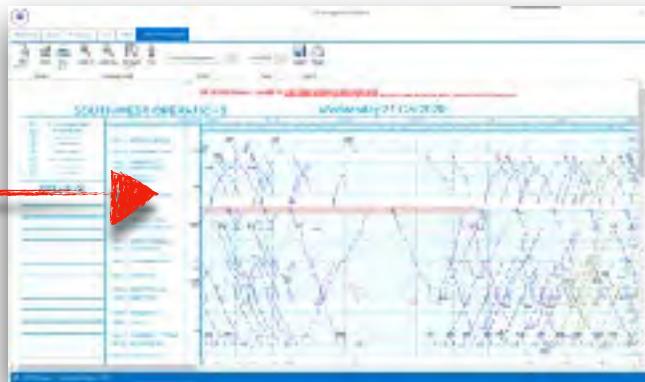


## Chap. 2 : Pourquoi les utilisateurs commettent-ils des erreurs ?

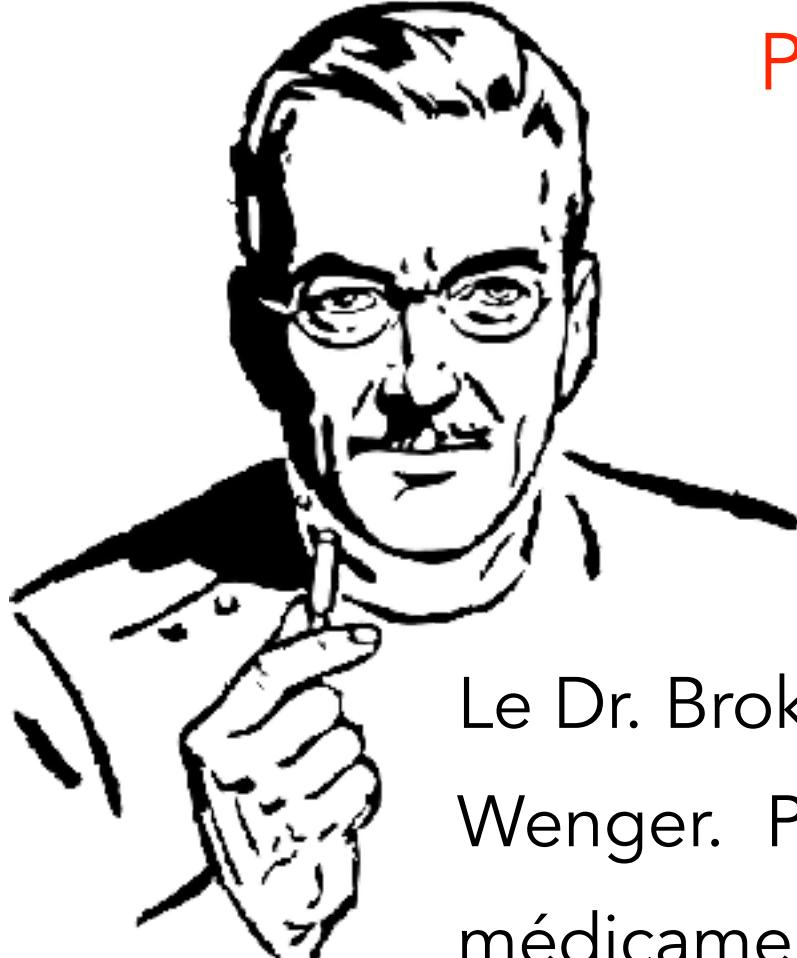
### 2.1. Charge cognitive, modèles mentaux et raisonnement spatial

# CS-213 Projet



- App ou site web
- > **20 fonctionnalités = 20 user significant actions**
- > 3 écrans
- Pas de back end, No full stack => WOZ

« Il n'a même pas lu le mode d'emploi !!!! »



## Pourquoi fait-on des erreurs ?

Le Dr. Brok a prescrit de la Mycine à Mme Wenger. Peu de temps après la prise du médicament, Mme Wenger a perdu tous ses cheveux.

