



THOMSON
images & beyond

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Special Session, Image and Video Quality Evaluation

Task impact on the visual attention in subjective image quality assessment

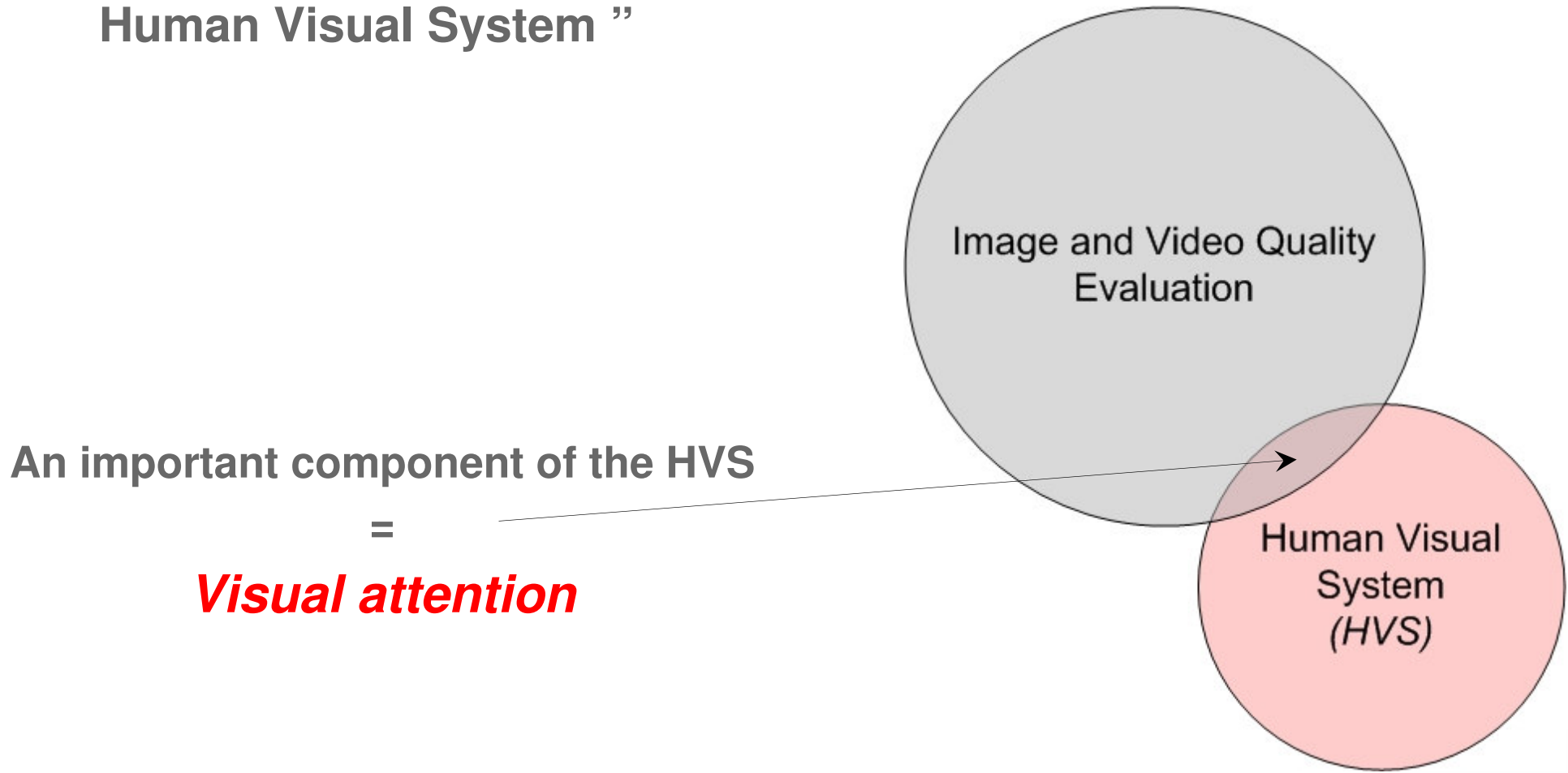
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Introduction

“ The most efficient quality metrics are based on the Human Visual System ”



An important component of the HVS

=

Visual attention

Synopsis

- 1. Visual attention**
- 2. Some questions ...**
- 3. Experiments**
- 4. Results : Some answers ...**
- 5. Conclusion**

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Visual attention : *Definition*

“ Visual attention allows us to select the relevant information in our environment, in connection or not with a particular task ”

Two mechanisms are involved in visual attention control

Bottom-up

(voluntary attention)

Salient elements of our visual field catch our attention



Mechanism based on signal

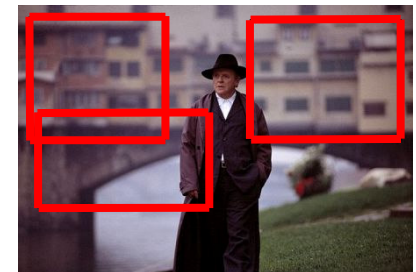
Top-down

(involuntary attention)

Our attention is guided by the task to accomplish



Mechanism based on task



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Does the quality assessment task affect the visual strategy?

Importance of the mechanisms :

- *Bottom-up?*
- *Top-down?*

It is fundamental if we want to elaborate a quality metric based on visual attention model : Which visual strategy must be imitated?

Does a learning process exist during a quality assessment campaign ?

If the same picture is shown several times (DSIS protocol as an example) :

- Do we learn how to evaluate the picture?*
- Do we learn where to look ?*

Do the artifacts modify the visual strategy ?

It is fundamental if we want to elaborate a quality metric based on visual attention model : Which visual strategy must be imitated?

