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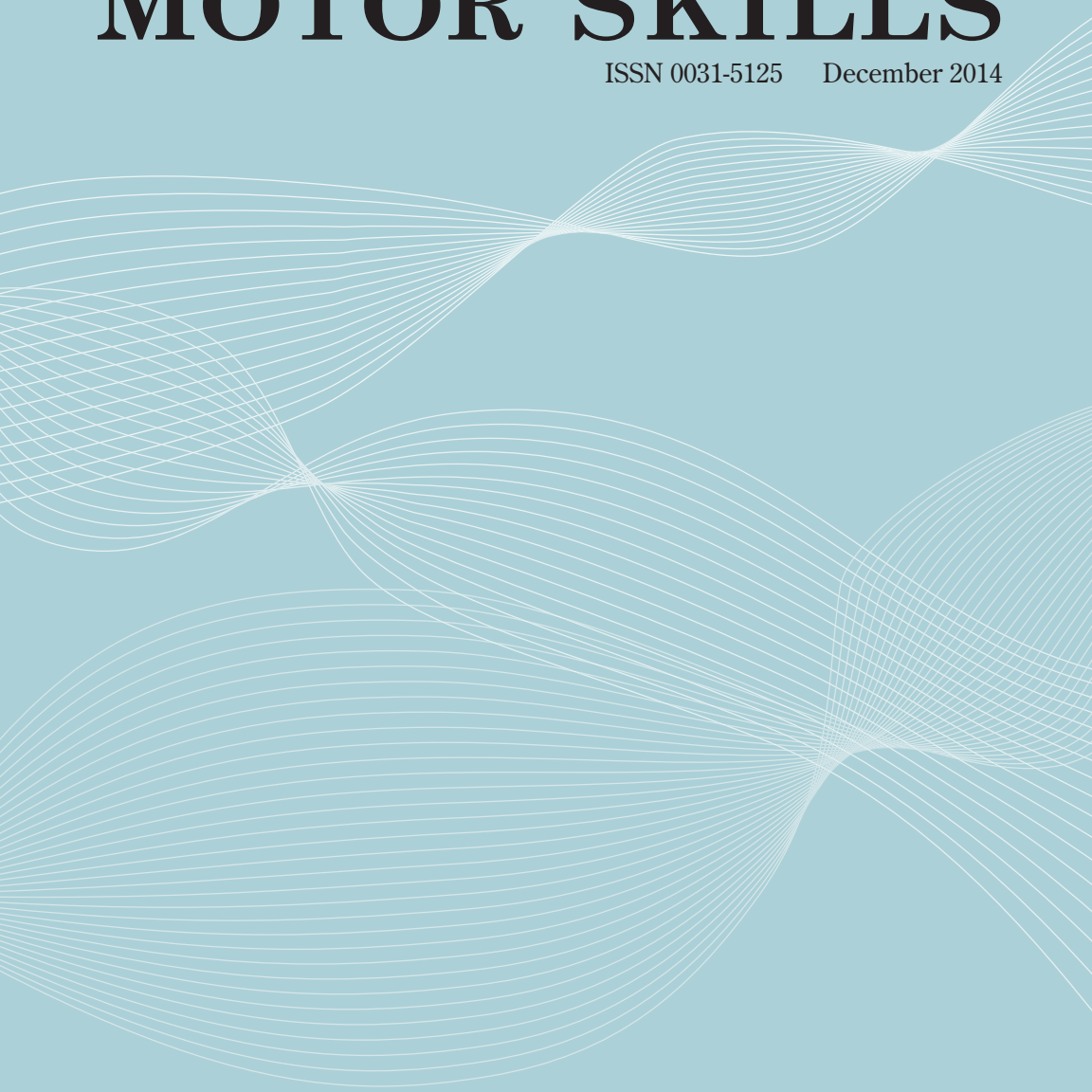

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AFFECTIVE AND RESTORATIVE VALENCES FOR THREE ENVIRONMENTAL CATEGORIES[1, 2]

JOEL MARTÍNEZ-SOTO, LEOPOLDO GONZALES-SANTOS, FERNANDO A. BARRIOS

Universidad Nacional Autónoma de México, Instituto de Neurobiología, Querétaro, Qro, México

MARIA E. MONTERO-LÓPEZ LENA

Universidad Nacional Autónoma de México, Facultad de Psicología, México D.F., México

Summary.—The present study evaluated images of environments in three categories with different affective and restorative valences through two computerized assessments. A non-verbal computerized response scale and the Mexican Scale of Environmental Restoration Perception were employed. 104 students assessed the affective qualities of 117 images (47 natural, 37 urban with nature, and 33 built-up without nature) according to pleasure and activation dimensions. Then 96 students assessed 54 images with high and low valence for their restorative quality. Natural images were found to generate positive affective reactions of liking and activation and high restorative quality. Affective responses to urban with nature environments tended to be positive with moderate restorative quality. Built-up without nature environments were perceived as less pleasant and had low restorative quality. However, among built-up without nature environments, some settings with striking architectural qualities evoked positive affective valences.

Restorative Quality of the Environment

Negative emotional states can be modified significantly by the presence of positive environmental qualities, especially natural ones, which promote better attention and more favorable emotional reactions. These qualities, designated "restorers," have been well documented in the literature about psychological restoration and restorative environments (Martínez-Soto, 2010).

Psychological restoration is a process involving the recovery of the cognitive resources and the capacity for a psycho-physiological response from a present state of some deficits, e.g., environmental stress, to a more stable state (Van den Berg, Hartig, & Staats, 2007). The context where this recovery takes place is referred to as a restorative environment, and the

[1]Address correspondence to Fernando Barrios, Instituto de Neurobiología, UNAM Campus Juriquilla, Blvd. Juriquilla 3001, Querétaro, Qro. 76230 Mexico or e-mail (fbarrios@unam.mx).
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perception of environmental qualities that help to promote psychological restoration is termed perception of environmental restoration (Kaplan & Talbot, 1983). Restorative environments must have four aspects to best facilitate restoration of attention fatigue: Being Away, Fascination, Compatibility, and Coherence (Hartig, Korpela, Evans, & Gärling, 1996). Being Away refers to a geographical or psychological distance from demanding tasks and the associated escape from distractions. Fascination refers to an effortless curiosity about one's surroundings that allows a person to redirect attention away from stressful demands. Compatibility associates an individual's needs and desires with what the environment offers. Coherence indicates the ability to make sense of the structure, connectedness, and scope of the environment. Generally, settings with vegetation and water contribute significantly to an environment being perceived as having a greater restorative quality. Natural environments tend to be perceived as more restorative than urban environments (Purcell, Peron, & Berto, 2001). Some studies have emphasized the greater restorative quality of urban environments with nature or vegetation (parks or urban green areas) compared to urban or built-up environments without nature (Hartig, Korpela, Evans, & Gärling, 1997; Hernández & Hidalgo, 2005).

Affective Qualities of the Environment

The affective quality of a physical environment is understood as the quality of an induced emotion that a person verbally attributes to it, through expressions of pleasure, attraction, value, enjoyment, preference, repulsion, etc. (Russell & Snodgrass, 1987). People derive a particular pleasure from biophysical traits of the environment: certain biomes, climate conditions, and vegetation are important for inducing pleasure, e.g., forests with trees and orange-brown foliage (Buhyoff, Wellman, & Daniel, 1982); subalpine, coniferous, and alpine forests (Pearce & Waters, 1983); natural landscapes with large and varied topography or color (Zube, 1970); tundra-style biomes (Han, 2007); and some landscapes with high maintenance (Herzog, 1989). In urban environments, the presence of trees and artificial bodies of water are important for inducing a feeling of pleasure (Lohr & Pearson-Mims, 2006). In settings that are built without nature (e.g., streets and shops, residential and industrial areas, parking lots, buildings, and skyscrapers), people also prefer certain architectural traits including antique architectural structures, the facades of modernist buildings, and historical, religious, and cultural sites (Hidalgo, Berto, Galindo, & Getrevi, 2006).