# Pourquoi fait-on des erreurs ?

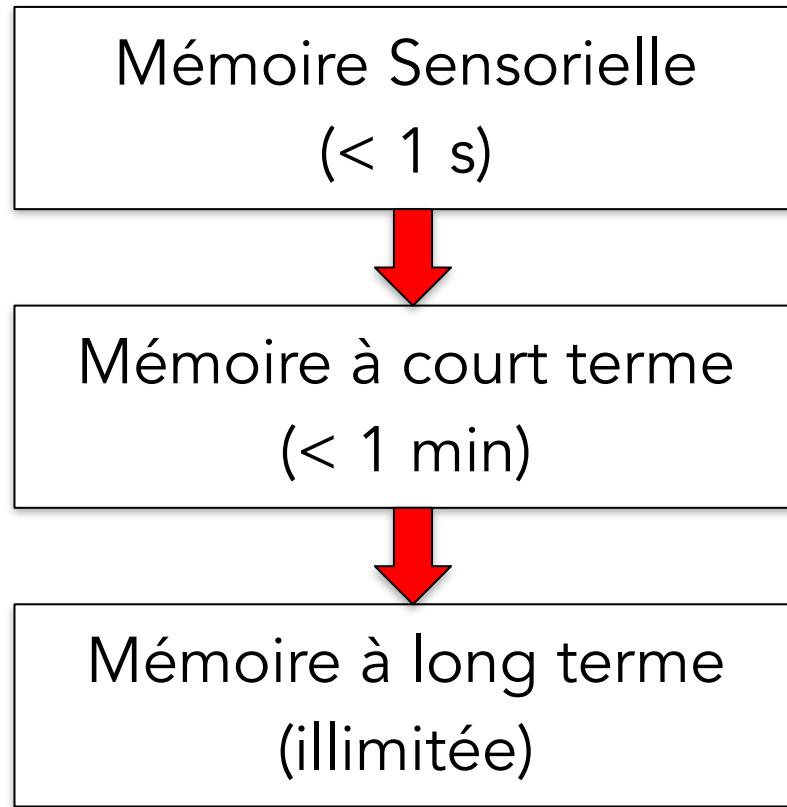
- Le Dr Brok n'a jamais **compris** la relation entre la Mycine et la pousse des cheveux Formation
- Le Dr Brok a **oublié** que le Mycine pouvait provoquer la chute des cheveux Mémoire long terme
- Le Dr Brok était **absorbé** par ses conflits au travail Attention
- Le Dr. Brok savait que la Mycin comprenait du XX, que le XX augmente la sécrétion de YY, que le YY détruit le ZZ et que le ZZ est nécessaire pour la pousse des cheveux et que Mme Wenger a justement un déficit en ZZ mais il n'a **pas lié toutes ces relations.** ?
- Mme Wenger est **l'ex-épouse** du Dr. Brok. Malveillance

«S'il est une chose qui fait l'unanimité au sein des associations d'artistes, à quelques heures de l'ouverture du festival cinématographique et des arts de la rue, organisé cette année par la ville de Marseille aménagée en labyrinthe géant pour ce week-end estival, et qui sera gratuit cette année en raison de l'évolution rapide de la pandémie dont tout le monde parle dans tous les médias, c'est l'importance de la poursuite du développement des initiatives auprès des jeunes des quartiers défavorisés.»

«S'il est une chose qui fait **l'unanimité** au sein des associations d'artistes, à quelques heures de l'ouverture du festival cinématographique et des arts de la rue, organisé cette année par la ville de Marseille aménagée en labyrinthe géant pour ce week-end estival, et qui sera gratuit cette année en raison de l'évolution rapide de la pandémie dont tout le monde parle dans tous les médias, c'est **l'importance de la poursuite du développement des initiatives auprès des jeunes** des quartiers défavorisés.»

«S'il est une chose qui fait l'unanimité au sein des associations d'artistes, à quelques heures de l'ouverture du festival cinématographique et des arts de la rue, organisé cette année par la ville de Marseille aménagée en labyrinthe géant pour ce week-end estival, et qui sera gratuit cette année en raison de l'évolution rapide de la pandémie dont tout le monde parle dans tous les médias, c'est l'importance de la poursuite du développement des initiatives auprès des jeunes des quartiers défavorisés.»

