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Neurorecreation: A Conceptual Framework Building a Bridge Between Neuroscience and Recreation*

Sohret PAKIS **

Abstract

A new phenomenon regarding the relationship between recreation and neuroscience, coined as neurorecreation, underlies a new concept and/or a new field of research. Recent studies into the possible relationships between recreation and neuroscience have the potential to contribute a great deal to our understanding of recreation in terms of behavioural, functional, physiological, and neurochemical effects. The aim of this study, was to explain and outline the concept and phenomenon of "Neuro-Recreation" as the intersection of Recreation and Neuroscience. The findings from theoretical explanations also have important implications, which primarily suggest that recreation — which is a powerful contributor to the emotional, physical, mental, and social well-being of individuals — is a meaningful form of experience. These explanations also theorize that using neuroscientific measures can provide an alternative method of measuring, understanding, designing, and optimizing experiences offered in a recreational context. Finally, these experiences effect humans', communities', and cities' happiness and emotional well-being as well as stress levels; enhancing happiness and decreasing stress levels.

Keywords— Neuroscience, Neurorecreation, Leisure, Recreation, Experience, Happiness

Nörorekreasyon: Rekreasyon ve Sinirbilim Arasında Köprü Kuran Kavramsal Bir Çerçeve

Öz

Rekreasyon ve nörobilim arasındaki ilişkiyi inceleyen ve nörorekreasyon olarak adlandırılan yeni bir fenomen; araştırılması gereken yeni bir kavramı ve/veya yeni bir alanının temelini oluşturmaktadır. Son dönemde yapılan rekreasyon ve nörobilim alanındaki çalışmalar, rekreasyonu davranışsal, işlevsel, psikolojik, nöral ve nörokimyasal etkileri açısından anlamamıza katkıda bulunma potansiyeli taşımaktadır. Bu çalışmanın amacı, Rekreasyon ve Nörobilimin kesişme noktası olan nörorekreasyon kavramını ve olgusunu açıklamak ve ana hatlarını çizmektir. Teorik açıklamalardan elde edilen bulgulardan da önemli çıkarımlar yapılabilir. Bu teorik açıklamalar doğrultusunda, bireylerin duygusal, fiziksel, zihinsel ve sosyal iyilik haline güçlü bir katkı sağlayan rekreasyonun, öncelikle etkili bir deneyim biçimi olduğunu öne sürmek mümkündür. Ayrıca bu açıklamalardan yola çıkarak, nörobilimsel ölçümlerin rekreasyonel bir bağlamda sunulan deneyimleri ölçmek, anlamak, tasarlamak ve optimize etmek açısından alternatif bir yöntem sağlayabileceğini kuramını ileri sürmek de mümkündür. Son olarak, bu deneyimler insanların, toplulukların ve şehirlerin mutluluk ve duygusal refahının yanı sıra stres seviyelerini de etkilemektedir, mutluluğu arttırırken, stres seviyelerini azaltmaktadır.

Anahtar Kelimeler: Nörobilim, Nörorekreasyon, Serbest Zaman, Rekreasyon, Deneyim, Mutluluk

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**Üsküdar University, Institute of Health Sciences, Neuroscience, Istanbul-Turkey, e-posta:sohret.pakis@gmail.com

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INTRODUCTION

A new phenomenon regarding the relationship between recreation and neuroscience, coined as neurorecreation (Pakis, 2019a, 2019b), points to a novel approach and perspective within areas of learning. Neurorecreation is a new concept study examining the function between the nervous system and brain as they relate to recreational and leisure experiences. This study considers how neuroscience may contribute to the measurement of recreational experiences and ultimately attraction design, along with discussing the potentials of neurorecreation.

This paper reviews literature from neuroscience that explores the experiences and emotions that emerge from leisure activities. It also discusses the limitations of current methods used for measuring experiences and reviews neuroscientific methods for measuring experiences and emotions.

Many interdisciplinary studies have been performed focusing on the connection between neuroscience and other fields such as marketing, sports, exercise, etc. (Agarwal and Dutta, 2015; Basso and Suzuki, 2017; Chattopadhyay, 2020; Keil et al., 2010; Lee et al., 2019). However, studies that reveal the relationship between recreation and neuroscience are rare. Some can be found that describe efforts to define the relationship between activity, happiness, etc., and other studies can be found about neuroscience specifically (Nann et al., 2019). However, it is almost impossible to find a study specifically on the concept of neurorecreation. In essence, finding a study that reveals the relationship between recreation and neuroscience is one in a million. This study, then, aims to illustrate the institutional framework of neurorecreation where neuroscience and recreation intersect.

This paper explores the relationship between neuroscience and recreation and leisure to highlight the potential and benefits of using neuroscientific methods in these two fields. It also will showcase several alternative methods for accurately measuring experience (which results in emotions critical for decision-making processes, buying behaviors, experience optimization, and — above all — enhancing the happiness of individuals and society) and will discuss the implications of neurorecreation for both academic and business leisure/recreation partnerships.

