Health, Wellness and Trees:
Effects of Nature Images on Pain Research

ISA Annual Conference
Orlando, FL
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Ellen Vincent Ph.D.

1. **Identify healing landscapes**
2. **Recognize research processes that use theory and reduce variables**
3. **Appreciate trees' role in promoting health (reducing stress)**

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A C K N O W L E D G E M E N T S
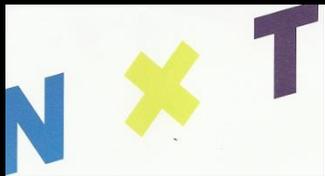
RELATED LITERATURE

Problems with therapeutic environments (nature and health) research:

Multiple variables (Ruso, Renninger, & Atzwanger, 2003; Dijkstra et al., 2006)

Poor replication of images (Stamps, 2004)

Unclear category titles and descriptions (Stamps, 2004)

Investigator preference substituted for sample population (Stamps, 2004)

Interdisciplinary research is weak in theory (RMNO 2004; IJsselsteijn 2004; Dilani 2005 **)**

Getty images

INTRODUCTION

OBJECTIVE

Measure the therapeutic benefits of nature images for healthcare settings using mixed methods (psychological and physiological data).

INTRODUCTION

PURPOSE
(Phase I) Establish a methodology to select images

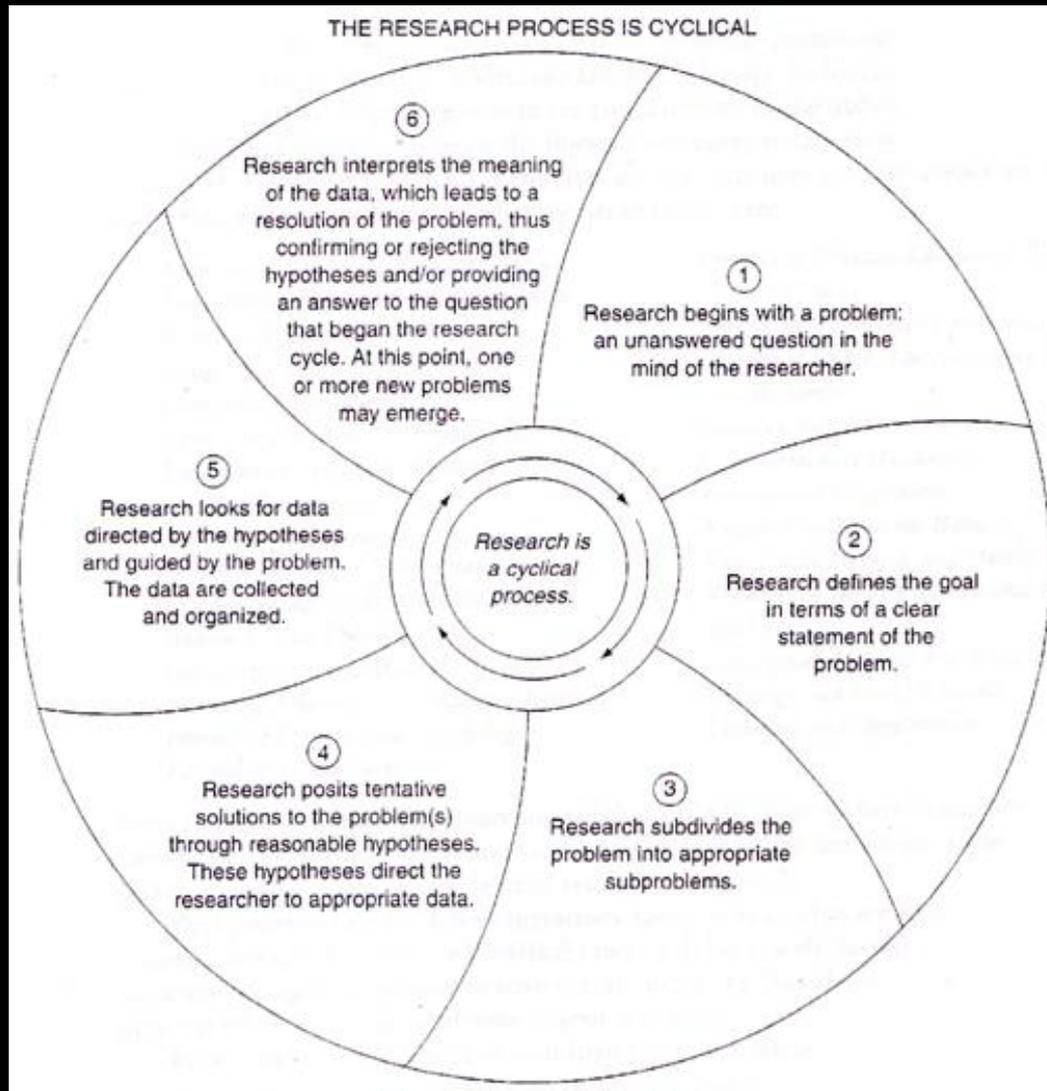(Phase II) Study how images impact physiological and psychological indicators

Getty images

RESEARCH

THE RESEARCH PROCESS IS CYCLICAL

⑥ Research interprets the meaning of the data, which leads to a resolution of the problem, thus confirming or rejecting the hypotheses and/or providing an answer to the question that began the research cycle. At this point, one or more new problems may emerge.

① Research begins with a problem: an unanswered question in the mind of the researcher.

⑤ Research looks for data directed by the hypotheses and guided by the problem. The data are collected and organized.

Research is a cyclical process.

② Research defines the goal in terms of a clear statement of the problem.

④ Research posits tentative solutions to the problem(s) through reasonable hypotheses. These hypotheses direct the researcher to appropriate data.

③ Research subdivides the problem into appropriate subproblems.

