



University of Glasgow | School of Psychology



# The Effectiveness of Augmented Reality in Enhancing the Experience of Visual Impact Assessment for Wind Turbine Development

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# Visual Impact Assessment (VIA)

- formal requirement for many proposed building developments where the development is likely to affect the way a particular area looks
- UK Guidelines for VIAs laid out by the Landscape Institute and Scottish National Heritage (SNH)
- production of visual materials which are designed to show how the area will be affected, such as
  - maps
  - photomontages of the area as it currently appears and how it would appear with the proposed development.



# Aim of Project

- **Comparing different techniques of visualising the impact of a proposed development**
  - Strict guidelines on how photomontages should be
  - But what do users think?



**Print**  
static



**Laptop**  
static



**Tablet**  
animated / live view

# Print (static, stations A & D)



# Laptop (static, stations B & E)



# Tablet

(animated & live animated, stations C & F)



# Tablet (animated)

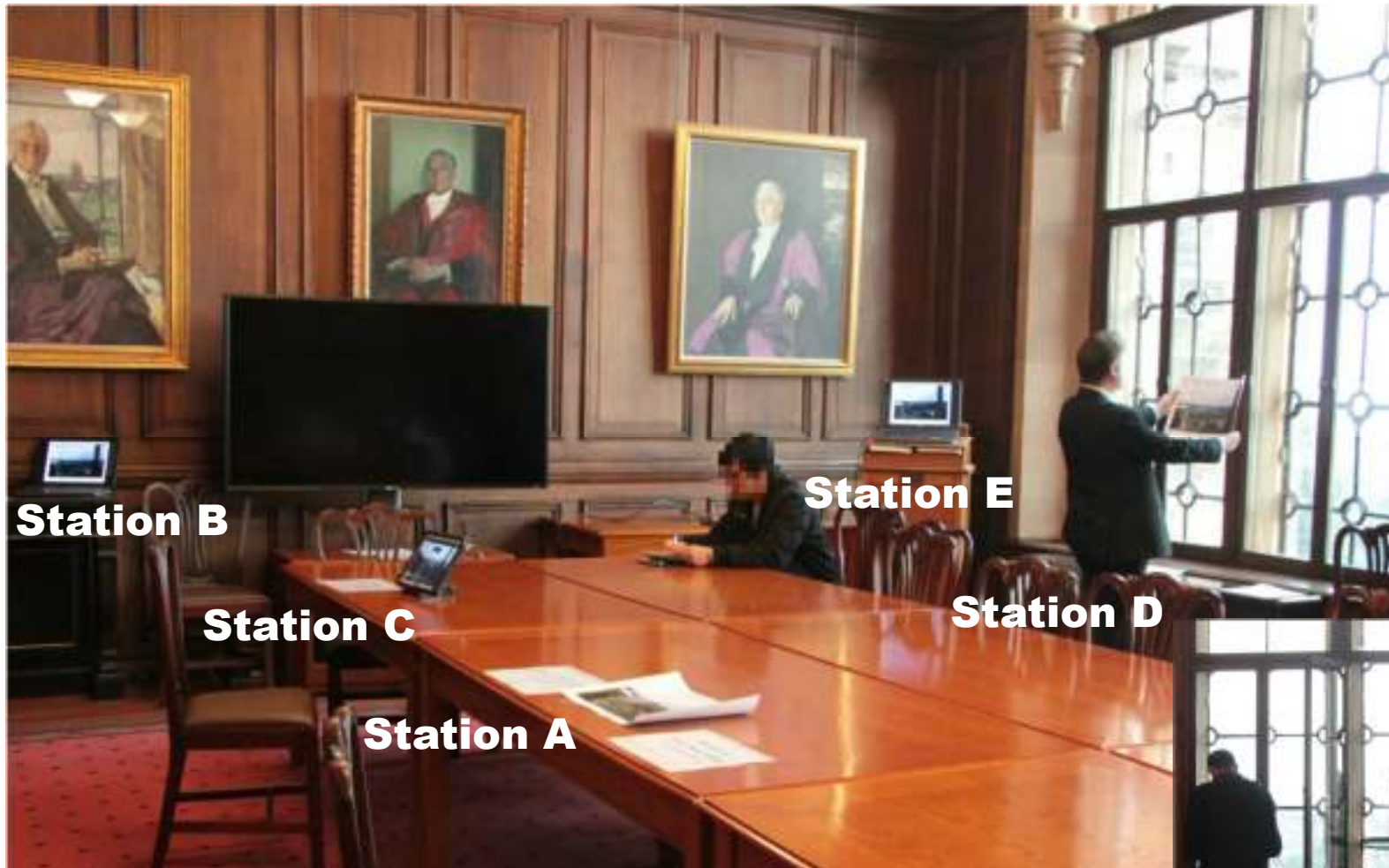


# Tablet *(live animated)*





# Room setup



# Method

## 67 participants

- 32 male/ 35 female
- 19 – 69 years old (mean age = 36, SD = 14.5)
- 6 “experts” who have attended at least 1 VIA in the past (e.g. Landscape Architect)
- 22 who knew what a VIA is but hadn’t attended one
- 39 who never heard of a VIA before

Each participant viewed the stations in a different, predefined order

# Results

1. **Ease of Use** of technique to assess the visual impact of the wind turbines in the environment
2. **Clarity** of the wind turbine simulation in the environment
3. **Information** (simulation shows everything I need to know to be able to assess the visual impact)
4. **Effectiveness** of wind turbine simulation for VIA
5. **Trustworthiness** of wind turbine simulation