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Eye gaze tracking experiments



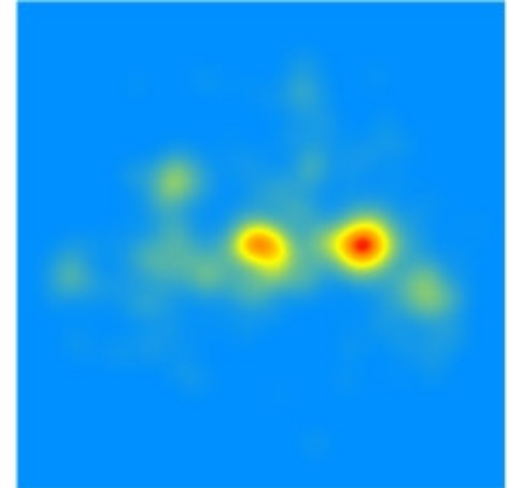
An ***eye-tracker*** is a device elaborated to measure and to record the position where a human observer is looking at

Experiments :

- 20 observers
- 120 still pictures
- Visualization distance 4H



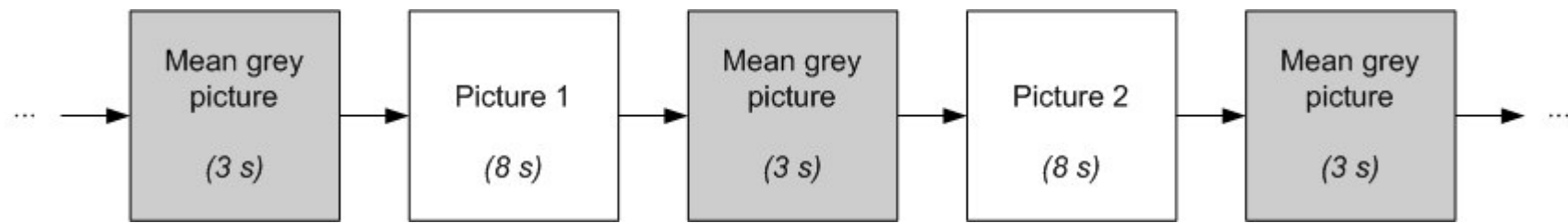
Original picture



Fixation density map

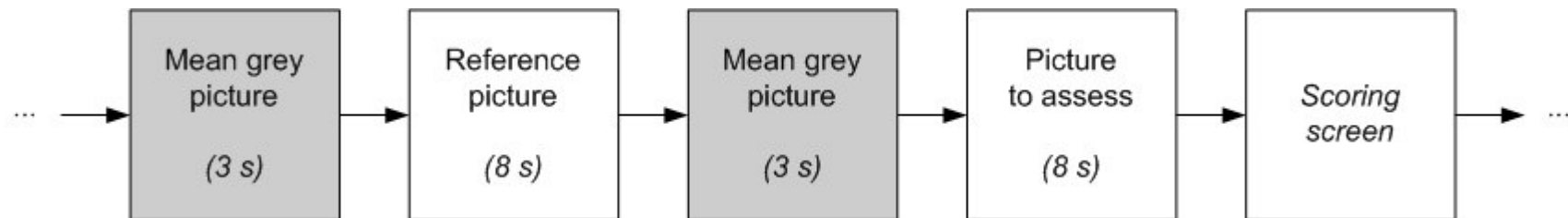
Free viewing task

20 pictures (10 unimpaired references, 10 impaired versions)



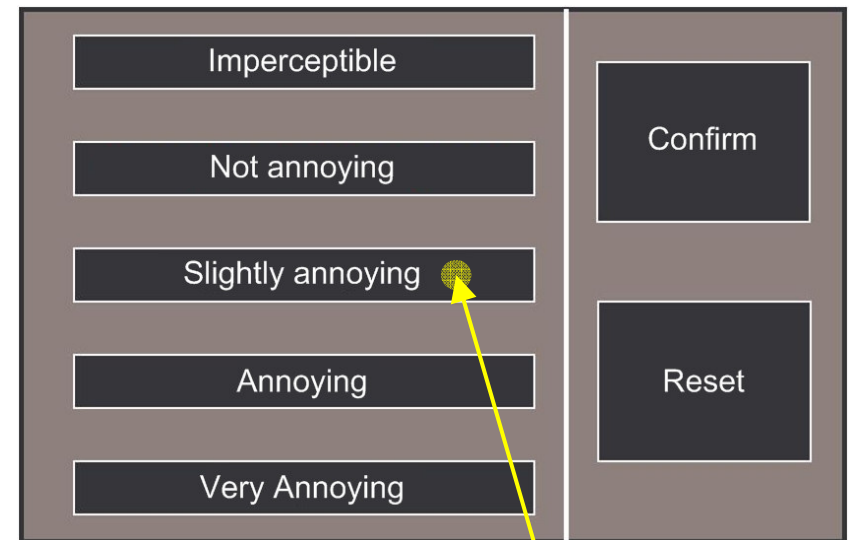
Picture quality assessment task

- 130 pictures (10 unimpaired references, 120 impaired versions)
- DSIS protocol (*Double Stimulus Impairment Scale*)
- *Constraint : 2 sequences from the same reference picture must not follow themselves*



Degradation category rating (5 scores) :

- *Imperceptible*
- *Not annoying*
- *Slightly annoying*
- *Annoying*
- *Very annoying*



How to rate ?