CONCEPTUAL FRAMEWORK

Definitions of Neuroscience, Recreation and Neurorecreation

Neuroscience is currently one of the most rapidly growing areas of science. Research in this field has been on the rise for more than 50 years with publications increasing at a steady rate (between 5 % and 15 % per year; "Neuro-science Research," 2015). However, between 2012 and 2014, there was a 105 percent increase in the number of publications discussing neuroscience (statistics based on data from "Neuro-science Research," 2015). Results from these studies have brought about a boom in neurotechnology innovation; patents have doubled since 2010 and quadrupled since the beginning of the millennium (Begley, 2015; Erhardt and Zagorac, 2019).

Recreation, most simply defined, refers to experiences and activities chosen and pursued by an individual during his/her leisure time. Specifically, the experiences sought and activities pursued, in the real sense of the word, "re-creates" the individual so that he/she may be refreshed and, thus, enabled to resume daily obligations, whatever those may be (Veal, 2004). According to Kesim (2016), recreation consists of leisure activities in which individuals willingly participate voluntarily to develop and renew themselves. Recreation includes not only physical activities but also all activities in which they participate for their social, mental, and spiritual motivation. According to Juniu and Henderson (2001), the selection of activities is not unlimited. On the contrary, the choice is limited based on distinct kinds of conditions. Therefore, in leisure, the concept of free will, which is expressed by Kesim, would be more realistically described as "free will as far as the circumstances allow" (Kesim, 2018).

Gurbuz and Henderseon (2014), who considers the concept of leisure time, and Harris (2005), who consider the concept of leisure time (part of our lifelong development processes by which we have the right of free choice) together can be considered as conceptually studying the affect states of emotion, such as enjoyment and contentment.

It is important that societies support individuals' engagement in recreational activities in their leisure time. The reason for such support is these activities contributes to people's existence, making them more creative and helping with their well-being and development (Ozkan, 2018), which ultimately benefit societies.

Another definition often used for "recreation" is the leisure pursuit of activities during individuals' free time – that is, time away from work or any activity to which people are highly committed [(overtime work, home study, gig work, home maintenance responsibilities, etc. (Tribe, 2011)]. This type of recreation comprises a variety of options: rock climbing, ice skating, golfing, or sport fishing, for example. Additionally, Tribe (2005) reports that activities typically performed at home (e.g. reading or watching TV) and those away from home (tourism, theatre, sports, and cinema) are similarly considered to be recreational.

Torkildsen (1999) states that, historically, most experts define recreation as an activity that energizes individuals to pursue work, though others perceive this approach as one with limitations. After all, recreation does require energy. So, rather than referring to recreation as a restorative exercise, most experts look at recreation as an activity itself. Some authorities who support the idea of recreation being an activity also connect it to one that other people consider socially acceptable. In general, researchers consider recreation to be an activity that one does out of personal choice, without obligation. Specifically, the Dictionary of Sociology defines recreation as "any activity pursued during leisure, either individual or collective, that is free and pleasureful, having its own immediate appeal, not impelled by a delayed reward beyond itself." Similarly, Williams (2003) connects the idea of "recreation" to the concept of an activity that has purpose and also a goal.

At this point, in order to understand the relationship between neuroscience and recreation, I suggest to deepen our understanding of human as social beings. If we can understand human beings, how their brains work, and their emotions, how they are shaped, how they are remembered; then we can optimize those aspects and build and offer experiences accordingly to enhance happiness in recreation field. Humans are very social creatures – able to cooperate in extremely flexible ways. This can very basically explained by humans' being physically weak and vulnerable when you compare us to other creatures in the nature. We have no claws, fur, sharp teeth, or wings – nothing to protect us from the environment. We are literally naked (Canan, 2019). What we do have is a superior intellect and social skills. A major part of the fundamental circuits of the brain are allocated for this purpose. These circuits serve many uses, one of which is to make us socially dependent on one another. Humans have such a deep need for one another that they cannot survive away from others for long without negative impacts on their mental and emotional health. Thus, on both a technical and emotional level, our need for socialization must be met in one way or another. Certain hormones and neural systems in our brains are intricately linked to us in being very social creatures (Tolomeo et al., 2020). One of these hormones is oxytocin neurotransmitter (Levy et al., 2016). This hormone is released by the hypothalamus in the brain. Most are familiar with oxytocin's impact on the contraction of the uterus during the birth of a baby, as well as effecting lactation. However, in addition to these types of familiar functions, studies have recently shown that oxytocin performs another important function. It is released anytime that humans engage in positive, social relations and when They interact with others. Oxytocin is stimulated every time we hug, talk to one another, shake hands, greet each other, sing together, play team sports, play games, engage in recreational activities and basically have fun with others (Kosfeld at al., 2005). For this reason, we can rationally call oxytocin the hormone for biological and emotional attachment. Increasing levels of oxytocin are also important because they reduce the activity of the amygdala, which is the stress-alarm center of the brain. Oxytocin "takes the edge off," boosting our confidence in others, and creating happiness and social as a key emotion. Oxytocin is not the only chemical in our brain that has such a positive impact; many chemicals help facilitate social relations and cooperation with others, such as dopamine, endorphins, serotonin, and adrenalin. All told, these hormones create tremendous relief and happiness when we get closer to one another, share things, gain new experiences, laugh, and have fun. In short, we are creatures programmed to yearn for and to spend time together. It is our fundamental need.