Much of the work done on the affective evaluation of an environment is based on the circumplex model of Russell and Pratt (1980). These authors proposed two bipolar and independent dimensions, pleasure (feeling well, happy, etc.) and arousal (interest, desire to be active, etc.), to explain the variations in quality and intensity of environmental affection. Russell, Ward, and Pratt (1981) found that a third dimension measuring

the dominance of the affective reaction is not as important as pleasure and arousal in explaining people's evaluations of the settings.

Emotional reactions to the environment may be complicated and tend to differ according to the type of setting (Staats, Gatersleben, & Hartig, 1997), sociodemographical variables, motives, and personal interest in the environment (Stamps, 1999). However, some evidence suggests that in the dichotomy of stimulus effects (beauty inheres in the environment) vs respondent's effects (beauty inheres in people), places accounted for more variance than did people in determining environmental preferences (Stamps, 1994, 1995).

With respect to emotional reactions towards the presence of nature, it has been documented that the exposure to natural environments evoked greater feelings of tranquility, power, and vigor, and less fatigue and confusion in non-stressed people. In stressed people, contact with nature resulted in less stress and fear, and in greater happiness, pleasure, and freedom. Without considering stress, contact with nature was related to a greater positive affection, arousal, and relaxation, and was also linked to lower ratings of anger, hostility, depression, tension, and anxiety (Hartig, Korpela, *et al*., 1996; Berman, Jonides, & Kaplan, 2008; Kjellgren & Buhrkall, 2010) where a correlation of 0.4 for positive effect and a partial-eta of 0.24 for relaxation was reported. Affective evaluation of the exposure to built-up environments devoid of nature showed that stressed people experienced greater activation of fear and less calm, whereas non-stressed participants had emotional reactions of hostility, tension, and anxiety. In general, both stressed and non-stressed individuals reported feeling greater sadness when exposed to urban settings (Hartig, Nyberg, Nilsson, & Gärling, 1999; Karmanov & Hamel, 2008) where significant differences were shown only for between group and conditions differences. Recent studies prove that urban settings with high landscape value (architectural features, horizons with views of skyscrapers) and biophysical traits (bodies of water, e.g., fountains, ponds, etc.) also tended to increase environmental preference (Nasar & Terzano, 2010). Limited research has documented people's emotional responses toward settings with urban nature. Some evidence suggests that when exposed to such environments, people expressed more positive affection and less fear, aggression, hostility, and sadness, measured as a partial-eta of 0.67 (Sheets & Manzer, 1991; White, Smith, Humphryres, Pahl, Snelling, & Depledge, 2010).

Measurement of Affective and Restorative Responses

Various measures, such as physiological (Ulrich, Simons, Losito, Fiorito, Miles, & Zelson, 1991), emotional (Cackowski & Nasar, 2003), and cognitive (Berto, 2005) have been employed to assess the restorative effects of nature in experimental conditions. In most studies of this type, the passive

exposure to visual encounters with nature in laboratory conditions, either simulated (virtual) or mediated (slides), has resulted in restorative effects similar to those experienced in real environments. In the same way, regardless of whether the observation is real or mediated, the nature content of the image influences its restorative quality. For these and other kinds of investigations, it is important to rely on an image bank that defines and possesses certain attributes with emotional value and content, and perceptual categories that evoke affective responses for particular settings. A bank of standardized images may be useful to: (a) determine which of them evoke predictable responses and can be manipulated in diverse research contexts, (b) allow experimental control over the selection of restorative stimuli, (c) facilitate comparison of the results between different studies conducted in the same or different research laboratories, and (d) allow for replication between and within research centers (Lang, Bradley, & Cuthbert, 1997). Study 1 evaluated a series of images with different affective and restorative qualities that could be employed later as reference stimuli within a functional magnetic resonance imaging (fMRI) paradigm to identify the neural correlates of an environmental psychological restoration process derived from viewing three environment classes: natural, urban with nature, and built up without nature, that differ both in their restorative and affective qualities.

To evaluate the emotional reactions towards the environment, various scales have been employed. Among them is Zuckerman's (1977) Inventory of Personal Reactions (ZIPERS), which was used by Ulrich (1981); Hartig, Mang, and Evans (1991); Ulrich, *et al*. (1991); Hartig, Böök, Garvill, Olsson, and Gärling (1996); Hartig, Korpela, *et al*. (1996); Korpela and Hartig (1996); and Hartig, *et al*. (1997). Other scales include the mood profile (McNair, Lorr, & Droppleman, 1971), the PANAS scale of positive and negative affect (Watson, Clark, & Tellegen, 1988), a check list of mood adjectives (Sjöberg, Svensson, & Persson, 1979), and measures of circumplex affection proposed in the model of Russell and Snodgrass (1987; cf. Sheets & Manzer, 1991; Staats, *et al*., 1997; Nasar & Terzano, 2010; White, *et al*., 2010). All these evaluations have been performed in different international contexts: North American, European, and Asian samples, which require establishing a strict methodological protocol of the instruments' cultural adaptation (Costa & Brito, 2002). In the two studies presented here, emotional reactions to the environment were evaluated by a proposed alternative method, which can also cover a complete range of emotions in diverse samples without any cultural or linguistic interference (Bradley, Greenwald, & Hamm, 1993).

The visual Self-Assessment Manikin model (SAM; Lang, 1980) is a non-verbal technique that evaluates the dimensions of affective valence,

arousal, and dominance. SAM is an adaptation of the Semantic Differentiation Scale developed by Mehrabian and Russell (1974; see Bradley & Lang, 1994). Compared to the traditional paper-and-pencil assessments, computerized self-reports offer many advantages, such as flexibility of presentation, ease of scoring, immediacy of results, and facilities for data transfer and analysis (Lane, Heddle, Arnold, & Walker, 2006; Booth-Kewley, Larson, & Miyoshi, 2007). Also, participants tend to prefer computerized assessments (Booth-Kewley, Edwards, & Rosenfeld, 1992). Accordingly, two electronic assessments of data were collected.

Study 1 was designed to characterize the affective qualities of the three environment classes, and Study 2 was performed to assess the restorative quality of these environments.

Study 1

The goal was to document the affective qualities of three environment classes: natural, urban with nature, and built-up without nature. With this broad theme, the research had two specific objectives: (a) through a procedure of image selection and stimulus development, to design and apply software for the affective evaluation of three classes of settings: natural, urban with nature, and built-up without nature; and (b) define and obtain a series of images for the three environment classes, considering the affective values that may be used to measure their restorative quality.

Preliminary Study of Image Selection and Stimulus Development

Aligned with the previous findings about the differences in the restorative quality of natural, built-up, and mixed scenarios (Hartig, *et al*., 1997; Hernández & Hidalgo, 2005), three categories of settings were selected according to the biophysical traits of the pictures employed in the research on the affective reactions to the environment (e.g., Pearce & Waters, 1983; Hidalgo, *et al*., 2006; Lohr & Pearson-Mims, 2006). Initially, 450 diverse photographs of settings were systematically collected from the Internet and other sources. Some were environments with particular aquatic elements (waterfalls, lakes, lagoons, rivers, and beaches), mountain landscapes with vegetation (alpine forests), and topographic variations, grasslands, rural landscapes, and some particular biomes (e.g., mangrove forests and Arctic tundra). Other pictures were of urban forest, exterior green areas, and home gardens. Another set of images included scenes with house facades without nature, buildings, housing developments, and buildings with antique architectural styles.