- *Scoring screen*
- *selection and confirmation based on eye gaze position*

Score is **Not annoying**



Synopsis

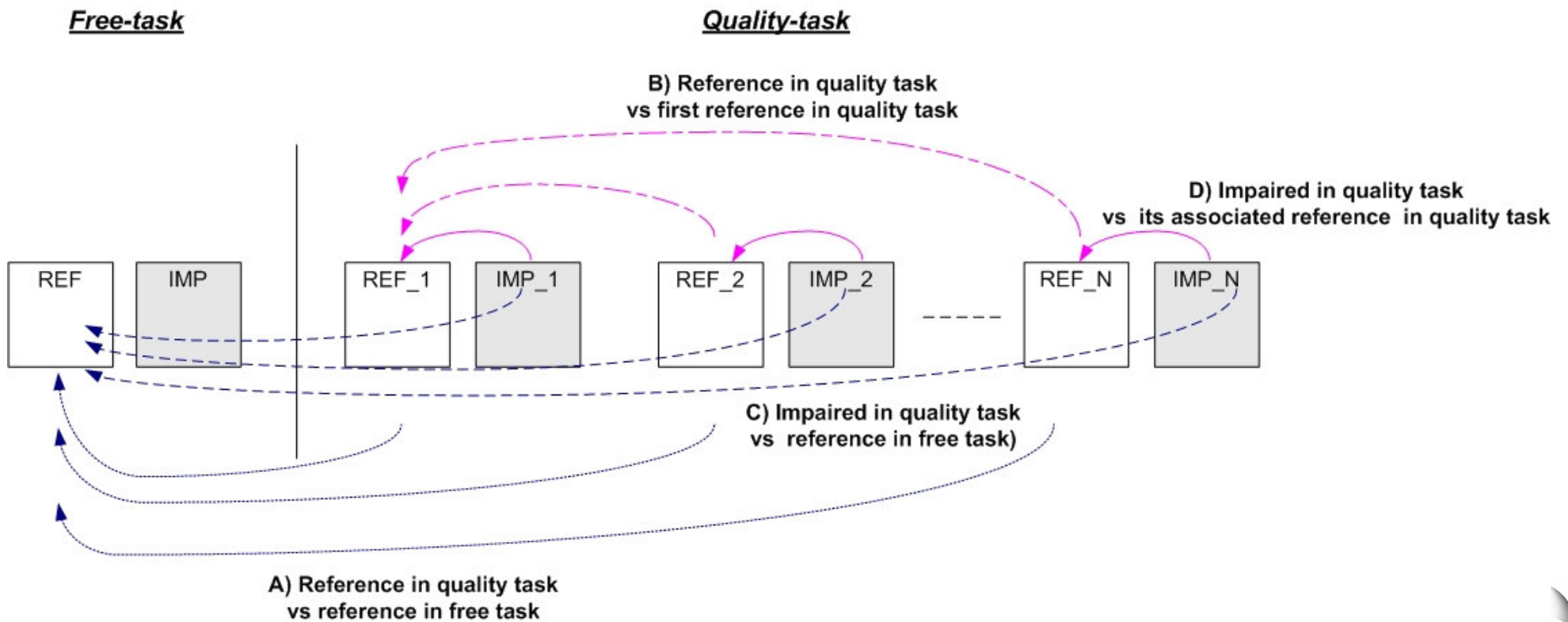
1. Visual attention
2. Some questions ...
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Synopsis

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Results : *Analysis*

- Fixation duration
- Saliency map (average fixation density map)
 - Kullback-Leibler divergence KL
 - Correlation coefficient CC



Results : *Some answers ...*

Does the quality assessment task affect the visual strategy?

- Fixation duration :

Reference in quality task > Reference in free task

Observers try to accurately memorize some parts of the picture

- Saliency map :

<i>Comparison A) and C)</i>	<i>KL range</i>	<i>CC range</i>
<i>Reference in quality task vs reference in free task</i>	[0.3,0.5]	[0.77,0.92]
<i>Impaired in quality task vs reference in free task</i>	[0.42,0.95]	[0.66,0.9]

