

## Seeing Observation Studies — Individual Exhibits

### **Summary of results:**

#### **Seeing Yellow**

No improvement from Pre to Post. In fact, the visitor experience became slightly worse.

- Marginally shorter holding time.
- The same fraction of visitors getting the critical experience.
- Fewer visitors using the filter.
- No demographic differences.

#### **Peripheral Vision**

Significant improvements across the board from Pre to Post.

- Significantly longer holding time.
- Significantly more visitors getting the critical experience and using the exhibit correctly. Nearly every observed action shows improvement from Pre to Post.
- Marginally more Child-only groups.
- In both pre and post, groups with adults do better than groups with only kids.
- No gender differences.

#### **Motion Detector**

Significant improvements across the board from Pre to Post.

- Significantly longer holding time.
- Significantly more visitors getting the critical experience from Pre to Post.
- Significantly more Child-only groups.
- In both pre and post, groups with adults do better than groups with only kids.
- No gender differences.

**Detailed Results:****Seeing Yellow**Holding time

Holding time marginally decreased from Pre (avg = 50 sec) to Post (avg = 38 sec). The distributions for pre and post both look plausible (i.e., they look like exponential decays).

**ANOVA Table for Log(time)**

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Obs Type	1	.541	.541	3.045	.0818	3.045	.396
Residual	388	68.895	.178				

**Means Table for Log(time)****Effect: Obs Type**

	Count	Mean	Std. Dev.	Std. Err.
Posttest	255	1.415	.411	.026
Pretest	135	1.493	.440	.038

**Means Table for Time (Secs)****Effect: Obs Type**

	Count	Mean	Std. Dev.	Std. Err.
Posttest	255	38.420	36.480	2.284
Pretest	135	49.741	51.562	4.438

Getting the critical experience (turning knobs)

There was no change in getting the critical experience (i.e., turning the knobs) from Pre to Post. Virtually all visitors in both conditions turned the knobs:

**Summary Table for Obs Type, Turned knobs**

Num. Missing	0
DF	1
Chi Square	.088
Chi Square P-Value	.7669
G-Squared	.087
G-Squared P-Value	.7686
Contingency Coef.	.015
Phi	.015
Cty. Cor. Chi Square	0.000
Cty. Cor. P-Value	>.9999
Fisher's Exact P-Value	.7725

**Observed Frequencies for Obs Type, Turned knobs**

	no	yes	Totals
Posttest	8	247	255
Pretest	5	130	135
Totals	13	377	390

**Percents of Row Totals for Obs Type, Turned knobs**

	no	yes	Totals
Posttest	3.137	96.863	100.000
Pretest	3.704	96.296	100.000
Totals	3.333	96.667	100.000

Using the filter

The percentage of visitors using the filter decreased from Pre (36%) to Post (26%):

**Summary Table for Obs Type, Uses Filter**

Num. Missing	0
DF	1
Chi Square	4.242
Chi Square P-Value	.0394
G-Squared	4.176
G-Squared P-Value	.0410
Contingency Coef.	.104
Phi	.104
Cty. Cor. Chi Square	3.776
Cty. Cor. P-Value	.0520
Fisher's Exact P-Value	.0476

**Observed Frequencies for Obs Type, Uses Filter**

	no	yes	Totals
Posttest	188	67	255
Pretest	86	49	135
Totals	274	116	390

**Percents of Row Totals for Obs Type, Uses Filter**

	no	yes	Totals
Posttest	73.725	26.275	100.000
Pretest	63.704	36.296	100.000
Totals	70.256	29.744	100.000

Using the Spectrograph (Pre only)

37% of the visitor groups successfully used the spectrograph.

**Frequency Distribution for Uses spectrograph**

	Count
no	85
yes	50
Total	135

Demographics

There were no differences in the number of users who were children from Pre to Post.

**Summary Table for Obs Type, Child or adult**

Num. Missing	0
DF	1
Chi Square	1.048
Chi Square P-Value	.3061
G-Squared	1.048
G-Squared P-Value	.3059
Contingency Coef.	.052
Phi	.052
Cty. Cor. Chi Square	.841
Cty. Cor. P-Value	.3591
Fisher's Exact P-Value	.3385

**Observed Frequencies for Obs Type, Child or adult**

	Adult	Child	Totals
Posttest	124	131	255
Pretest	73	62	135
Totals	197	193	390

**Percents of Row Totals for Obs Type, Child or adult**

	Adult	Child	Totals
Posttest	48.627	51.373	100.000
Pretest	54.074	45.926	100.000
Totals	50.513	49.487	100.000

There were no differences in the age makeup of the groups using the exhibit Pre to Post.