The pictures were then classified into three environmental categories according to the criteria proposed by Wohlwill (1983). Thus, 252 natural, 85 built-up, and 115 mixed images were selected. None of the photographs included people or animals. All 450 images were evaluated according to

complexity, color, size, water quantity, and vegetation (Kweon, Ulrich, Walker, & Tassinary, 2008). The selected images were turned into a slide show with software designed in the authors' laboratory specifically for this purpose. One group of four art professionals with an average of 6 years of photographic experience assigned a value to the images based on their visual quality (Collier & Collier, 1986; scale of 1–5; where 1 was the lowest score and 5 was the highest, with scores of 1 to 3 as elimination criteria). This procedure ensured the selection of appropriate landscape slides that did not have serious photo irregularities or distortion of colors or shapes (Han, 2010). Three landscape architects evaluated the photographs for content (representation validity; Sheppard, 1982). Evaluations of environmental design (beauty and harmony) for each environmental category were obtained (scale of 1–5, where 1 was the lowest score on environmental design and 5 was the highest). The reliability of both the visual quality and environmental design evaluations was obtained with Cronbach's α method as an internal consistency indicator (Palmer & Hoffman, 2001). Moderate to high reliability rates were found with $\alpha = .70$ for the evaluations of natural environments, $\alpha = .82$ for urban settings with nature, and $\alpha = .88$ for built-up environments without nature. Based on the judges' assessment of visual quality, 117 of the 450 photographs were selected as visual stimuli, with natural environments represented by 47 images (visual quality $M = 4.30$, $SD = 0.44$; environmental design $M = 5.00$, $SD = 0.00$), urban scenes with nature by 37 (visual quality $M = 3.63$, $SD = 0.60$; environmental design $M = 4.24$, $SD = 0.42$), and built-up settings without nature by 33 (visual quality $M = 3.25$, $SD = 0.57$; environmental design $M = 2.82$, $SD = 0.94$). These average ratings show the perceptual quality of the photographs (Herzog & Barnes, 1999). Among urban nature scenes, 26 (70.27%) included interior and exterior spaces with vegetation and some functional deficits, harmony among their elements, and lack of landscape design. Eleven (29.27%) of the images depicted high-maintenance landscaping, functionality, comfort, and coherence among their elements. With respect to built-up settings without nature, 18 (54.54%) were environments with deteriorated urban landscapes, visual contamination, and lack of maintenance and harmony. In contrast, 15 (45.45%) were pictures of settings with antique exterior and interior architectural styles. With this set of images as stimuli, the computer software to evaluate the affective reactions toward the environment was developed.

Method

Participants

The participants were 104 students (81 women, 23 men; M age = 20 yr., $SD = 4.7$) from the Psychology Department of the UNAM, who gave their

informed consent to being part of the study. The computer version of the Revised Symptom Checklist (SCL-90–R) (González-Santos, Mercadillo, Graff, & Barrios, 2007) was used to verify the absence of psychiatric disorders. All participants were rewarded for their participation with an academic credit.

Measures

The computerized version of the Self-Assessment Manikin (SAM; Lang, 1980) includes three scales: pleasure, which represents a continuum related to the hedonic tone; arousal, or the emotional stimulation experienced; and dominance, the extent of control in one extreme or another, the perception of maximum domain (Fernández Abascal, Guerra, Martínez, Domínguez, Muñoz, Egea, *et al*., 2008). Because of its lack of relevance in explaining people's affective evaluations of the settings (Russell, *et al*., 1981), the dominance dimension was eliminated in the present study. Each scale is formed by a sequence of five human figures (see Fig. 1), with graduated intensity. Each image is evaluated by placing an X on one of the five figures or on any of the four spaces between the figures, which gives a score ranging from 1 to 9 for each scale. The SAM scale was implemented in Java, compatible with any computer environment following the methodology proposed by González-Santos, *et al*. (2007).

Procedure

The images were evaluated in multiple experimental sessions with groups of 8–15 participants who were randomly assigned to three computer versions. The first randomized version of SAM was evaluated by

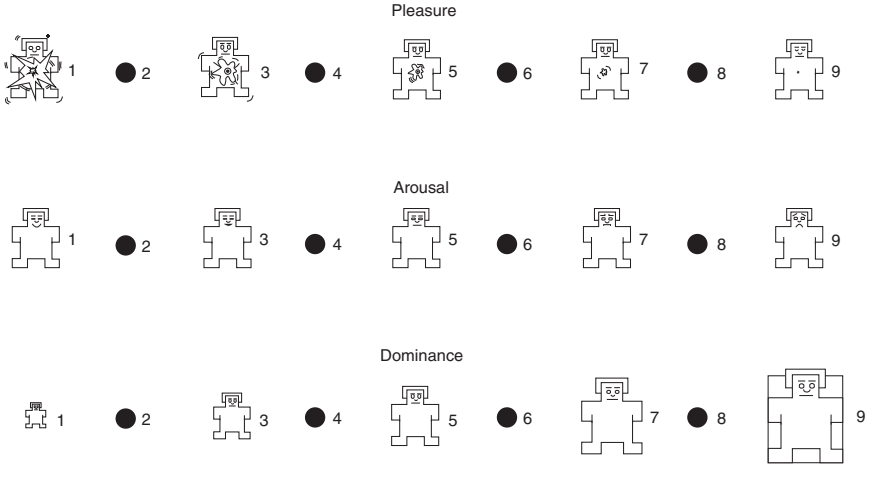

FIG. 1. Format of the Self-Assessment Manikin (SAM)

31.7% of the participants, the second by 37.5% of the participants, and the third by the last 30.7%. The evaluations were performed in a computer laboratory in the UNAM Psychology Department. The laboratory had an area of 12 m^2 and constant low-intensity lighting, and it was isolated from noise and distractions. The participants were placed at a distance of 60 cm from a 43.17 cm flat-screen monitor with a liquid crystal display and high resolution (900 x 1400 pixels). For all the experimental stimuli, the photographic image took up 75% of the screen on a black background. Before presenting the slides, the participants were carefully instructed on how to manage the computerized version of the software in relation to the menus and answering options. The program began with filling out the sociodemographics data (age, sex, etc.), a letter of informed consent, and voluntary approval to participate, followed by an electronic version of the SCL-90–R. After these activities, the participants read an introductory passage that indicated the approximate length of the evaluation and the objective of the research: The present application is designed to obtain the emotional reactions people have toward different places. This exercise will not take more than 45 min. to complete. All the responses given will remain anonymous. There are no correct or incorrect responses. Answer as honestly as possible. Subsequently, I will explain your participation in greater detail.

The participants were then given instructions about the answering format for each of the two dimensions (pleasure and arousal), which followed the protocol proposed by Lang, *et al*. (1997). Next, three practice exercises were performed to evaluate images that were different from the test categories (a dog, a crying boy, and some firefighters putting out a house fire). After these trials, the participants began the main study. They were instructed to evaluate the images in terms of the content, not the quality, of the photograph shown. Each evaluation task began with the presentation of an image for 6 sec.; immediately after the image disappeared, a screen appeared with a slide bearing the response options for evaluating each of the three dimensions: pleasure, arousal, and dominance. The length of the evaluation depended on the individual participant's own response speed. After an answer was completed, the next image appeared, again for a period of 6 sec., and then the response options; the process was the same for evaluating each of the 117 images. Each session lasted an average of 45 min.