Leedy & Ormond (2005). *Practical Research: Planning and Design*, p. 7

RELATED LITERATURE

Stress, anxiety, & pain hinder well-being (healing) in the healthcare setting
(Selye 1976; Johnston & Wallace 1990; Kiecolt-Glaser & Marucha 1995; Kiecolt-Glaser et al. 1998; Frederickson & Levenson 1998)

Nature views can reduce stress, anxiety, & pain (Moore 1981; West; Ulrich 1984; West 1985; Verderber 1986; Frumkin, 2001, 2008)

Architecture affects medical outcomes (Horsburgh 1995; Verderber 1987, 2000; Frampton et al. 2003)

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Virtual views may serve hospitals whose design prohibits a view

Nature art on the wall reduced anxiety or stress among patients
(Heerwagen 1990; Ulrich et al. 1993)

Nature videos reduced stress
(Ulrich & Simons 1986; Frederickson & Levenson 1998; Parsons et al. 1998; Laumann et al. 2003; Ulrich et al. 1991, 2003; Sponselee et al. 2004; de Kort et al. 2006

Nature videos reduced pain levels
(Miller et al. 1992; Tse et al. 2002)

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R E L A T E D   L I T E R A T U R E

Photographs are suitable surrogates for the real experience in research (Zube, Pitt, & Anderson 1975; Kaplan & Kaplan 1989; Stamps 1990, 2007, 2008; Shang & Bishop 2000; Laumann, Garling, & Stormark 2001; de Kort & IJsselsteijn 2006**)**

Photographs need to be reproducible (Stamps 2004; Singleton and Straits 2005)

Realism may be preferred by vulnerable people experiential realism (Sponselee et al. 2004; deKort & IJsselsteijn 2006) visual realism (Ulrich & Gilpin 2003)

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RELATED LITERATURE

Evolutionary theory for landscape preference has a distinguished following (Appleton 1975, 1996, Kaplan and Kaplan 1989, Ulrich 1991, 2008; Heerwagen & Orians 1993; Kellert & Wilson 1993; Frumkin 2001, 2008)

Appleton's prospect refuge theory has been used in literature, design (Wenner 1993; Tetlow, 1996; Hudson 1993; Segal 2003)

and research for 30 years (Yeates, 1997; Ramanujam 2006; Juras 1997; Herzog & Kutzli 2002; Makhzoumi & Zako 2007)

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T H E O R Y

Appleton's Prospect Refuge Theory & Evolutionary Theory

30-year history of research use and has informed recent research (Kaplan, Ulrich, Cooper Marcus, Hartig, Kellert, IJsselsteijn, Stamps)

Reproducible category definitions

Utilizes real and symbolic landscape views

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Prospect refuge theory of landscape preference

"To see without being seen."

Jay Appleton, 1996

Present day landscape preferences stem from our hereditary hunter-gatherer roles in the African savannah.

Human's selection of habitats had serious life and death consequences.

Appleton developed a descriptive functional classification for landscapes.

Categories include "prospect"; "refuge"; and "hazard".

Getty image

OPERATIONAL DEFINITION

PROSPECT

An environmental condition, situation, object, or arrangement that presents real or symbolic access to a view.

PROSPECT: SAMPLE IMAGES

Getty Image

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PROSPECT REFUGE THEORY

OPERATIONAL DEFINITION

REFUGE

An environmental condition, situation, object, or arrangement that presents real or symbolic situations for hiding or sheltering.

Refuges provide protection from hazards.

Hides provide concealment from animate hazards.

Shelters provide concealment from inanimate hazards.

REFUGE : SAMPLE IMAGES

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Getty Image

PROSPECT REFUGE THEORY

OPERATIONAL DEFINITION

HAZARD

Incidents or conditions that present real or symbolic threats to life and well-being.

HAZARD:SAMPLE IMAGES

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Getty Image

PROSPECT REFUGE THEORY

OPERATIONAL DEFINITION

MIXED PROSPECT + REFUGE

An equal balance of each (50%) is shown in image.

PROSPECT REFUGE THEORY

MIXED PROSPECT+REFUGE: SAMPLE IMAGES

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	RESEARCH QUESTION
1)	Which photographic image best represents Appleton's categories of prospect, refuge, hazard, and mixed prospect + refuge?

METHODS: IMAGE SELECTION CRITERIA

Horizontal orientation
Color
Limited reference to animals, structures, equipment
Dominant nature over built features
No distinguishable people
No national, international landmark places
Limited number of variables
Clear category operational definitions (Appleton's words)
Use royalty free Getty Images and own images (for replication)
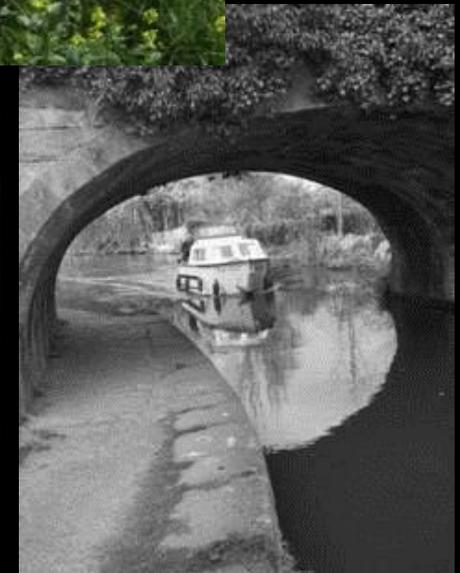
Photos by Ellen Vincent

PHASE I: NATURE IMAGE SELECTION

METHODS: SEQUENTIAL MODEL

	A Investigator select	B Focus groups	C Sorting task	D Content validity
Who	Investigator	55 experts & students	100 students	Subject experts
	informal	informal	controlled	informal
What	Identify images based on theory	Identify preferred category images	Identify preferred category images	Compare findings with category definitions and characteristics
Where	Computer	Classroom	Classroom	Conference room
How	Subjective selection based on Appleton's definitions	Sorting task using "most" to "least" scale	Sorting task using "most" to "least" scale	Content validity rating "most" to "least" scale
Results	300 to 72 images	72 to 20 images (5 per category)	20 to 4 images (1 per category)	20 to 4 images (1 per category) for use in experiment

PHASE I(C): NATURE IMAGE SELECTION

RESULTS: CATEGORY IMAGES

Prospect

Refuge

Hazard

Mixed Prospect + Refuge

	RESEARCH QUESTION
1)	Which nature image categories are most therapeutic as evidenced by reduced pain and positive mood?

	Hypotheses
1)	Nature views are variable in their impact on specific psychological and physiological health status indicators.
2)	Prospect and refuge nature scenes are more therapeutic than hazard nature scenes.

