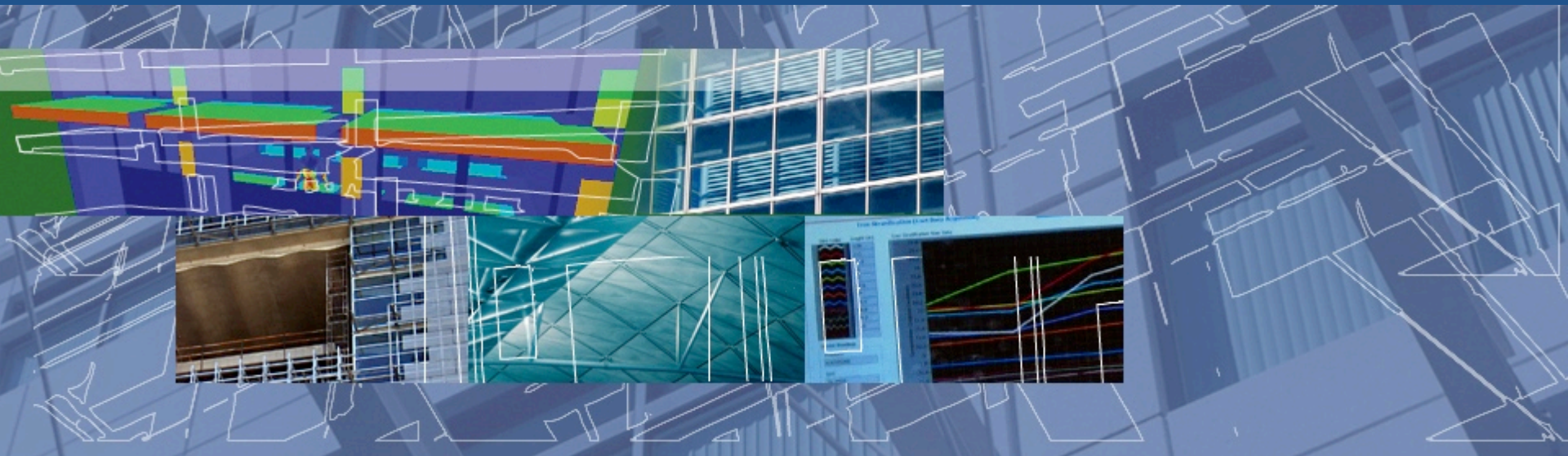


Occupant satisfaction in LEED and non-LEED certified buildings

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Objectives

Overarching Goal

- Investigate the relationship between LEED certification and occupant IEQ satisfaction

Specific Objectives

- Ascertain if LEED-rated buildings create a higher, equal, or lower occupant IEQ satisfaction
- Investigate the influence of factors unrelated to environmental quality on occupant IEQ satisfaction

CBE IEQ Occupant Survey Database

- 700 buildings and 65,000 individual occupants' responses

The initial subset analysed consisted of:

- 350 office buildings
- 52,980 responses
- Responses collected under 15 IEQ categories
- Satisfaction with building and workspace

How satisfied are you with the amount of light in your workspace?

Very Satisfied    Very Dissatisfied

Office Layout

Office Furnishings

Thermal Comfort

Air Quality

Lighting

Acoustic Quality

**Cleanliness and
Maintenance**

General Comments

Macro Categories of the CBE survey

Final dataset

Dataset	LEED Buildings	Non-LEED Buildings	Total
Buildings	65	79	144
Occupant responses	10,129	11,348	21,477

Two indicators were considered for consistency in comparison:

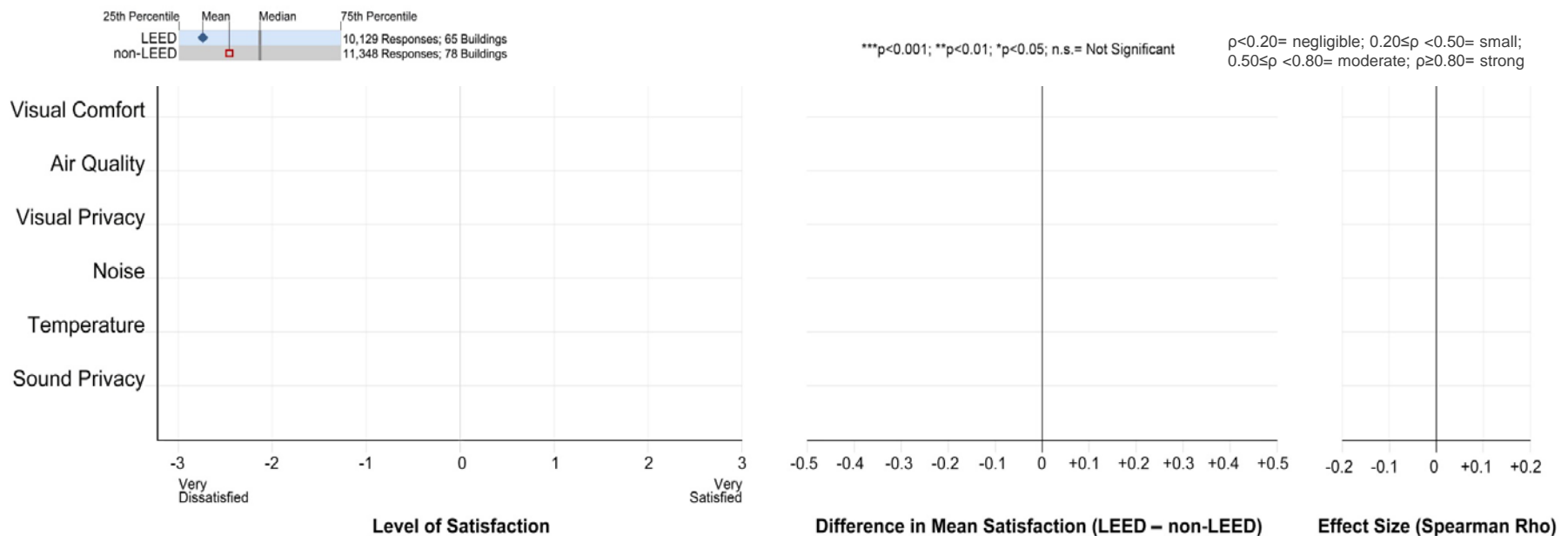
- Building size
- Year of construction and/or renovation (1998)

