The first category included 6 of the 15 participants (40%) while the second one included 9 (60%). The results of the Chi-square were not significant $\chi^2(1, N = 15) = 0.18$, $p = .67$. 
CHAPTER 5 – Discussion
5.0 Summary of findings

The main objective of the study was to explore the relationships between the experience and content of drug dreams (DD) and self-reported drug craving and negative affect in 86 volunteers enrolled in two residential addiction treatment programs. It was found that the experience of DD was associated with higher levels of both craving and negative affect. Negative affect scores also demonstrated a stronger and more consistent association with DD nights compared to positive affect scores. These findings were supported by a correlational analysis that revealed a stronger relationship between negative affect and DD than between positive affect and DD.

Mean craving scores were for their part significantly higher following nights with DD than when RD or ND nights were experienced. However, mean craving scores were not significantly different amongst participants on the day preceding the dream night report. Negative affect and craving scores were significantly correlated in four of the 5 weeks studied for the participants who had experienced at least one DD during a given week, whereas no such significant correlational pattern was observed when no DD was experienced.

In terms of the exploration of DD frequency in relation to the main drug of addiction, it was found that cocaine users experienced more DD than their opiates or alcohol users counterparts. Nicotine patch users for their part experienced more DD but not more dreams overall during treatment than non-patch users.

When a female only analysis was performed, the negative affect scores in relation to the experiencing of DD, RD and ND for each week of the study followed the same general pattern as the one observed for the mixed gender analysis, whereas no such pattern was observed in the male only analysis.
Finally, the relationship between DD content and daytime negative affect was significantly greater for dreams involving drug use (i.e., “active”) than for dreams involving searching drugs, resisting use, temptations to use, and looking at/seeing drugs (i.e., “passive”). The same was observed for craving, but the result was not statistically significant. Furthermore, the presence of dream content relating to fear, distress and nervousness resulted in significantly greater levels of negative affect than that reported when DD did not include those emotions. Only the category related to happiness content in DD was significantly associated with negative, positive and craving scores reported in the morning, compared to dreams in which no such content was observed.

5.1. Discussion of the findings

There are at least two possible interpretations for the main findings of this study as they related to the impact of DD on negative affect and craving. As stated above, the hypothesis formulated on the basis of neurobiological evidence suggests that drug dreams function as drug conditioned stimuli and, therefore, can induce conditioned responses experienced either during sleep, or during subsequent waking, or both. Within this context, it is possible that DD induce two separate effects: reactivation of memories of drug stimuli, and elicitation of a negative affective state resulting from the experience of conditioned craving.

However, it is also possible that DD act as general stressful stimuli, rather than specific conditioned stimuli. Indeed, it is known that disturbed dreaming alters sleep (Simor et al., 2012), and that disturbed sleep can cause negative affective states (Brower & Perron, 2010; Hartmann, 2000; Levin, 2011; Zadra & Donderi, 2000).
Of course, these two interpretations are not mutually exclusive, and it is very likely that DD, craving and negative affect interact in complex ways. For example, there is evidence that hypnotically-induced negative mood states alter the intensity of craving precipitated by exposure to drug conditioned stimuli (Childress et al., 1994). Further, negative affect experienced during the day can facilitate disturbed dreaming during the night (Pesant & Zadra, 2006), essentially reversing the direction of effects hypothesized in the current study. Unfortunately, correlational data cannot clarify the direction of the effect. However, when the data were analyzed looking at the level of craving reported the day before the dreams were experienced, it was found that craving scores for the day preceding the dream nights were not significantly different amongst participants. Although this can be an indication of the impact of DD on the craving of the participants in the morning, these results remain correlational in nature.

An exploration of the positive affect scores of the participants following DD supports the idea mentioned above of complex interactions between pre-existing and dream induced affect. Hence, the lack of significant fluctuations in positive affect following DD in this study may well reflect the interactions and/or continuity effect between daily events and dream content. For example, it has been mentioned in the literature on disturbed dreaming that night terrors, which are not necessarily related to specific daytime events, can induce a state of negative affect upon awakening, whereas in the case of bad dreams and nightmares, determination of the causal versus effect element is much more difficult to pinpoint.

Whereas the starting point of the affective state reported upon awakening cannot be determined with confidence, the results of the positive affect analysis nonetheless provides support to the idea that the two phenomena (pre-existing affect state and dreaming affect) seem to work in an additive manner when they have the same emotional valence (negative affect +
negative affect), but remain neutral when they are opposite (negative + positive). Because most participants in this study reported at least one diagnosis of depressive or anxiety disorder in their baseline questionnaire, the overall negatively toned valence of their reported scores to the PANAS scale is not surprising. But whereas a negatively toned dream may strengthen the pre-existing emotional state of the participant, the effect of a positively toned one is unlikely to affect the emotional state of that participant upon awakening since the dream, in this case, did not add to the participant pre-existing affect (or vice versa). This may explain why little fluctuations of the positive affect scores have been observed in the current study.

The finding that negative affect and craving scores are only correlated when DD are experienced, however, is novel information that allows for the formulation of a new hypothesis regarding the role of affect as a potential modulator of craving intensity and subsequent DD occurrence. Hence, the results of the correlational analysis performed with the current study data revealed that negative affect and craving scores were significantly correlated in four of the 5 weeks studied for the participants who had experienced at least one DD during a given week, whereas no such significant correlational pattern was observed when no DD was experienced (Table 2 and 3).

In addiction studies, craving and affect have already been found to be associated. For example, Epstein et al. (2009) studied 114 cocaine and heroin users using ecological momentary assessment method (EMA) to assess precipitants’ cravings and drug use. The results of their study revealed that cocaine craving and cocaine use were significantly associated with reports of good mood, whereas precipitants to heroin use included feelings of sadness or anger (Epstein et al., 2009). In another study by Childress et al., hypnotically induced moods were assessed for their ability to trigger craving in 10 abstinent opiate users (Childress et al., 1994). The findings
of this study revealed that induced depressive and anxious moods reliably increased craving for
drugs. Interestingly, in the above-mentioned study, induced depressive mood was also found to
increase withdrawal symptoms.

Negative affect and dreaming have for their part been found to be associated in many
studies interested in the phenomena of disturbed dreaming (Pesant & Zadra, 2006; Simor,
Koteles, Sandor, Petke, & Bodizs, 2011). One example of such a study is that of Pesant and
Zadra (2006) which explored the role of well being on the experiencing of disturbed dreaming.
Their study was based on the longitudinal assessment of 28 participants over a 6 to 10 years
period during which dream reports and measures of wellbeing were collected at two different
time periods. It was revealed from this study that participants’ negative affect scores were
significantly associated with aggressive dream content, failures and misfortunes, whereas a
higher level of reported wellbeing was associated with more positive dream content (such as
friendly interactions, successes and good fortune occurrences). In a similar type of study, Simor
et al., explored the role of wakeful mindfulness on the emotions experienced during dreaming,
using a sample of 587 undergraduate students (Simor, Koteles, Sándos, Petke, & Bòdizs, 2011).
The authors concluded that an inverse relationship exists between wakeful mindfulness of
participants and their experiencing of disturbed dreaming (Simor et al., 2011).

In the context of DD, very few indications of a link between negative affect and disturbed
dreaming have been provided in the literature. It is interesting to note, however, that the DSM-5
includes negative affect, craving and disturbed dreaming in the symptoms of drug withdrawal for
many of the drug categories, suggesting that the three may occur concurrently in many cases, or
at least be associated to one another (DSM-5, 2013). Brower and Perron (2010) support a
relationship between sleep disturbances (disturbed dreaming) and addiction based on the fact that
sleep disturbances, as mentioned above, are a common factor to withdrawal from all drugs of abuse. While craving was not a criterion for drug and alcohol withdrawal in the DSM-IV (Brower & Perron, 2010), this symptom was added to the DSM-5 for all drugs of abuse, thus making craving another universal withdrawal symptom of withdrawal across all substances of abuse. Brower and Perron go one step further by also suggesting that if anxiety and depressed moods can be characterized as “negative affect”, then the triad negative affect, craving and disturbed dreaming is a phenomenon universal to the withdrawal phase for nearly all drugs of abuse, reinforcing the idea that three symptoms may share some neurophysiological correlates. Moreover, it is widely agreed upon and it has been demonstrated many times in research studies on DD that not all individuals who experience cravings will also experience DD (Colace, 2014), thus indicating that craving by itself is not sufficient to trigger DD. Given the results of this current research demonstrating that negative affect and craving scores are positively correlated only when DD are experienced, however, it is suggested that negative affect may be the other (or at least another) factor of importance to be included in the existing model to explain DD occurrence during withdrawal and recovery. Hence, it may be that the intensity of the reported negative affect acts as a modulator of the subsequent intensity of craving and determinant of the occurrence of DD. More specifically, it is suggested that a certain threshold of negative affect load may be required in order for the combination of negative affect and craving to trigger the occurrence of DD. This would help explain why not all cravings trigger DD, and why DD occur sporadically rather than constantly during recovery. Therefore, based on the above-mentioned findings and the results of the analysis performed in the current study, further research should focus on this potentially important dynamic between craving, affect and DD in order to clarify
the role of affect as a potential mediator of the intensity of craving and the subsequent occurrence of DD.

In the current study, occurrence of DD did not decrease significantly over the 5 weeks of treatment. However, it has been observed that frequency of DD significantly abates over longer periods of time (i.e., months following treatment); (Christo & Franey, 1996; Reid & Simeon, 2001; Yee, Perantie, Dhanani, & Brown, 2004). Hence, because almost half of the participants stopped using drugs only a few days prior to recruitment in the current study, it appears that DD may be particularly common during early withdrawal from drugs. This may also explain why there were no significant relationships between DD and craving or negative affect in week 1: acute withdrawal may have interfered with the ability of the subjects to identify and/or self-report dreams and affective states.