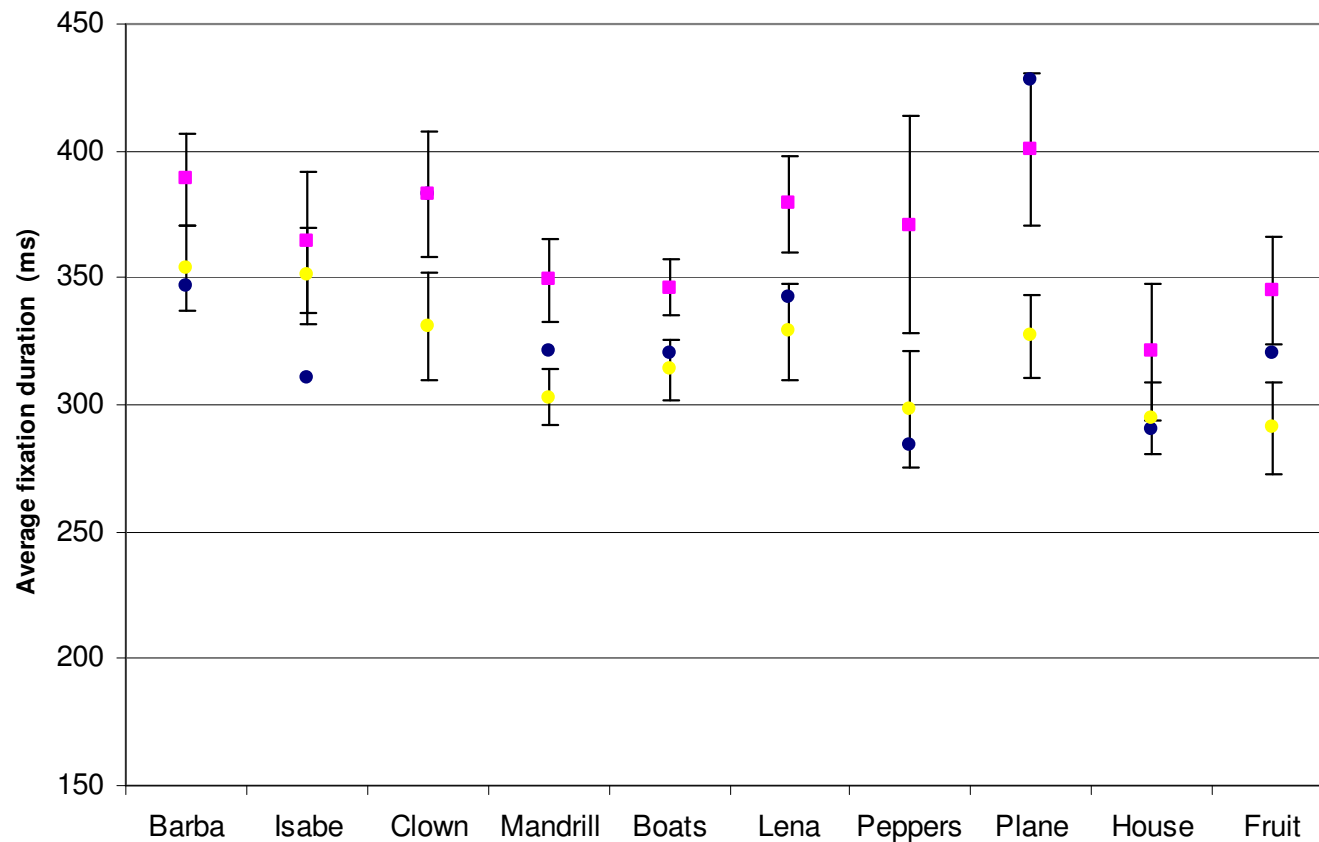
Notable dissimilarity

→ *The quality assessment task affects the visual strategy*

Results : *Some answers ...*

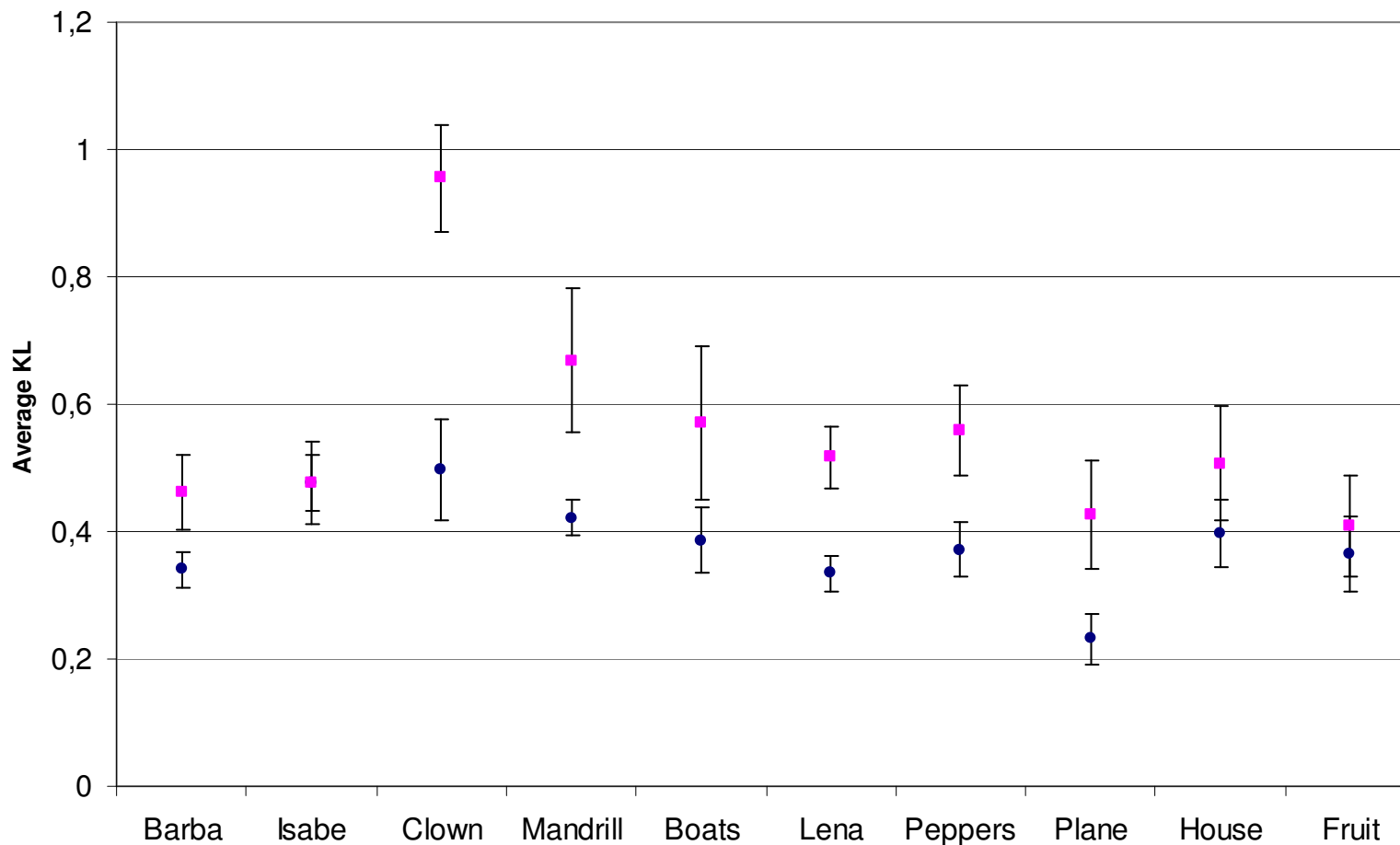
Average fixation duration by picture for :

- ● The reference pictures in free task
- ■ The reference pictures in quality task
- ◆ The impaired pictures in quality task