Analysis

Descriptive statistics were computed. Internal consistency (Cronbach's α) was calculated for the two dimensions and for each of the environment categories. The differences between the three environment classes and the pleasure and activation dimensions were analyzed with the Welch two-sample *t* test.

Results

Internal consistency of the three affective dimensions in the three environmental categories ranged from .93 to .99 (Table 1). Thus, the computerized version of the SAM is equivalent to other pencil-and-paper applications (Guidelines for Computer-Based Tests and Interpretations; American Psychological Association, 1986).

Table 2 shows mean ratings for the 117 images; significant differences based on the Welch *t* test were found regarding the three affective dimensions. Results indicated higher mean ratings (>5, scale 1 to 9) for the arousal variable for natural and urban with nature environments, compared to lower means (on average <5) for built-up settings without nature and for the differences between environments that were natural, urban with nature, and built-up without nature. Higher mean scores were observed for the affective valence of natural settings, and lower affective valence for urban environments with and without nature. In this dimension only, significant differences were found between environments that were natural vs urban with nature, and natural vs built-up without nature (Table 2).

The bi-dimensional representation of affect within the Cartesian plane (Barret & Russell, 1998; Fig. 2) suggests that natural environments generally tend to evoke alertness and stimulating affective reactions. On the other hand, since they denote moderate and low valences on both dimensions, the urban settings with nature tend to be located within quadrant II, which refers to emotional states linked to some discomfort; however, due to their direction and moderate magnitude, the affect evoked by some urban nature environments cannot be generalized as negative. Finally, environments that are built-up without nature have low valences and are therefore located in quadrant III and characterized as evoking negative emotional reactions. Within this bi-dimensional representation, some built-up scenes without nature but with stimulating qualities stand out (quadrant I), notably those pertaining to interior spaces with positive architectural qualities (Fig. 2). Figure 3 comprises representative pictures characterized by their affective valence.

Image Selection

In order to maximize the variance of the stimulus (Kerlinger & Lee, 2002) and to select pictures with very high (score ≥ 5.5) and low (score ≤ 3.5) affective valences, the images with intermediate mean affective ratings were eliminated. With this criterion, only 54 of 117 images were selected. Of these, 24 (41.8%) were natural environments, 14 (29.1%) were of urban settings with nature, and 16 (29.1%) were built-up environments without nature. In this sample of images were 7 pictures of urban environments with nature that included interior and exterior spaces with vegetation, some deficits in functionality and harmony among their elements, and

TABLE 1
RELIABILITY COEFFICIENTS (α) FOR VALENCE AND AROUSAL IN THE THREE ENVIRONMENT CLASSES

Affective Dimension	*N*	Environment			Total α
		Natural	Urban With Nature	Built-up Without Nature	
Pleasure	104	0.99	0.97	0.95	0.99
Arousal	104	0.97	0.96	0.93	0.98

TABLE 2
STATISTICALLY SIGNIFICANT DIFFERENCES FOUND AMONG THE THREE ENVIRONMENT CLASSES FOR PLEASURE AND ACTIVATION

Affective Dimension	E[a]	*N*	*M*	95%*CI M*	*SD*	Welch Two-sample *t* Test	*df*	*p*	ES
Arousal	NE	104	7.31	6.24, 8.55	1.23	NE vs UNE = 9.08	205	.001	1.23
						NE vs BwNE = 16.31	196	.001	1.62
	UNE	104	5.80	5.62, 5.98	1.16	UNE vs BwNE = 6.82	200	.001	.66
	BwNE	104	4.78	4.49, 5.07	1.83				
Pleasure	NE	104	5.16	5.04, 5.27	2.27	NE vs UNE = 4.60	188	.001	.63
						NE vs BwNE = 5.90	169	.001	.82
	UNE	104	3.89	3.73, 4.04	1.66	UNE vs BwNE = 1.25	198	ns	.17
	BwNE	104	3.62	3.44, 3.80	1.37				

Note.—E = Type of environment. ES = effect size of *t* test, Cohen's *d*. The dimensions were measured on scales from 1 to 9. NE = natural environment, UNE = urban environment with nature, BwNE = built-up environment without nature.

lack of landscape design; and 7 other images of settings with high maintenance, functionality, comfort, and coherence among its elements. For built-up environments without nature, 12 pictures showed deteriorated urban landscapes, visual contamination, and lack of maintenance and harmony; only 2 were pictures of settings with antique exterior and interior architectural styles. Table 3 shows the distribution of the pictures according to their affective valences. This reduced sample of images was used for the environmental restoration scale that will be developed in Study 2.

DISCUSSION

The main goal of Study 1 was to document the affective qualities of three environment classes: natural, urban with nature, and built-up without nature. Through the procedure of image selection and the design, construction, and application of a computerized version of the SAM (Lang, 1980), the three affective qualities of 117 images were evaluated. As expected, the environments with vegetation and primary aquatic content (beaches, rivers, waterfalls) consistently generated affective reactions of

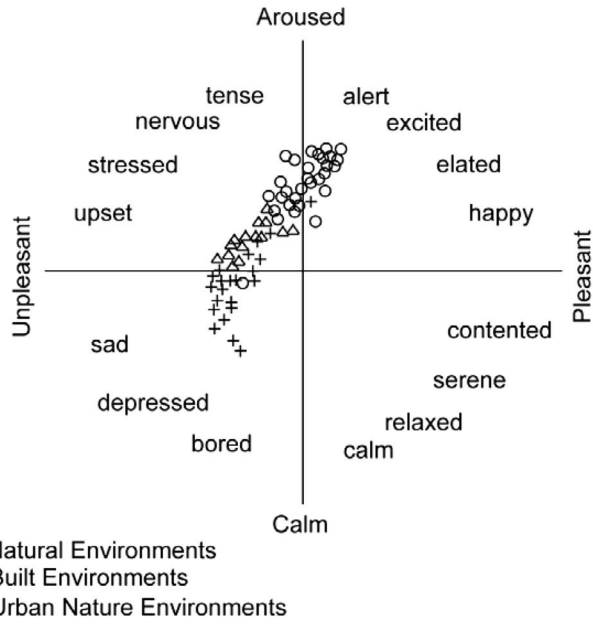

FIG. 2. Empirical location of affect and arousal scores for three environment classes in semantic space: natural environments (circles), built environments (crosses), and urban nature environments (triangles).

pleasure and positive arousal (high; >5, scale 1 to 9) when compared to built-up environments without nature (streets, exterior facades), which had the lowest affective valences among the three categories. The affective responses toward the urban settings with nature were mixed. The presence of vegetation in these environments was not necessarily related to higher pleasure, which complicates the interpretation of their affective qualities. Within the urban environment with nature category, moderate to high affective valences were obtained for settings with notable natural features (botanical garden), better maintenance, artistic combinations

TABLE 3
DISTRIBUTION OF THE SELECTED PICTURES ACCORDING TO THEIR AFFECTIVE VALENCES

Type of Environment	Affective Dimension			
	Pleasure		Arousal	
	High	Low	High	Low
Natural	15	0	14	0
Urban with nature	0	4	13	0
Built-up without nature	0	13	2	9

(monuments and gardens), and secondary aquatic content. Settings that lacked visual harmony or were poorly maintained received lower affective ratings.