It was also found in the analysis of DD frequency by primary drug used that cocaine users experienced twice as many DD during treatment than opiates and alcohol users (DD nights accounted for 26.1% of the nights in treatment for cocaine users versus 13.1% and 12.8% for opiates and alcohol users, respectively).

It is possible that this finding is the result of a combined effect of gender and main drug used. Hence, in our study, 71% (61) of the participants were women, and 57% (35) of them reported stimulants as their main drug of abuse, compared to only 8% (2) in the men’s group. Whereas DD gender analysis comparisons were not performed in other studies of drug dreams, in the general literature on dreaming, it has been revealed that gender differences exists in terms of dream frequency, women reporting a higher dream recall frequency than their male counterparts (Schredl & Piel, 2005; Schredl & Reinhard, 2008). In the context of our findings, it is consequently possible that the gender bias in the cocaine group could have affected the results.
Moreover, disturbed dreaming episodes are reported as frequent occurrences for withdrawing cocaine users in the DSM-5, but there is no mention of such withdrawal symptoms in that same manual for alcohol or opiates, underlying that cocaine users are more prone to this type of disturbed dreaming than alcohol and opiates users. Therefore, the combination of gender and main drug used may be responsible for the results obtained.

It is also possible that the physiological impact of the withdrawal from the drug of abuse itself, rather than a gender difference, impacted on the results. However, this alternative explanation is less likely than the first given that, overall, the frequency of all dreaming episodes (regular dreams and DD) did not vary significantly amongst the three types of drug studied.

A gender specific analysis was performed with the available data but the relatively small sample size resulting from a breakdown of the data by weeks within the groups of participants does call for some caution in the interpretation of the results. For the female only analysis, the negative affect scores in relation to the experiencing of DD, RD and ND for each week of the study followed the same general pattern as the one observed when the mixed gender analysis was performed; that is, from week 2 to 5 inclusively, DD nights were followed by higher negative affect scores than RD nights. No such pattern or significant relationships were noted for the positive affect scores. The male only analysis also failed to show statistically significant differences between the mean levels of affect reported following DD, RD and ND each week.

The fairly high number of female participants allowed for the assessment of the craving for the two main drugs used for this group, that is, cocaine and alcohol. A comparative analysis of the craving levels reported following DD nights for the two drug categories was then performed based on these data. Both groups had approximately the same number of participants (n=19 and n=21 for cocaine and alcohol, respectively). DD nights were followed by higher levels
of craving compared to RD of ND nights in weeks 2 to 4 for cocaine users. However, no such pattern emerged for the female alcohol users. This finding supports the idea that the patterns observed when male and female data are analyzed together are driven by the reports of female stimulant users in terms of DD frequency, negative affect and cravings reported following DD.

Nineteen participants (18 females and 1 male) in the study reported using nicotine replacement therapy (NRT - in the form of transdermal patches) during treatment, which allowed an assessment of differences in frequency of DD between users and non-users of NRT. The results revealed that although NRT users experienced more DD during the 5 weeks of treatment than non-users, the overall frequency of all dreams (DD and regular dreams) was not significantly different between the two groups. These findings raise some interesting questions related to the importance of a physiological drug withdrawal as a central, if not crucial component in the occurrence of DD episodes, as is implied in the DD literature (for a review of those studies, see Colace, 2014). To date, researchers interested in the DD phenomena have in fact focused on the link between physiological withdrawal, craving and DD as a chain reaction and this can be appreciated by looking at the timing of DD studies. Hence, most DD studies have been conducted during the period of physiological withdrawal and early recovery from drug addiction - although many of them have also included a follow up months after the acute withdrawal phase and consequently, have provided some information pertaining to the occurrence of DD in later phases of the recovery process (Colace, 2014; Flowers & Zweben, 1998; Reid & Simeon, 2001). While the validity of the physiological withdrawal, craving, DD model and evidences presented in its support as a partial explanation for DD occurrence is not questioned here, the model fails to explain why DD also occur during NRT or periods of active drug use.
Studies of DD during “active use” periods (including during administration of replacement therapy such as NRT and methadone) have not generated much interest by researchers to date and consequently, accounts of DD occurrences during active use have stemmed mainly from the gathering of information during the intake process of studies exploring the DD phenomena from the physiological withdrawal perspective. A few exceptions exist to this general statement however, one being Hajek and Belcher’s study (1991) that observed DD occurrence during NRT administration (nicotine gum use). In this case, the DD were explained as resulting of cravings for smoking rather than the “withdrawal” per se, since it was assumed that through NRT use, nicotine levels would not fall (Hajek & Belcher, 1991). Another one is Colace’s study of heroin users using methadone maintenance therapy (MMT) (Colace, 2004). In that study, 13 participants were split into two groups, that is, one group comprised those who stayed abstinent from heroin while on MMT (7 participants) and the other including those who used heroin despite MMT (6 participants). It was found that in the MMT only group, 6 (86%) experienced DD, while in the active use and MMT group, none of the participants reported DD (Colace, 2004).

The reported frequency of DD during active use warrants further investigation. Hence, in this research, 40 (61%) of the 66 participants for whose data were available reported having experienced DD during active drug use (i.e. prior to entering treatment). Moreover, of the 19 participants in our study using NRT, 16 (84%) also reported experiencing DD during their residential treatment. These data provide some solid grounding for acknowledging that DD cannot be the sole action of a physiological withdrawal process. In addition, the fact that withdrawal and craving may occur without the concurrent triggering of DD (since not all study
participants withdrawing from drugs experience DD) speaks to the complexity of the matter and the impossibility of attributing DD solely to withdrawal and craving.

Since DD and physiological withdrawal seem to be at times dissociated, as in the case of DD occurrence during active use, one interpretation of the results obtained could be that a psychological withdrawal from drugs may be as important as a physiological one in triggering DD. In the specific case of DD during NRT use, which can also be considered as a type of active use period, it is more specifically suggested that a psychological reaction to smoking cessation rather than a physiological reaction to the absence of nicotine intake may account for the DD occurrence noted during NRT use. This explanation would also match the findings of Colace’s study on heroin users and MMT summarized above. It should be noted, however, that one important underlying assumption of the scenario is that NRT administration precludes a physiological withdrawal for that particular drug to occur (i.e., the dosage of the patches is sufficient to prevent nicotine craving). However, it is important to remember that despite nicotine administration through NRT protocol, clients may not experience the “rewarding effects” normally associated with cigarette smoking. It can be expected in this case that a psychological withdrawal to smoking cessation (as opposed to a physiological one) is still perceived by the participants, and might lead to craving and in some cases, subsequent DD occurrences, in line with Hajek et al.’s study conclusion (Hajek & Belcher, 1991). While this scenario may help explain DD occurrence during NRT use (i.e. when drugs are still being administered), more is needed to explain why DD are more frequent for NRT users than non-users.

One possibility is that the priming effect of drugs may account for the difference in the observed frequency of DD between users and non-users of NRT. Hence, although the dose of
nicotine administered may be assumed sufficient to alleviate the craving for nicotine, it is suggested here that the priming effect created by the administration of nicotine during abstinence from other drugs may trigger craving for the main drug of abuse (which is unavailable to the recovering users during treatment). Thus, in this scenario, the priming effect resulting from nicotine administration would consequently reactivate the expectancy for the effect previously associated with drug intake, and in the absence of the expected effect, would heighten the craving and/or negative affect, possibly increasing the propensity of the recovering users to experience DD. Whereas the extension of the priming effect from one class of drug to another has not been evidenced in the literature (stimulant priming leading to craving for depressants, for example), some support has been provided for the idea that the priming effects of one drug may extend to other drugs from the same class (deWit, 1996).

A last hypothesis to explain the increased frequency of DD in NRT users compared to non-users entails that the dose of nicotine administered through the NRT protocol would not be sufficient to alleviate the cravings. Consequently, this constant state of physiological withdrawal (despite nicotine administration) experienced by the users of NRT would provide an environment in which cravings and negative affect prevail, thus increasing the propensity of DD occurrences. Given that NRT patches are delivered in pre-set doses that cannot be adjusted exactly to the users’ particular needs to ensure that craving will not occur, such explanation is highly plausible (in fact, the NRT protocol implies a tapering of the NRT doses and consequently, physiological withdrawal is most likely to occur at some point, albeit on a gradual basis). Moreover, numerous participants using the NRT have reported, through informal conversations with the investigator, that the vivid dreaming side effect had led them to use the patches on an “on and off” basis,
which further increases the likelihood of quickly fluctuating nicotine levels which in turn, are likely to cause craving.

Finally, the current study revealed that negative affect scores following DD involving “active” drug use were significantly more elevated than when DD content involved searching for drugs, resisting use, temptations to you, and looking at/seeing drugs (i.e. “passive use”). The same was observed for craving, although the relationship was not statistically significant. The explanations of these findings from a theoretical and clinical perspective are reviewed in detail as part of the manuscript presented in Chapter 2 of this thesis and therefore, the reader should refer to that section for the discussion on that particular topic.

Additional findings pertaining to the dream content analysis revealed that the presence of DD content relating to fear, distress and nervousness resulted in significantly greater levels of negative affect in the morning compared to DD that did not include those emotions. Again, these results may reflect the dream continuity effect previously discussed in this chapter as those three emotions are most likely to be disproportionately present at the early stages of withdrawal and recovery for individuals attending residential treatment.

Of note is the finding that the emotion category “happy” was significantly associated with negative affect, positive affect and craving scores reported in the morning when compared to DD in which no such content was observed. Hence, when happiness was experienced during a DD, the morning negative mean affect scores were more elevated, and the craving and positive scores less elevated than in instances where no happiness was mentioned in the dreams. This raises the possibility that the Abstinence Violation Effect (AVE) concept may also be a phenomenon with relevance in the context of DD.
According to Marlatt et al. (2007) an AVE can be described as the cognitive and emotional responses of recovering individuals to a drug use episode (lapse) following a period of abstinence. The AVE’s “cognitive” component relates to attribution factors assessed by the recovering individual as being responsible for the lapse, whereas the “emotional dimension” refers to the level of negative affective state experienced following the lapse (Curry, Marlatt, & Gordon, 1987). The model posits that it is the intensity of the AVE response as well as the cognitive dissonance between the goal of abstinence and the drinking behavior that determines whether an individual will relapse or resume abstinence following the lapse (Curry et al., 1987). This type of transgressive behavior in drug addiction and its AVE response have been explored mostly in the context of smoking cessation (Kirchner, 2012; Shiffman et al., 1997) and alcohol abstinence (Marlatt, 2007).