The other system for meeting our socializing need is mirror neuron system that was discovered late 90s which helps us to build empathy and trust. (Altınbaş et al., 2010.) Goleman (2006) states that mirror neurons help people to understand others' emotions and share feelings. Throughout life, it is the pattern of activity among the mirror neurons and perhaps, the super mirror neurons that allows human beings—the species wired for empathy—to understand the existential meaning of engagement in the world of experience. Specialized for involvement with others, these cells "show that we are not alone, but are biologically wired and evolutionarily designed to be deeply interconnected with one another" (Iacoboni, 2008, p. 267).

Recreation at this point is crucial serving human beings to meet their fundamental need of socializing to survive and live a happy life both emotionally and physically. Recreational activities and experiences bring people together, make people move, socialize and share; bind them together and allow people to make connections. When experiencing activities and attractions, you strengthen your bonds with your family members and friends that you are together, and you share this experience with many new people.

Recreation is ideal particularly for improving communication among children. Participation in recreational activities can contribute to an improved level of quality of life (Nkwanyana, 2020). Participating in sports, joining clubs, taking music and dance classes is a way of dealing with challenges that are faced by society, these classes will assist young people to be able to participate in their communities, learn skills and socialize beyond their families boundaries (cited by the Council on Social Development (CCSD, 2001). Recreational programs create capacity for social inclusion (Coakley, 2002). That is why recreation ensures a happier being and a happier society by serving our fundamental trait of which is our being a social creature.

Neurorecreation, which is a new concept merging areas of recreation and neuroscience, is the study of the function of the nervous system and the brain as they relate to recreational and leisure experiences. However, the number of studies that have examined the relationship between recreation and neuroscience — such as in the field of recreation, theme parks, waterparks, recreational parks, and leisure activities is very limited.

Recent advances in neuroscience have the potential to highlight the relationships between cognitive and emotional functions, which tie into the understanding of reaction and experience in recreational events. The question is how recreational experiences effect the functioning of the brain. The state of happiness, pleasure, or adrenaline-rush that emerges after an experience is fundamentally concerned with the connection between brain signals and emotional reactions. At this point, we can integrate the tools of neuroscience that make it possible to approach recreational experiences not only by the reaction-oriented reporting and research but also by approaching mood changes during activity. We can incorporate neuroscience into the "research" or into the "experience" or both. We can have multiple people's brains influence the experience, i.e., steering a virtual reality plot, or make the experience more scary/less scary. To highlight the potential of neuroscience in the recreational context, "experience" will be used as the main factor (both real experiences and virtual-reality experiences). Additionally, this paper will provide a perspective on neurorecreation, which is concerned with experiences related to or caused by recreational activity.

Bonding, "Experience, Emotion, Happiness, Well-Being and Stress"

Experience

Experience is the offering in a leisure context. Experience-based factors influence the neural networks in the brain underlying emotions and, in turn, behaviors. The brain is continuously and dynamically being shaped by experience. Experience has a transformative effect on our brains. This is because of the plasticity structure of the brain, which is called neuroplasticity. Evidence is growing that speculates regular moderate physical exercise (Ericson et al., 2011) and cognitive therapy (Clark and Beck, 2010; Disner et al., 2011) are among interventions that can create alterations of the plasticity in the brain. These therapies are based on ancient contemplative practices (Lutz et al., 2008) with apparently positive behavioral outcomes.

A long tradition in experimental psychology and cognitive neuroscience in thinking about experiences does exist (Jantzen, 2013). Bastiaansen et al. (2019) takes those insights as a point of departure and proposes that emotions form the key ingredient of an experience. More precisely, it has been convincingly demonstrated that it is the succession of instantaneous emotional responses during an experience that determines how it is evaluated and remembered (Kahneman, 2011).

Due to their importance, emotions have been used as a segmentation variable for leisure services (Bigne and Andreu, 2004). Emotions are an indispensable component of a memorable experience (Aho, 2001; Mcintosh and Siggs, 2005), and the intensity of emotions vary during the whole experience (Kyle and Lee, 2012).

If we can measure how and under which conditions emotions shape experiences, then we can design, re-design, and optimize the experience and/or attractions accordingly and maximize the benefit for the users in terms of enhanced well-being and happiness.

Emotion

William James (1842–1910) published a famous essay with the title ‘‘What is an Emotion?’’ in Mind, 1884, that led to a fanciful, counterintuitive theory that was essentially wrong at the evolutionary, foundational level but remained influential in psychology for more than a century (Ellsworth, 1994) and still has its proponents. Robert Solomon (1942–2007) creatively summarized classic preneuroscientific theories of emotions in a collection of philosophical and cognitive essays on emotions by that same name in 2003. Both of these scholars had a deep appreciation of the diverse facets of human emotional experiences — multi-layered phenomenal states of mind — but they knew essentially nothing about how emotions arise from brain activities. Neither of these philosophers knew what emotions really are evolutionarily and neuroscientifically. Philosopher Paul Griffiths, better versed in the experimental evidence than his predecessors, came closer to a defensible experimental view in his heralded 1997 book, “What Emotions Really Are,” and we can now come even closer by paying attention to the increasingly abundant neural evidence that, unfortunately, has not yet been well-integrated into traditional psychological and philosophical perspectives (Panksepp, 2012). However, as neuro-technology improves; we may accept the neuroscientific and neuroimaging methods come in to play more to understand neural functioning of emotions.