Considering the circumplex model proposed by Russell and Pratt (1980) and pleasure and arousal as the two dimensions most relevant for the affective response to the environment (Russell, 1980), these findings suggest that exposure to natural environments tends to evoke more positive feelings and greater arousal (excitement). On the other hand, the built-up environments with little or no nature (except those with exceptional architectural qualities) generate responses of more negative qualities (sadness, depression, and boredom). In the case of urban environments with nature, since there are some images with low valences and others with moderate ones, some images provoke emotional reactions of tension, and others presumably follow the same tendency as natural scenes, one of greater pleasure and arousal. These findings on the emotional reactions derived from exposure to nature are consistent with previous studies of environmental preference (cf. Sheets & Manzer, 1991; Han, 2007). This research resulted in the selection of 54 images with high and low valences; the restorative quality of these 54 images will be systematically determined, as described in Study 2.

Study 2

The goal was to evaluate the restorative quality of three environments and to assess differences between them. Similar to Study 1, a computer method of data collection was developed and tested. Based on the previous literature, a hypothesis about significant differences between the restorative qualities of natural, urban with nature and built-up without nature environments was formulated.

Method

Participants

Ninety-six students (81 women, 15 men; M age = 21.5 yr., SD = 0.4) from the Psychology Department of the UNAM gave their informed consent to be part of the study. All the participants were compensated for their participation with an extra-curricular credit.

Visual Stimuli

The series of images comprised the 54 photographs selected in the previous study. Five images were added in order to increase the variability and authenticity of the images of urban nature and built-up environments without nature. The photographs were digitalized and organized using software for presentation and image evaluation. To reduce the effect of order and the fatigue from evaluating images, eight computerized

programs were created (1a, 1b, 2a, 2b, 3a, 3b, 4a, and 4b) and applied to eight groups of participants; each group evaluated 15 images. Versions a and b were from the same group of 15 images, in random order.

Measures

Restorative qualities of the environment were evaluated by developing and applying a computer-adapted version of the Mexican Revised Scale of Environmental Restoration Perception (EPRA–R, Escala de Percepción de Restauración Ambiental Revisada; Martínez-Soto & Montero y López-Lena, 2010). The questionnaire has 25 items rated on an 11-point scale with response anchors 0: Nothing, does not apply to the experience described and 10: Completely, it does apply to the experience. There are five dimensions: Being Away (5 items; e.g., "This place is a refuge from unwanted distractions"), Fascination (5 items; e.g., "This place is fascinating"), Compatibility (5 items; e.g., "It is easy to do what I want here"), Coherence (4 items; e.g., "It is easy to see how things here are organized"), and Scope (4 items; e.g., "I experience this place as very spacious") and two indicators of environmental preference (e.g., "I like this place"). The psychometric properties of the EPRA–R have been documented with North American and European samples. In Mexico, Martínez-Soto and Montero y López-Lena (2008) tested the reliability and validity of the EPRA–R scale in 260 university students. Cronbach's αs indicated moderate to high reliability (Being Away .76, Fascination .81, Compatibility .75, Coherence .70, and Scope .81). Differences in the scores for natural and built-up environments (Hartig, *et al*., 1997) were indicative of the dimensions' ability to discriminate aspects of restorative quality. Concurrent validity was assessed using a stress and arousal scale (King, Burrows, & Stanley, 1983), with positive and significant associations between the EPRA–R dimensions (Fascination and Coherence) and arousal. Test-retest reliability with a 15-day interval in a subsample of 195 students was moderate (from .50 to .54) for each dimension. What is pertinent to the present application is the reliability and validity of a computerized version of the EPRA–R as indicators of equivalence between paper-and-pencil and computerized versions of a test (Lewis, Watson, & White, 2009). The computerized version of the EPRA–R was implemented in Java, following the methodology proposed by González-Santos, *et al*. (2007).

Procedure

The images were evaluated in several experimental sessions with groups of 8-15 participants who were randomly assigned to one of the various computerized versions of the EPRA–R: 1a, 14.5%; 1b, 11.45%; 2a, 11.45%; 2b, 12.5%; 3a, 12.5%; 3b, 11.45%; 4a, 13.54%; and 4b, 12.5%. The participants were registered in a computer lab in the Psychology Depart-

ment of the UNAM under the same conditions and circumstances described in Study 1. After they had read an introductory paragraph that indicated the approximate duration and objective of the test, the students were shown evaluation instructions for the images: We are interested in knowing how you experience/understand/perceive a place. To help us understand your experience, we are presenting the following phrases. These phrases may be used to describe different places. Please, read each phrase carefully and ask yourself: How well does this phrase describe my experience in this place? Please keep in mind the people, things, and activities that occur together in this place when you choose your answer.

Subsequently, to familiarize the participants with the activity, three test exercises were performed for evaluating the images. After these tests, the participants started the main study, beginning with the presentation of an image for 6 sec. and under it the phrase: "Observe!" At the end of 6 sec., the first of the 26 EPRA-R items were presented together with the image. After presenting the 26 potential responses to the image, a blank transition slide appeared, followed by a new image, continuing the same process of presentation and evaluation. The duration of the evaluation depended on each participant's response speed. Each session lasted around 30 min.

Analysis

Internal consistency (Cronbach's α) was calculated for dimensions of the computerized EPRA–R version. Restorative quality ratings of the three environment classes were compared by a one-way ANOVA.

Results

Moderate to high reliability indexes were obtained. Cronbach's αs were: Being Away .95, Fascination .96, Compatibility .89, Coherence .78, and Scope .92, for the 59 pictures. The computerized version of the EPRA–R detected significant differences among the three environment classes' restorative quality ratings. The reliability indicators obtained were *higher* to those reported in previous studies using the paper-and-pencil version of the EPRA–R (Martínez-Soto, 2010; Martínez-Soto & Montero y López Lena, 2010). In this respect, it is important to emphasize the greater global restorative quality (the mean of the five EPRA–R dimensions) of natural environments, followed by urban with nature, and last of all the lower restorative quality of built-up environments without nature (Table 4).

Restorative Qualities

Comparing the valence results obtained in Study 1 with the restorative qualities found for the 54 selected images, natural settings are found to have a tendency toward high affective valences with a higher global restorative quality; while the affective valences of urban nature environments are also high, they have a only moderate to high global restorative

TABLE 4
STATISTICALLY SIGNIFICANT DIFFERENCES FOUND BETWEEN THE GLOBAL RESTORATIVE QUALITY OF THE THREE ENVIRONMENT CLASSES

EPRA–R Dimension	Natural		Urban With Nature		Built-up Without Nature		*F*	ES
	M	*SD*	*M*	*SD*	*M*	*SD*		
Being Away	8.39	1.98	5.56	2.77	2.22	2.50	789.80	0.52
Fascination	8.39	1.93	5.17	2.89	2.43	2.78	683.09	0.48
Compatibility	7.69	2.13	5.71	2.45	2.88	2.27	532.78	0.42
Coherence	8.04	1.94	6.47	2.28	4.91	2.58	232.85	0.24
Scope	8.10	2.17	4.52	2.90	2.61	2.40	623.39	0.46
Global EPRA–R	8.13[a]	1.81	5.48[b]	2.44	2.94[c]	2.18	712.25†	

Note.—The restorative quality of the environment was evaluated on an 11-point scale ranging from 0 to 9. Differing superscripts indicate significant differences between group means, $p < .001$. ES = effect size, eta squared. †$p < .01$.

quality. Finally, built-up settings without nature show the lowest valences that correspond to a lower global restorative quality, except for two images with a moderate restorative quality; these are images of interior settings with striking architecture.