6. **Overall Experience**

# Results

## Median, IQR

	Ease of use	Clarity	Trustworthiness	Information shown	Effectiveness	Overall
<b>Print (A + D)</b>	Mdn=6, IQR=5-6	6, 5-7	5, 4-6	4, 3-5	5, 4-6	5, 4-6
<b>Laptop (B + E)</b>	6, 4.75-7	6, 4-6.25	5, 4-6	4, 3-5	5, 4-6	5, 4-6
<b>Tablet (C + F)</b>	6, 5-7	6, 5-7	6, 4-6.25	5, 4-6	6, 5-7	6, 5-6
<b>Station A</b>	6, 4-6	6, 4-6	5, 4-6	4, 3-5	5, 3-6	5, 4-6
<b>Station B</b>	6, 4-6.75	6, 4-6	5, 4-6	4, 3-5.75	5, 4-5	5, 4-6
<b>Station C</b>	6, 5-7	6, 5-7	6, 4-6	5, 4-6	5, 4-6	6, 4.25-6
<b>Station D</b>	6, 5-6	6, 5-7	5, 4-6	5, 4-6	5, 4-6	5, 4-6
<b>Station E</b>	6, 5-6.75	6, 4-7	5, 4-6	4, 3-5	5, 3.25-6	5, 4-6
<b>Station F</b>	6, 5-7	6, 5-7	6, 5-7	6, 4-6	6, 5-7	6, 4-6

# Results

## Print vs. Laptop vs. Tablet

1. Ease of Use

2. Clarity

3. Information

4. Effectiveness

5. Trustworthiness

6. Overall Experience

➤ **Tablet** was **always** rated significantly better than **print** and **laptop**

➤ No difference between print and laptop

# Results

## Print vs. Laptop vs. Tablet

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	<i>Ease of use</i>	<i>Clarity</i>	<i>Trustworthiness</i>	<i>Info shown</i>	<i>Effectiveness</i>	<i>Overall</i>
<b>Tablet (C &amp; F) vs. Print (A &amp; D)</b>	<i>Z</i> =-3.059, <i>p</i> =.002	<i>Z</i> =-2.714, <i>p</i> =.007	<i>Z</i> =-2.178, <i>p</i> =.29	<i>Z</i> =-4.479, <i>p</i> <.001	<i>Z</i> =-5.158, <i>p</i> <.001	<i>Z</i> =-4.285, <i>p</i> <.001
<b>Tablet (C &amp; F) vs. Laptop (B &amp; E)</b>	<i>Z</i> =-3.503, <i>p</i> <.001	<i>Z</i> =-4.33, <i>p</i> <.001	<i>Z</i> =-2.015, <i>p</i> =0.44	<i>Z</i> =-5.021, <i>p</i> <.001	<i>Z</i> =-5.661, <i>p</i> <.001	<i>Z</i> =-5.551, <i>p</i> <.001
<b>Laptop (B &amp; E) vs. Print (A &amp; D)</b>	<i>Z</i> =-.019, <i>p</i> =.985	<i>Z</i> =-1.769, <i>p</i> =.077	<i>Z</i> =-.091, <i>p</i> =.928	<i>Z</i> =-1.042, <i>p</i> =.297	<i>Z</i> =-.166, <i>p</i> =.868	<i>Z</i> =-.708, <i>p</i> =.479