### Summary Table for Obs Type, Group Comp recode

Num. Missing	0
DF	2
Chi Square	2.028
Chi Square P-Value	.3628
G-Squared	2.021
G-Squared P-Value	.3641
Contingency Coef.	.072
Cramer's V	.072

### Observed Frequencies for Obs Type, Group Comp recode

	Adults & Minors	Adults only	Minors only	Totals
Posttest	59	100	96	255
Pretest	28	63	44	135
Totals	87	163	140	390

### Percents of Row Totals for Obs Type, Group Comp recode

	Adults & Minors	Adults only	Minors only	Totals
Posttest	23.137	39.216	37.647	100.000
Pretest	20.741	46.667	32.593	100.000
Totals	22.308	41.795	35.897	100.000

There were no gender differences from Pre to Post.

### Summary Table for Obs Type, Gender

Num. Missing	0
DF	1
Chi Square	.537
Chi Square P-Value	.4638
G-Squared	.536
G-Squared P-Value	.4641
Contingency Coef.	.037
Phi	.037
Cty. Cor. Chi Square	.391
Cty. Cor. P-Value	.5316
Fisher's Exact P-Value	.5210

### Observed Frequencies for Obs Type, Gender

	f	m	Totals
Posttest	111	144	255
Pretest	64	71	135
Totals	175	215	390

### Percents of Row Totals for Obs Type, Gender

	f	m	Totals
Posttest	43.529	56.471	100.000
Pretest	47.407	52.593	100.000
Totals	44.872	55.128	100.000



## Peripheral Vision

### Holding Time

There was a significant increase in holding time from Pre (avg = 33s) to Post (avg = 51s).

#### ANOVA Table for Log(time)

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Obs type	1	6.090	6.090	21.775	<.0001	21.775	.999
Residual	277	77.471	.280				

#### Means Table for Log(time)

##### Effect: Obs type

	Count	Mean	Std. Dev.	Std. Err.
Posttest	161	1.464	.520	.041
Pretest	118	1.165	.541	.050

#### Means Table for SECS

##### Effect: Obs type

	Count	Mean	Std. Dev.	Std. Err.
Posttest	161	51.068	51.583	4.065
Pretest	118	32.576	47.772	4.398

Getting the critical experience

There was a significant increase in the number of visitors who could have had the critical experience from Pre to Post. Having the possibility of the critical experience means that the image on the block was exposed and the block was moved slowly enough to get the effect.

**Summary Table for Obs type, CRITICAL EXPERIENCE POSSIBLE?**

Num. Missing	0
DF	1
Chi Square	7.016
Chi Square P-Value	.0081
G-Squared	7.248
G-Squared P-Value	.0071
Contingency Coef.	.157
Phi	.159
Cty. Cor. Chi Square	6.287
Cty. Cor. P-Value	.0122
Fisher's Exact P-Value	.0104

**Observed Frequencies for Obs type, CRITICAL EXPERIENCE POSSIBLE?**

	0	1	Totals
Posttest	113	48	161
Pretest	99	19	118
Totals	212	67	279

**Percents of Row Totals for Obs type, CRITICAL EXPERIENCE POSSIBLE?**

	0	1	Totals
Posttest	70.186	29.814	100.000
Pretest	83.898	16.102	100.000
Totals	75.986	24.014	100.000

Used the exhibit correctly

There was a significant increase in the number of visitors who used the exhibit correctly from Pre to Post. Using the exhibit correctly means that the visitor's head was in the correct position (center of table, with nose in slot), the image on the block was exposed, the block was started at the 90° position, and the block was moved slowly enough to get the effect.

**Summary Table for Obs type, CORRECTLY DONE**

Num. Missing	0
DF	1
Chi Square	12.074
Chi Square P-Value	.0005
G-Squared	13.560
G-Squared P-Value	.0002
Contingency Coef.	.204
Phi	.208
Cty. Cor. Chi Square	10.826
Cty. Cor. P-Value	.0010
Fisher's Exact P-Value	.0004

**Observed Frequencies for Obs type, CORRECTLY DONE**

	0	1	Totals
Posttest	132	29	161
Pretest	113	5	118
Totals	245	34	279

**Percents of Row Totals for Obs type, CORRECTLY DONE**

	0	1	Totals
Posttest	81.988	18.012	100.000
Pretest	95.763	4.237	100.000
Totals	87.814	12.186	100.000

Blocks on table

More visitors in Post arrived at exhibit to find it with its blocks in the correct place on the table than in the Pre.