P H A S E I I : E X P E R I M E N T

INDEPENDENT VARIABLES

Type of view (Appleton, 1975,1996)

Examples

$\longrightarrow$

(1) *Prospect View [clear view]:* distant or close views; multiple vantage or viewing points.

(2*)* *Refuge View [safety]*: shelters or hides.

(3) *Hazard View [alarming]:* danger; exposure; no place to hide; impediments to movement.

(4) *Prospect/Refuge Mixed [view & safety]*: equal amounts of both prospect and refuge.

(5) *No Image [control]:* The LCD digital screen will be blank.

DEPENDENT VARIABLES

Health status & perceived well-being: Psychological and physiological responses

Perceived well-being – therapeutic aspects developed by Cooper Marcus (1995, 1999).

Health Status – Physiological measures: continuous vital signs- blood pressure + heart rate.

Health Status – Psychological measures:

• Short Form McGill Pain Questionnaire

• Profile of Mood States (POMS)

• Visual analogue scale for presence

• Visual analogue scale for influence

• Hope Scale

• Success with Life Scale

PHASE II: EXPERIMENT

THERAPEUTIC ASPECT*	INSTRUMENT
Relief from physical symptoms	Short-Form McGill Pain Questionnaire
Stress reduction	Blood pressures: systolic and diastolic Heart rate
Improvement in overall sense of well-being, hopefulness	Profile of Mood States Hope Scale Success with Life Scale

* *Cooper Marcus and Barnes 1999*

PHASE II: EXPERIMENT DESIGN

METHODS: SEQUENTIAL MODEL

	A Pilot group	B Experiment group
Who	32 students	109 students
	controlled-yet seeking debriefing feedback and advice	controlled
What	Test effect of nature image on perceived pain and mood	Test effect of nature image on perceived pain and mood
Where	Simulated in-patient hospital room	Simulated in-patient hospital room
How	Psychological & physiological health data correlations with nature images	Psychological & physiological health data correlations with nature images
Results	Process refined due to feedback	Preliminary data towards most therapeutic image(s) category

PHASE II: PILOT EXPERIMENT

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Clemson University

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INSTRUMENTS : PSYCHOLOGICAL

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PHASE II: CONTROLLED EXPERIMENT

PSYCH		
Instrument	Short Form McGill Pain Questionnaire	Profile of Mood States (POMS)
Items	15 items 3 scales: sensory (throbbing, shooting), affective (punishing-cruel) and total	65 items 6 subscales
Description	Check a number from 0 "none" to 3 "severe"	Circle a number from 0 "not at all" to 4 "extremely"

INSTRUMENTS : PHYSIOLOGICAL

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Name	Description
1. Systolic blood pressure	Systolic pressure is the maximum arterial pressure of the heart. Measurements were taken using an arm cuff and a continuous vital sign tracker and are in millimeters of mercury (mmHg). 15 readings were used for comparison.
2. Diastolic blood pressure	The relaxed state of the heart beat. Measured in millimeters of mercury (mmHg).
3. Heart rate	Heart rate is measured in beats per minute (BPM).
4. Mean Arterial Pressure (MAP)	Describes a notational average blood pressure in an individual. Defined as an average arterial pressure taken during a single cardiac cycle.

RESEARCH DESIGN PAIN STRESSOR

COLD PRESSOR (INDEPENDENT VARIABLE)

Used in experimental psychology research
Used in cardiovascular research
(McClelland & McCubbin, 2008).

Immerse hand in cooler of ice water
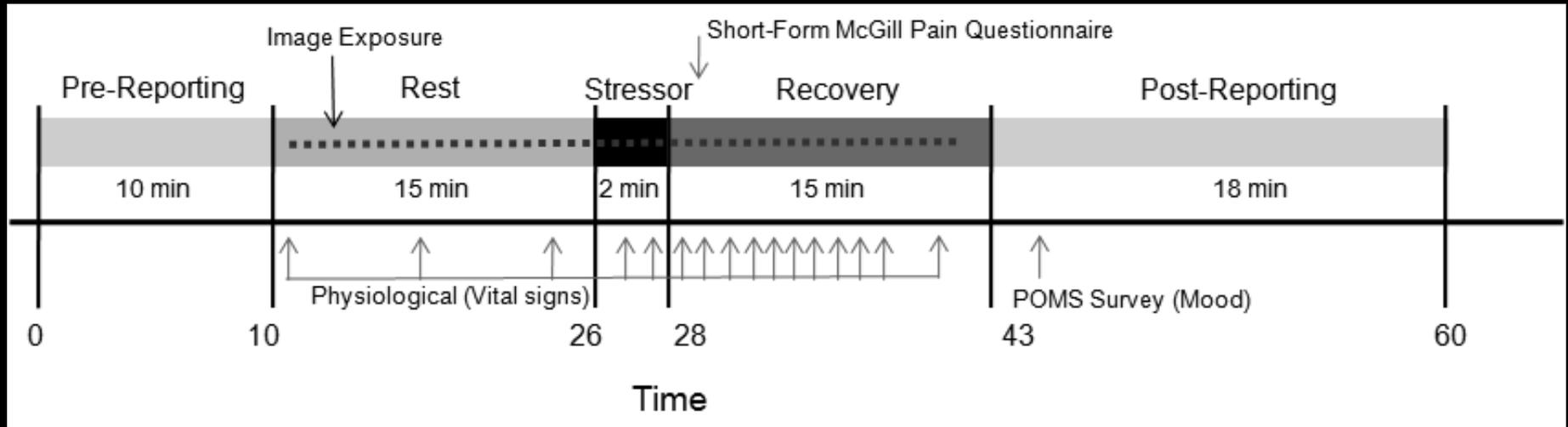(0° C = 32° F) for up to 120 seconds.

If pain is intolerable remove hand early and say "done".