Groups have similar populations in terms of non-environmental factors:

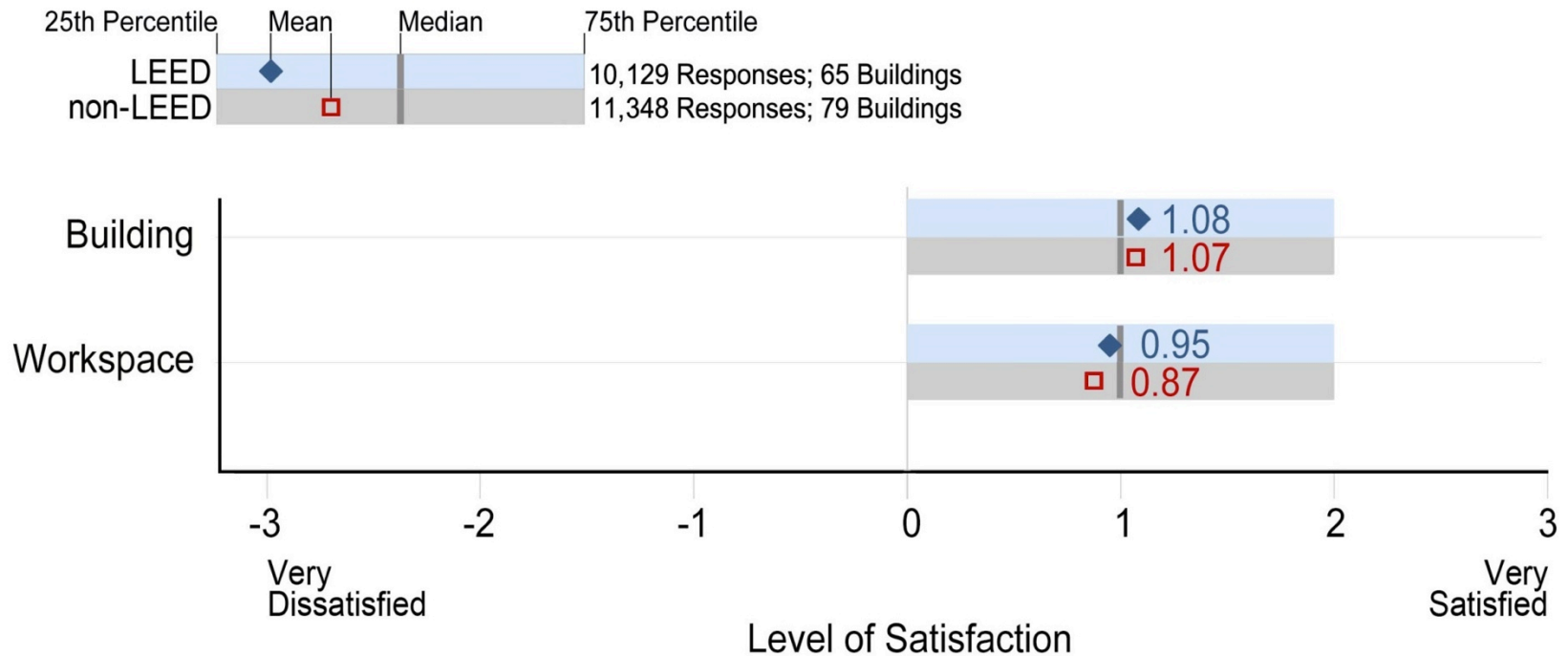
- Building and workspace features
- Personal attributes of occupants
- Work-related variables

Statistical analysis

- Means and medians were calculated by averaging individual votes
- Statistical significance depends on sample size
- Effect size provides an indication of the size of the difference between sample groups and its practical relevance