The past decade has seen robust scientific attention to the neural bases of human emotion. Developments in neuroimaging techniques over the past two decades have given us a much more nuanced understanding of the interactive interplay between cortical and subcortical zones in the circuitry of emotion and emotion regulation. Progress in understanding the neural bases of emotion, and happiness more specifically, has been helped by the availability of imaging methods that examine both the function and structure of the human brain. These methods have contributed importantly to our understanding of the different constituents of happiness and well-being (Helliwell, 2015).

In a review of more than 100 definitions of emotion, Kleinginna and Kleinginna (1981) found that, although disagreements exist about an explicit definition of emotion, most scholars endorse the view that emotions include three parts: subjective experience, an expressive component, and physiological arousal.

Emotional events often attain a privileged status in memory. Emotional events are learned and remembered in the human brain.

Emotion has powerful influences on learning and memory that involve multiple brain systems engaged at distinct stages of information processing (LaBar and Cabeza, 2006). Emotions are a core component of experiences, as emotions make experiences memorable. (Bastiaansen et al., 2019). At the same time, emotions are much neglected in the current hospitality, tourism, and leisure literature (Coghlan et al., 2017), although recently there has been a rapidly increasing awareness of the importance of emotions for understanding memorable experiences in this field (Li et al., 2015; Coghlan et al., 2017; Skavronskaya et al., 2017). Emotions are biologically based responses to situations that are seen as personally relevant and constitute the main driving force of human behavior (Ekman, 1992).

However, as Mauss and Robinson (2009, p. 228), noted, “There is no gold standard measure of emotional response.” Although psychophysiological measures can track nuances of consumers’ emotional experiences, they are not without limitations, especially in the interpretation of the psychophysiological data. It appears that the construct of emotion may be best measured using multiple methods (Lang, 1988; Mandler, 1975; Rachman, 1978). Triangulating and cross validating the results from those measurements with each other, as well as with self-reporting methodologies, will provide a more complete and comprehensive picture of the experience (Bastiaansen et al., 2019).

Happiness

Positive psychologists identify frequent positive affect, high life satisfaction, and infrequent negative affect as the three primary components of happiness (Lyubomirsky, Sheldon and Schkade, 2005). According to Lyubomirsky, Sheldon, et al. (2005), a genetically determined set point for happiness explains approximately 50 percent of variation in happiness between individuals. This component remains stable over time and is immune to influence or control. The circumstances of an individual’s life (e.g. place of residence, age, factors from the individual’s personal history) explains approximately 10 percent of an individual’s happiness. The remaining 40 percent that determine a person’s happiness is linked to voluntarily chosen activities and practices. Lyubomirsky, et al. (2005) found that long-term happiness increased through accumulations of positive daily experiences based on activities and behaviors that fit individual stimulators of positive emotions. On the other hand, in a more specific view of activities that contribute to happiness, Diener and Seligman (2002) found that exercising and religious engagement were not determinants of increased happiness, nor did their happiest respondents experience more objectively defined good events. Instead, Diener and Seligman found that social relationships with frequent interactions are a necessary condition for exceptional happiness. Thus, keeping in mind Lyubomirsky, et al.’s (2005) seminal finding that a substantial proportion of happiness can be explained by individually chosen activities, activities with high social interaction seem especially promising. The results suggest that participation in experiential activities, such as waterparks, theme parks and recreational parks, are associated with reduced stress, increased happiness, and stronger social relations.

Compelling evidence for pleasure causation, such as increases in “liking” reactions, has so far been found for only a few brain substrates, or hedonic hotspots. Those hedonic hotspots mostly reside — surprisingly, if one thought pleasure to be cortical — deep below the neocortex in subcortical structures. The occurrence of pleasure is coded by neural activity in many additional forebrain sites beyond the hotspots mentioned above, including in the amygdala and in the cortex: especially prefrontal cortical regions such as orbitofrontal cortex, anterior cingulate cortex, and insular cortex (Grabenhorst and Rolls, 2011; Kent et al., 2013; Kringelbach, 2010; Salimpoor et al., 2011).

Well-being

Philosophers often distinguish happiness from well-being. Happiness, they theorize, is a psychological state. Well-being, however, encompasses aspects of life that are considered good for you. The latter is not necessarily restricted to psychological happiness

(Haybron, 2008). More specifically, the social sciences consider happiness to be a positive psychological state, such as enjoyment, and they look at well-being as comprising those aspects of life that can make life positive. Yet others theorize that well-being is identical to happiness. "Happiness" is a positive psychological experience, and "well-being" is an experience gained by a person who lives a good life. Many within the social sciences maintain the assumption that a human's best life is one that feels good, but the Ancients though otherwise (Annas, 1995).