Results : *Some answers ...*

- **A)** *Reference in quality task vs reference in free task*
- **C)** *Impaired in quality task vs reference in free task*



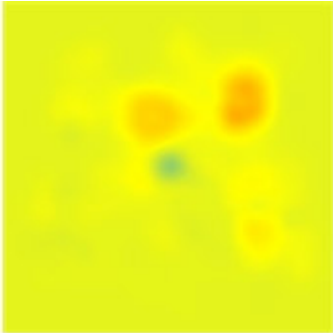
Results : *Some answers ...*

Illustration of the comparison A) :

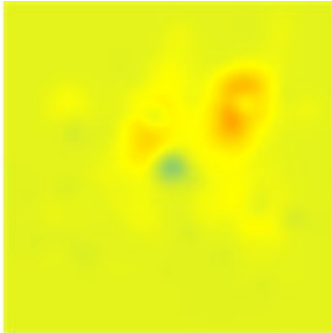
*Reference in quality task (1,2 and 5th) vs reference in free task
(Difference between saliency maps)*



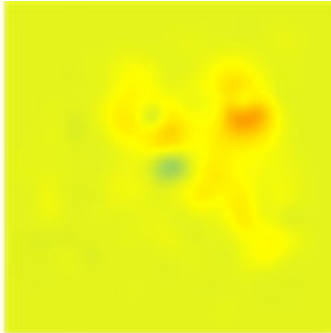
Clown



/ Reference 1



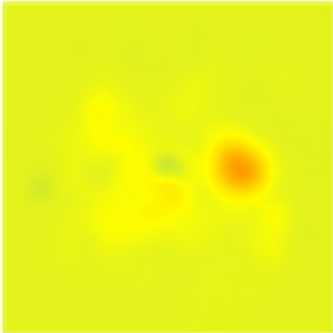
/ Reference 3



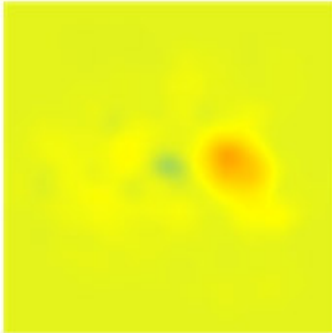
/ Reference 5



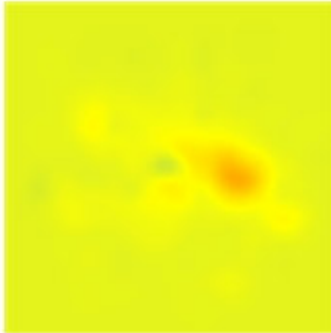
Boats



/ Reference 1



/ Reference 3



/ Reference 5

Results : *Some answers ...*

Does a learning process exist during a quality assessment campaign ?

Saliency map :

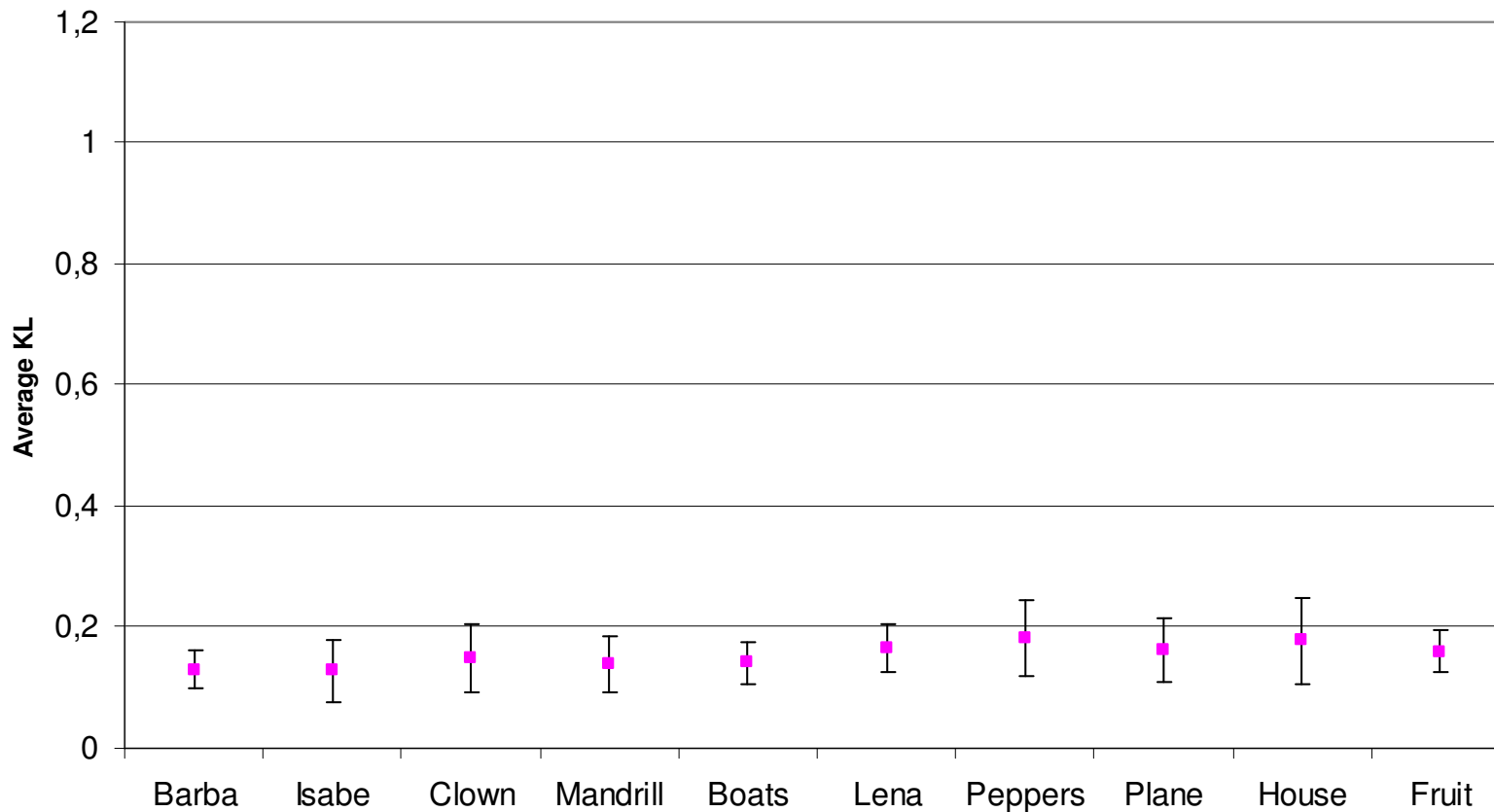
<i>Comparison B)</i>	<i>KL range</i>	<i>CC range</i>
<i>Reference in quality task vs first reference in quality task</i>	[0.12,0.18]	[0.9,0.97]