Whereas the relevance of the AVE response has not been assessed in the context of DD, our previous findings in this research suggest that drug cues in DD can mimic the affective and craving response to drug cues experienced by drug addicted individuals during the day, leading to suggest that the AVE may also occur following a DD. Certainly, the finding that happiness content in DD is followed by the report of more elevated negative affect scores than when no happiness is experienced in the dream leads to the formulation of such an hypothesis. In the model presented by Marlatt et al. (2007) it is suggested that the AVE response occurs following an episode of active use. I argue, however, that in the context of DD, the AVE response may not require such a discriminatory division between active and passive use in order to occur. The basis of this argument is as follows: while it may be quite unrealistic in the case of tobacco or alcohol cessation to expect individuals in recovery not to be in the presence of those substances in their everyday life (i.e., tobacco and alcohol are legal substances, and therefore are widely
displayed and available in our environment), the expectations for illegal drugs are different. For example, clients in recovery for heroin or cocaine addiction are expected not to place themselves in situations where those substances are seen or used. For this reason, it is suggested that passive DD may also produce an AVE response as the recovering individuals may perceive being in the presence of drugs as a transgression of their abstinence goal and lead to the emotional response of negative affect (guilt) described by Marlatt and Gordon in their model.

Due to the small sample of DD suitable for such analysis in this research, the negative affect score could not be broken down into specific emotions and therefore, it was not possible to assess the association between “happiness in DD” and “guilt” score upon awakening. Further research should be undertaken to explore such a relationship as this would provide additional support for the role of DD on subsequent affect that could be a factor in subsequent relapse.

5.2. Limitations of the study

No gold standard currently exists to consistently measure affect and craving across studies, as is the case for sleep research. Therefore, in this research, the PANAS scale short form was selected amongst others to measure daily affect upon awakening due to its shortness, user-friendly attributes, and scientific validation for use with different time points, i.e., daily, weekly, monthly, past 6 months (Watson, Clark & Tellegen, 1988; Watson and Clark, 1994). A visual analogue scale was used to measure craving as the validity of this measurement method in research and its ease of use have been well documented. However, the PANAS is a likert scale with a fairly narrow span of choices that can be selected by the participants (between 1 and 5) and this limits its ability to capture slight affect fluctuations within subjects. This may become even more problematic when the daily scores are further averaged to obtain weekly affect or craving data for each participant, or for a specific group of participants. This lack of gold
standard measurement methods may also make the findings of this research difficult to compare with others that have used different measurement and reporting systems.

Another limitation is the fact that both craving and affect can be perceived as either a state or trait affect, depending on the time span or length of retrospective recording that is asked from the participants (Polk, Cohen, Doyle, Skoner & Kirschbaum, 2005). For example, in this research, the daily dream journal responses provided a state affect rating for both craving and affect (participants were reporting in the moment and only for the previous night). However, when retrospective craving and affect scores were gathered in the Initial Questionnaires, participants had to provide an average rating of their affect and craving over the past week, or month prior to entry in treatment. In that context, the measures were looking at trait affect rating (reflecting the average rating over the course of the time frame mentioned). Although different concepts, both were used in the research in order to provide valuable information as to the overall affect and craving of the participants prior to, and during treatment. However, caution should be exercised when/if such measures are compared with each other, given the differences mentioned above.

The development of the key words to analyze for DD content focused on the identification of direct drug-related cues in the dreams. It is well known, however, that many drug cues are the result of personal experiences and thus, are unique to each individual. Although our analysis captured the direct drug cues, the ones that would be specific to each individuals were not captured in our research. For example, it was not possible for the investigators to know whether a certain building described in a DD constituted a drug cue for a participant (e.g., a building in which the participant has used drugs before, a situation or person that has led to drug use in the past, etc.). Therefore, some drug cues unique to some participants may have been
missed in the DD content analysis. Moreover, many of the reports were short and general (a few sentences), limiting the ability of the researchers to capture the emotions in the DD. Of course, reports provided by the participants were also a reflection of their individual ability to describe in writing the content of their dreams. More detailed reports might be gathered in the future using voice recording technology instead of pen and paper but this was not, in the context of this study, a method that could have been easily adopted due to technological and confidentiality issues.

One of the main limitations of this research study pertains to the follow up results obtained at the 3 months follow up mark. As it has been described in Chapter 4, only 19 of the 86 participants have been reached following treatment and accepted to participate in the phone follow up. Telephone lines had been disconnected in many cases, or participants were not willing to do the follow up. We also had agreed in the consent form to only try to call a maximum of 3 times, and this also probably eliminated many of our potential participants from the follow up. In future studies, a retrospective approach could be used with participants in recovery for more than 3 months to assess the frequency of their DD during and after treatment, rather than trying to follow up with participants 3 months following the end of their treatment. Of course this would be done at the expense of the loss of a lot of valuable daily information on affect, craving and the content of their DD but could provide information that could not be gathered to its fullest in this study.

5.3. Recommendations for addressing the impact of DD in therapy

The findings of this research study revealed that the occurrence of DD is associated with higher levels of negative affect and craving in the morning than the experiencing of regular dreams. Since negative affect and craving have been found to be related to lapses and relapses during recovery (Witkiewitz, Bowen, & Donovan, 2011), developing treatment modalities aimed
at alleviating their impact on recovering users should become a focus of attention in addiction research in the near future. Adapting existing therapeutic and pharmacological interventions used in the treatment of mental health conditions involving negative affect and disturbed dreaming could also prove beneficial in the treatment of DD. The following section provides examples of such existing interventions for future consideration in research and clinical work with clients affected by drug dreams during early recovery.

**Imagery Rehearsal Techniques**

A meta-analysis of imagery rehearsal techniques efficacy in improving the sleep quality of individuals suffering from post-traumatic nightmares revealed that this type of intervention can significantly reduce nightmare frequency and improve overall sleep quality (Casement & Swanson, 2012; Moore & Krakow, 2007). Imagery rehearsal therapy (IRT) requires that the client, with the guidance of the therapist, “re-organize” the storyline of the nightmares by visualizing a positive development, or ending, to the dream. This can be achieved using narrative techniques, writing or drawing of the storyline. This step is followed by daily rehearsals of the “re-organized” dream. Significant improvements have been noted for study participants after 4 to 6 weeks of daily rehearsals (Casement & Swanson, 2012). IRT is not commonly used in addiction treatment centers but this is not surprising given the very limited amount of attention currently focused on the treatment of drug dreams during recovery from drug addiction. However, given the similarities in terms of the distressing nature of DD and that of post traumatic nightmare, the integration of such therapeutic approach in addiction treatment centers may be beneficial for DD sufferers.
Mindfulness

Mindfulness approaches in therapy promote emotional self-regulation by helping clients increase their self-awareness in the present moment, without judging or labeling their internal or external experiences (Marcus & Zgierska, 2012; Witkiewitz, Bowen, Douglas, & Hsu, 2013; Witkiewitz & Bowen, 2010). By doing so, clients become “witnesses, or watchers” of their emotional states and this self-awareness improves their ability to be more accepting of perceived distressing internal or external events. Due to its ability to increase the individual’s level of self-regulation, mindfulness therapy is well suited in the treatment of psychological conditions involving negative affective states. Hence, a number of studies have provided evidence for the effectiveness of mindfulness therapy in the treatment of depression and anxiety disorders (Hofman, Sawyer, Witt, 2010) but also in the treatment of drug and alcohol addiction (Carmody, Vieten, & Astin, 2011; Garland, 2014; Witkiewitz et al., 2013; Witkiewitz & Bowen, 2010).

Most importantly, mindfulness and dream quality have been found to be inversely related, supporting the idea that mindfulness training can in fact help alleviate the affect distress resulting from disturbed dreaming and by the same token, improve general well-being (Simor, Koteles, Sandor, Petke & Bodizs, 2011). Mindfulness techniques are slowly being integrated into addiction treatment but are still not a mainstream form of therapeutic approach in the field. Hence, treatment centres adopting a more holistic perspective on treatment and recovery are more likely to offer this kind of training than those focused on the medical model. It is interesting to note, however, that the AA philosophy of “one day at a time” and “acceptance of what cannot be changed” in many ways touch upon those mindfulness concepts, without teaching them from a meditative perspective, which is essential to reap the
full benefit of the technique.

The integration of these mindfulness approaches to help clients process their DD could work by providing the clients with the tools required to self-regulate their affect throughout the day, but especially upon awakening from a disturbing dream. By doing so, the level of negative affect that accompanies DD could be regulated downward by the client and consequently also reduce the potential craving state often associated with that negative affect.

**Pharmaceutical approach to the treatment of DD**

Prozasin is an alpha-1 adrenergic antagonist that has been found to reduce the frequency of nightmares in PTSD (Cukor, Spitalnick, Difede, Rizzo, & Rothbaum, 2009; Taylor, Freeman, & Cates, 2008; Raskind et al., 2003) and has also shown promising results in reducing stress and cue-induced craving in detoxifying alcohol users (Fox et al., 2012; Simpson et al., 2009). Moreover, and most relevant in the context of this research study, compared to a placebo group, Prozasin users did not report an increase in anxiety and negative emotions in response to stress and alcohol-related cues in a clinical trial involving alcohol dependent individuals (Fox et al., 2012). Together, these findings make Prozasin an interesting option to explore in an attempt to alleviate the impacts of drug dreams on the affect and craving of newly abstinent users.