# La ou les mémoire(s)



# Test 1

Citez autant de villes que possible en 20 secondes

# Test 2

Veuillez mémoriser la liste des villes suivantes pendant 30 secondes

1. Manchester
2. Brussels
3. Paris
4. Bordeau
5. Osaka
6. Helsinki
7. Olten
8. Athens
9. Lisbon
10. Los Angeles
11. Zurich
12. Amsterdam
13. Lisbon
14. Washington
15. Berlin
16. Tunis
17. Lausanne
18. Montreal
19. Tokyo
20. Oslo

# Test 2

## Vérification

1. Manchester
2. Brussels
3. Paris
4. Bordeau
5. Osaka
6. Helsinki
7. Olten
8. Athens
9. Lisbon
10. Los Angeles
11. Zurich
12. Amsterdam
13. Lisbon
14. Washington
15. Berlin
16. Tunis
17. Lausanne
18. Montreal
19. Tokyo
20. Oslo

Mémoire Sensorielle  
(< 1 s)

Je lis la liste que je vois

Mémoire de travail  
(< 1 min)

Je mémorise la liste que j'ai lue

Mémoire à long terme  
(quasi illimitée)

Je connais de nombreuses villes

Point de vue Fonctionnel  
*(Ce ne sont pas des boîtes)*  
Psychologie cognitive

Mémoire Sensorielle

(< 1 s)



Mémoire de travail

(< 1 min)

**Charge Cognitive**



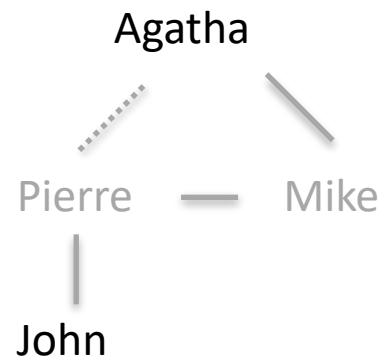
Mémoire à long terme

(illimitée)

1. John is the son of Pierre
2. Pierre is the brother of Mike
3. Mike is the son of Agatha

**Who is the grand-son of Agatha ?**

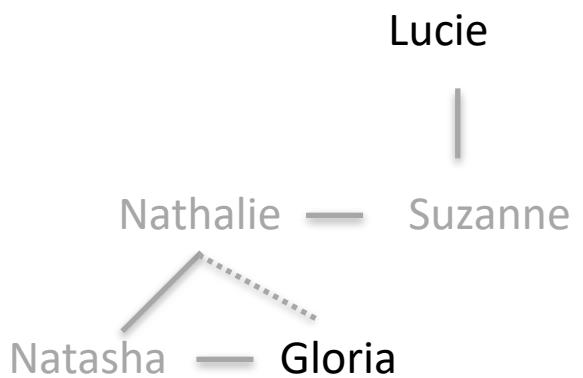
- John
- Pierre
- Mike



1. Nathalie is the sister of Suzanne
2. Suzanne is the daughter of Lucie
3. Natasha is the daughter of Nathalie
4. Gloria is the sister of Natasha

**Who is the grand-mother of Gloria?**

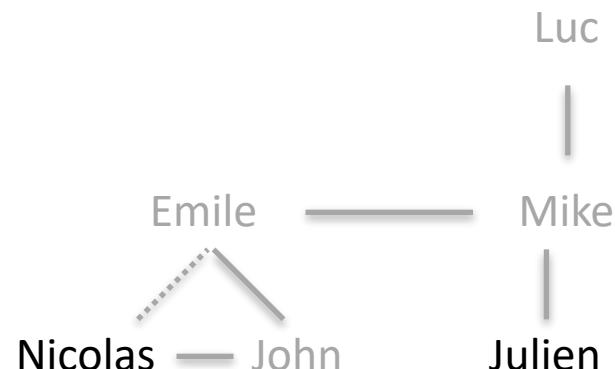
- Nathalie
- Suzanne
- Natasha
- Lucie



1. Luc is the father of Mike
2. Mike is brother of Emile
3. John is the son of Emile
4. Nicolas is the brother of John
5. Julien is the son of Mike