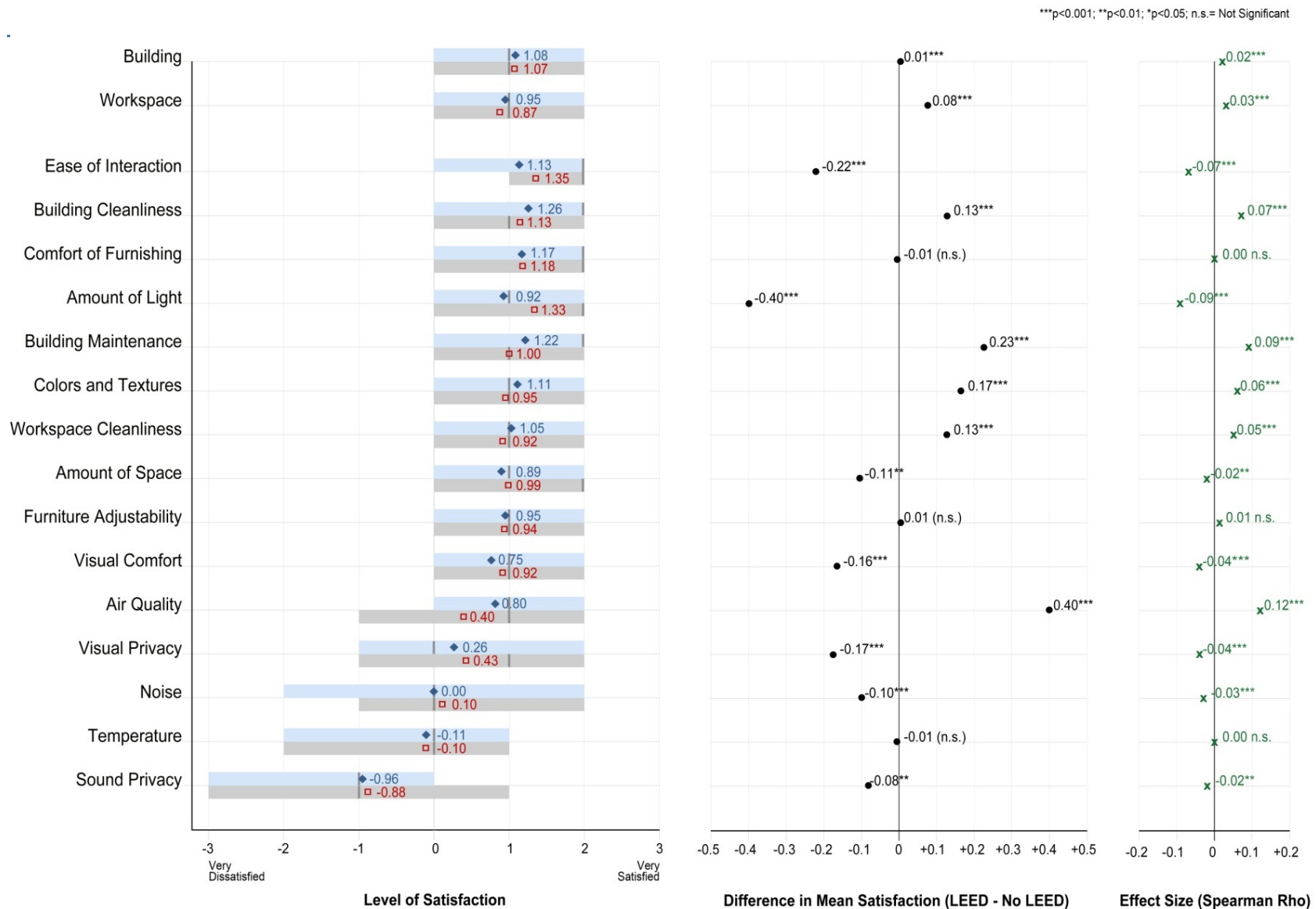


Overall occupant satisfaction



- Users of LEED and non-LEED buildings have equal satisfaction

LEED vs non-LEED



Source: Altomonte, Schiavon, 2013; Available on <http://escholarship.org/>

Impact of non-environmental factors on satisfaction

Office Type

Enclosed

Open

Spatial Layout

Private Office

Shared Office

Cubicles with high partitions*

Cubicles with low partitions

Other**

Distance from Window

Within 4.6 meters (15 feet)

Further than 4.6 meters (15 feet)

Building Size

Small (less than 4,645 m² or 50,000 gsf)

Medium (between 4,645 and 18,580 m²)

Large (higher than 18,580 m² or 200,000 gsf)