However, this recommendation for the clinical trial of Prozasin to alleviate DD is based on the assumption that DD have no adaptive function in the recovery process, or at the least that the weight of the negative affect produced by DD upon awakening out-weights the beneficial effects of their adaptive function for the individuals experiencing them. Hence, many studies have suggested that nightmares may have an adaptive function that works by reducing the salience of specific stressors of traumatic events through exposure to those stressors during sleep (Hartmann, 1998; Picchioni et al., 2002; Revonsuo, 2000).
5.4. Conclusion

In all accounts, it would appear that the relationship between DD, craving and affect is a complex one that underlines intricate relationships between neurophysiological and psychological mechanisms active during both sleep and awake periods. This research has broadened the scope of existing work on DD by further integrating the role of affect in the already established craving to DD relationship originating from the work of various researchers in the field of addiction. The findings of this research have also provided evidence that DD, as stipulated in the main hypothesis of this research, can act as drug conditioned stimuli that impact on the craving and affect dynamic of participants during their early recovery phase. Given the frequency and disturbing nature of the DD experienced by participants in our study, this finding is critically important from a clinical perspective as it provides an opportunity, in future research, to assess the efficacy of different therapeutic modalities to alleviate the impact of drug cue exposure experienced through DD during treatment. For example, Imagery Rehearsal Therapy, mindfulness training and the use of Prozasin should be carefully considered in future research studies or clinical trials to confirm their ability, alone or in combination, in decreasing the impact of DD on the negative affect and craving of newly abstinent users.

The study of the emotional content of DD provided novel information on the relationship between DD content and affect experienced upon awakening, again broadening the scope of what is known on the impact of disturbed dreaming on daily affect, and providing additional support for the continuity hypothesis discussed as part of this thesis. It is hoped that such results will also stimulate more research into the relationship between DD and affect as well as its potentially important role in the maintenance of a sustained recovery from drug addiction.
Table 1. Demographic profile, drug use history and mental health diagnosis of participants recruited from two residential treatment centres.

<table>
<thead>
<tr>
<th></th>
<th>Males % (n=25)</th>
<th>Females % (n=61)</th>
<th>Total % (n=86)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25</td>
<td>8 (2)</td>
<td>7 (4)</td>
<td>7 (6)</td>
</tr>
<tr>
<td>25-35</td>
<td>20 (5)</td>
<td>34 (21)</td>
<td>30 (26)</td>
</tr>
<tr>
<td>&gt;35</td>
<td>68 (17)</td>
<td>51 (31)</td>
<td>56 (48)</td>
</tr>
<tr>
<td><strong>Main drug used</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol</td>
<td>60 (15)</td>
<td>36 (21)</td>
<td>43 (36)</td>
</tr>
<tr>
<td>Cocaine/Crack</td>
<td>8 (2)</td>
<td>33 (19)</td>
<td>25 (21)</td>
</tr>
<tr>
<td>Opiates</td>
<td>20 (5)</td>
<td>15 (9)</td>
<td>16 (14)</td>
</tr>
<tr>
<td>Cannabis</td>
<td>4 (1)</td>
<td>9 (5)</td>
<td>7 (6)</td>
</tr>
<tr>
<td>Methamphetamines</td>
<td>0 (0)</td>
<td>2 (1)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Benzodiazepines</td>
<td>4 (1)</td>
<td>3 (2)</td>
<td>4 (3)</td>
</tr>
<tr>
<td>Other</td>
<td>4 (1)</td>
<td>2 (1)</td>
<td>2 (2)</td>
</tr>
<tr>
<td><strong>Nicotine patch</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>4 (1)</td>
<td>30 (18)</td>
<td>22 (19)</td>
</tr>
<tr>
<td>No</td>
<td>96 (24)</td>
<td>70 (43)</td>
<td>78 (67)</td>
</tr>
<tr>
<td><strong>Mental health diagnosis</strong>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>41 (10)</td>
<td>64 (39)</td>
<td>58 (49)</td>
</tr>
<tr>
<td>PTSD</td>
<td>4 (1)</td>
<td>15 (9)</td>
<td>12 (10)</td>
</tr>
<tr>
<td>Bipolar</td>
<td>0 (0)</td>
<td>18 (11)</td>
<td>13 (11)</td>
</tr>
<tr>
<td>Schizophrenia</td>
<td>0 (0)</td>
<td>2 (1)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>29 (7)</td>
<td>53 (32)</td>
<td>46 (39)</td>
</tr>
<tr>
<td>Other</td>
<td>8 (2)</td>
<td>5 (3)</td>
<td>6 (5)</td>
</tr>
</tbody>
</table>

* 1 male and 5 females did not report their age on the questionnaire, which accounts for the sums not adding up to the total n for the age category.
** 3 females reported more than 1 drug of choice and were therefore not entered into any of the categories.
*** Participants were asked to report all of their mental health diagnoses, which were included in the relevant categories. Therefore, sum of diagnoses is higher than the total number of male and female participants.
Table 2. Correlation coefficients between mean affect and craving scores (aggregated at the participant level) when at least one DD was experienced during the week.

<table>
<thead>
<tr>
<th>Week</th>
<th>Positive affect and craving</th>
<th>Negative affect and craving</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>$r$</td>
</tr>
<tr>
<td>1</td>
<td>31</td>
<td>-.15</td>
</tr>
<tr>
<td>2</td>
<td>35</td>
<td>-.32</td>
</tr>
<tr>
<td>3</td>
<td>31</td>
<td>-.48**</td>
</tr>
<tr>
<td>4</td>
<td>26</td>
<td>-.57**</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>-.29</td>
</tr>
</tbody>
</table>

* $p < .05$

** $p < .001$
Table 3. Correlation coefficients between mean affect and craving scores (aggregated at the participant level) when no DD was experienced during the week.

<table>
<thead>
<tr>
<th>Week</th>
<th>n</th>
<th>Positive affect and craving</th>
<th>Negative affect and craving</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26</td>
<td>.02</td>
<td>.34</td>
</tr>
<tr>
<td>2</td>
<td>28</td>
<td>-.29</td>
<td>.18</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>-.54*</td>
<td>-.39</td>
</tr>
<tr>
<td>4</td>
<td>23</td>
<td>-.23</td>
<td>.27</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>.36</td>
<td>.50*</td>
</tr>
</tbody>
</table>

* *p < .05
** *p < .001
Table 4. Correlation coefficients between DD frequency, negative affect and craving for week 1 to 5.

<table>
<thead>
<tr>
<th>Week</th>
<th>Negative affect and DD frequency</th>
<th>Craving and DD frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$r \ (n)$</td>
<td>$r \ (n)$</td>
</tr>
<tr>
<td>1</td>
<td>.33 (31)</td>
<td>.33 (32)</td>
</tr>
<tr>
<td>2</td>
<td>.47 (35)*</td>
<td>.30 (36)</td>
</tr>
<tr>
<td>3</td>
<td>.51 (31)*</td>
<td>.62 (31)**</td>
</tr>
<tr>
<td>4</td>
<td>-.12 (25)</td>
<td>-.14 (26)</td>
</tr>
<tr>
<td>5</td>
<td>.37 (7)</td>
<td>.16 (8)</td>
</tr>
</tbody>
</table>

* $p < .05$

** $p < .001$
Table 5. Operational definitions of DD content.

<table>
<thead>
<tr>
<th>Words</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drug Content</strong></td>
<td></td>
</tr>
<tr>
<td>Use</td>
<td>The dreamer is drinking, injecting or inhaling drugs or alcohol.</td>
</tr>
<tr>
<td>Search</td>
<td>The dreamer is actively trying to obtain drugs/alcohol, but the substance is not actually present.</td>
</tr>
<tr>
<td>Temptation</td>
<td>The dreamer is craving or wanting to use drugs/alcohol either for intrinsic (themselves) or extrinsic (other people) reasons. The substance may or may not be present.</td>
</tr>
<tr>
<td>Looking at/seeing</td>
<td>The dreamer is witnessing others around them in possession of drugs/alcohol, or using them; the dreamer is in possession of drugs/alcohol; drugs or drug packaging is in their sight.</td>
</tr>
<tr>
<td>Resisting use</td>
<td>The dreamer is tempted or wants to use but resists the temptation (does not use the drug/alcohol). The dreamer is resisting drug use or pressure from others to use.</td>
</tr>
<tr>
<td><strong>Social interaction</strong></td>
<td></td>
</tr>
<tr>
<td>Aggressive</td>
<td>Either the dreamer is involved in or is witness to verbal altercations, yelling/screaming, physical violence, accidents/injury, or death.</td>
</tr>
<tr>
<td>Friendly</td>
<td>The dreamer is buying drugs from another person in a civil exchange; the dreamer is helping others resist drugs or others are helping them; individuals in the dream are smiling/laughing together; with friends.</td>
</tr>
<tr>
<td><strong>Object</strong></td>
<td></td>
</tr>
<tr>
<td>Drug paraphernalia</td>
<td>Items used to facilitate drug/alcohol use are present in the dream.</td>
</tr>
<tr>
<td><strong>Characters</strong></td>
<td></td>
</tr>
<tr>
<td>Familiar</td>
<td>Personally known character to the dreamer including friends, family, health professionals etc.</td>
</tr>
<tr>
<td>Unfamiliar</td>
<td>A person is present that the dreamer does not recognize as someone they know; do not know the person’s name.</td>
</tr>
<tr>
<td><strong>Emotion</strong></td>
<td></td>
</tr>
<tr>
<td>Afraid</td>
<td>The dreamer is fearful of someone or something, panicked, or hiding.</td>
</tr>
<tr>
<td>Distressed</td>
<td>The dreamer feels shame, guilt, anxiety or sadness.</td>
</tr>
<tr>
<td>Nervous</td>
<td>The dreamer is worried, jittery, or stressed.</td>
</tr>
<tr>
<td>Hostile</td>
<td>The dreamer is angry, annoyed, frustrated or fed-up.</td>
</tr>
<tr>
<td>Happy</td>
<td>The dreamer is enjoying themselves, enthusiastic,</td>
</tr>
<tr>
<td>Emotion</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Proud</td>
<td>The dreamer is pleased or happy with their own actions</td>
</tr>
<tr>
<td>Sad</td>
<td>The dreamer is crying or is telling others that he is sad.</td>
</tr>
<tr>
<td>Places</td>
<td></td>
</tr>
<tr>
<td>Familiar</td>
<td>A place the dreamer knows, recognizes, or has been to before (e.g. my house, my parents’ house… etc).</td>
</tr>
<tr>
<td>Unfamiliar</td>
<td>Foreign places, unrecognized by the dreamer, unknown to them.</td>
</tr>
</tbody>
</table>
Figures
Figure 1. Mean craving scores per dream types, week 1 to 5.