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Dina Battisto

RESULTS : PSYCHOLOGICAL

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RESULTS:MCGILL SENSORY PAIN SUBSCALE
(e.g. throbbing, shooting)
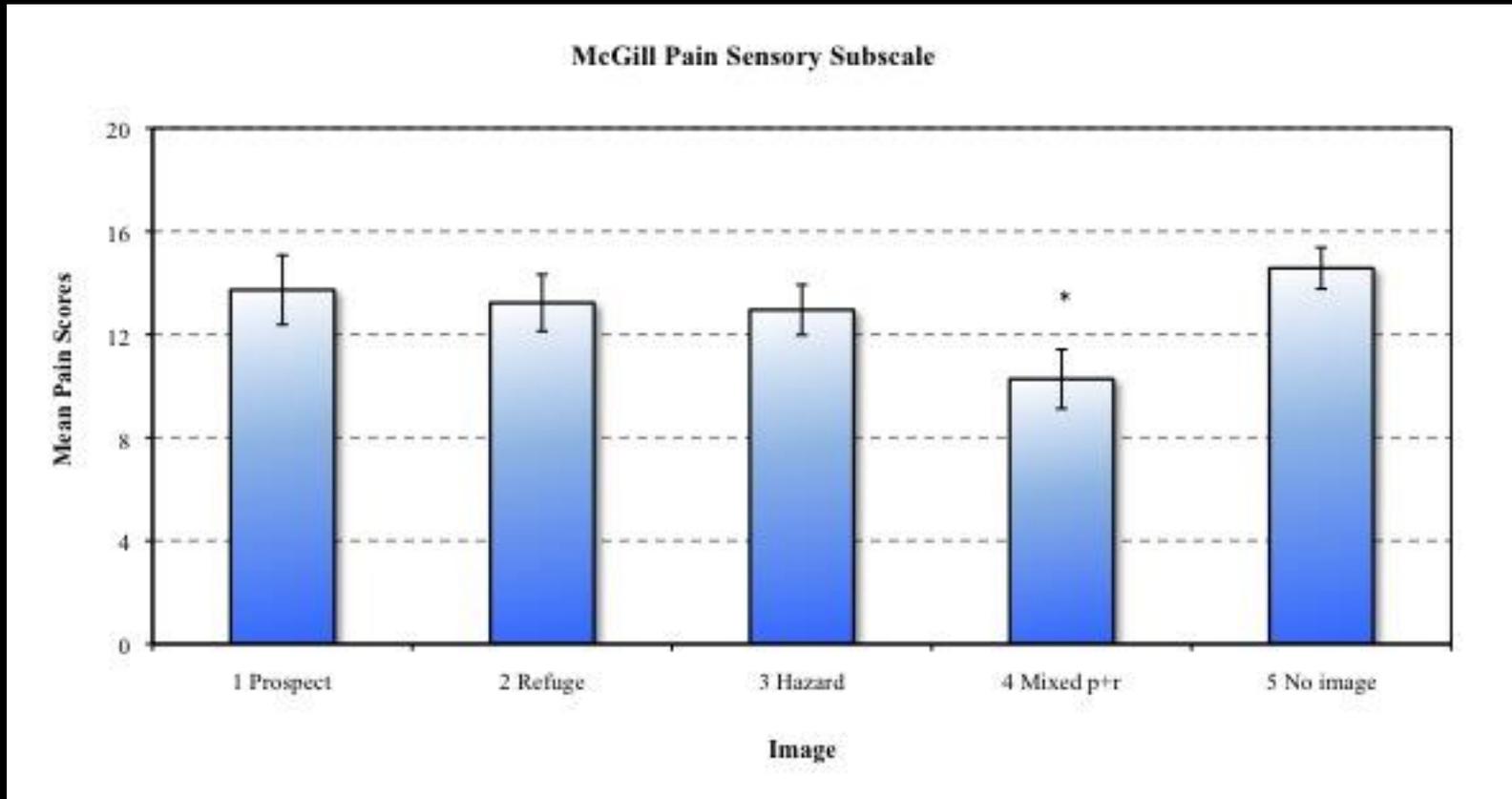
*Statistically significant $\alpha = 0.1$, F Value = 2.22, df = 4, 104 , $P = 0.0715$
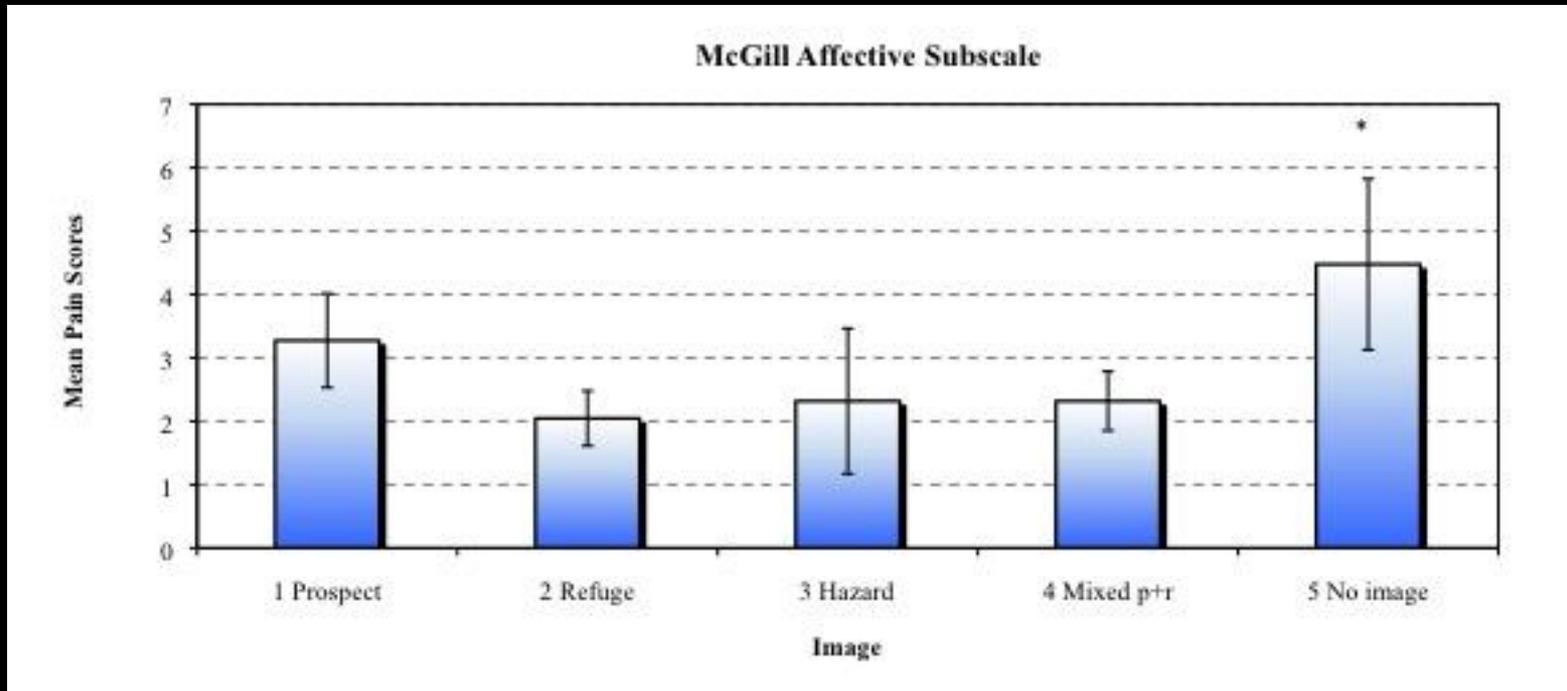Mixed prospect refuge image shows lowest pain levels