Gender

Female

Male

Age

30 or under

31-50

Over 50

Type of Work

Administrative

Technical

Professional

Managerial/Supervisory

Other

Time at Workspace

Less than 1 year

More than 1 year

Weekly Working Hours

10 or less

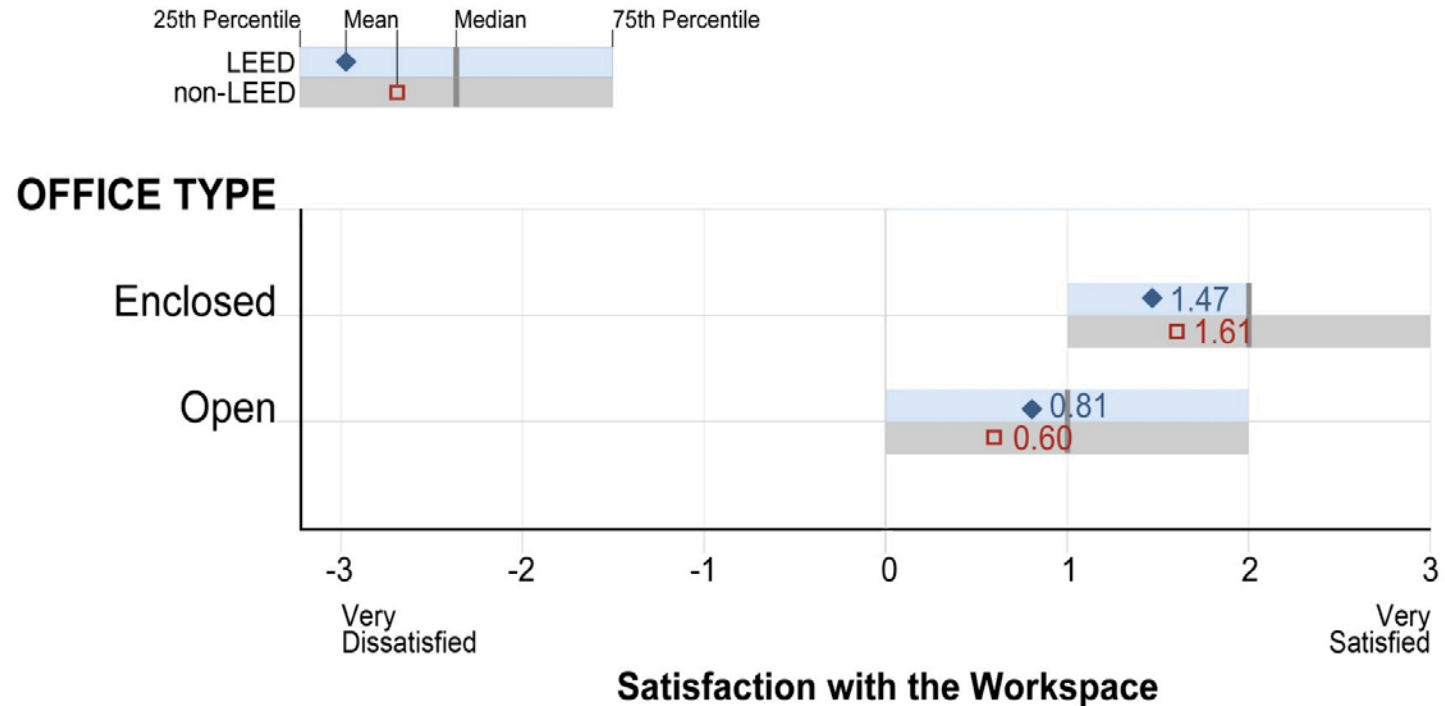
11-30

More than 30

*Higher than 1.5 meters

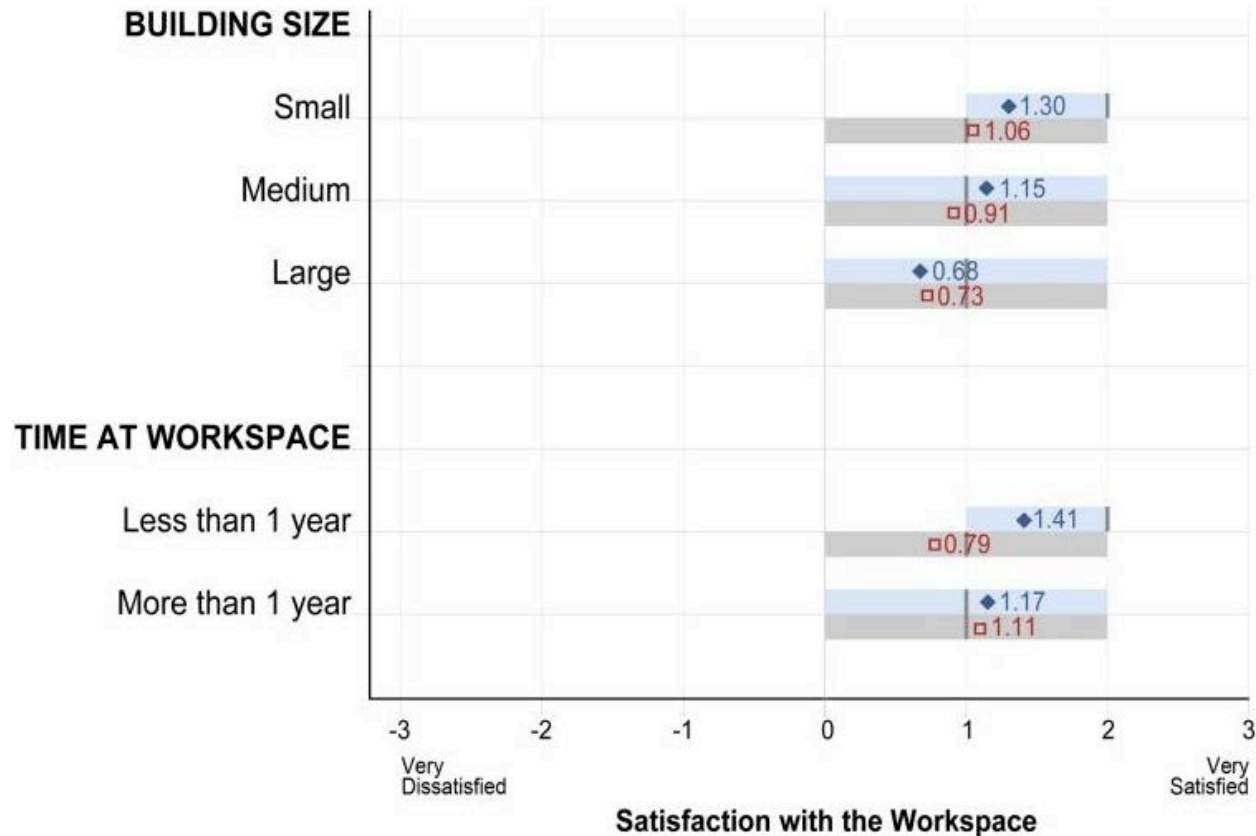
**Open plan office with limited or no partitions; partitions of different heights; group work areas; etc.