Mean (SEM) craving scores (maximum score = 10) self-reported by participants after the experience of drug dreams (DD), regular dreams (DR), or no dreams (ND), on each of the 5 weeks of treatment. The numbers above the bars represent the significance value of individual mean comparisons yield by a linear mixed model analysis followed by the Bonferroni correction.
Figure 2. Mean negative affect scores per dream types, week 1 to 5.

Mean (SEM) negative affect scores (maximum score = 5) self-reported by participants after the experience of drug dreams (DD), regular dreams (DR), or no dreams (ND), on each of the 5 weeks of treatment. The numbers above the bars represent the significance value of individual mean comparisons yield by a linear mixed model analysis followed by the Bonferroni correction.
Figure 3. Active versus passive dream content.

Panel A: Mean (SEM) negative affect scores self-reported in dream journals that included “active” vs “passive” drug dreams. The number above the bars represents the significance value of a mean comparisons yield by a linear mixed model analysis. Panel B: Mean (SEM) craving scores self-reported by participants in dream journals that included “active” vs “passive” drug dreams.
Figure 4. Mean positive affect scores per dream types, week 1 to 5.

Mean (SEM) positive affect scores (maximum score = 5) self-reported by participants after the experience of drug dreams (DD), regular dreams (DR), or no dreams (ND), on each of the 5 weeks of treatment.
Figure 5. Mean negative affect scores per dream types for male participants, week 1 to 5.

Mean (SEM) negative affect scores (maximum score = 5) self-reported by male participants after the experience of drug dreams (DD), regular dreams (DR), or no dreams (ND), on each of the 5 weeks of treatment.

<table>
<thead>
<tr>
<th>Dreams last night</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>No dream</td>
<td>1.69</td>
<td>1.57</td>
<td>1.57</td>
<td>1.43</td>
<td>1.86</td>
</tr>
<tr>
<td>Drug dream</td>
<td>2.10</td>
<td>1.91</td>
<td>1.78</td>
<td>1.79</td>
<td>1.46</td>
</tr>
<tr>
<td>Regular dream</td>
<td>2.08</td>
<td>1.42</td>
<td>1.45</td>
<td>1.39</td>
<td>1.44</td>
</tr>
</tbody>
</table>
Figure 6. Mean positive affect scores per dream types for male participants, week 1 to 5.

Mean (SEM) positive affect scores (maximum score = 5) self-reported by participants after the experience of drug dreams (DD), regular dreams (DR), or no dreams (ND), on each of the 5 weeks of treatment.

<table>
<thead>
<tr>
<th>Dreams last night</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>No dream</td>
<td>2.97</td>
<td>2.73</td>
<td>2.59</td>
<td>2.92</td>
<td>2.77</td>
</tr>
<tr>
<td>Drug dream</td>
<td>2.99</td>
<td>2.43</td>
<td>2.73</td>
<td>2.75</td>
<td>3.04</td>
</tr>
<tr>
<td>Regular dream</td>
<td>2.67</td>
<td>2.93</td>
<td>2.53</td>
<td>2.86</td>
<td>2.83</td>
</tr>
</tbody>
</table>
Figure 7. Mean craving scores per dream types for male participants, week 1 to 5.

Mean (SEM) craving scores (maximum score = 10) self-reported by male participants after the experience of drug dreams (DD), regular dreams (DR), or no dreams (ND), on each of the 5 weeks of treatment.

<table>
<thead>
<tr>
<th>Dreams last night</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean craving scores (males only)</td>
<td>1.92</td>
<td>1.65</td>
<td>2.08</td>
<td>1.71</td>
<td>1.75</td>
</tr>
<tr>
<td>No dream</td>
<td>1.21</td>
<td>2.52</td>
<td>3.12</td>
<td>1.98</td>
<td>0.90</td>
</tr>
<tr>
<td>Drug dream</td>
<td>3.46</td>
<td>1.57</td>
<td>1.57</td>
<td>0.51</td>
<td>0.88</td>
</tr>
<tr>
<td>Regular dream</td>
<td>4.58</td>
<td>2.89</td>
<td>3.51</td>
<td>2.09</td>
<td>1.45</td>
</tr>
</tbody>
</table>
Figure 8. Mean negative affect scores per dream types for female participants, week 1 to 5.

Mean (SEM) negative affect scores (maximum score = 5) self-reported by female participants after the experience of drug dreams (DD), regular dreams (DR), or no dreams (ND), on each of the 5 weeks of treatment.

<table>
<thead>
<tr>
<th>Dreams last night</th>
<th>Week</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>No dream</td>
<td>1.66</td>
<td>1.56</td>
<td>1.46</td>
<td>1.31</td>
<td>1.48</td>
</tr>
<tr>
<td>Drug dream</td>
<td>1.86</td>
<td>2.15</td>
<td>2.21</td>
<td>2.19</td>
<td>2.71</td>
</tr>
<tr>
<td>Regular dream</td>
<td>1.71</td>
<td>1.53</td>
<td>1.57</td>
<td>1.50</td>
<td>1.22</td>
</tr>
</tbody>
</table>
Figure 9. Mean positive affect scores per dream types for female participants, week 1 to 5.

Mean (SEM) positive affect scores (maximum score = 5) self-reported by female participants after the experience of drug dreams (DD), regular dreams (DR), or no dreams (ND), on each of the 5 weeks of treatment.

<table>
<thead>
<tr>
<th>Dreams last night</th>
<th>Week</th>
<th>Mean positive affect scores (females only)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>No dream</td>
<td>2.68</td>
<td>2.76</td>
</tr>
<tr>
<td>Drug dream</td>
<td>2.28</td>
<td>2.35</td>
</tr>
<tr>
<td>Regular dream</td>
<td>2.36</td>
<td>2.67</td>
</tr>
</tbody>
</table>
Figure 10. Mean craving scores per dream types for female participants, week 1 to 5.

Mean (SEM) craving scores (maximum score = 10) self-reported by female participants after the experience of drug dreams (DD), regular dreams (DR), or no dreams (ND), on each of the 5 weeks of treatment.

<table>
<thead>
<tr>
<th>Dreams last night</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean craving scores (females only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No dream</td>
<td>2.63</td>
<td>1.84</td>
<td>2.16</td>
<td>1.64</td>
<td>2.02</td>
</tr>
<tr>
<td>Drug dream</td>
<td>3.78</td>
<td>4.07</td>
<td>3.59</td>
<td>3.32</td>
<td>2.86</td>
</tr>
<tr>
<td>Regular dream</td>
<td>2.33</td>
<td>2.18</td>
<td>1.67</td>
<td>1.58</td>
<td>0.93</td>
</tr>
</tbody>
</table>
Mean (SEM) craving scores (maximum score = 10) self-reported by female participants using cocaine as the main drug of abuse, after the experience of drug dreams (DD), regular dreams (DR), or no dreams (ND), on each of the 5 weeks of treatment.
Figure 12. Mean craving scores per dream types for female alcohol users, week 1 to 5.

Mean (SEM) craving scores (maximum score = 10) self-reported by female participants using alcohol as the main drug of abuse, after the experience of drug dreams (DD), regular dreams (DR), or no dreams (ND), on each of the 5 weeks of treatment.

<table>
<thead>
<tr>
<th>Dreams last night</th>
<th>Week</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean craving scores (females only, alcohol)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No dream</td>
<td>1.60</td>
<td>1.15</td>
<td>2.56</td>
<td>2.17</td>
<td>2.10</td>
<td></td>
</tr>
</tbody>
</table>
| Drug dream       | 1.67 | 3.66| 3.21| 2.00|--
| Regular dream    | 1.89 | 1.73| 1.44| 1.98| 1.88|
References:


Hartmann, E. (2010b). The dream always makes new connections: the dream is a creation, not a replay. *Sleep Medicine Clinics, Dreams and Nightmares, 5*(2), 241.


APPENDIX A. Consent forms

(St Joseph’s Healthcare Hamilton and Homewood Health Centre)
PARTICIPANT INFORMATION SHEET

Title of Study: Drug-dreams in Addiction: A study of the impacts of drug-dreams on affect and relapses.

Locally Responsible Investigator: Debbie Bang, Integrated Manager of Addiction Services, St Joseph’s Healthcare Hamilton.

Principal Investigator: Hélène Tanguay, PhD candidate, Department of Psychology, University of Guelph.

Research supervisor: Dr. Francesco Leri, Associate Professor, Department of Psychology, University of Guelph.

Funding Source: NSERC Discovery Grant

You are being invited to participate in a research study conducted by Hélène Tanguay, PhD candidate in the Department of Psychology at the University of Guelph, and Dr. Francesco Leri, Associate Professor, Department of Psychology, also from the University of Guelph. This research project is conducted under the supervision of Dr. Leri, and will contribute to the doctoral thesis of Hélène Tanguay. The local Principal Investigator for this study at St Joseph’s Healthcare Hamilton is Debbie Bang, Integrated Services Manager.