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# Results

Comparing all 6 “stations”

1. Ease of Use
2. Clarity
3. Information
4. Effectiveness
5. Trustworthiness
6. Overall Experience

- **Live animated tablet** was **always** rated significantly better than **all other stations**



# Results

Comparing all 6 “stations”

## 1. Ease of Use

## 2. Clarity

## 3. Information

## 4. Effectiveness

## 5. Trustworthiness

## 6. Overall Experience

- **animated tablet** was sometimes rated significantly better than **some static stations**





# Results

Comparing all 6 “stations”

1. **Ease of Use**

2. **Clarity**

3. **Information**

4. **Effectiveness**

5. **Trustworthiness**

6. **Overall Experience**

➤ **animated tablet** was rated better than **laptops**



# Results

Comparing all 6 “stations”

## 1. Ease of Use

## 2. Clarity

## 3. Information

## 4. Effectiveness

## 5. Trustworthiness

## 6. Overall Experience

- **animated Tablet** was rated better than **other print and laptop without view**



# Results

Comparing all 6 “stations”

## 1. Ease of Use

## 2. Clarity

## 3. Information

## 4. Effectiveness

## 5. Trustworthiness

## 6. Overall Experience

- **animated Tablet** was rated better than **all other static techniques**



# Results

Comparing all 6 “stations”

## 1. Ease of Use

## 2. Clarity

## 3. Information

## 4. Effectiveness

## 5. Trustworthiness

## 6. Overall Experience

- **animated Tablet** was rated better than **laptops** and **print without view**



# Results

Comparing all 6 “stations”

1. Ease of Use

2. Clarity

3. Information

4. Effectiveness

5. Trustworthiness

6. Overall Experience

- **Print with view** was sometimes rated significantly better than other **static techniques**



# Results

## Comparing all 6 stations (significant differences)

	Ease of use	Clarity	Trustworthiness	Info shown	Effectiveness	Overall
<b>F vs. A</b>	$Z=-2.665, p=.008$	$Z=-3.011, p=.003$	$Z=-2.345, p=.019$	$Z=-4.41, p<.001$	$Z=-4.166, p<.001$	$Z=-4.367, p<.001$
<b>F vs. B</b>	$Z=-3.103, p=.002$	$Z=-3.48, p=.001$	$Z=-2.383, p=.017$	$Z=-4.55, p<.001$	$Z=-4.381, p<.001$	$Z=-4.556, p<.001$
<b>F vs. C</b>	$Z=-2.185, p=.029$	$Z=-2.388, p=.017$	$Z=-2.445, p=.014$	$Z=-2.691, p=.007$	$Z=-2.418, p=.016$	$Z=-2.876, p=.004$
<b>F vs. D</b>	$Z=-2.733, p=.006$	$Z=-2.063, p=.039$	$Z=-2.412, p=.016$	$Z=-3.478, p=.001$	$Z=-3.688, p=.001$	$Z=-3.363, p=.001$
<b>F vs. E</b>	$Z=-2.785, p=.005$	$Z=-3.866, p<.001$	$Z=-2.668, p=.008$	$Z=-4.372, p<.001$	$Z=-4.371, p<.001$	$Z=-4.395, p<.001$
<b>C vs. A</b>				$Z=-2.716, p<.001$	$Z=-3.412, p=.001$	$Z=-2.653, p=.008$
<b>C vs. B</b>	$Z=-2.113, p=.035$	$Z=-2.151, p=.031$		$Z=-2.665, p=.008$	$Z=-3.608, p<.001$	$Z=-3.315, p=.001$
<b>C vs. D</b>					$Z=-2.018, p=.044$	
<b>C vs. E</b>		$Z=-2.269, p=.023$			$Z=-2.133, p=.033$	$Z=-2.082, p=.037$
<b>D vs. A</b>				$Z=-2.247, p=.025$		$Z=-2.642, p=.008$
<b>D vs. B</b>						$Z=-2.245, p=.025$
<b>D vs. E</b>		$Z=-2.085, p=.037$				