As far back as Aristotle, philosophers have studied well-being versus positive psychology, typically proposing that they consist of at least two aspects: hedonia and eudaimonia (Aristotle, 350 B. C. 2009; Seligman et al., 2005). While definitions have varied, most philosophers — and psychologists — seem to concur that hedonia is related psychologically to pleasure. The flip side of that is eudaimonia, which many find less easy to define. For most, however, it relates to aspects of a life well-lived, not any specific emotional state. Here, we will define eudaimonia as, essentially, a life considered to be valuably meaningful and engaging.

Some researchers have recommended that we simply ask people how they feel — in the hedonistic sense — as the simplest measure of well-being. We could then track their "hedonic accumulation" across daily life (Kahneman, 1999a). We could use self-reporting to identify what neurobiological hedonic brain traits are most stable in helping a person to achieve happiness. On the other hand, you'll likely concur that our "normal" well-being requires a capacity for pleasure. And, as a result, people who are happy seem to find more pleasure in life.

Hedonic hotspots work together as a network to increase the response of core pleasure. Within a rodent brain, a brain hotspot is only about a cubic millimeter in volume (and, likely, similarly proportional in the human brain). Nevertheless, this tiny dimension points to what appears to be a concentration of sufficient-cause mechanisms that allow for the brain to experience deep pleasure. The properties of this network appear to be based on a delicate substrate for pleasure that demands numerous parts of the brain work together to elevate hedonic "liking" (Peciña, 2008; Peciña and Smith, 2010; Smith et al., 2010).

Stress

Stress has a different meaning for different people under different conditions. The first and most generic definition of stress is that proposed by Hans Selye: "Stress is the nonspecific response of the body to any demand." Selye (1976) repeatedly emphasized the fact that the continued use of the word "stress" as a nonspecific response to any demand was most appropriate. Selye (1976) argued that stress is not identical to emotional arousal or nervous tension because stress can occur under or in response to anesthesia in man and animals, and it can also occur in plants and bacteria that have no nervous system. This point is elaborated later in the context of stress-induced heat shock protein (Hsps) that play a key role in cytoprotection across all three phylogenetic domains of organism on Earth. The word stress, as used by Selye, is accepted in all foreign languages, including those in which no such word existed previously.

In order to understand stress better, there also needs to be a conversation about cortisol, the stress hormone. Stress is a chronic problem among people today. On the contrary to what many think, being exposed to short-term and reasonable amounts of stress is something quite good. When we are stressed for a brief period, our body activates its defense, repair and development mechanisms. Short-term stress, then, is good for us both physically and mentally. Unfortunately, we are constantly exposed to stress in city life. When the brain perceives stress, it releases a hormone called ACTH, which stimulates the suprarenal glands. This hormone causes the brain to start releasing cortisol, which increases blood sugar, giving power to muscles and suppressing immunity. Cortisol is appropriately beneficial when we are presented with an acute stress. But, when we are exposed to stress constantly, such as those who live in cities experience, an omnipresent amount of cortisol overwhelms our brain cells. This extensive amount of cortisol shrinks our brains and continuously suppresses our immune systems, making us vulnerable to all kinds of diseases (Pakis, 2019c).

Virtual Reality Technology

Virtual reality (VR) is a type of advanced human-computer interface that allows the user to interact with computers in real time and immerse themselves in the environment created by computers (Yeh, 2018). Virtual reality, a combination of two words, "Virtual" and "Reality", describes an artificial environment created with software and presented to the user in a way that causes the user to suspend belief and accept it as a real environment. Virtual reality is a computer-based technology that incorporates specialized input and output devices to allow the user to interact with and experience an artificial environment as if it were the real world. VR can range from simple environments presented on a desktop computer to fully immersive multi-sensory environments experienced through complex headgear and bodysuits. VR is basically a way of simulating or replicating an environment and giving the user a sense of being there, taking control, and personally interacting with that environment with his/her own body (Cruz-Neira et al., 2018).

Virtual reality (VR) is a remarkable technology that allows the user to experience a version of real life through a computer that "thinks ahead" to re-create what the user sees. The user wears a headset and holds controllers that interact with other units and a computer. Together, these components deliver a real-life experience by taking images from the user and then predicting, via previous head and body movements, how to alter the image to speculate what will happen and what the user will see (Tham et al., 2018). This ability to anticipate what the user's next movements will be, referred to as asynchronous re-projection, sets VR significantly above the experiences offered by other technologies, such as film, (digital) television, and video games (Verkoelen, 2017).

Approaches to Measure Experience in Recreational Research

Most researchers measure experience using questionnaires and interviews, particularly focusing on self-reporting within the field of leisure. Some of these are post-experience self-reports (basically the same as interviews and questionnaires), while others rely on real-time self-reports (Bastiaansen et al., 2019). Both of these methods are easy and cost-effective to perform and effectively encapsulate individuals' emotional reactions, even in studies involving many, many individuals (Poels and Dewitte, 2006). Additionally, researchers can use these methods for measuring emotions at nearly any time: the past, real time, the future, or simply in general (Jacobs et al., 2012).