In order to decide whether or not you want to be a part of this research study, you should understand what is involved and the potential risks and benefits. This form gives detailed information about the research study, which will be discussed with you. Once you understand the study, you will be asked to sign this form if you wish to participate.

The research team reports no conflicts of interests between St Joseph’s Healthcare and the investigators Debbie Bang, St Joseph’s Healthcare Hamilton, Hélène Tanguay, University of Guelph, and Dr. Francesco Leri, University of Guelph
WHY IS THIS RESEARCH BEING DONE?

Dreams about drugs have been found to be frequent at different stages of the addiction recovery process. During those dreams, individuals either use or seek drugs. The drug-dream experience has been described by some individuals as highly disturbing and at times increasing their need to use drugs. Those dreams, for many users, start within the first week of abstinence and can persist for weeks, months, and even years after an individual has stopped using drugs. There is some evidence that dreams and moods influence each other. In fact, it is well known that stress plays an important role in relapses, but we do not yet know if drug-dreams can play a role in triggering stress that can in turn increase the risk of relapses. This research project addresses this question.

WHAT IS THE PURPOSE OF THIS STUDY?

The purpose of the study is to explore the impacts of drug-dreams on recovery from drug abuse, cravings and stress.

WHAT WILL MY RESPONSIBILITIES BE IF I TAKE PART IN THE STUDY?

If you volunteer to participate in this study, we will ask you to do the following things:

You will be asked to fill out an initial questionnaire about your recent drug use, cravings, moods, dreams, as well as the occurrence of drug-dreams, if any. You do not need to have experienced drug-dreams in order to participate in this study. You will be given the opportunity to bring the Initial Questionnaire with you and return it to the study investigator (Hélène Tanguay) with your Dream Journal at the end of the week. This questionnaire contains multiple choice questions and should take you about 20 minutes to fill out.

Starting on the first day of your participation in the study, you will also be asked to fill out a daily Dream Journal containing a few questions about your moods and cravings, and to record your drug-dreams (if any) with as many details as you can remember. You will be able to keep this Dream Journal with you during the week and you will be asked to complete it every morning as soon as you wake up. Depending on whether you have experienced a drug-dream during the night, this Dream journal will take you approximately 5 to 10 minutes to fill out daily.

Three months following the end of your treatment program, if you agree to it, you will be contacted by phone for a quick follow up. During this phone follow up, you will be asked whether you have experienced any drug-dreams since you left the treatment centre, the content of those dreams (seeking, using, looking at other people using, etc) and if you
have used any drugs during the past three months. This follow up will take at the most 5-10 minutes to complete and can be done at a time that is convenient for you.

Please note that you are free to withdraw this consent at any time during this study and that no messages will be left at the phone number you will give to us. A summary of the preliminary findings of this project will be made available to you if you request it. If you would like to receive such, please inform Hélène Tanguay at hтанguay@uoguelph.ca. You may request these preliminary findings via email or regular mail. We expect those findings to be available by the end of the summer 2012.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

Drug cravings are a very common symptom of drug withdrawal and are part of the recovery process. It is possible that experiencing drug-dreams and writing their content in your dream journal may cause you to crave drugs. In order to reduce the risk of cravings associated with the exercise of keeping a dream journal, we suggest that you write down your drug-dreams as soon as possible after they occur. This will reduce the number of times that you have to think about these dreams after you experience them.

Participants in the study will also be asked to pick up and drop off questionnaires with the research investigator every week during their treatment cycle. While this will be done in a private office at the treatment centre, it is possible that other clients of the centre, staff or other participants in the research study will see you entering or leaving the office.

If you choose to take part in this study, you will be told about any new information which might affect your willingness to continue to participate in this research.

HOW MANY PEOPLE WILL BE IN THIS STUDY?

This research project will involve 63 participants from two drug detoxification facilities in Hamilton and four residential and/or day treatment centres in the Southwestern Ontario Region. The expected number of participants for the Womankind centre is between 30 and 40.

WHAT ARE THE POSSIBLE BENEFITS FOR ME AND/OR FOR SOCIETY?

We cannot promise any personal benefits to you from your participation in this study and choosing not to participate in this study will in no way affect your care or treatment. However, monitoring your dreams, moods and cravings on a daily basis may help you increase your awareness of the role of drug-dreams on your recovery. This can be

Consent Form Date: __________  Page 3 of 6  Protocol # 11-3586, Version: November 9, 2011
Pt. initial __________
especially helpful to you as drug-dreams may in some case be related to cravings and drug use and the early identification of this trigger will allow you to develop alternative coping mechanisms to drug use when necessary.

The potential benefits of this research to science are also important as the results of this study may help scientists/psychologists to better understand the relationship between drug-dreams and recovery in addiction. Moreover, the transfer of this knowledge into clinical practices may improve the quality of the addiction treatment programs that you and other individuals fighting addiction may access in the future.

WHAT INFORMATION WILL BE KEPT PRIVATE?

Your data will not be shared with anyone except with your consent or as required by law. All personal information such as your name, address or phone number will be removed from the data and will be replaced with a number. A list linking the number with your name will be kept in a secure place (locked cabinet in a locked institutional office), separate from the rest of your file. The data without identifying information will also be stored securely on a computer with data encryption. Moreover, please note that employees from the treatment centre that you attend will not have access to the information and data you provide to us for this study.

For the purposes of ensuring the proper monitoring of the research study, it is possible that a member of the St Joseph’s Healthcare Hamilton Research Ethics Board or a member of the University of Guelph Research Ethics Board may consult the research data. However, no records which identify you by name or initials will be released. By signing this consent form, you authorize such access. Your information will otherwise be kept confidential and only the individuals related to this study will have access to it.

In the event that you would leave the treatment centre before the end of the week, you will be able to hand in your questionnaire/Dream Journal to a staff member in a sealed envelope that will be provided to you by the study investigator.

CAN PARTICIPATION IN THE STUDY END EARLY?

If you volunteer to be in this study, you may withdraw at any time and this will in no way affect the quality of care you receive at this institution. You have the option of removing your data from the study. You may also refuse to answer any questions you don’t want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise which warrant doing so. For example, leaving early or being discharged from your treatment program before its completion will automatically terminate your participation to the study. Unless otherwise specified by yourself upon
leaving or being discharged however, the data already gathered from you will still constitute part of the research data. All your personal information will however be removed from the study data.

WILL I BE PAID TO PARTICIPATE IN THIS STUDY?

Your participation in this research project is greatly appreciated. You will be handed a $5 Tim Hortons gift certificate immediately following your signing of the consent form, at which time you will also be provided with your Initial questionnaire and first week Dream Journal. You will receive an additional $5 Tim Hortons gift certificate each week when picking up your new Dream Journal and handing in the filled out one for the previous week. These gift certificates will be handed in to you directly.

WILL THERE BE ANY COSTS?

Your participation in this research project will not involve any additional costs to you or your health care insurer.

IF I HAVE ANY QUESTIONS OR PROBLEMS, WHOM CAN I CALL?

If you have any questions about the research now or later, please contact Hélène Tanguay, PhD candidate and research investigator at 905-641-3822 (htanguay@uoguelph.ca) Dr. Francesco Leri, Associate Professor, Department of Psychology, University of Guelph at 519-824-4100, ext. 58264 or Debbie Bang, Local Principal Investigator for St. Joseph’s Healthcare Hamilton at (905) 521-9591, ext. 231.
CONSENT STATEMENT

Participant:

I have read the preceding information thoroughly. I have had an opportunity to ask questions and all of my questions have been answered to my satisfaction. I agree to participate in this study. I understand that I will receive a signed copy of this form.

Do you agree to participate in the phone follow up? Note that you can participate in the study without participating in the phone follow up (please put your initials where it applies).

Yes ________ No ________

If you agree to participate in the phone follow up, please indicate the phone number where we can reach you.

Phone number: ____________________

Name ____________________________ Signature ____________________________ Date ____________________________

Person obtaining consent:

I have discussed this study in detail with the participant. I believe the participant understands what is involved in this study.

Hélène Tanguay, Research Investigator ____________________________ Signature ____________________________ Date ____________________________

This study has been reviewed by the St. Joseph’s Healthcare Hamilton Research Ethics Board (SJHH REB). The REB is responsible for ensuring that participants are informed of the risks associated with the research, and that participants are free to decide if participation is right for them. If you have any questions about your rights as a research participant, please call The Office of the Chair, St. Joseph’s Healthcare Hamilton REB at 905.522.1155 Ext. 33537.
CONSENT TO PARTICIPATE IN RESEARCH (Homewood)

Drug-dreams in addiction: A study of the impact of drug-dreams on affect and recovery

You are asked to participate in a research study conducted by Hélène Tanguay (doctoral candidate) and Francesco Leri (associate professor and research supervisor), from the Department of Psychology at the University of Guelph. The results of this project will contribute to the doctoral thesis of Hélène Tanguay.

If you have any questions or concerns about the research, please feel free to contact Helene Tanguay at (905) 641-3822 or Francesco Leri, associate professor and research supervisor, at (519) 824-4120, ext.58264.

PURPOSE OF THE STUDY

Drug-dreams are frequent occurrences during withdrawal and early recovery and consist of very realistic dreams about using drugs, seeking drugs or even looking at other people handling or using drugs.

The objective of this study is to assess the impact of drug-dreams on recovery from drug dependence.

Please note that you do not have to experience drug-dreams in order to participate in the study as we also need a group of participants that do not dream about drugs at the beginning of treatment but might, later during their residential or day program, start having drug-dreams.

PROCEDURES

If you volunteer to participate in this study, we would ask you to do the following things:

If you agree to participate in this study, you will be asked to fill out an initial questionnaire about your recent drug use pattern, cravings, moods, dreams, as well as the occurrence of drug-dreams, if any. You do not need to have experienced drug-dreams in order to participate in this study. You will be given the opportunity to bring the initial questionnaire at home and return it to us within 2 days. The questionnaire contains multiple-choice questions and should take you about 20 minutes to fill out.
Starting on the first week of your participation in the study, you will also be asked to fill out a daily dream journal containing a few questions about your affect and cravings and a section to record your drug-dreams (if any) with as many details as you can remember. You will be able to bring your questionnaire at home and fill it out every morning upon awakening. Depending on whether you experience drug-dreams, the Dream journal would take you approximately 5 to 10 minutes to fill out daily.