**Summary Table for Obs type, Blocks on table**

Num. Missing	0
DF	1
Chi Square	17.117
Chi Square P-Value	<.0001
G-Squared	18.291
G-Squared P-Value	<.0001
Contingency Coef.	.240
Phi	.248
Cty. Cor. Chi Square	15.143
Cty. Cor. P-Value	<.0001
Fisher's Exact P-Value	<.0001

**Observed Frequencies for Obs type, Blocks on table**

	0	1	Totals
Posttest	2	159	161
Pretest	16	102	118
Totals	18	261	279

**Percents of Row Totals for Obs type, Blocks on table**

	0	1	Totals
Posttest	1.242	98.758	100.000
Pretest	13.559	86.441	100.000
Totals	6.452	93.548	100.000

Head in correct position

There was a large increase in the number of visitors who put their head in the correct position from Pre to Post.

**Summary Table for Obs type, Head in correct position**

Num. Missing	0
DF	1
Chi Square	48.186
Chi Square P-Value	<.0001
G-Squared	50.827
G-Squared P-Value	<.0001
Contingency Coef.	.384
Phi	.416
Cty. Cor. Chi Square	46.506
Cty. Cor. P-Value	<.0001
Fisher's Exact P-Value	<.0001

**Observed Frequencies for Obs type, Head in correct position**

	0	1	Totals
Posttest	64	97	161
Pretest	96	22	118
Totals	160	119	279

**Percents of Row Totals for Obs type, Head in correct position**

	0	1	Totals
Posttest	39.752	60.248	100.000
Pretest	81.356	18.644	100.000
Totals	57.348	42.652	100.000

Moved block

There was a large increase in the fraction of visitors who moved a block from Pre to Post.

**Summary Table for Obs type, Moved block**

Num. Missing	0
DF	1
Chi Square	25.966
Chi Square P-Value	<.0001
G-Squared	27.256
G-Squared P-Value	<.0001
Contingency Coef.	.292
Phi	.305
Cty. Cor. Chi Square	24.690
Cty. Cor. P-Value	<.0001
Fisher's Exact P-Value	<.0001

**Observed Frequencies for Obs type, Moved block**

	0	1	Totals
Posttest	85	76	161
Pretest	97	21	118
Totals	182	97	279

**Percents of Row Totals for Obs type, Moved block**

	0	1	Totals
Posttest	52.795	47.205	100.000
Pretest	82.203	17.797	100.000
Totals	65.233	34.767	100.000

Correct starting angle

There was no Pre/Post change in the fraction of visitors who started the block at the correct angle of 90°.

**Summary Table for Obs type, Correct starting angle**

Num. Missing	0
DF	1
Chi Square	.546
Chi Square P-Value	.4600
G-Squared	.551
G-Squared P-Value	.4579
Contingency Coef.	.044
Phi	.044
Cty. Cor. Chi Square	.335
Cty. Cor. P-Value	.5627
Fisher's Exact P-Value	.5223

**Observed Frequencies for Obs type, Correct starting angle**

	0	1	Totals
Posttest	131	30	161
Pretest	100	18	118
Totals	231	48	279

**Percents of Row Totals for Obs type, Correct starting angle**

	0	1	Totals
Posttest	81.366	18.634	100.000
Pretest	84.746	15.254	100.000
Totals	82.796	17.204	100.000

Correct exposure of image

There was a significant increase in the fraction of visitors who held the block so that the image would appear.

**Summary Table for Obs type, Correct exposure of image**

Num. Missing	0
DF	1
Chi Square	25.658
Chi Square P-Value	<.0001
G-Squared	27.004
G-Squared P-Value	<.0001
Contingency Coef.	.290
Phi	.303
Cty. Cor. Chi Square	24.380
Cty. Cor. P-Value	<.0001
Fisher's Exact P-Value	<.0001

**Observed Frequencies for Obs type, Correct exposure of image**

	0	1	Totals
Posttest	87	74	161
Pretest	98	20	118
Totals	185	94	279

**Percents of Row Totals for Obs type, Correct exposure of image**

	0	1	Totals
Posttest	54.037	45.963	100.000
Pretest	83.051	16.949	100.000
Totals	66.308	33.692	100.000



Block moved slowly enough

There was an increase from Pre to Post in the fraction of visitors who moved the block slowly enough to see the effect.