**Who is the cousin of Nicolas?**

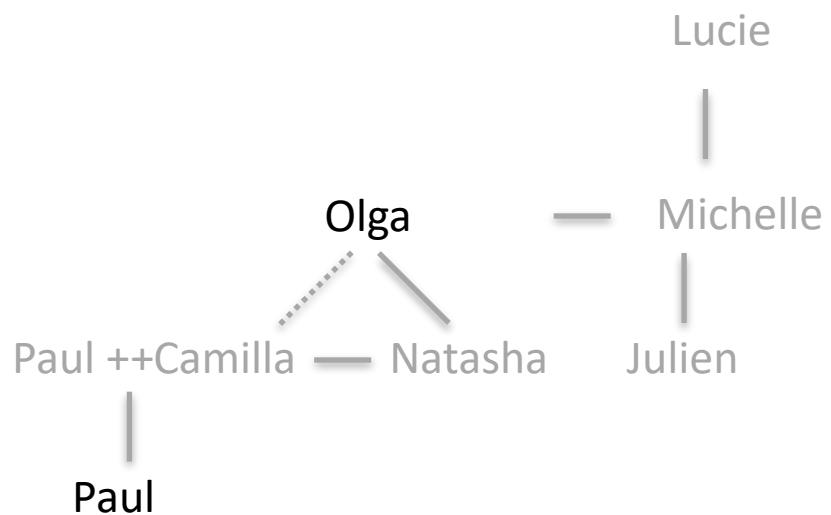
- Luc
- Mike
- John
- Luc
- Nicolas



1. Olga is the sister of Michelle
2. Michelle is the daughter of Lucie
3. Natasha is the daughter of Olga
4. Camilla is the sister of Natasha
5. Paul is the husband of Camilla
6. Donald is the son of Paul

**Who is the grand-mother of Donald ?**

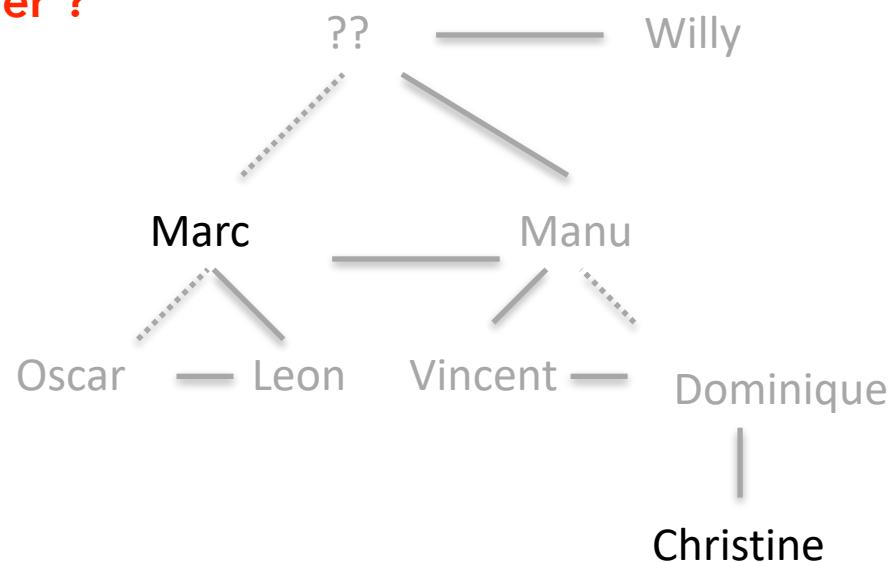
- Michelle
- Olga
- Natasha
- Camilla
- Lucie



1. Marc and Manu are brothers
2. Leon and Oscar are brothers
3. Leon is the son of Marc
4. Vincent is the son of Manu
5. Willy is the uncle of Marc
6. Dominique is the brother of Vincent
7. Christine is the daughter of Dominique