One problem with self-reporting is that it does not fully encapsulate the most important emotional dynamics of experiences (Larsen and Fredrickson, 1999). More specifically, no matter how recently a self-report takes place after an experience, it is not actually measuring the experience but the memory of the experience (Zajchowski et al., 2017). Thus, these measurement methods can adversely impact reliability. After all, people simply may remember their experiences differently after some time has passed (Tonetto and Desmet, 2016). Additionally, there is an element of bias that must be considered in regard to self-reports due to individuals' concepts of social desirability and even their emotional-coping strategies (for example, efforts to repress negative emotions) (Larsen and Fredrickson, 1999). Finally, we must consider the fact that a large part of our emotions are unconscious (Clore and Ketelaar, 1997; Morris, 1999; LeDoux, 2000; Winkielman and Kent, 2004). With all of that in mind, we must conclude that self-reports can only provide a limited cognitive appraisal of the small portion of emotions felt by a person during an experiential episode. Therefore, researchers relying on questionnaires and interviews for their primary source of measuring experiences are inevitably going to face limitations. To provide a more nuanced understanding, Bastiaansen et al. (2019) described three negative consequences that resulted from such techniques. They noted that not having a continuous temporal measure of an individual's emotions limits the ability of experience-design managers to create the most ideal experience. For example, these designers are unable to identify the best peak and ending of an experience. Similarly, they are unable to identify the aspects that have the least interest — or that could even be harmful to the individual. Such a limitation also inhibits researchers from being able to specifically identify principles of superior experience design; they simply can't improve on or even question their peak-end theories. Finally, self-reports are unable to accurately depict the essential parts of an experience that make it memorable: the emotions. Therefore, an additional alternative set of research methodologies may be considered, which together with the current approaches make for a more comprehensive and effective toolbox for measuring experiences: neuroscience.

Alternative Ways to Measurement: Neurotechnology

Neurotechnology has the potential to transform nearly every aspect of society. Revolutions in neurotechnology will soon influence every aspect of human life. Neurotechnology can be used to further understand the natural processes of the brain, study and treat neurological disorders and injuries, and enhance neural capabilities, resulting in increased human intelligence and efficiency. Outside of the realm of health, it can be used in social contexts to improve overall quality of life (Metha et al., 2015).

Some literature studies are researching emotional changes that extreme movements can cause. Nann et al. (2019), for example, measured brain activities of bungee jumpers. EEG signals of these individuals showed that their brain signals aligned closely with the rates of acceleration and forces on the jumpers. The electroencephalographic (EEG) recordings obtained in the study of Nann et al. and a picture taken during the test are given below in Figure 1.

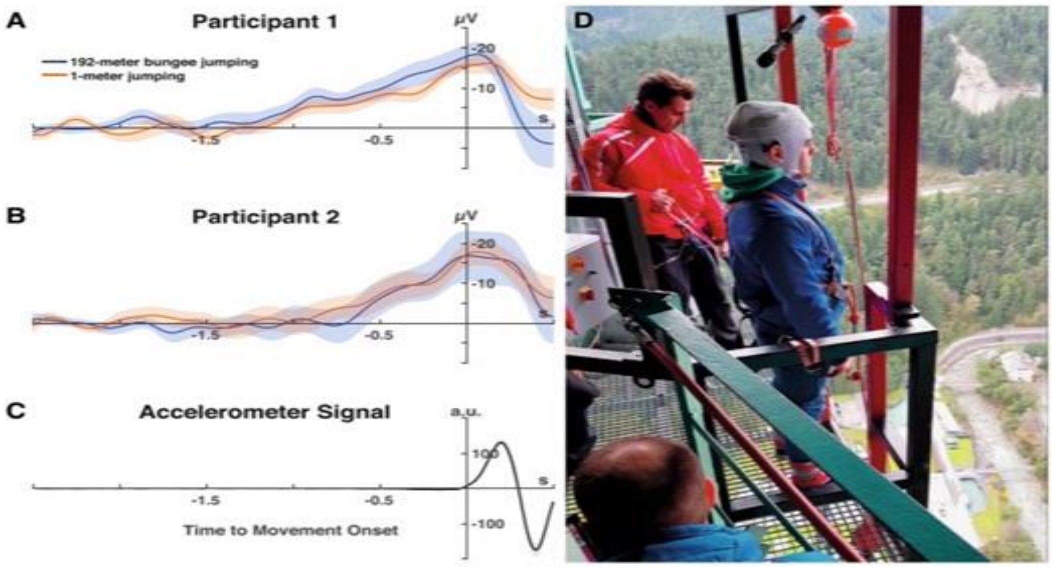

Figure 1. Electroencephalographic (EEG) recordings before bungee jumping (Nann et al., 2019)

In the near future, we will have EEG technology available for daily use. These wireless wearable EEG systems will be compact, lightweight, and require ultra-low power. They will incorporate advanced algorithms that permit real-time classification of workload during a subject's motion, which will soon make it possible to measure real-time experience measurement at amusement parks (Matthews et al., 2008).