DISCUSSION

In Study 1, 54 images with high and low affective valences were selected, and their restorative quality was evaluated in Study 2 by designing, building, and applying a computerized version of the EPRA–R. Greater restorative quality was expected for natural environments, compared to urban environments with and without nature. Additionally, images of urban scenes with nature were expected to be perceived as having greater restorative quality than built-up environments without nature. Among the latter, those with aesthetic attributes were expected to have a higher restorative quality than other subcategories of built-up environments. The findings indicated that natural environments had a greater restorative quality than urban with nature and built-up without nature (Purcell, *et al*., 2001); urban environments with nature were perceived as having greater restorative quality than those without nature (White, *et al*., 2010); and among built-up environments without nature, those images with aesthetic qualities (e.g., buildings with unique architectural styles) had greater restorative quality than ordinary built-up spaces. These results coincide with previous research (Hernández & Hidalgo, 2005; Hidalgo, *et al*., 2006; Berto, Baroni, Zainaghi, & Bettella, 2010). This study documented that the environments with high affective valences are generally those with a high global restorative quality, while those with low valences, such as built-up environments, are rated as having low restorative quality. This proves the

close relationship between the affective qualities of the environment, its biophysical features, and its perceived restorative quality.

General Discussion

Contact with nature may promote positive emotional states and restorative sensations. Unlike other research that documents the relaxing effects of exposure to nature (Nasar & Terzano, 2010; White, *et al*., 2010), this study found that in non-stressed participants the presence of nature was more stimulating than relaxing. According to Berlyne (1971), if the initial state of an individual is stressed or excessively aroused, a decrease in arousal produces an increase in agreeable feelings. In these participants, the arousal caused by such landscapes refers more to a search for sensations than to a need for reducing stress (Ulrich, 1993). Arousal (interest, desire to be active; Hull & Harvey, 1989) is one of the key dimensions for distinguishing the quality and intensity of the response to the environment in evaluating the affective qualities of natural settings. King, *et al*. (1983) describe this dimension in terms of a series of psychological responses that people use to confront stress, among them feeling active, vigorous, cheerful, and full of energy. This last response partly documents the possible link between high arousal and pleasure, and the high restorative quality of natural environments, whereas the relaxing sensation that comes from a decrease in arousal and an increase in positive emotions may be related to the restorative components Being Away and Compatibility (Laumann, Gärling, & Stormark, 2001). An increase in arousal and pleasure may be linked to an interest in environmental stimuli, just as the interest promoted through the Fascination component is an important dimension for an attention-restoration process (Kaplan & Kaplan, 1989). Supposing that paying attention to an interesting stimulus does not require much effort, Kleinsmith and Kaplan (1964) demonstrated that arousal increased when people observed interesting stimuli, the qualities of which may be observed without great effort (Lang, Greenwald, Bradley, & Hamm, 1993), e.g., natural stimuli that also evoke fascination.

There is little controlled, systematic research that evaluates both the affective and restorative qualities of urban environments with nature, and the present study yielded mixed results. It seems that in urban settings the variability of emotional responses toward urban nature is greater than may have been expected, since different images within this category evoked favorable and non-favorable responses (Staats, *et al*., 1997). An analysis of urban environments with nature that have low valences shows that settings with low scenic quality (e.g., natural arrangements that are not as aesthetic, extensive, and visually harmonious; chaotic scenes with poor maintenance and visibility conditions) do not have high affective

value (Hidalgo, *et al*., 2006). Therefore, the findings show that good maintenance and harmonious design are critical for the restorative quality of urban environments with nature. It is important to point out as well that the relation between nature and environmental restoration, particularly for urban settings, may be mediated by other variables such as positive (Regan & Horn, 2005) and negative emotions (Hartig, Böök, *et al*., 1996), positive aesthetic experiences (Nasar & Jones, 1997), the congestion experienced outdoors (Cole & Hall, 2010), and restoration needs (Smolders, de Kort, Tenner, & Kaiser, 2012). Future studies may explore the mediating role of these variables.

Limitations and Conclusions

This study has the following limitations. Due to the complexity of evaluating the affective quality and restorative quality for dozens of images on 25 items, it wasn't possible to identify a causal relation between the affective qualities of the environments and their restorative quality in a single study, which would have been desirable (Cox & Wermuth, 2004). Instead, several studies were performed based on a methodological strategy aimed at measuring the variability in the responses toward the stimuli presented and reducing the number of mistakes due to fatigue in evaluating images and the effects of the order in presenting stimuli (Cook & Campbell, 1979). Future studies may explore the relation between the affective qualities of environments and the evaluation of their global restorative quality using a short version of the Revised Scale of Environmental Restoration Perception, e.g., Berto (2005). A bias in the responses may occur due to the fact that most of the participants in both studies were students, who tend to respond in a more homogeneous way when compared to other populations (Peterson, 2001). Despite this, a meta-analysis by Stamps (1999) of the demographic effects of environmental aesthetics suggests that student evaluations may be generalizable to the general population. Likewise, it is important to note that most of the participants were women; therefore, the results of this particular sample may not be generalizable to populations. There is, however, little evidence of sex-based differences in the perception of restorative and affective qualities in the environment (cf. Scopelliti & Giuliani, 2004; Martínez-Soto & Montero y López-Lena, 2008), and a *post hoc* analysis showed no sex differences between the three environmental categories and the affective and restorative qualities. Another possible limitation concerns how representative the evaluated stimuli were. Perhaps the photographs that were considered in the final studies do not sufficiently represent the three categories of environments proposed. Future work may explore the three classes of environments (Brunswik, 1956) using a more representative sample that

would cover the four quadrants of the circumplex model proposed earlier (Barret & Russell, 1998).

The present study constitutes an important contribution to the study of restorative environments by obtaining group of images whose affective and restorative qualities could be used to document the neural correlates of psychological restoration through the technique of functional magnetic resonance imaging. The restorative settings generated in this study could also be useful in other experimental setups of psychological restoration and other environmental areas (Lang, *et al*., 1997).

Another contribution of this work is the implementation of two computerized versions to evaluate three environment classes. The first version of the SAM (Bradley & Lang, 1994) was introduced as a pictorial technique; here, a verbal evaluation of affective responses toward an environment was employed, which is novel in the field of environmental psychology. With the computerized version of the EPRA–R, the restorative quality was obtained in a contextualized way. Both techniques show indicators of reliability close to their paper-and-pencil versions; both are dynamic tools that are easily applied and have high technical compatibility, which reduces costs and application times.[3]

The fact that built-up environments without nature are perceived as "anti-restorative" constitutes an important appeal for the planning and design of urban communities, especially when considering that stress, the syndrome of urban modernization and the physical and mental illnesses related to it, represents an annual expenditure of at least 100 billion dollars (O'Donnell & Harris, 1994). Therefore, just as with priorities for the implementation of public health policies, the beneficial relation between environment and human beings must not be ignored (Frumking, Frank, & Jackson, 2004). In this context, theories of psychological restoration and restorative environments have much to contribute.

REFERENCES

American Psychological Association. (1986) *Guidelines for computer-based tests and interpretations.* Washington, DC: Author.

Barret, L., & Russell, J. (1998) Independence and bipolarity in the structure of current affect. *Journal of Personality and Social Psychology*, 74(4), 967-984.

Berlyne, D. E. (1971) *Aesthetics and psychobiology.* New York: Appleton-Century-Crofts.

Berman, M., Jonides, J., & Kaplan, S. (2008) The cognitive benefits of interacting with nature. *Psychological Science*, 19(12), 1207-1212.

Berto, R. (2005) Exposure to restorative environments helps restore attentional capacity. *Journal of Environmental Psychology*, 25, 249-259.

[3]The computerized versions of SAM and EPRA in Spanish and English are available upon request to the authors.