**Who is the brother of Christine's grand-father ?**

- Willy
- Dominique
- Marc
- Manu
- Leon
- Oscar
- Vincent



# Cognitive overload

Michel est le père de  
Martine

Martine est la sœur de  
Serge

Serge est le père de  
Tristan

Tristan est le frère de Tristan

Serge est la mère de  
Nadine

Nadine est la fille de  
Tristand

Marc est le frère de Michel

Michel est le père de  
Martine

Martine est la sœur de  
Serge

Serge est le père de  
Tristan

Luc est le frère de Tristan

Lucie est la mère de  
Serge

Nadine est la fille de  
Tristand

Lena est la sœur de Lucie

Marc est le frère de Michel

Martine est la sœur de

$$5 ? + 2$$

Lucie est la mère de  
Serge

Nadine est la fille de  
Tristand

Sophie est la sœur de

Serge

Lena est la sœur de

Marc est le frère de

Michel est le père de  
Martine

Martine est la sœur de  
Serge

Serge est le père de  
Tristan

Luc est le frère de Tristan

Lucie est la mère de  
Serge

Nadine est la fille de  
Tristand

# Michel is the father of Martine

Martine is the

Serge is the fa

Luc is the brot

Lucie is the mo

Nadine is the da

Michel

Martine

Lucie

Serge

Tristan — Luc

Nadine



- Verbal / Phonological Loop
- Visual-Spatial Sketchpad

→ Who is the ant of Luc ?

# A lesson

# NUUK

What is the capital of Greenland?

# The Lecture Model

*Information*

Perception

The capital of Greenland is Nuuk

Processing

Storage

*Knowledge*

# The Lecture Model

*Information*

Perception

Sensory  
Memory

The capital of Greenland is Nuuk

Processing

Storage  
*Knowledge*



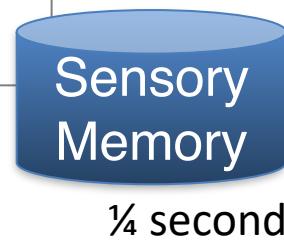
As you can guess, the Danish name of this city is Godthåb

What is the capital of Greenland ?