Furthermore, as neurochemical-measurement techniques improve, recreation providers may find themselves equipped with real-time, objective, sensitive measures of program fidelity and program effectiveness that move beyond subjective observations and self-reporting. This objective form of assessment will be especially useful when practitioners are dealing with populations that are either unable or unwilling to self-report accurately (Stone, 2018). The future will be particularly bright as new neurochemical approaches are developed, and new and more specific brain-stimulation approaches emerge (Ikemoto, 2010), including optogenetic procedures that allow selective stimulation of discrete neuronal populations (e.g., Zhang et al., 2007) and new electrophysiological measures for analyzing large-scale neural network dynamics. The latter has the potential to capture distinct types of emotional arousals (e.g., Kenemans and Kähkönen, 2011; Panksepp, 2012).

Neural measures of emotions through brain activity (Neuroimaging studies)

These help us describe the functional neuroanatomy of emotion. Emotional brain responses have been measured predominantly by three neuroimaging methods:

• Functional magnetic resonance imaging (fMRI) (Cabeza and Nyberg, 2000; _ENREF_15 Phanetal, 2002).

• EEG (Electroencephalography) (Olofsson et al., 2008; Hajcak et al., 2012). EEGs are used to measure the bodily expression of emotional responses using electrodes placed on the scalp that record brain activity. EEG signals are based on the fact that brain activity operates by minute changes in electrical potential that travel from one nerve cell to another across the networks of the brain. The raw, untreated EEG signals are not highly informative with respect to specific cognitive or emotional processes in the brain. However, after well-established signal-processing techniques are applied, the recorded signals can be related to emotional responses. EEG currently does have limitations in its applicability to experience research. First, EEG is limited to lab settings; it is not yet applicable in real-time experience research. Although technically it is possible to measure EEG outside of the laboratory using ambulatory EEG equipment (Matthews et al., 2008; Yazicioglu et al., 2008), in practice, it is hardly possible to obtain recordings of sufficient quality when participants are freely moving, because movement introduces massive measurement error (Mihajlovic et al., 2015). Such issues impose considerable constraints on the type of experiences that can be studied. It is, at present, certainly not possible to study experiences such as a water park slide, recreational fishing, or a ride on a roller coaster with EEG in a straightforward manner. Nevertheless, a viable alternative to these real-life experiences is to make use of the rapidly emerging virtual reality technology, which allows for the creation of real-life-like experiences in a neuroscience laboratory setting (Bohil et al., 2011). Experiences can be created for guests with a higher degree of control while we record changes in emotional brain activity. The compatibility of VR technology with EEG-recording systems allow for the creation of experiences with a higher degree of ecological validity and control; recording changes in emotional brain activity that combine the combination of VR technology with EEG seem the most likely to provide successful and valid results in studying the emotional content of the types of experiential episodes we seek to measure. Plus, this method allows us to optimize experience design by systematically varying and evaluating different options based on the emotions they elicit.

• PET (Positron Emission Tomography). This technology enables the acquisition of images of the brain’s activity by injecting short-lived radioactive chemicals into the experimental animals and by capturing the gamma rays emitted by markers. Fluoro-deoxy glucose, which is an analog of glucose, is extensively used in analyzing the metabolic rate of neurons, by mapping the regions of brain involved during behavioral tasks.

There is a large body of evidence on which aspects of fMRI and EEG signals are indicative of emotional engagement. EEG is proposed as the most appropriate neuroimaging method in application to our study, because fMRI research is expensive for experience-measurement research projects in our context and has some restrictions (e.g., lying still — not being able to move — in a scanner).

Biometric measures of emotions

The following methods create measurements through biometric measures of facial expression, heart rate, and skin conductance. All are better for understanding the relationship between emotions and experiences (Larsen and Fredrickson, 1999):

- Facial EMG (Facial Electromyography) records the electrical activity of facial muscles. This is a sensitive way of decoding facial expressions.

- SCR (The Skin Conductance Response) / GSR (Galvanic Skin Response) is also referred to as electro dermal activity, which is a recording of the changes (increases) in the skin's ability to conduct electricity caused by an opening of the sweat glands. These sweat glands are controlled by the sympathetic nervous system, which is activated by emotional arousal. Hence, SCRs are considered to be a reliable index of emotional arousal (Bradley et al., 2008).

- HRV (Heart Rate Variability) is a measure of high-frequency HRV, which corresponds to the rate of firing of the vagus nerve and relates to individuals' ability to return the body to a low-arousal state after an emotional stimulus (Appelhans and Luecken, 2006). This method, then, can be used as a proxy for emotional arousal. The two measures combined provide a good view on emotional engagement and, under certain circumstances in a controlled laboratory setting, can even distinguish to a limited extent between some basic emotions (Ekman et al., 1992; Lang et al., 1988).

- Eye-movement or eye-tracking measures often supplement other psychophysiological methods. This technique is important because it allows us to know which specific stimulus a subject is looking at when his/her facial muscles move, or the heart rate changes. Eye-movement measurements record the number of fixations and duration of fixations of the eyes when the participants are exposed to a stimulus (Stewart and Furse, 1982). Eye-movement measure can identify the particular components of external stimuli (e.g. words or images) that receive attention. The measurement of eye movement is performed with an eye-tracking system that can identify the point or specific region the participant is paying attention to in real time. Researchers can keep track of eye and external (environment) data at the same time and acquire a video image of the environment with the superimposed eye-tracking information (Ravaja, 2004). Combined with other physiological methods (e.g. EDA or HR), the correlation between specific visual scenes and physiological reactions can be observed.