No notable dissimilarity

→ *No significant learning process*

Results : *Some answers ...*

■ **B) Reference in quality task vs first reference in quality task**



Results : *Some answers ...*

Do the artifacts modify the visual strategy ?

- Saliency map comparison :

Comparison D)	KL range	CC range
<i>Impaired in quality task vs its associated reference in quality task</i>	[0.11,0.4]	[0.8,0.96]

Notable dissimilarity

- Saliency map cross analysis (*confidence intervals ci*) :

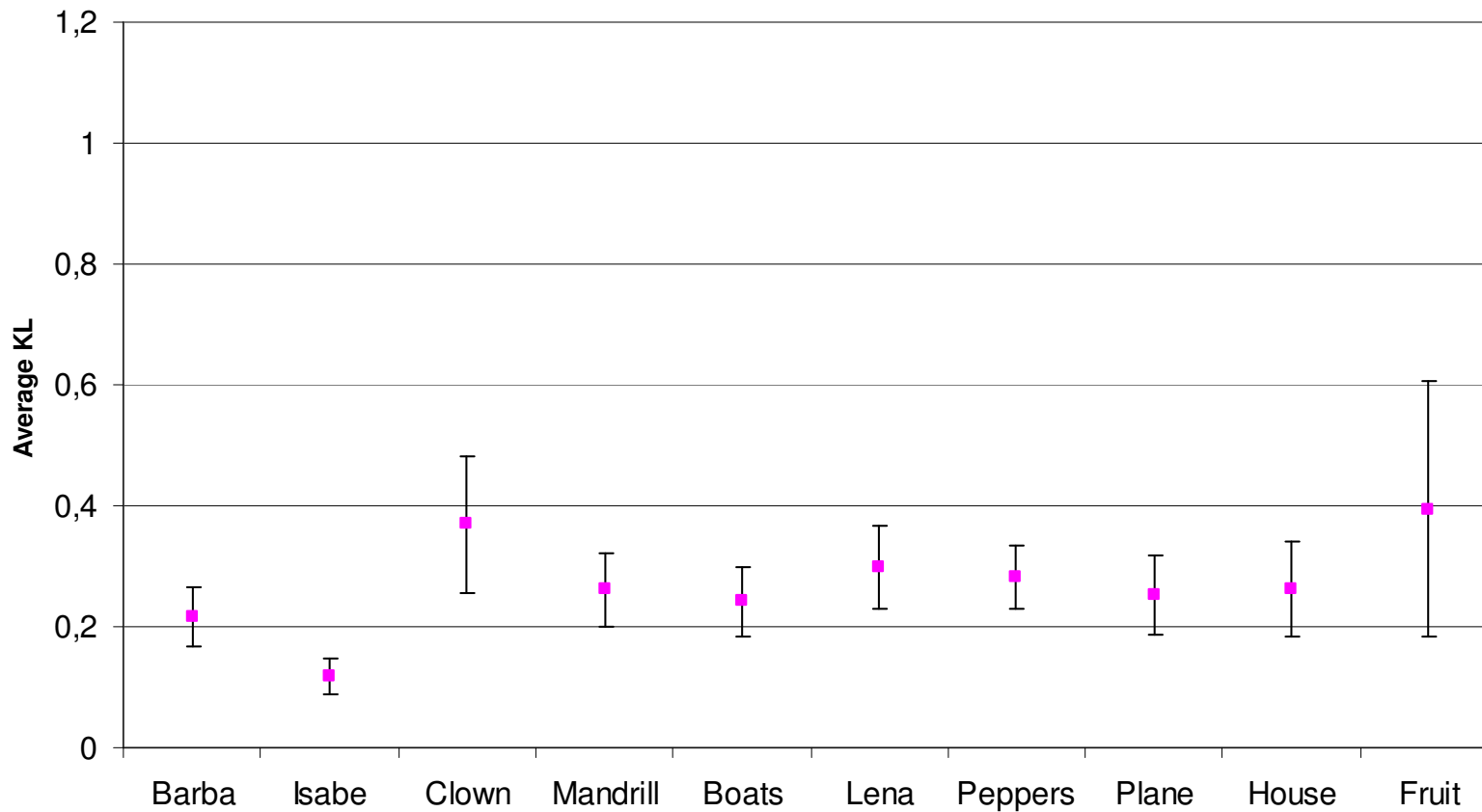
Comparison A) and C)	KLci range	CCci range
<i>Reference in quality task vs reference in free task</i>	[0.02,0.09]	[0.007,0.04]
<i>Impaired in quality task vs reference in free task</i>	[0.04,0.13]	[0.008,0.1]

Confidence interval increase between A) et C)