# The Lecture Model

## *Information*

### Perception



$\frac{1}{4}$  second

### Processing



20-30 seconds

The capital of Greenland is Nuuk

### Storage

## *Knowledge*

My phone number is 076 825 34 57

My phone number is 076 825 34 57

Manu's phone number is 079 353 11 64

1390



Manu's phone number is 079 353 11 64

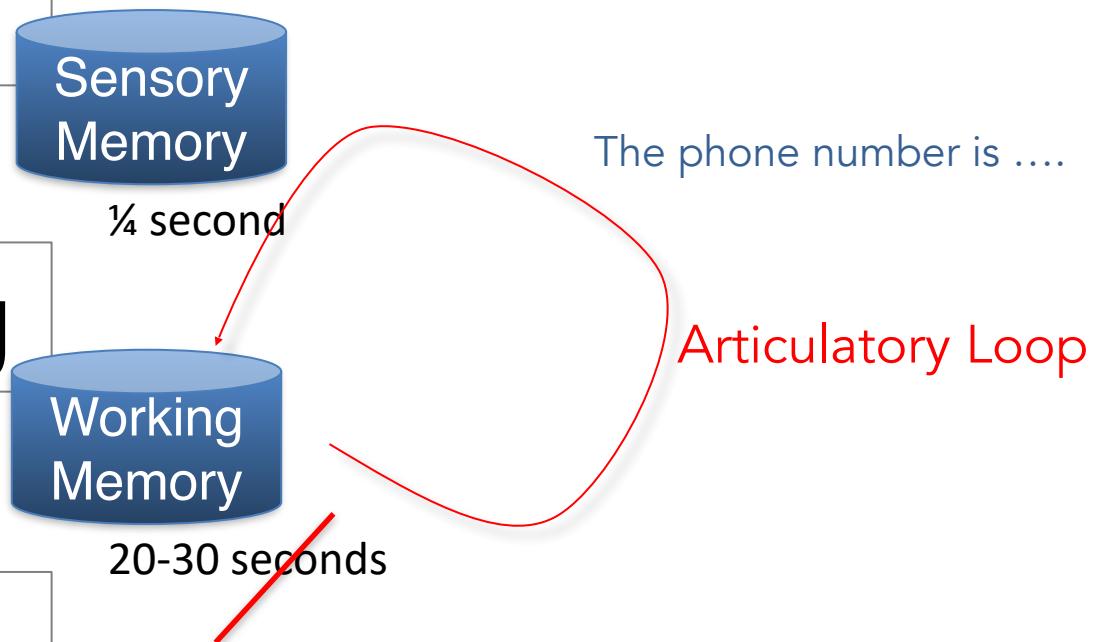
# The Lecture Model

## Information

### Perception

### Processing

### Storage Knowledge



My car plates are VD 657 31 07

## *READ ALOUD*

Nuuk has a long history of habitation. The area around Nuuk was first occupied by the ancient pre-Inuit, Paleo-Eskimo people of the Saqqaq culture as far back as 2200 BC when they lived in the area around the now abandoned settlement of Qoornoq.

My car plates are VD 657 31 07

# The Lecture Model

## Information

### Perception

### Processing

### Storage Knowledge



$\frac{1}{4}$  second



20-30 seconds

The phone number is ....

Articulatory Suppression Loop

My password is 123680



## *READ ALOUD*

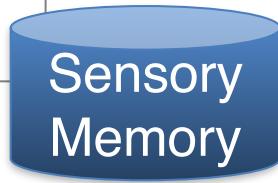
For a long time, Nuuk was occupied by the Dorset culture around the former settlement of Kangeq but they disappeared from the Nuuk district before AD 1000. The Nuuk area was later inhabited by Viking explorers in the 10th century (Western Settlement), and shortly thereafter by Inuit peoples.

# What is my password ?



# *Information*

Perception



Processing



- Verbal / Phonological Loop
- Visual-Spatial Sketchpad

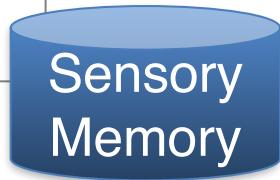
Storage

*Knowledge*

What is the capital of Greenland ?

# *Information*

Perception



Processing



Storage  
*Knowledge*



The capital of Greenland is Nuuk

# *Information*

Perception

Processing

Working  
Memory

Storage  
*Knowledge*

Long Term  
Memory

# Who did what?

Dave wrote a play

Jean made a discovery

Lara ate an apple

Rebecca pressed the light switch

John set for sail

Carol made a movie

Emmanuel sang a song

Timothy played football

Zoe performed a dance

# Recall

Who wrote a play?

Who made a discovery?

Who ate an apple?

Who pressed the light switch?

Who set for sail?

Who made a movie?

Who sang a song?

Who played football?

Who performed a dance?

# Who did what?

Shakespeare wrote a play

Einstein made a discovery

Adam ate an apple

Edison pressed the light switch

Columbus set for sail

Jackie Chan made a movie

Elton John sang a song

Ronaldo played football

Michael Jackson performed a dance

# Recall

Who wrote a play?

Who made a discovery?

Who ate an apple?

Who pressed the light switch?

Who set for sail?

Who made a movie?

Who sang a song?

Who played football?

Who performed a dance?

# Test 3

Memoire de travail

'privée' de mémoire à long terme.

1. Kortrijk
2. Grossetto
3. Appeldoorn
4. Sintra
5. Valladolid
6. Redwood
7. Obergransen
8. Hoegaarden
9. Ingletton
10. Eigenbrakel
11. Saanenmoser
12. Gluringen
13. Milton Keynes
14. Verviers
15. ...