Type of office



- LEED performs better in open spaces rather in enclosed offices

Building size and time at workspace



- LEED performs better in small buildings than in large one
- LEED effectiveness on IEQ satisfaction may tend to decrease with time

Effect size and statistical significance

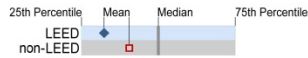
Variation of time at the workspace presents practically relevant effect size for ΔM s with the building, workspace, and various IEQ parameters (e.g., building and workspace cleanliness, and building maintenance)

ΔM (LEED minus non-LEED)			Building	Workspace	Building Cleanliness	Building Maintenance	Workspace Cleanliness
Time at Workspace	Less than 1 year	N= 1,864	+0.59	+0.63	+0.82	+0.97	+0.84
	More than 1 year	N= 3,859	+0.12	+0.05	+0.85	+0.92	+0.80

ΔM s for time at workspace and selected IEQ parameters

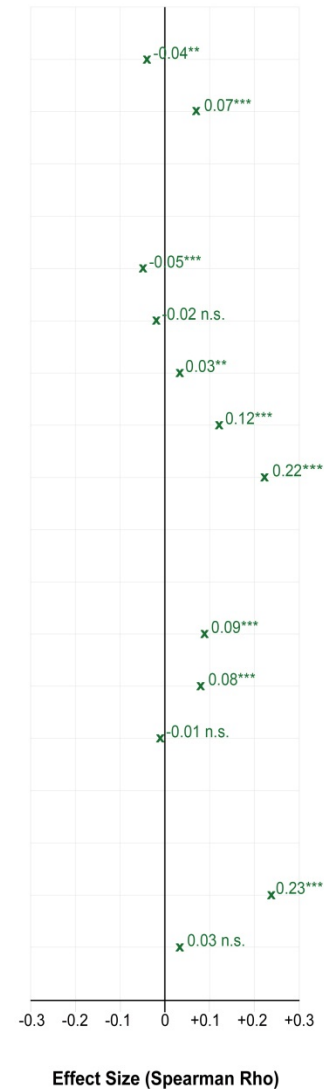
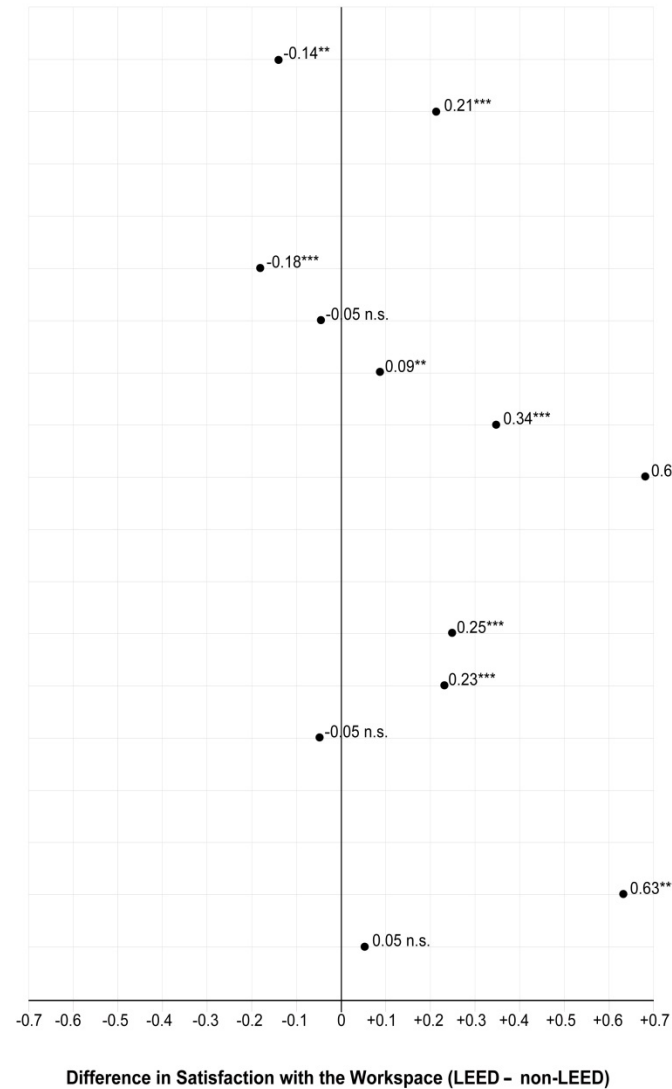
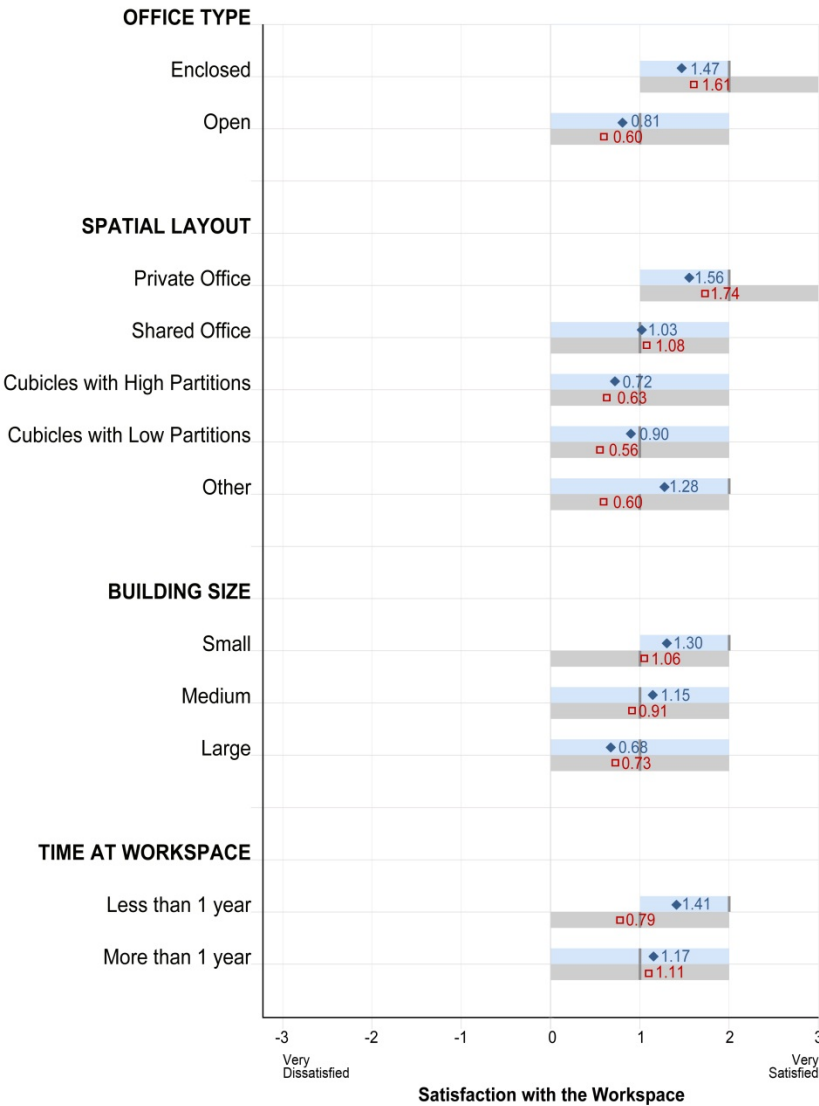
Effect size and statistical significance			Building	Workspace	Building Cleanliness	Building Maintenance	Workspace Cleanliness
Time at Workspace	Less than 1 year		0.22***	0.23***	0.31***	0.36***	0.28***
	More than 1 year		0.06***	0.03n.s.	0.28***	0.29***	0.25***

Effect size and significance of ΔM for time at workspace and selected IEQ parameters



*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; n.s. = Not Significant

$p < 0.20$ = negligible; $0.20 \leq p < 0.50$ = small; $0.50 \leq p < 0.80$ = moderate; $p \geq 0.80$ = strong



Limitations

- Occupant responses were not linked with physical measurements of environmental parameters
- Buildings selection was not randomized
- Mainly representative of versions 2.0 and 2.1 of LEED-NC