# Results

- “**View**” always preferred to “**no view**”
  - Particularly **live animated tablet** higher ratings than all other techniques
  - **Print with view** best static technique
  - No difference between “view” vs. “no view” for **laptop**

## Comments:

### View

- **Tablet: “Live”, real viewpoint**
- **Print/laptop: Can be compared with view**

# Results

- **Animated techniques (tablets)** higher ratings than **static techniques (print & laptop)**, laptop lowest ratings

## Comments:

### Tablet:

- Moving, more realistic and trustworthy
- poor animation, image not clear, movement distracting, dimensions doesn't seem correct

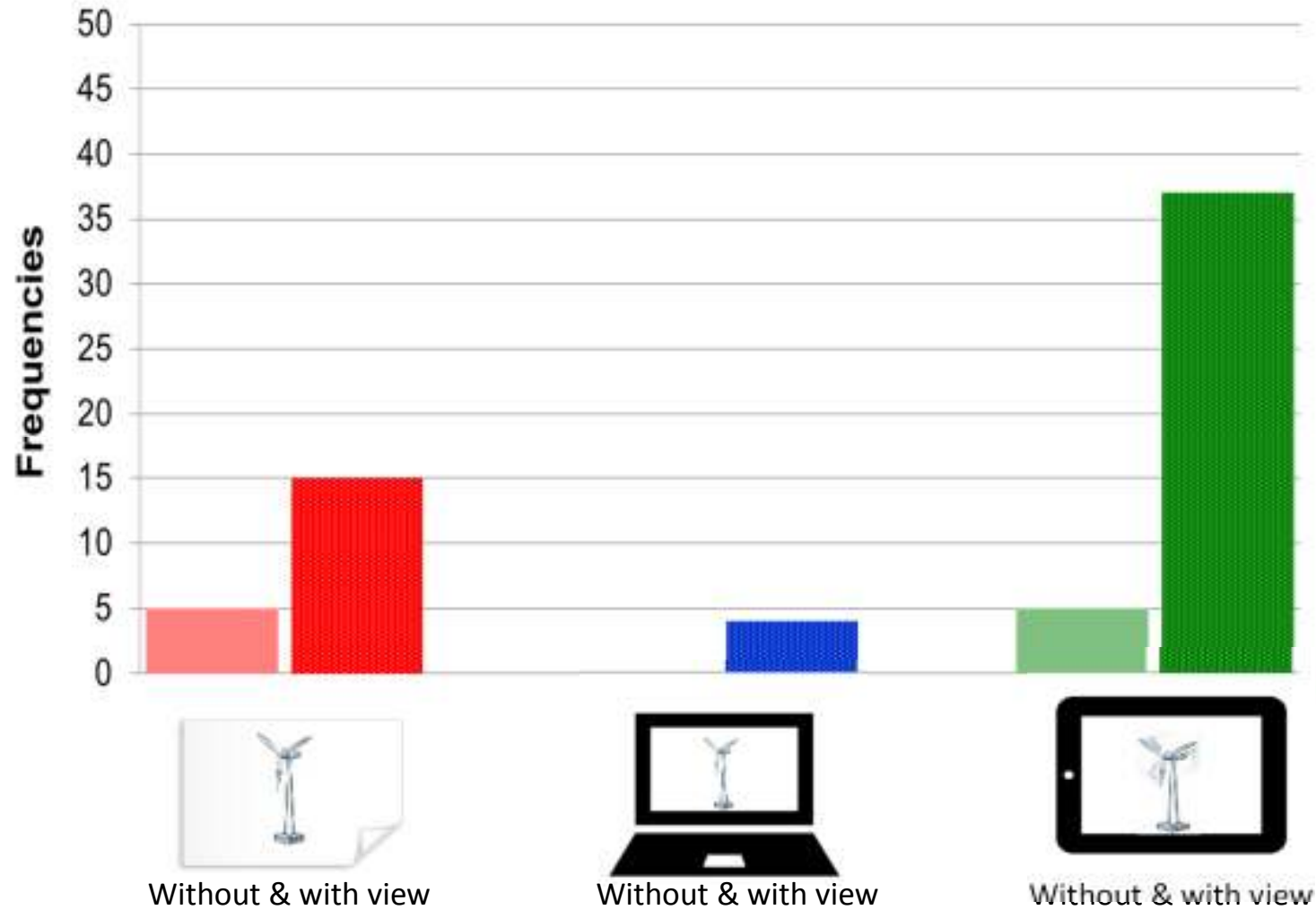
### Print (laptop):