Berto, R., Baroni, M. R., Zainaghi, A., & Bettella, S. (2010) An exploratory study of the effect of high and low fascination environments on attentional fatigue. *Journal of Environmental Psychology*, 30, 494-500.

Booth-Kewley, S., Edwards, J. E., & Rosenfeld, P. (1992) Impression management, social desirability, and computer administration of attitude questionnaires: does the computer make a difference? *Journal of Applied Psychology*, 77(4), 562-566.

Booth-Kewley, S., Larson, G. E., & Miyoshi, D. K. (2007) Social desirability effects on computerized and paper-and-pencil questionnaires. *Computers in Human Behavior*, 23, 463-477.

Bradley, M., Greenwald, M., & Hamm, A. (1993) Affective picture processing. In N. Birbaumer & A. Ohman (Eds.), *The structure of emotion: psychophysiological, cognitive, and clinical aspects*. Toronto, ON: Hogrefe & Huber.

Bradley, M., & Lang, P. (1994) Measuring emotion: the Self-Assessment Manikin and the Semantic Differential. *Journal of Behavioral Therapy and Experimental Psychiatry*, 25, 49-59.

Brunswik, E. (1956) *Perception and the representative design of psychological experiments*. Berkeley, CA: Univer. of California Press.

Buhyoff, G. J., Wellman, J. D., & Daniel, T. C. (1982) Predicting scenic quality for mountain pine beetle and western spruce budworm damaged forest vistas. *Forest Science*, 28, 827-838.

Cackowski, J-M., & Nasar, J. L. (2003) The restorative effects of roadside vegetation: implications for automobile driver anger and frustration. *Environment & Behavior*, 35, 736-751.

Cole, D., & Hall, T. (2010) Experiencing the restorative components of wilderness environments: does congestion interfere and does length of exposure matter? *Environment & Behavior*, 42(6), 806-823.

Collier, J., & Collier, M. (1986) *Visual anthropology: photography as a research method*. Albuquerque, NM: Univer. of New Mexico Press.

Cook, T., & Campbell, D. (1979) *Quasi-experimentation: design and analysis issues for field settings*. Boston, MA: Houghton Mifflin.

Costa, N., & Brito, E. (2002) Adaptación cultural de instrumentos utilizados en salud ocupacional [Cultural adaptation of instruments used in occupational health]. *Revista Panamericana de Salud Pública*, 11(2), 109-111.

Cox, D., & Wermuth, N. (2004) Causality: a statistical view. *International Statistical Review*, 3, 285-305.

Fernández Abascal, E. G., Guerra, P., Martínez, F., Domínguez, F. J., Muñoz, M. A., Egea, D. A., Martín, M., Mata, J., Rodríguez, S., & Vila, J. (2008) El Sistema Internacional de Sonidos Afectivos (IADS): adaptación española [The International Affective System Sounds (IADS): Spanish adaptation]. *Psicothema*, 20, 104-113.

Frumking, H., Frank, L., & Jackson, R. (2004) *Urban sprawl and public health.* Cambridge, MA: MIT Press.

González-Santos, L., Mercadillo, R. M., Graff, A., & Barrios, F. A. (2007) Versión Computarizada para la aplicación del Listado de síntomas 90 (SCL–90) y del inventario de temperamento y carácter (ITC) [Computerized version of the application in Symptom Checklist–90 (SCL–90) and the Temperament and Character Inventory (TCI)]. *Salud Mental*, 30, 31-40.

HAN, K. T. (2007) Responses to six major terrestrial biomes in terms of scenic beauty, preference, and restorativeness. *Environment & Behavior*, 39, 529-556.

HAN, K. T. (2010) An exploration of relationships among the responses to natural scenes: scenic beauty, preference, and restoration. *Environment & Behavior*, 42, 243-270.

HARTIG, T., BÖÖK, A., GARVILL, J., OLSSON, T., & GÄRLING, T. (1996) Environmental influences on psychological restoration. *Scandinavian Journal of Psychology*, 37, 378-393.

HARTIG, T., KORPELA, K., EVANS, G. W., & GÄRLING, T. (1996) Validation of a measure of perceived environmental restorativeness. *Göteborg Psychological Reports*, 26(7). Göteborg, Sweden: Department of Psychology, Göteborg Univer.

HARTIG, T., KORPELA, K., EVANS, G. W., & GÄRLING, T. (1997) A measure of restorative quality in environments. *Scandinavian Housing and Planning Research*, 14, 175-194.

HARTIG, T., MANG, M., & EVANS, G. (1991) Restorative effects of natural-environment experiences. *Environment & Behavior*, 23, 3-26.

HARTIG, T., NYBERG, L., NILSSON, L. G., & GARLING, T. (1999) Testing for mood congruent recall with environmentally induced mood. *Journal of Environmental Psychology*, 19, 353-367.

HERNÁNDEZ, B., & HIDALGO, C. (2005) Effect of urban vegetation on psychological restorativeness. *Psychological Reports*, 96, 1025-1028.

HERZOG, T. (1989) A cognitive analysis of preference for urban nature. *Journal of Environmental Psychology*, 9, 27-43.

HERZOG, T., & BARNES, G. (1999) Tranquility and preference revisited. *Journal of Environmental Psychology*, 19, 171-181.

HIDALGO, M., BERTO, R., GALINDO, M., & GETREVI, A. (2006) Identifying attractive and unattractive urban places: categories, restorativeness and aesthetic attributes. *Medio Ambiente y Comportamiento Humano* [*Environment and Behavior*], 7(2), 115-133.

HULL, R., & HARVEY, A. (1989) Explaining the emotion people experience in suburban parks. *Environment & Behavior*, 21, 323-345.

KAPLAN, R., & KAPLAN, S. (1989) *The experience of nature: a psychological perspective*. New York: Cambridge Univer. Press.

KAPLAN, S., & TALBOT, J. (1983) Psychological benefits of a wilderness experience. In I. Altman & J. F. Wohlwill (Eds.), *Behavior and the natural environment*. New York: Plenum. Pp. 163-203.

KARMANOV, D., & HAMEL, R. (2008) Assessing the restorative quality of contemporary urban environment(s): beyond the nature versus urban dichotomy. *Landscape and Urban Planning*, 86(2), 115-125.

KERLINGER, F. N., & LEE, H. B. (2002) *Investigación del comportamiento* [Behavioral research]. (4th ed.) México City, México: McGraw-Hill.

KING, M., BURROWS, G., & STANLEY, G. (1983) Measurement of stress and arousal: validation of the stress/arousal adjective checklist. *British Journal of Psychology*, 74, 473-479.

KJELLGREN, A., & BUHRKALL, H. (2010) A comparison of the restorative effect of a natural environment with that of a simulated natural environment. *Journal of Environmental Psychology*, 30(4), 464-472.

KLEINSMITH, L. J., & KAPLAN, S. (1964) The interaction of arousal and recall interval in nonsense syllable paired-associate learning. *Journal of Experimental Psychology*, 67, 124-126.

Korpela, K., & Hartig, T. (1996) Restorative qualities of favorite places. *Journal of Environmental Psychology*, 16, 221-233.

Kweon, B., Ulrich, R., Walker, V., & Tassinary, L. (2008) Anger and stress: the role of landscape posters in office settings. *Environment & Behavior*, 40, 355-381.

Lane, S., Heddle, N., Arnold, E., & Walker, I. (2006) A review of randomized controlled trials comparing the effectiveness of hand computers with paper methods for data collection. *BioMedCenter*, 6, 23.