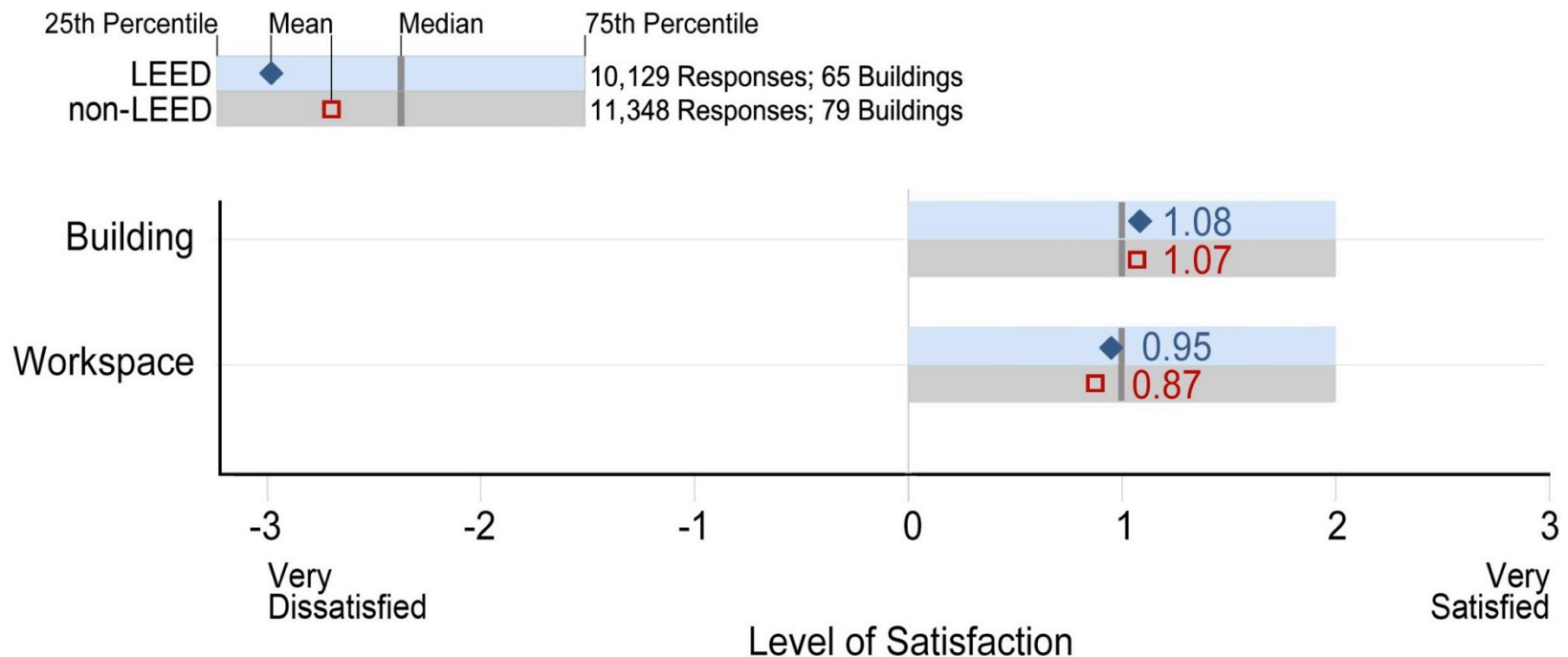
Conclusions

- Users of LEED and non-LEED buildings have equal satisfaction with all parameters considered independently of office type, spatial layout, distance from window, building size, gender, age, type of work and weekly working hours
- LEED buildings tend to be more effective in providing satisfaction in open layouts rather than in enclosed offices, and in small rather than in large buildings
- The positive value of LEED certification on occupant satisfaction may tend to decrease with time

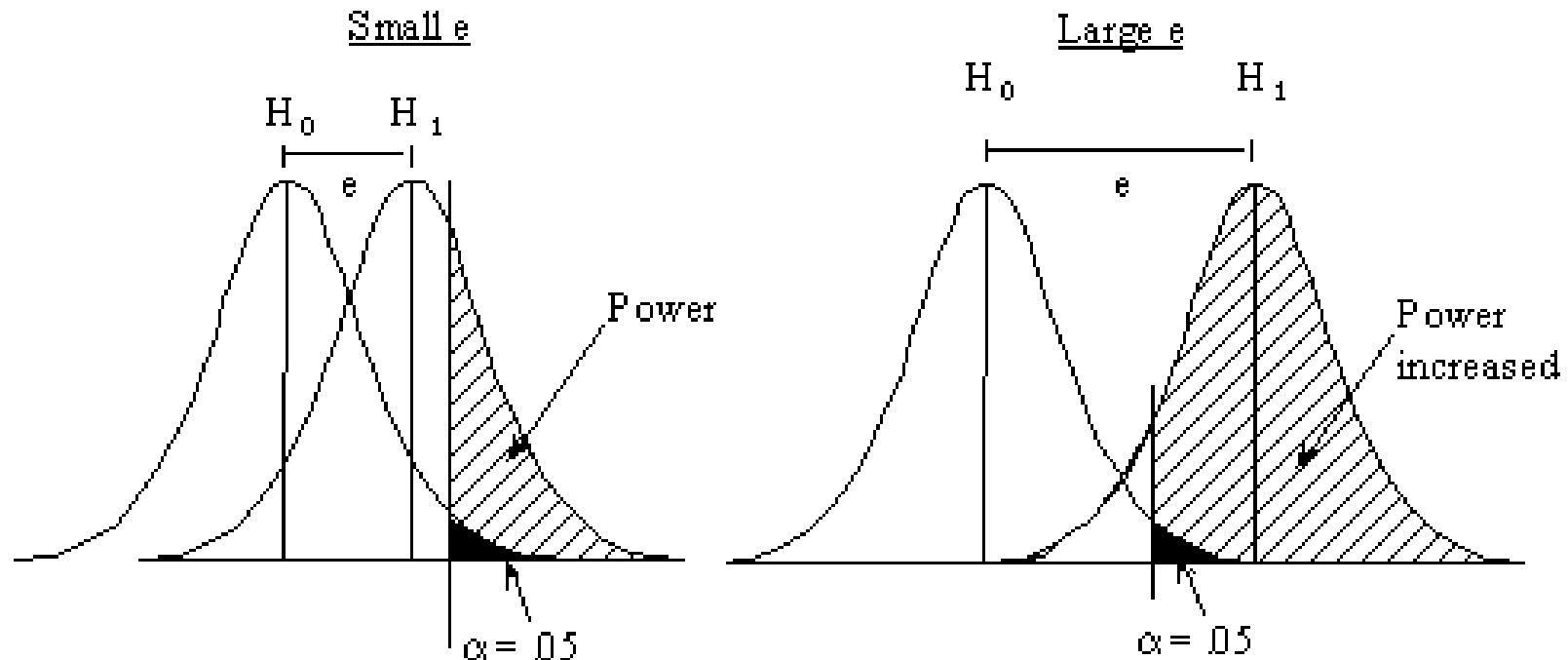
Questions?