→ *The artifacts do modify the visual strategy*

Results : *Some answers ...*

- **D)** *Impaired in quality task vs its associated reference in quality task*



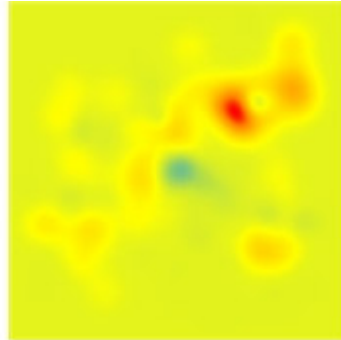
Results : *Some answers ...*

Illustration of the comparison D) :

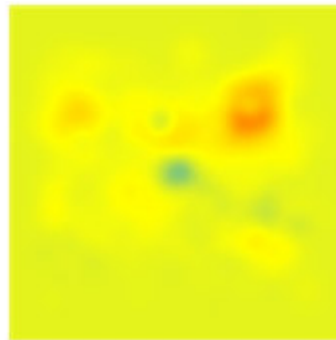
*Impaired in quality task vs its associated reference in quality task
(Difference between saliency maps)*



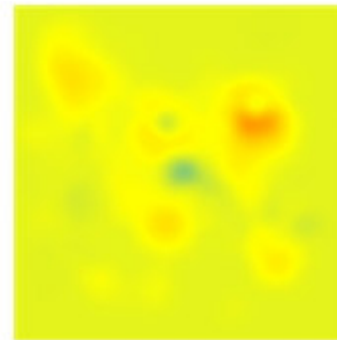
Clown



/ JPEG2000



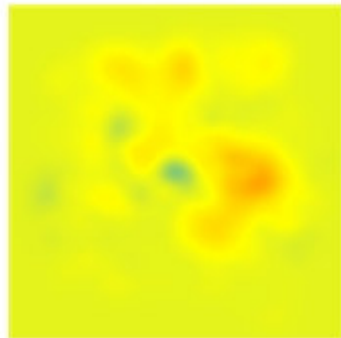
/ JPEG (rate 1)



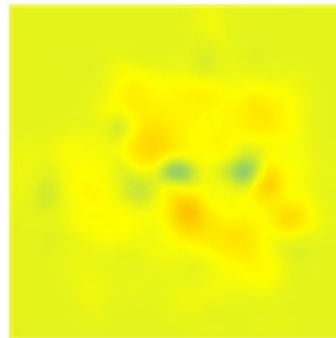
/ JPEG (rate 2)