Three months following the end of your treatment program, if you agree to it, you will be contacted by phone for a quick follow up. During this phone follow up, you will be asked whether you have experienced further drug-dreams since your discharge, the content of those dreams (seeking, using, looking at other people using, etc) and if you have had any lapse or relapse during that same period of time. This follow up will take at the most 5-10 minutes to complete and can be scheduled at a time that is convenient for you.

Do you agree to participate in the phone follow up? Note that you can participate in the study without participating in the phone follow up (please put your initials where it applies).

Yes ________  No ________

If you agree to participate in the phone follow up, please indicate the phone number where we can reach you.

Phone number: ____________________

Please note that you are free to withdraw this consent at any time during this study and that no messages will be left at the number provided.

A summary of the preliminary findings of this research project will be made available to you upon request. If you would like to receive such, please inform Hélène Tanguay at htanguay@uoguelph.ca. You may request receipt of these preliminary findings via email or regular mail. We expect those findings to be available around September 2013.

POTENTIAL RISKS AND DISCOMFORTS

Whereas drug craving is a universal symptom of drug withdrawal and part of the recovery process, it is possible that experiencing drug-dreams and writing their content in your dream log may trigger cravings. In order to reduce the risk of cravings associated with the exercise of keeping a dream log, you may want to write down your drug-dreams as soon as possible after they occur. This will reduce the number of times that you have to think about these dreams following their occurrence. Participants in the study will also be asked to pick up and drop off questionnaires with the research investigator every week during their treatment cycle. While this will be done in a private office at the treatment centre, it is possible that other clients of the centre, staff or other participants in the research study will see you entering or exiting the office.
POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

Participating in this research study will allow you to increase your awareness of the role of drug-dreams on your recovery and moods. This can be especially helpful to you as drug-dreams may in some case be a trigger to cravings and subsequent drug use and the early identification of this trigger will enable you to develop alternative coping mechanisms to drug use when necessary.

The potential benefits of this research to science are also important as the results of this study may help scientists/psychologists to better understand the relationship between drug-dreams and recovery in addiction. Moreover, the transfer of this knowledge into clinical practices may improve the quality of the addiction treatment programs that you and other individuals fighting addiction may access in the future.

CONFIDENTIALITY

Every effort will be made to ensure confidentiality of any identifying information that is obtained in connection with this study.

Your data will not be shared with anyone except with your consent or as required by law. All personal information such as your name, address or phone number will be removed from the data and will be replaced by a number. A list linking the number with your name will be kept in a secured place (locked cabinet in a locked institution office), separate from the rest of your file. The data without identifying information will also be stored securely on a computer with data encryption. Moreover, please note that employees from the treatment centre that you attend will not have access to the information and data you provide to us for this study.

For the purpose of ensuring the proper monitoring of the research study, it is possible that a member of the Homewood Healthcare Research Ethics Board or a member of the University of Guelph Research Ethics Board may consult the research data. However, no records which identify you by name or initials will be released. By signing this consent form, you authorize such access. Your information will otherwise be kept confidential and only the individuals related to this study will have access to it.

In the event that you would leave the treatment centre or detox facility before the end of the week, you will be able to hand in your questionnaire/Dream Journal to a staff member in a sealed envelope (provided to you by the study investigator).

PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study. You may also refuse to answer any questions you don’t want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances
arise that warrant doing so. For example, leaving or being discharged from your detoxification or treatment program before its completion will automatically terminate your participation to the study. Unless otherwise specified by yourself before leaving, the data already gathered from you will still constitute part of the research data.

RIGHTS OF RESEARCH PARTICIPANTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. This study has been reviewed and received ethics clearance through the University of Guelph Research Ethics Board. If you have questions regarding your rights as a research participant, contact:

Sandra Auld
Director, Research Ethics
University of Guelph
437 University Centre
Guelph, ON N1G 2W1
Tel: (519) 824-4120, ext. 56606
sauld@uoguelph.ca
Fax: (519) 821-5236

Dr. Steve Abdool
Chair, Homewood Research Ethics Board
Homewood Health Centre
150 Delhi Street
Guelph, Ontario, N1E 6K9
Tel: (519) 824-1010 ext. 2118
abdostev@homewood.org
Fax: (519) 824-1827

SIGNATURE OF RESEARCH PARTICIPANT/LEGAL REPRESENTATIVE

I have read the information provided for the study “Drug-dreams in addiction: A study of the impact of drug-dreams on affect and recovery” as described herein. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

Name of Participant (please print)
_________________________________________

Signature of Participant ___________________________ Date __________

SIGNATURE OF WITNESS

Name of Witness (please print)
_________________________________________

Signature of Witness ___________________________ Date __________
APPENDIX B. Initial Questionnaire
**DRUG-DREAM QUESTIONNAIRE (INITIAL)**

Hélène Tanguay, PhD candidate
htanguay@uoguelph.ca

Please note that you are free to skip any question that you do not feel comfortable answering.

<table>
<thead>
<tr>
<th>Participant ID: ______________</th>
<th>Today’s date ______________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age:</td>
<td>□ &lt; 25 □ 25-35 □ &gt;35</td>
</tr>
</tbody>
</table>

**Treatment Centre:**

□ Day Treatment □ Residential Treatment □ Detox

**Date you entered detox, day treatment or residential treatment (IMPORTANT) _____________**

**Length of Treatment Program:** □ 15 days □ 18 days □ 21 days □ 5 weeks □ Detox

**Methadone maintenance program:** □ Yes  If Yes, how long □ Less than a month □ 1-6 months □ 6 - 12 months □ More than a year □ No

Dosage: ______mg/day

**Are you currently on a nicotine replacement program:** □ Yes □ No

If Yes, how long: □ Less than 7 days □ Between 8-15 days □ More than 15 days

Dosage: ______mg/day

**Do you have a diagnosis of:**

□ Schizophrenia □ Psychosis □ Bipolar disorder with psychotic features □ Depression □ Anxiety □ Post traumatic stress disorder (PTSD) □ Other (please specify): ______________
Section 1.

The main drug I use is: (check only the one you use the most often)

- Cocaine/Crack
- Methampetamines
- Amphetamines
- Ecstasy
- Heroin
- Oxycontin
- Glue/Inhalants
- Benzodiazepines
- Mushrooms
- LSD
- Ketamine
- Barbituates
- Alcohol
- Cannabis
- GHB
- Other (Please specify) __________

The month before entering treatment (detox, day treatment program or residential), I have used this drug:

- Not used
- 1-3 times a month
- 1-2 times a week
- 3-4 times a week
- 5-6 times a week
- Daily
- Binge

Approximate quantity used on a typical day: __________

Number of times used on a typical day: __________

The week before entering treatment (detox, day treatment or residential) I have used this drug:

- Not used
- 1-2 times a week
- 3-4 times a week
- 5-6 times a week
- Daily
- Binge

Approximate quantity used on a typical day: __________

Number of times used on a typical day: __________

Since entering treatment (detox or day treatment or residential), I have used this drug:

- Not used
- 1-2 times a week
- 3-4 times a week
- 5-6 times a week
- Daily
- Binge

Please indicate what other drugs you have used in the month before entering detox, day treatment or residential treatment and the frequency of use for each one (check all that apply):

<table>
<thead>
<tr>
<th>Drug</th>
<th>1-3 times per month</th>
<th>1-2 times per week</th>
<th>3-4 times per week</th>
<th>5-6 times per week</th>
<th>Daily</th>
<th>Binge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocaine/Crack</td>
<td></td>
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<td></td>
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<tr>
<td>Methampetamines</td>
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<tr>
<td>Amphetamines</td>
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<tr>
<td>Ecstasy</td>
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<tr>
<td>Heroin</td>
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<tr>
<td>Oxycontin</td>
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<tr>
<td>Benzodiazepines</td>
<td>Barbiturates</td>
<td>Glue/Inhalants</td>
<td>Mushrooms</td>
<td>LSD</td>
<td>Ketamine</td>
<td>Alcohol</td>
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<td>-----------------</td>
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</tbody>
</table>

**Section 2. Treatment history.**

**How many times have you tried to stop using drugs or alcohol in your lifetime (with or without treatment)?**
- 0 None
- 1 O 1 time
- 2 times
- 3 times
- 4 times
- More than 5 times

**How many times have you been in treatment (outpatient, day or residential) for drugs or alcohol in your lifetime? (not including this one)**
- 0 None
- 1 O 1 time
- 2 times
- 3 times
- 4 times
- More than 5 times

**How many times have you tried to stop using drugs or alcohol in the past 12 months (with or without treatment)?**
- 0 None
- 1 O 1 time
- 2 times
- 3 times
- 4 times
- More than 5 times

**How many times have you been in treatment (outpatient, day or residential) for drugs or alcohol in the past 12 months?**
- 0 None
- 1 O 1 time
- 2 times
- 3 times
- 4 times
- More than 5 times

**When did you last used drugs or alcohol?**
- 0 Less than 24 hours ago
- 1 24-48 hours ago
- 2 48-72 hours ago
- 3 More than 72 hours ago
- 4 More than a week ago
- 5 More than a month ago

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What is the longest period of time you have been able to abstain from drugs before a lapse/relapse?

- Less than a week
- 1-2 weeks
- 3-4 weeks
- 1-6 Months
- 7-12 months
- More than 1 year

Section 3 A, B and C. Positive and Negative Affect Scale (PANAS) short form (Watson, Clark & Tellegen, 1988).