DISCUSSION AND CONCLUSION

The aim of this paper is to showcase the potential and the benefits of using neuroscientific methods in a recreational context and open a new field of research named neurorecreation. Less stress, enhanced happiness, increased well-being (both emotionally and physically), better social relations — these are the type of results that we may find through neuroscientific studies that will prove the positive effects of experiences delivered in recreational and leisure context and with reliable findings. The result of such research may lead to increased happiness and well-being of people and may also result in more investment of both the public and private sectors in the recreational field. As a result, both the recreation field and industry and — more importantly — society can benefit. Additionally, this study provides an alternative, valid, and trustworthy tool for attraction and experience designers to use in creating attractions and experiences that can increase the well-being and happiness of customers. Thus, if we can understand humans, how their brains work, how their emotions are shaped, how experiences are remembered, then we can optimize those aspects and build and offer experiences accordingly to enhance happiness in the recreation field.

The importance of R&D support in regard to experimental studies of companies that have been developing neurorecreation as stated by Argan (2004) is considerable; these efforts indicate a direct relationship between an activity or company's brand name in connection with the development of sports or recreation.

The most common trend in the recreational and leisure industry is the integration of technology, such as Virtual Reality (VR) and Augmented Reality (AR). Through neuroscientific techniques, we can measure the effects of the technology integration versus real experience.

Milgram et al. (1994) defined VR as the artificial simulations — usually a re-creation of a real-life environment — that enhance an imagery reality or situation (e.g., impersonating a character in a Minecraft game adventure). Burdea and Coiffet define VR as “a simulation in which computer graphics are used to create a realistic-looking world” (Burdea and Coiffet, 2003, p. 2) (Tham et al., 2018).

Simulation techniques are used to build virtual worlds in which users are immersed and to deceive the human senses, so that the perceptual cues that reach the brain are aligned with an alternative reality. These perceptual cues can be of different natures, including acoustic, visual, haptic, smell, and motion stimuli. VR is a consolidated solution in many cases (e.g., driving simulators) as it provides: safety and risk reduction, greater trial availability, no danger, the possibility of recreating a variety of situations, and the possibility of repeating the same situations under the same conditions (Casas et al., 2017; Cruz-Neira et al., 2018).

The measurement of traditional self-reported methods encounters some difficulties in capturing emotions. Therefore, using neuroscientific methods can be an alternative and/or a collaborative technique that enables us to better measure and understand experience and emotions. Because neurotechnology is growing quickly, it is suggested that the restrictions cited above will soon be eliminated, and neuroscientific methods will become a beneficial tool to use in the recreational/leisure industry. Diamond and Whitington (2015) claimed that the gap between “what we know and what we do” can be bridged by neuroscience findings. By using these technologies as they advance, recreational and leisure experiences will also advance.

Additionally, in gaining knowledge via use of these technologies, the recreational and leisure experiences will advance and, more importantly, they will help us create a happier society with increased well-being. Neurorecreation has important implications for academic-leisure/recreation partnerships and an understanding of the brain. However, more empirical research regarding the relationship between neuroscience and recreation is needed to better understand neurorecreation.

The recreational and leisure industry is growing every day (Themed Entertainment Association TEA/AECOM Theme Index and Museum Index 2017; International Association of Amusement Parks and Attractions [IAAPA], “The IAAPA Global Theme and Amusement Park Outlook 2018-2022” by Wilkofsky Gruen Associates, “The Global Attractions Attendance Report”). The two sides of the industry — both design/engineering and supplier/operating companies — are working to create and offer attractions, events, and parks that ensure memorable experiences and keep guests coming back. The neuroscientific methodologies may allow these companies to better understand the factors that affect guests’ experiences so they can design/offer attractions/events, etc., that create the most memorable experiences. Here, it is important to note that our brains can only learn and remember things with which they can build an emotional link. We can learn and remember things that make us build an emotional connection so these neuroscientific methods will first help us measure the emotions. Additionally, we can design experiences accordingly. In effect, the world is shifting from service-based to experience-based (Flagestad, 2006).

As the previous information indicates, no experimental methods have been used to study the brain activity of water slide riders. A method would be necessary to measure brain activity during and throughout the experience. Necessary measures would require participants to wear sensors for EEG (Electroencephalography), HRV (Heart Rate Variability), and SCR (Skin Conductance Response)/GSR (Galvanic Skin Response) sensors. A photo taken during the biometric and So far, one experimental study has begun of this type in Turkey. A photo taken during the biometric and neural tests carried out within the scope of this study is given in Figure 2.

Figure 2: EEG and Biometric Measurements of the Ongoing Research in Turkey (Source: Author).

LIMITATION AND FUTURE STUDIES

Although this paper is the first study to identify the relationship between recreation and neuroscience, this study has its own limitations. With inspiration from studies conducted in different fields, this study sheds light on the potential of neurorecreation. Above all, to scientifically support the relationship between these two significant disciplines, it is necessary to conduct studies based on research and measurement. Having a wide scope, recreation-related field measurements, in terms of activity, etc., need to be conducted.

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