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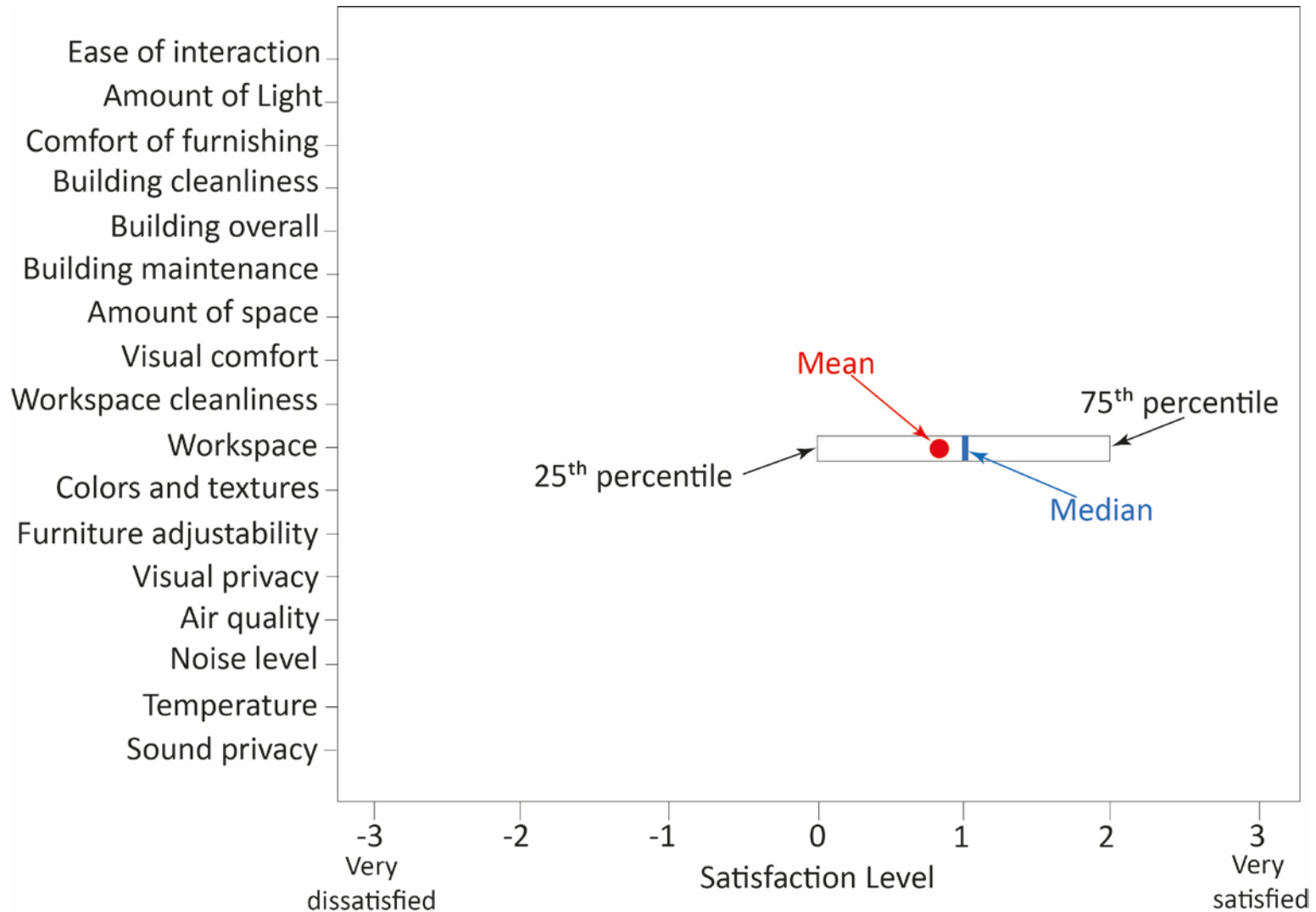
Significance difference vs effect size



- Statistical difference tests tell you if there is a difference
- Effect size calculations tells how big is this difference

Building occupant satisfaction

CBE survey on 351 bldg. and 52,980 occupants



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