**Summary Table for Obs type, Block moved slowly enough**

Num. Missing	0
DF	1
Chi Square	7.210
Chi Square P-Value	.0073
G-Squared	7.438
G-Squared P-Value	.0064
Contingency Coef.	.159
Phi	.161
Cty. Cor. Chi Square	6.481
Cty. Cor. P-Value	.0109
Fisher's Exact P-Value	.0079

**Observed Frequencies for Obs type, Block moved slowly enough**

	0	1	Totals
Posttest	111	50	161
Pretest	98	20	118
Totals	209	70	279

**Percents of Row Totals for Obs type, Block moved slowly enough**

	0	1	Totals
Posttest	68.944	31.056	100.000
Pretest	83.051	16.949	100.000
Totals	74.910	25.090	100.000

Demographics — Gender

There were no differences in the gender of the users from Pre to Post.

**Summary Table for Obs type, M/F**

Num. Missing	5
DF	1
Chi Square	.342
Chi Square P-Value	.5587
G-Squared	.342
G-Squared P-Value	.5588
Contingency Coef.	.035
Phi	.035
Cty. Cor. Chi Square	.213
Cty. Cor. P-Value	.6443
Fisher's Exact P-Value	.6228

**Observed Frequencies for Obs type, M/F**

	f	m	Totals
Posttest	69	90	159
Pretest	54	61	115
Totals	123	151	274

**Percents of Row Totals for Obs type, M/F**

	f	m	Totals
Posttest	43.396	56.604	100.000
Pretest	46.957	53.043	100.000
Totals	44.891	55.109	100.000

Demographics — Age

There was a marginal difference in the age composition of the user groups from Pre to Post. In the Post, there were proportionally fewer Adult-only groups.

**Summary Table for Obs type, Group Comp recode**

Num. Missing	9
DF	2
Chi Square	4.759
Chi Square P-Value	.0926
G-Squared	4.801
G-Squared P-Value	.0907
Contingency Coef.	.132
Cramer's V	.133

**Observed Frequencies for Obs type, Group Comp recode**

	Adults & Minors	Adults only	Minors only	Totals
Posttest	33	75	52	160
Pretest	15	66	29	110
Totals	48	141	81	270

**Percents of Row Totals for Obs type, Group Comp recode**

	Adults & Minors	Adults only	Minors only	Totals
Posttest	20.625	46.875	32.500	100.000
Pretest	13.636	60.000	26.364	100.000
Totals	17.778	52.222	30.000	100.000

Demographics x Use: The effect of age

There was a significant effect of a group's age composition on getting the critical experience. Groups with proportionately more adults were more likely to get the critical experience. There was no effect of age composition on using the exhibit correctly, however.

**Summary Table for CRITICAL EXPERIENCE POSSIBLE?, Group Comp recode**

Num. Missing	9
DF	2
Chi Square	7.770
Chi Square P-Value	.0206
G-Squared	8.241
G-Squared P-Value	.0162
Contingency Coef.	.167
Cramer's V	.170

**Observed Frequencies for CRITICAL EXPERIENCE POSSIBLE?, Group Comp recode**

	Adults & Minors	Adults only	Minors only	Totals
0	32	103	70	205
1	16	38	11	65
Totals	48	141	81	270

**Percents of Row Totals for CRITICAL EXPERIENCE POSSIBLE?, Group Comp recode**

	Adults & Minors	Adults only	Minors only	Totals
0	15.610	50.244	34.146	100.000
1	24.615	58.462	16.923	100.000
Totals	17.778	52.222	30.000	100.000

## Motion Detector

### Holding Time

There was a significant increase in the holding time from Pre to Post.

#### ANOVA Table for Log(time)

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Obs Type	1	1.111	1.111	6.987	.0086	6.987	.759
Residual	344	54.689	.159				

#### Means Table for Log(time)

##### Effect: Obs Type

	Count	Mean	Std. Dev.	Std. Err.
Posttest	254	1.681	.395	.025
Pretest	92	1.553	.408	.043

#### Means Table for SECONDS

##### Effect: Obs Type

	Count	Mean	Std. Dev.	Std. Err.
Posttest	254	66.571	50.884	3.193
Pretest	92	51.793	46.426	4.840

Getting the critical experience

There was a significant increase in the fraction of visitors who got the critical experience from Pre to Post.

**Summary Table for Obs Type, Success**

Num. Missing	0
DF	2
Chi Square	10.280
Chi Square P-Value	.0059
G-Squared	9.644
G-Squared P-Value	.0081
Contingency Coef.	.170
Cramer's V	.172

**Observed Frequencies for Obs Type, Success**

	No	Yes	Yes, But Head In Wrong Place	Totals
Posttest	105	141	8	254
Pretest	46	37	9	92
Totals	151	178	17	346

**Percents of Row Totals for Obs Type, Success**

	No	Yes	Yes, But Head In Wrong Place	Totals
Posttest	41.339	55.512	3.150	100.000
Pretest	50.000	40.217	9.783	100.000
Totals	43.642	51.445	4.913	100.000

Problems visitors encountered

There was a significant change in the **kinds** of problems visitors encountered at this exhibit. Of the visitors who were not successful, a smaller fraction visitors in the Posttest failed to push the button or place their heads in the right place. However, a larger fraction in the Posttest failed to coordinate moving the cylinder.