Lang, P. J. (1980) Behavioral treatment and bio-behavioral assessment: computer applications. In J. B. Sidowski, J. H. Johnson, & T. A. Williams (Eds.), *Technology in mental health care delivery systems*. New York: Ablex. Pp. 119-167.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1997) *International Affective Picture System (IAPS): technical manual and affective ratings.* Gainesville, FL: NIMH Center for the Study of Emotion and Attention.

Lang, P. J., Greenwald, M. K., Bradley, M. M., & Hamm, A. O. (1993) Looking at pictures: affective, facial, and behavioral reactions. *Psychophysiology*, 30, 261-273.

Laumann, K., Gärling, T., & Stormark, K. (2001) Rating scale measures of restorative components of environments. *Journal of Environmental Psychology*, 21, 31-44.

Lewis, I., Watson, B., & White, K. (2009) Internet versus paper-and-pencil survey methods in psychological experiments: equivalence testing of participant responses to health-related messages. *Australian Journal of Psychology*, 61(2), 107-116.

Lohr, V. I., & Pearson-Mims, C. (2006) Responses to scenes with spreading, rounded, and conical tree forms. *Environment & Behavior*, 38(5), 667-688.

Martínez-Soto, J. (2010) Impacto de la naturaleza urbana próxima: un modelo ecológico social [Impact of nearby urban nature: a social ecological model]. Unpublished doctoral dissertation, Univer. Nacional Autónoma de México, México.

Martínez-Soto, J., & Montero y López-Lena, M. (2008) Escala de restauración ambiental percibida- EPRA (PRS): diferencias por edad y sexo en muestras de adolescentes y adultos mexicanos [Scale of environmental restoration EPRA: age and sex differences in samples of adolescent and adult Mexicans]. In B. Rodríguez & M. Chapin (Eds.), *Linking differences / defining actions*: *proceedings of the 39th Annual Conference of the Environmental Design Research Association*. Boca del Rio, Veracruz, México: The Environmental Design Research Association. Pp. 70-77. Retrieved from www.edra.org/sites/default/files/publications/EDRA39proceedings_final_lowres.pdf.

Martínez-Soto, J., & Montero y López-Lena, M. (2010) Percepción de cualidades restauradoras y preferencia ambiental [Perceived restorative qualities and environmental preference]. *Revista Mexicana de Psicología*, 27(2), 183-190.

McNair, D., Lorr, M., & Droppleman, L. (1971) *Profile of Mood States.* San Diego, CA: Education and Industrial Testing Services.

Mehrabian, A., & Russell, J. A. (1974) A verbal measure of information rate for studies in environmental psychology. *Environment & Behavior*, 6, 233-252.

Nasar, J. L., & Jones, K. (1997) Landscapes of fear and stress. *Environment & Behavior*, 29, 291-323.

Nasar, J. L., & Terzano, K. (2010) The desirability of views of city skylines. *Journal of Environmental Psychology*, 30(2), 215-225.

O'Donnell, M., & Harris, J. (1994) *Health promotion in the workplace.* Albany, NY: Delmar Publishers.

PALMER, J., & HOFFMAN, R. (2001) Rating reliability and representation validity in scenic landscape assessments. *Landscape and Urban Planning*, 54, 149-161.

PEARCE, S. R., & WATERS, N. M. (1983) Quantitative methods for investigating the variables that underlie preference for landscape scenes. *Canadian Geographer*, 27, 328-344.

PETERSON, R. (2001) On the use of college students in social science research: insights from a second-order meta-analysis. *The Journal of Consumer Research*, 28, 450-461.

PURCELL, T., PERON, E., & BERTO, R. (2001) Why do preferences differ between scene types? *Environment & Behavior*, 33, 93-106.

REGAN, C. L., & HORN, S. (2005) To nature or not to nature: associations between environmental preferences, mood states and demographic factors. *Journal of Environmental Psychology*, 25(1), 57-66.

RUSSELL, J. (1980) A circumplex model of affect. *Journal of Personality and Social Psychology*, 39(6), 1161-1178.

RUSSELL, J., & PRATT, G. (1980) A description of the affective quality attributed to environments. *Journal of Personality and Social Psychology*, 38, 311-322.

RUSSELL, J., & SNODGRASS, J. (1987) Emotion and the environment. In D. Stokols & I. Altman (Eds.), *Handbook of environmental psychology*. Vol. 1. New York: Wiley. Pp. 245-280.

RUSSELL, J., WARD, L., & PRATT, G. (1981) Affective quality attributed to environments: a factor analysis study. *Environment & Behavior*, 13, 259-288.

SCOPELLITI, M., & GIULIANI, M. (2004) Choosing restorative environments across the lifespan: a matter of place experience. *Journal of Environmental Psychology*, 24, 423-437.

SHEETS, V., & MANZER, C. (1991) Affect, cognition, and urban vegetation: some affects of adding trees along city streets. *Environment & Behavior*, 23, 285-304.

SHEPPARD, S. R. J. (1982) Predictive landscape portrayals: a selective research review. *Landscape Journal*, 1, 9-14.

SJÖBERG, L., SVENSSON, E., & PERSSON, L. O. (1979) The measurement of mood. *Scandinavian Journal of Psychology*, 20(1), 1-18.

SMOLDERS, K., DE KORT, Y., TENNER, A., & KAISER, F. (2012) Need for recovery in offices: behavior-based assessment. *Journal of Environmental Psychology*, 32, 126-134.

STAATS, H., GATERSLEBEN, B., & HARTIG, T. (1997) Change in mood as a function of environmental design: arousal and pleasure on a simulated forest hike. *Journal of Environmental Psychology*, 17(4), 283-300.

STAMPS, A. (1994) Formal and nonformal stimulus factors in environmental preference. *Perceptual & Motor Skills*, 79, 3-9.

STAMPS, A. (1995) Stimulus and respondent factors in environmental preference. *Perceptual & Motor Skills*, 80, 668-670.

STAMPS, A. (1999) Demographic effects in environmental aesthetics: a meta-analysis. *Journal of Planning Literature*, 14, 155-175.

ULRICH, R. S. (1981) Natural versus urban scenes: some psychophysiological effects. *Environment & Behavior*, 13, 523-556.

ULRICH, R. S. (1993) Biophilia, biophobia, and natural landscapes. In S. R. Kellert & E. O. Wilson (Eds.), *The biophilia hypothesis*. Washington, DC: Island Press. Pp. 77-137.

ULRICH, R. S., SIMONS, R. F., LOSITO, B. D., FIORITO, E., MILES, M. A., & ZELSON, M. (1991) Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology*, 11, 201-230.

Van den Berg, A., Hartig, T., & Staats, H. (2007) Preference for nature in urbanized societies: stress, restoration, and the pursuit of sustainability. *Journal of Social Issues*, 63, 79-96.

Watson, D., Clark, L., & Tellegen, A. (1988) Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*, 54, 1063-1070.

White, M., Smith, A., Humphryres, K., Pahl, S., Snelling, D., & Depledge, M. (2010) Blue space: the importance of water for preference, affect, and restorativeness rating of natural and built scenes. *Journal of Environmental Psychology*, 30, 482-493.

Wohlwill, J. F. (1983) The concept of nature: a psychologist's view. In I. Altman & J. F. Wohlwill (Eds.), *Human behavior and environment: advances in theory and research*. New York: Plenum. Pp. 5-37.

Zube, E. H. (1970) Evaluating the visual and cultural landscape. *Journal of Soil Water Conservation*, 25, 1137-1150.

Zuckerman, M. (1977) Development of a situation-specific trait-state test for the prediction and measurement of affective responses. *Journal of Consulting and Clinical Psychology*, 45, 513-523.

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