Mixed prospect + refuge

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PHASE II: CONTROLLED EXPERIMENT

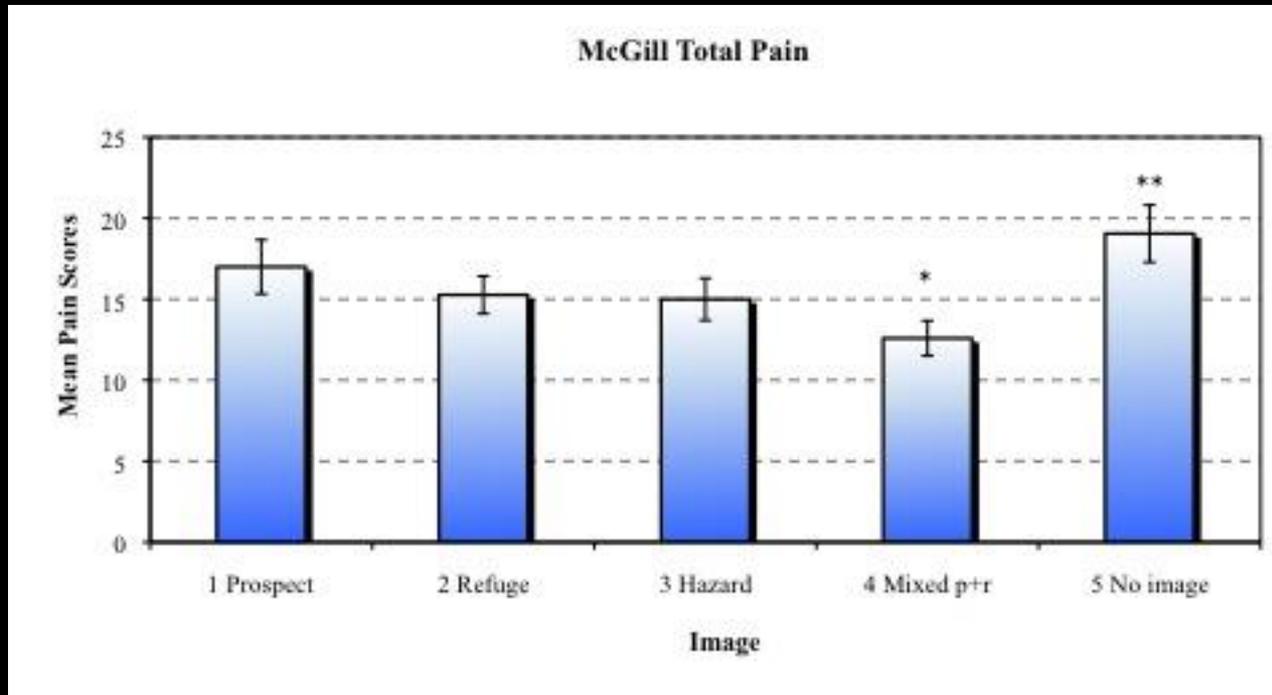**RESULTS: MCGILL AFFECTIVE PAIN SUBSCALE (e.g. sickening, punishing-cruel)**

*Statistically significant $\alpha = 0.1$, F Value = 2.98, df = 4, 104. *P* = 0.0226

No Image treatment shows highest pain but prospect is not statistically different from any other treatment.

*Statistically significant $\alpha = 0.1$, F Value = 2.87, df = 4, 104, $P = 0.0265$