- Clear and trustworthy image, easy to use
- Static, photo not recent/live



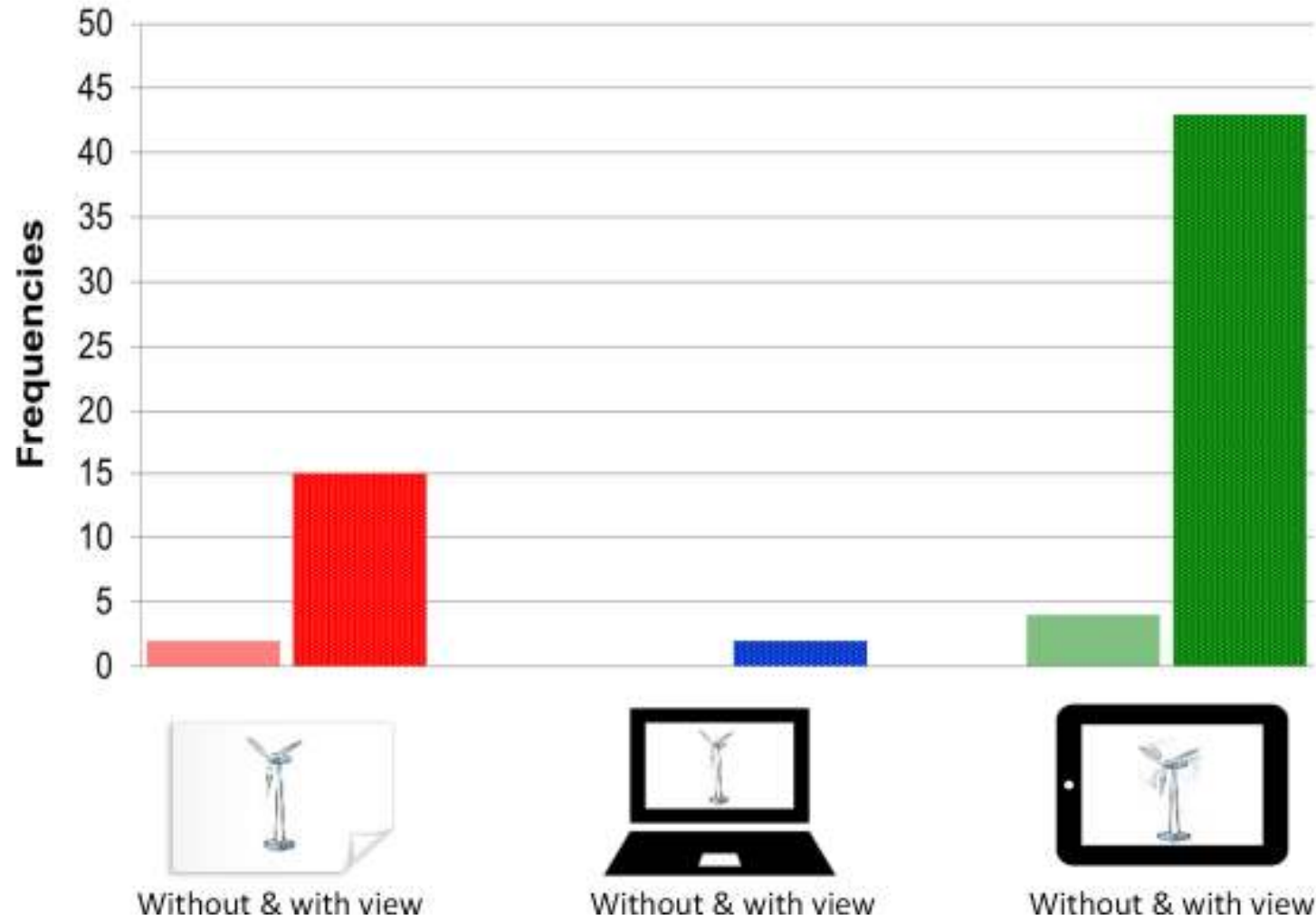
# Results

## Most trustworthy technique



# Results

## Preferred technique



# Thank you



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