**Summary Table for Problem, Obs Type**

**Inclusion criteria: Users w problems from Motion Detect\_for Statvw\_01 (imported)**

Num. Missing	0
DF	3
Chi Square	16.624
Chi Square P-Value	.0008
G-Squared	17.540
G-Squared P-Value	.0005
Contingency Coef.	.300
Cramer's V	.315

**Observed Frequencies for Problem, Obs Type**

**Inclusion criteria: Users w problems from Motion Detect\_for Statvw\_01 (imported)**

	Posttest	Pretest	Totals
Never Coordinated Moving Cylin...	40	6	46
Nobody Pushed Button	28	25	53
Poor Head Placement	8	9	17
Poor Object Placement	37	15	52
Totals	113	55	168

**Percents of Column Totals for Problem, Obs Type**

**Inclusion criteria: Users w problems from Motion Detect\_for Statvw\_01 (imported)**

	Posttest	Pretest	Totals
Never Coordinated Moving Cylin...	35.398	10.909	27.381
Nobody Pushed Button	24.779	45.455	31.548
Poor Head Placement	7.080	16.364	10.119
Poor Object Placement	32.743	27.273	30.952
Totals	100.000	100.000	100.000

Demographics – Age of observed user

There was a significant decrease in the mean age of users from Pre to Post.

**ANOVA Table for Age**

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Obs Type	1	735.162	735.162	3.824	.0513	3.824	.482
Residual	341	65553.712	192.240				

**Means Table for Age**

**Effect: Obs Type**

	Count	Mean	Std. Dev.	Std. Err.
Posttest	253	21.206	14.223	.894
Pretest	90	24.533	12.796	1.349



Demographics – Age composition of groups

There was a significant change in the age composition of the groups, with more Minors only and Adults & Minors groups in the Post-test (fewer Adults only groups).

**Summary Table for Obs Type, Group Comp recode**

Num. Missing	2
DF	2
Chi Square	9.294
Chi Square P-Value	.0096
G-Squared	9.299
G-Squared P-Value	.0096
Contingency Coef.	.162
Cramer's V	.164

**Observed Frequencies for Obs Type, Group Comp recode**

	Adults & Minors	Adults only	Minors only	Totals
Posttest	79	89	85	253
Pretest	24	48	19	91
Totals	103	137	104	344

**Percents of Row Totals for Obs Type, Group Comp recode**

	Adults & Minors	Adults only	Minors only	Totals
Posttest	31.225	35.178	33.597	100.000
Pretest	26.374	52.747	20.879	100.000
Totals	29.942	39.826	30.233	100.000

Demographics x Use: The effect of age

There was a significant effect of a group’s age composition on getting the critical experience. Groups made up only of minors were less likely to be successful in using the exhibit.

**Summary Table for Group Comp recode, Success Recode**

Num. Missing	2
DF	2
Chi Square	8.989
Chi Square P-Value	.0112
G-Squared	8.951
G-Squared P-Value	.0114
Contingency Coef.	.160
Cramer's V	.162

**Observed Frequencies for Group Comp recode, Success Recode**

	No	Yes	Totals
Adults & Minors	40	63	103
Adults only	52	85	137
Minors only	58	46	104
Totals	150	194	344

**Percents of Row Totals for Group Comp recode, Success Recode**

	No	Yes	Totals
Adults & Minors	38.835	61.165	100.000
Adults only	37.956	62.044	100.000
Minors only	55.769	44.231	100.000
Totals	43.605	56.395	100.000

Demographics – Gender

There were no significant differences in the gender of the users from Pre to Post.

**Summary Table for Obs Type, Gender**

Num. Missing	1
DF	2
Chi Square	.406
Chi Square P-Value	.8163
G-Squared	•
G-Squared P-Value	•
Contingency Coef.	.034
Cramer's V	.034

**Observed Frequencies for Obs Type, Gender**

	f		m	Totals
Posttest	1	119	134	254
Pretest	0	44	47	91
Totals	1	163	181	345

**Percents of Row Totals for Obs Type, Gender**

	f		m	Totals
Posttest	.394	46.850	52.756	100.000
Pretest	0.000	48.352	51.648	100.000
Totals	.290	47.246	52.464	100.000

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