No image treatment is higher than mixed p + r
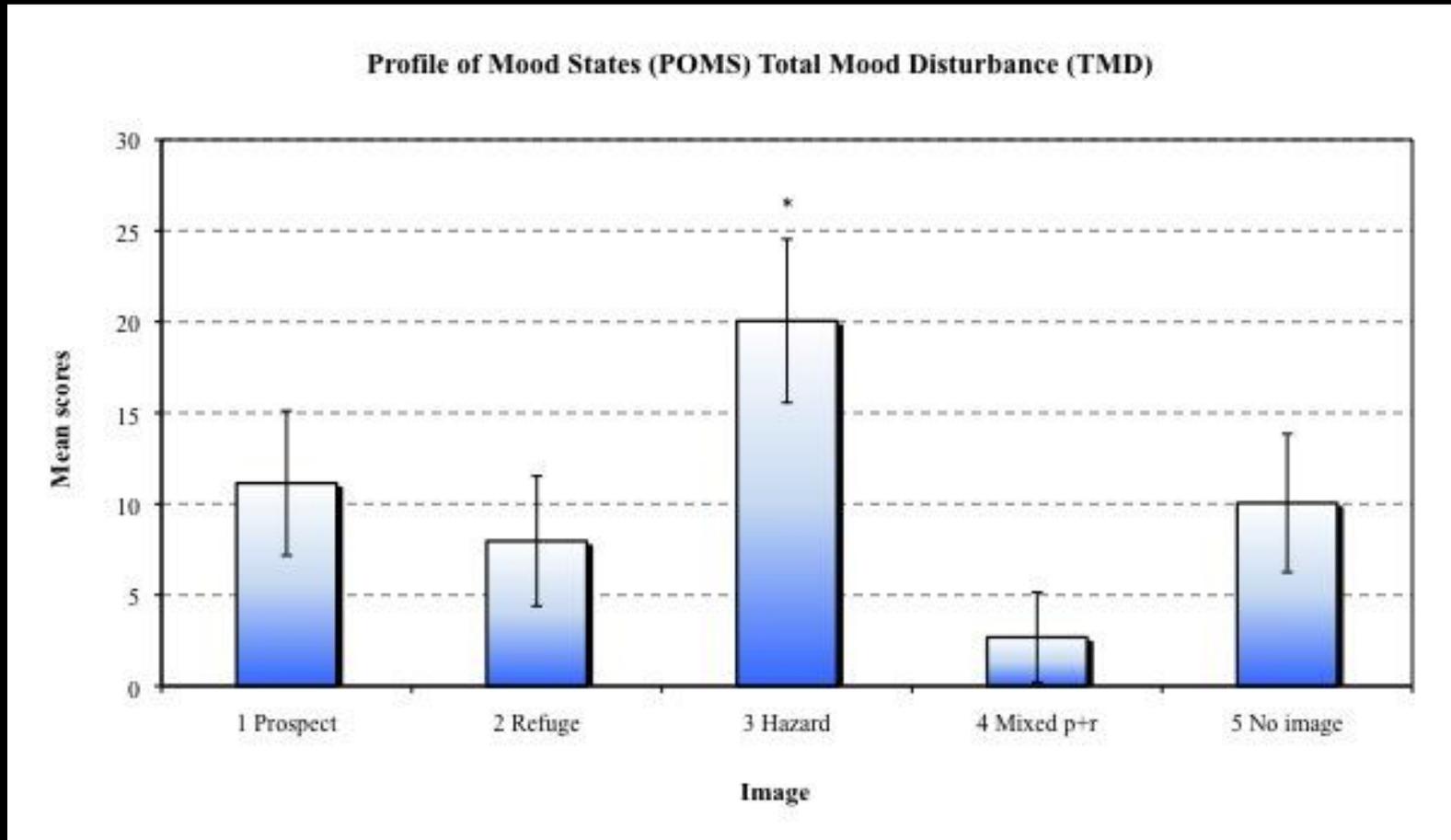
PHASE II: CONTROLLED EXPERIMENT

No Image treatment shows highest pain
No image treatment is higher than mixed p + r

RESULTS: POMS TOTAL MOOD DISTURBANCE (TMD)

Profile of Mood States (POMS) Total Mood Disturbance (TMD)

*Statistically significant $\alpha = 0.1$, F Value = 2.90, df = 4, 104, P = 0.253
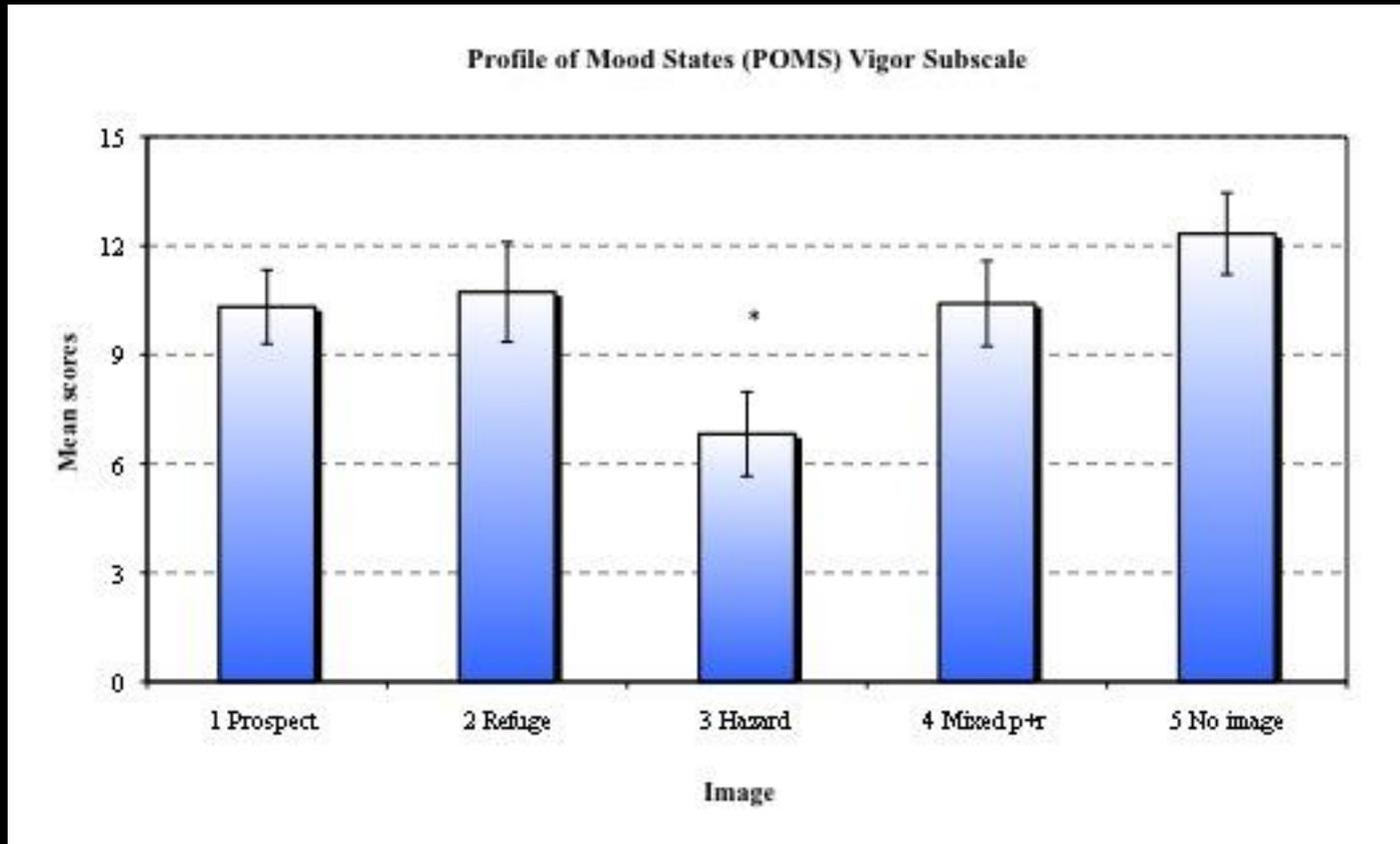Hazard image has highest total mood disturbance responses