*Information*

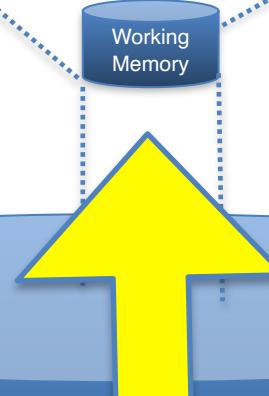
Experience

Perception

Processing

Storage  
*Knowledge*

Long Term Memory

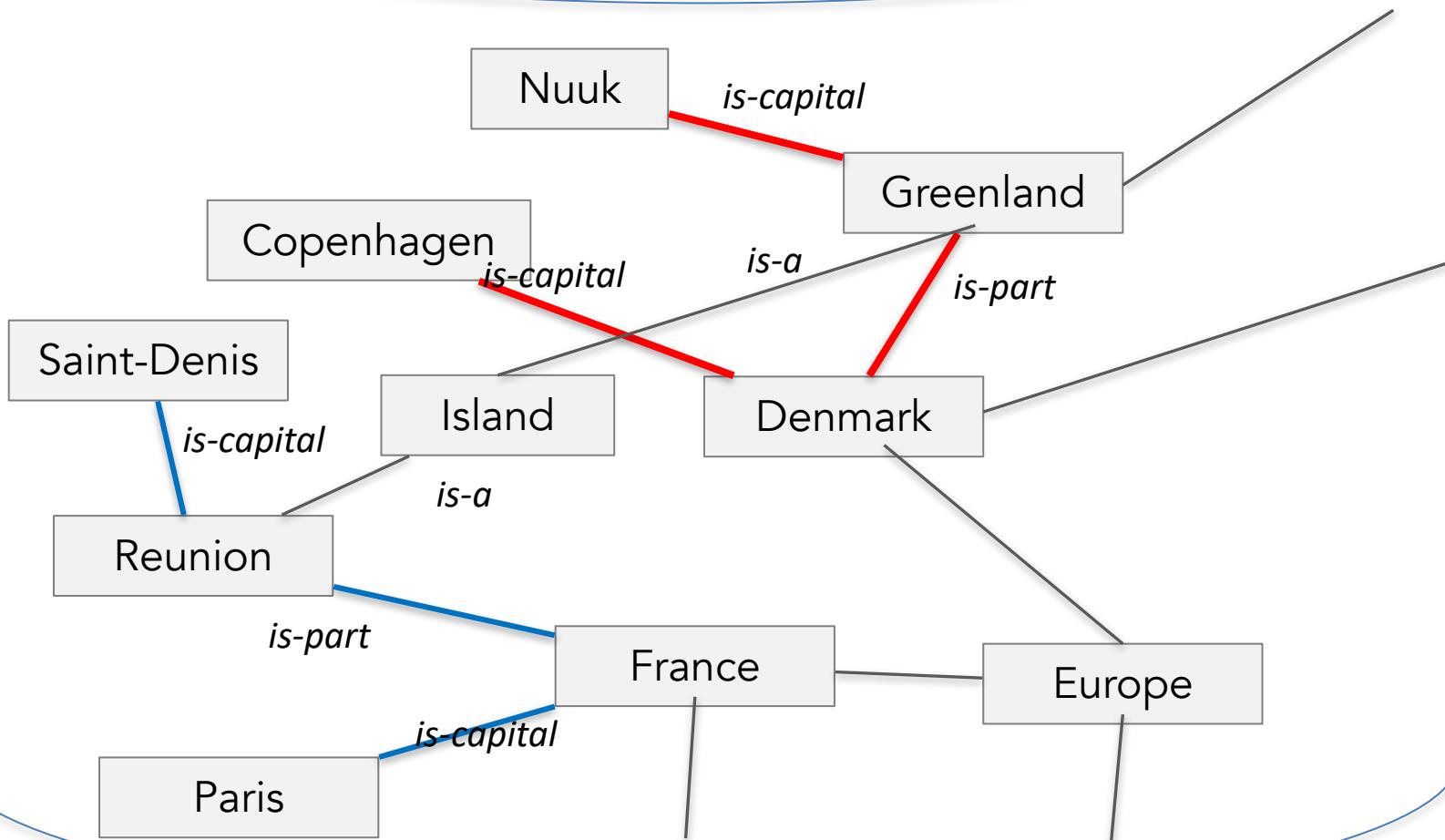


Nuuk is to Copenhagen,

what

Saint-Denis is to ..... ?