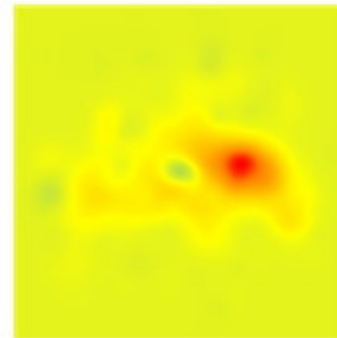
Boats



/ JPEG2000



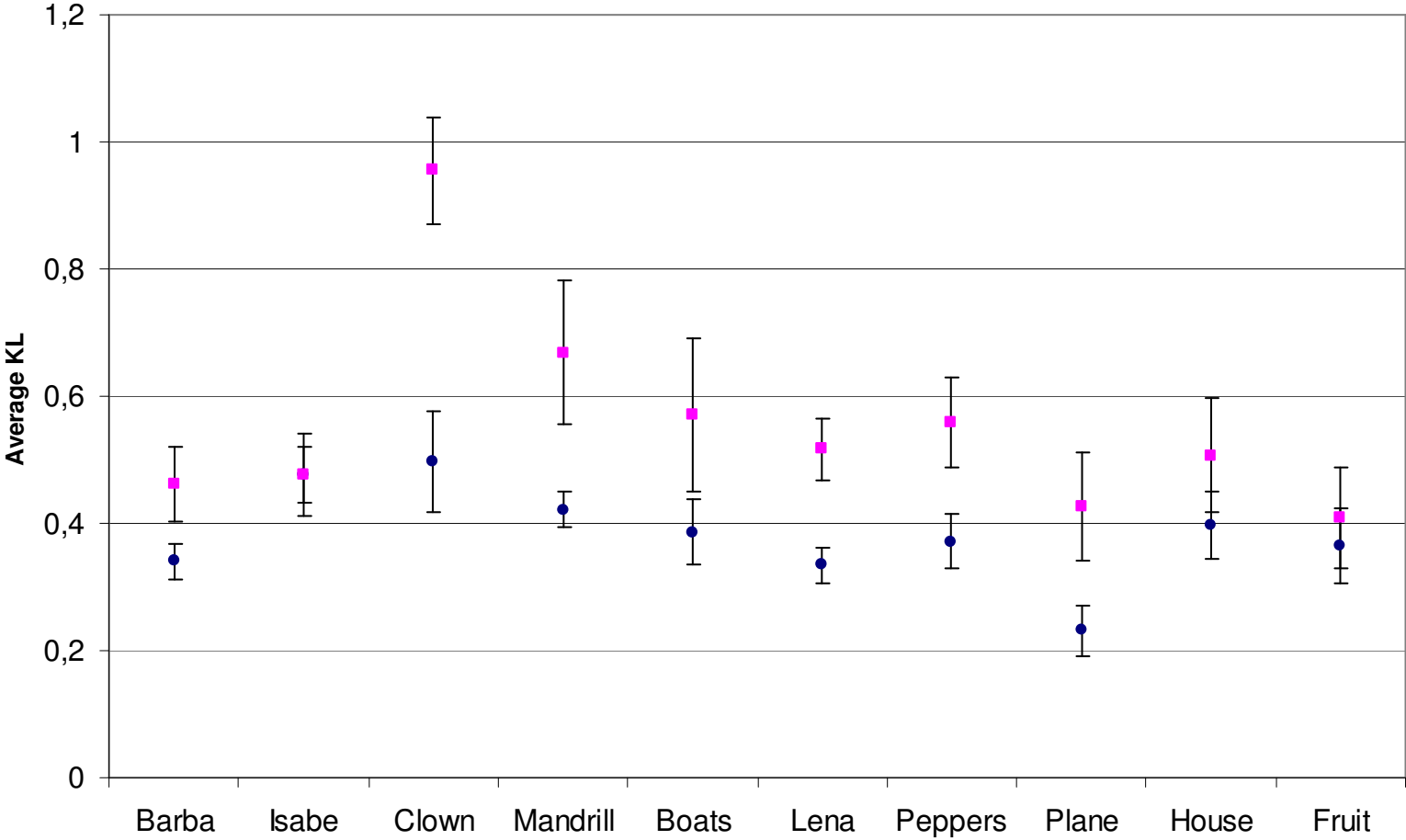
/ JPEG



/ Blur

Results : *Some answers ...*

- **A)** *Reference in quality task vs reference in free task*
- **C)** *Impaired in quality task vs reference in free task*



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Conclusion

→ *The quality assessment task affects the visual strategy*

- Fixation duration
- Saliency map

→ *No significant learning process*

Observers are not more competitive at the end of the test than at the beginning. No visual adaptation or task learning.

To elaborate a quality metric based on visual attention model, we must be conscious that :

- We can use a bottom-up model (*free view condition*)
- But, In a quality assessment campaign the visual strategy is different

Future work :

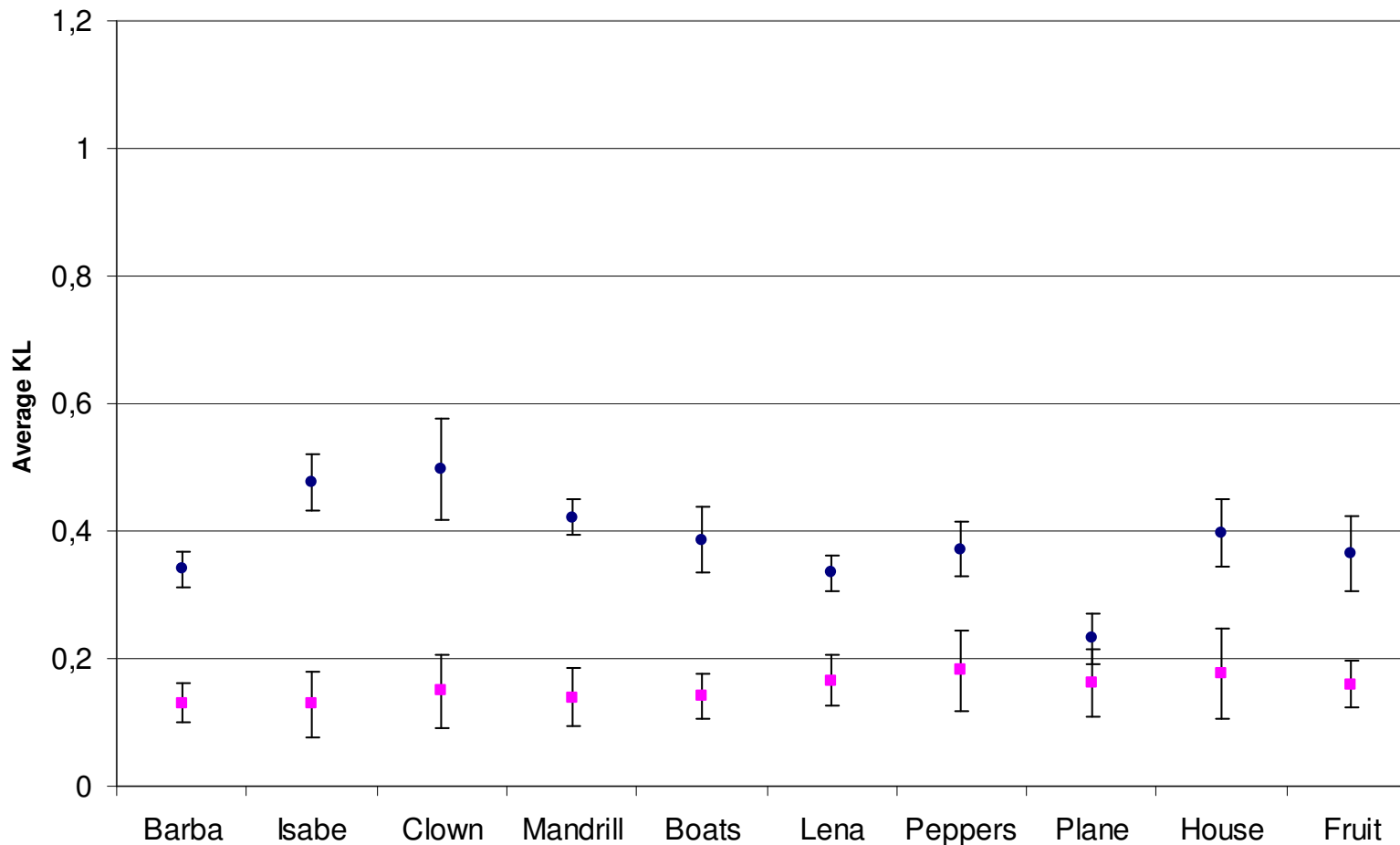
Study the dependence between visual attention and type of degradation

→ *The artifacts do modify the visual strategy*

Appendix

Appendix : Results

- **A)** Reference in quality task *vs* reference in free task
- **B)** Reference in quality task *vs* first reference in quality task



Appendix : Results

- C) Impaired in quality task **vs** reference in free task
- D) Impaired in quality task **vs** its associated reference in quality task