Getty Image

*Statistically significant $\alpha = 0.1$, F Value = 2.90, df = 4, 104, P = 0.253
Hazard image has highest total mood disturbance responses

R E S U L T S : PROFILE OF MOOD STATES (POMS) VIGOR SUBSCALE

Profile of Mood States (POMS) Vigor Subscale

*Statistically significant $\alpha = 0.1$, F Value = 2.93, df = 4, 104, P = 0.0244

Hazard image shows lowest positive mood responses

Getty Image

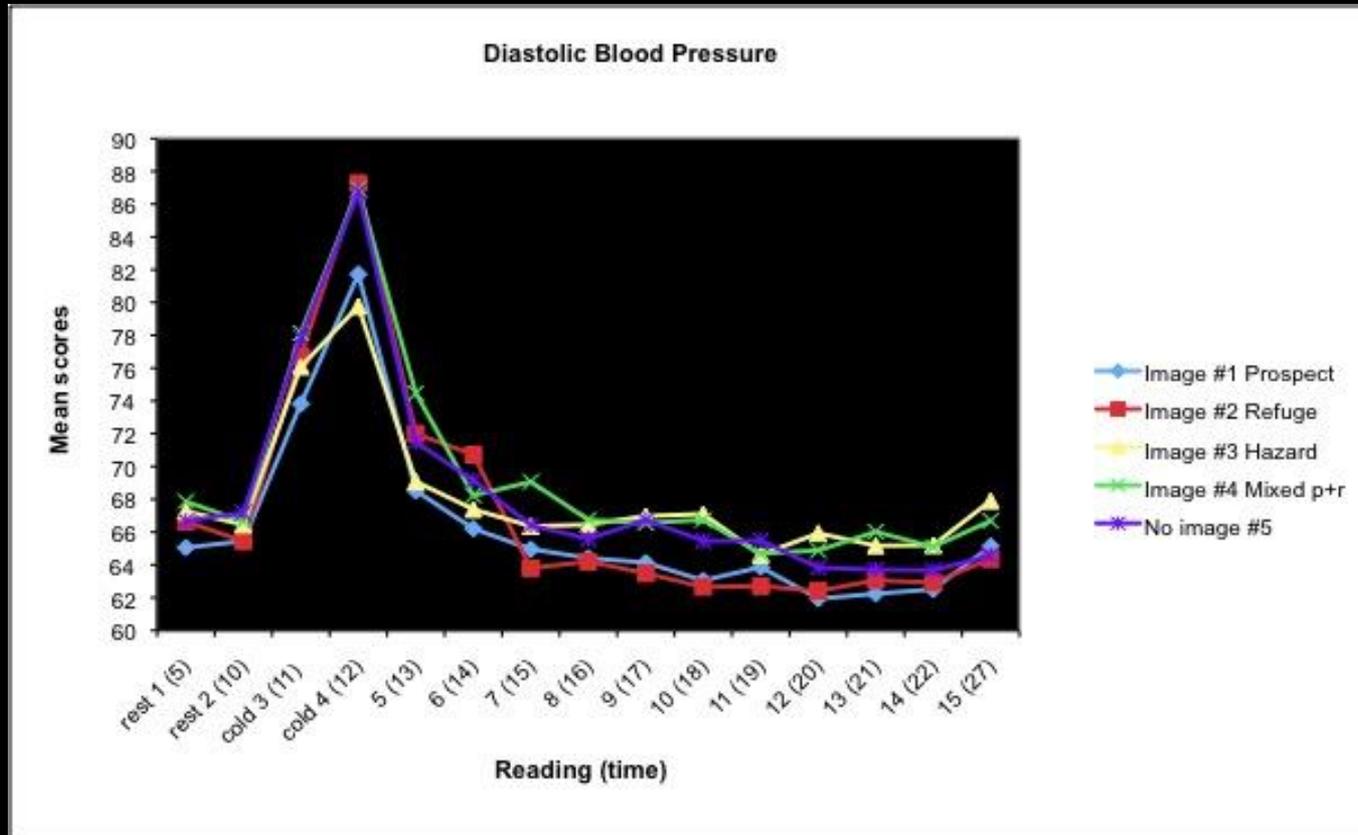Hazard image shows lowest positive mood responses

RESULTS:PHYSIOLOGICAL

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R E S U L T S : Diastolic Blood Pressure

*Statistically significant $\alpha = 0.1$ for changes in readings over time

Hazard image is lowest during pain stressor then rises during recovery

R E S U L T S : DIASTOLIC BLOOD PRESSURE

Statistics of interaction between reading and image group

Effect	Numerator DF	Denominator DF	F Value	Probability F
Image	4	104	0.57	0.6884
Reading	14	1245	118.88	<.0001**
Image *Reading	56	1245	1.33	0.0561**

**Statistically significant $\alpha = 0.1$, to assess trends for changes over time

Hazard image is lowest during pain stressor then rises during recovery

Getty Image

Hazard

PHASE II : CONTROLLED EXPERIMENT

R E S U L T S : EFFECTIVE STRESSOR

Measurement	Difference	Pr > [t]
Systolic	13.7628*	< .0001
Diastolic	14.0398*	<.0001
Heart rate BPM	7.6703*	<.0001
Mean arterial pressure (MAP)	15.6177*	<.0001

*Statistically significant $\alpha = 0.1$
Stressor was very effective

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	RESEARCH QUESTION & RESULTS
1)	Which nature image categories are most therapeutic as evidenced by reduced pain and positive mood?
Result	Mixed prospect + refuge showed significantly lower sensory pain responses. Hazard received lowest diastolic blood pressure and highest influence responses.
Discussion	No one image clearly was "most" therapeutic. Hazard was not therapeutic due to low level mood responses.