In those 3 sections, participants had to rate their affect, relying on the items of the Positive and Negative Affect Scale (PANAS) for:

1) the month before entering treatment;
2) the week before entering treatment, and;
3) since entering treatment.

Section 4: Craving.

On a typical day during the month prior to entering detox or residential treatment, please indicate the average intensity of your cravings by placing an X on the line below.

No cravings

Extreme cravings

(10 cms)

On a typical day during the week before entering detox or residential treatment, please indicate the average intensity of your cravings by placing an X on the line below.

No cravings

Extreme cravings

On a typical day since entering detox or residential treatment, please indicate the average intensity of your cravings by placing an X on the line below.

No cravings

Extreme cravings
### Section 5. This section refers to your dreams in general, NOT SPECIFICALLY your dreams about drugs.

**How often do you remember your dreams?**

- [ ] More than once a night
- [ ] Once a night
- [ ] More than once a week
- [ ] Once a week
- [ ] Once every 2 to 3 weeks
- [ ] Once a month
- [ ] Never

**On average, how many dreams do you usually remember per week:** ________

**Nightmares are very disturbing dreams in which the unpleasant visual imagery and/ or emotions wake you up (i.e. the dream's unpleasant content woke you up while the dream was still ongoing).**

**How frequently do you have nightmares?**

- [ ] More than once a week
- [ ] Once a week
- [ ] More than once a month
- [ ] Once a month
- [ ] Once every 3 or 4 months
- [ ] Once a year
- [ ] Never

**Bad dreams are very disturbing dreams, which, though being unpleasant, do not cause you to awaken.**

**How frequently do you have bad dreams?**

- [ ] More than once a week
- [ ] Once a week
- [ ] More than once a month
- [ ] Once a month
- [ ] Once every 3 to 4 months
- [ ] Once a year
- [ ] Never

### Section 6. Drug-Dreams

A drug-dream is one in which you are either using drugs, seeking drugs or are in a situation where people around you are handling or using drugs. Have you **ever** had drug dreams?

- [ ] Yes
- [ ] No

**If you answered No, you are now finished completing this questionnaire.**

**If you answered Yes, please fill out the section below**
<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>When did your most recent drug-dream occur?</strong></td>
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<tr>
<td>Less than a week ago</td>
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<tr>
<td>1-2 weeks ago</td>
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<td>3-4 weeks ago</td>
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<tr>
<td>More than a month ago</td>
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<tr>
<td>More than a year ago</td>
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<tr>
<td><strong>Since entering detox, residential or day treatment, how many drug-dreams have you experienced?</strong></td>
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<td>0 (none)</td>
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<td>1-2</td>
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<td>3-4</td>
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<tr>
<td>More than 4</td>
<td></td>
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<tr>
<td><strong>In the week before entering detox, residential or day treatment, how many drug-dreams have you experienced?</strong></td>
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<td>O</td>
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<td>0 (none)</td>
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<td>1-2</td>
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<td>3-4</td>
<td></td>
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<tr>
<td>More than 4</td>
<td></td>
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<tr>
<td><strong>In the month before entering detox, residential or day treatment, how many drug-dreams have you experienced?</strong></td>
<td></td>
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<td>0 (none)</td>
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<td>1-2</td>
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<td>3-4</td>
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<td>More than 4</td>
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<tr>
<td><strong>In your most recent drug-dream, did you seek, use, or attempt to use drugs?</strong></td>
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<tr>
<td>Yes</td>
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<tr>
<td>No</td>
<td></td>
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<tr>
<td>Don't remember</td>
<td></td>
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<tr>
<td><strong>Do drug-dreams awaken you during the night?</strong></td>
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<td>O</td>
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<tr>
<td>Yes</td>
<td></td>
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<tr>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Don't Know</td>
<td></td>
</tr>
<tr>
<td><strong>Are your drug-dreams more vivid than your other dreams?</strong></td>
<td></td>
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<tr>
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<td>O</td>
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<td>O</td>
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<tr>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Don't Know</td>
<td></td>
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<tr>
<td><strong>Have you ever had drug-dreams while you were an active drug user?</strong></td>
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<td>O</td>
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<tr>
<td>Yes</td>
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<tr>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Don't Know</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX C. Daily Dream Journal
DREAM JOURNAL

Participant ID: 

Treatment Centre: 

Instructions:

Please note that you are free to skip any question that you do not feel comfortable answering.

- Please fill out one page per day. EVEN IF YOU DO NOT HAVE DRUG-DREAMS DURING THE PREVIOUS NIGHT.

- Fill out your daily diary each morning UPON AWAKENING. If you forget, please fill it out as soon as you can on that day.

- Hand in your questionnaire directly to the research investigator (Hélène Tanguay) at the end of the week (room__). At that time, you will receive a new journal for the week as well as your weekly compensation for participating in the study.

- If you leave the treatment centre prior to the end of the week, please hand in your questionnaire to a staff member in the sealed envelope provided to you.
<table>
<thead>
<tr>
<th>Participant #_________</th>
<th>Date_________</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>As part of the daily dream journal, participants had to rate their affect daily, relying on the Positive and Negative Affect Scale (PANAS) short form (Watson, Clark &amp; Tellegen, 1988).</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Please indicate by placing an X on the line below how confident you are at this moment that you will maintain your recovery:</strong></td>
<td></td>
</tr>
<tr>
<td>Not at all</td>
<td>Extremely</td>
</tr>
<tr>
<td><strong>Upon awakening this morning, please rate the intensity of your craving for drug or alcohol by placing an X on the line below:</strong></td>
<td></td>
</tr>
<tr>
<td>Not at all</td>
<td>Extreme</td>
</tr>
<tr>
<td><strong>Please rate the intensity of your craving for drug or alcohol during the day yesterday by placing an X on the line below:</strong></td>
<td></td>
</tr>
<tr>
<td>Not at all</td>
<td>Extreme</td>
</tr>
</tbody>
</table>
| **Do you remember dreaming (about anything except drugs) last night**
**Did you have a drug-dream last night?**  
○ No  
○ Yes  
**If you answered Yes, you are now finished**  
**If you answered NO, please continue** |
| **Please indicate how vivid your drug-dream was by placing an X on the line below:** |
| Not vivid at all | Extremely vivid |
| **Please indicate how distressing your drug-dream was by placing an X on the line below:** |
| Not at all | Extremely |
| **Please describe your drug-dream with as much detail as you can remember (location, drug used, feelings, etc).** |
APPENDIX D. Follow-up phone interview
Phone Follow-up script

Hello, my name is Helene Tanguay and I am a PhD candidate in the department of Psychology at the University of Guelph. I am calling you today because you participated in a research study on drug-dreams during your residential or day treatment program 3 months ago and you indicated on your consent form that you were willing to participate in this phone follow up. This follow up should take about 5 minutes to complete and you are free to skip any questions that you do not want to answer.

Although you indicated your willingness to participate in this phone follow up, you are free to withdraw your consent at this time, should you want to do so.
Do you agree to participate in this phone follow up today?

If yes, go to question 1;

If participant answers “no”, interviewer says the following:

“I thank you for your time and participation in this research during your treatment at _____ centre. I wish you the best with your recovery”.

1) Since the end of your treatment at ____________ centre 3 months ago, have you had any drug-dreams? Yes ___  No ___  Refused to answer ___

If no, researcher continues with section 2.
If yes:

- Approximately how many of those dreams have you had?
  1-2 ___  3-4 ___  More than 4 ___  Refused to answer ___
In your drug-dreams:

- Did you seek drugs? Yes ___ No ___ Don’t know ___ Refused to answer ___

If yes, were you able to find it?

- Yes ___ No ___ Don’t know ___ Refused ___
- Did you use drugs? Yes ___ No ___ Don’t know ___ Refused to answer ___
- Did you see others seek or use drugs? Yes ___ No ___ Don’t know ___ Refused ___

Were your drug-dreams more vivid than your other dreams?

Yes ___ No ___ DK ___ Refused ___

2) In the past 3 months:

- Did you have a lapse? Yes ___ No ___ Refused to answer ___
- Did you relapse? Yes ___ No ___ Refused to answer ___

This was the last question. I would like to thank you again for participating in this study and taking the time to complete this phone follow up.
APPENDIX E. Drug dreams examples
Research participant #11  Dream #5  Week #3  Day #19

I dreamt I was putting a needle into my arm, I’d stop, than I’d do it again 2 minutes later. When I woke up I was soaked in sweat and felt my left arm blood was boiling.

Research participant #14  Dream #1  Week #1  Day #4

I was at home, and the dealer came over. I bought some drugs and I was using. I felt that I was injecting and I could feel poking on my arm and the spot that I had injected was pulsating. I was also smoking crack in my dream and I could taste the crack in my mouth and from when I opened my eyes I kind of felt high.

Research Participant # 27  Dream # 4  Week # 2  Day # 10

Last night I had a crazy dream, I was back with my ex and her and I were living in our old apartment, and that’s for me where it all began. In my dream, I was smoking coke, and meth. Smoking crack and drinking Budweiser and Crown Royal. I seemed to be enjoying myself throughout the dream but when I woke up I was covered in sweat and unsure of where I was.

Research Participant # 50  Dream # 2  Week # 1  Day # 7

Being attacked by dogs when going to unfamiliar house to buy drugs i.e. cocaine. While at the house I changed my mind and didn't buy any cocaine. Went home went home and wife wouldn't even look at me. That's about all I remember.

Research Participant # 76  Dream # 2  Week 1  Day # 7

My dealer burst into my home with a buddy. They wanted me to buy cocaine even though I wanted to save my money for something else. When my back was turned they found my $400, took it, left me 3.5g of cocaine, and left. I was excited to have cocaine in my possession again. I spent a long time trying to find an ideal place to sniff it. Eventually I found a change room at a waterpark. As soon as I started sniff it, it turned into a bedroom with children in it that saw what I had done. I felt very badly that they have seen that. I begged them not to tell. The rest of the dream I felt worried about getting “ratted out”.

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