	FUTURE RESEARCH QUESTION
Question	Why was hazard successful at distracting people from pain?
Discussion	Assess color effect by including sunrise and sunset image rich in yellow and orange in image selection choices. Yellow symbolizes prospect.
Discussion	Imagery effect of heat (fire) and cold (ice water) confounding variable (Turk 2002, Syrjala and Abrams (2002) . Will not be issue in hospital.

	RESEARCH HYPOTHESES & RESULTS
1)	Nature views are variable in their impact on specific psychological and physiological health status indicators.
Results	Perceived pain levels did vary. "No image" treatment had higher affective pain levels than all but prospect viewers. Sensory pain was lowest for mixed prospect and refuge.

	RESEARCH HYPOTHESES & RESULTS
2)	Prospect and refuge nature scenes are more therapeutic than hazard nature scenes.
Results	Yes-regarding mood. Mixed prospect + refuge shows potential for reducing sensory pain level perceptions.

External generalization to other populations not possible with one study and small sample size.

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EFFECTS OF NATURE IMAGES ON PAIN IN HOSPITAL SURGERY PATIENTS

HOSPITAL RESEARCH DESIGN

PERSON	DISCIPLINE	INSTITUTION
Dr. Ellen Vincent	Env Horticulture	Clemson University
Dr. Dina Battisto	Arch + Health	Clemson University
Dr. Jim McCubbin	Psychology	Clemson University
Dr. Larry Grimes	Experimental Statistics	Clemson University
Dr. Sarah White	Env. Horticulture	Clemson University
	Nursing	Hospital
	Anesthesiologist	Hospital
	Orthopedic surgeon	Hospital

RESEARCH QUESTION IMAGE SELECTION
1)   Which images best represent :   (1) the therapeutic aspects   (2) presence and influence (experiential realism)   (3) the mixed prospect /refuge theory experience

RESEARCH QUESTION OUTPATIENT	
1)	Does viewing mixed prospect and refuge images reduce stress and or pain in surgical patients in outpatient and post-operative surgical environments?

RESEARCH QUESTION INPATIENT	
1)	Does viewing mixed prospect and refuge images reduce stress and or pain in surgical patients in the inpatient hospital room?

HYPOTHESES	
1)	Patients viewing mixed prospect refuge nature images have higher psychological and physiological measures of health status than do those patients viewing no image.
2)	There are no statistical differences between patients viewing the three different images that represent the mixed prospect refuge image category.

12 mixed prospect + refuge images are sorted and ranked (by people registering for surgery) according to 10 situations/questions that represent:

- Therapeutic aspects
- Presence and influence
- Theory confirmation

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THEORY

THERAPEUTIC

PRESENCE AND INFLUENCE

PHASE IIA&B: HOSPITAL EXPERIMENT

OUTPATIENT:
Image attached to bed side rail

INPATIENT:
Image attached to wall

Kathy Dalton

Ellen Vincent

N = 40 participants
10 in each group
3 groups one image
1 group no image (control)

N = 20 participants
5 in each group
3 groups one image
1 group no image (control)

P H A S E I I A & B : H O S P I T A L E X P E R I M E N T

INDEPENDENT VARIABLES

View (Appleton, 1975,1996)

Examples

(1) *Mixed Prospect + Refuge View*

(2) *) Mixed Prospect + Refuge View*

(3) *) Mixed Prospect + Refuge View*

(4) *No Image [control]*

DEPENDENT VARIABLES

Health status & perceived well-being:
Psychological and physiological responses

→

Perceived well-being – therapeutic aspects developed by Cooper Marcus (1995, 1999).

Health Status – Physiological measures:

•Continuous vital signs-

•Blood pressures + heart rate

→

Health Status – Psychological measures:

•Short Form McGill Pain Questionnaire

•Profile of Mood States (POMS)

•Visual analogue scale for presence

•Visual analogue scale for influence

P H A S E II A & B: E X P E R I M E N T

PSYCH TOOLS	PAIN	MOOD	PRESENCE/ INFLUENCE
Instrument	Short Form McGill Pain Questionnaire	Profile of Mood States (POMS) Brief Form	Visual analogue
Items	15 items 3 scales: sensory (throbbing, shooting), affective (punishing-cruel) and total	30 items 6 subscales	One for presence One for influence
Description	Check a number from 0 "none" to 3 "severe"	Circle a number from 0 "not at all" to 4 "extremely"	Slash mark on a line anchored by choices "extremely weak" and "extremely strong"

All images result in lower diastolic blood pressure readings compared to no image (group #4)

*Statistically significant $\alpha = 0.1$

Control (no image) shows highest blood pressures

Getty images

Image Group #3

Lowest perceived pain

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Image Group #1

Highest perceived pain

RESULTS IMAGE EFFECT

Lowest perceived pain   Image Group #3

Getty images

Highest perceived pain Image Group #1

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RESULTS IMAGE EFFECT

Getty images

Highest perceived influence Image Group #3

*Statistically significant $\alpha = 0.1$

Control 4 (no image) shows highest degree of total mood disturbance

Getty images

Image Group #3

Lowest perceived pain

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Image Group #1

Highest perceived pain

External generalization to other populations not possible with one study and small sample size.

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At your work site-where is there evidence of prospect, refuge, or prospect refuge mixed?

Be aware that your good work removes "hazard".

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Computer simulations with local environmental data in 2010 showed that **trees and forests removed 17.4 million tons of air pollution** with **human health effects valued at 6.8 billion U.S. dollars**.
Most of the pollution removal occurred in rural areas and most health benefits were within urban areas.

Tree and forest effects on air quality and human health in the United States by D. Nowak, S. Hirabayashi, A. Bodine, and E. Greenfield in *Environmental Pollution* 193 (2014) 119-129.

PUBLICATIONS

- Vincent, E., Battisto, D., Grimes, L., & McCubbin, J. (2010). The effects of nature images on pain in a simulated hospital patient room. *Health Environments Research & Design Journal 3*(3), 42-55.

- Vincent, E., Battisto, D., & Grimes, L., (2010). The effects of presence and influence in nature images in a simulated hospital patient room. *Health Environments Research & Design Journal 3*(3), 56-69.

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