Nuuk is to Copenhagen  
What Saint-Denis is to ..... ?



*Information*

Experience

Perception

UNLIMITED, MULTIMODAL

Processing

MOSTLY VERBAL  
LIMITED in SIZE  
LIMITED In TIME (20-30 s)

Storage  
*Knowledge*

Working  
Memory

EXTREMELY LARGE, SEMANTIC

Long Term Memory

# Charge Cognitive

La capacité de notre  
mémoire de travail (CPU)  
est limitée à  $7 \pm 2$  éléments

Comment la mesure-t-on ?

# Charge cognitive

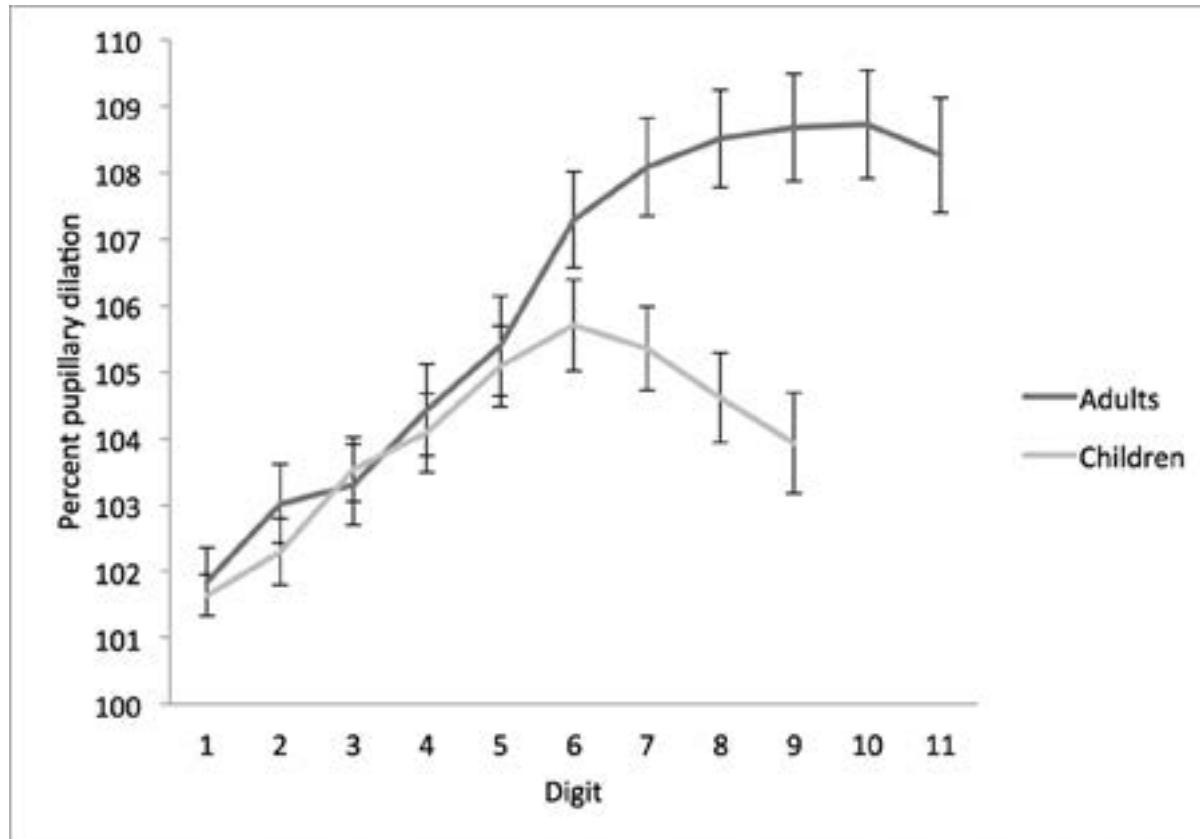
## 1. Mesures physiologiques



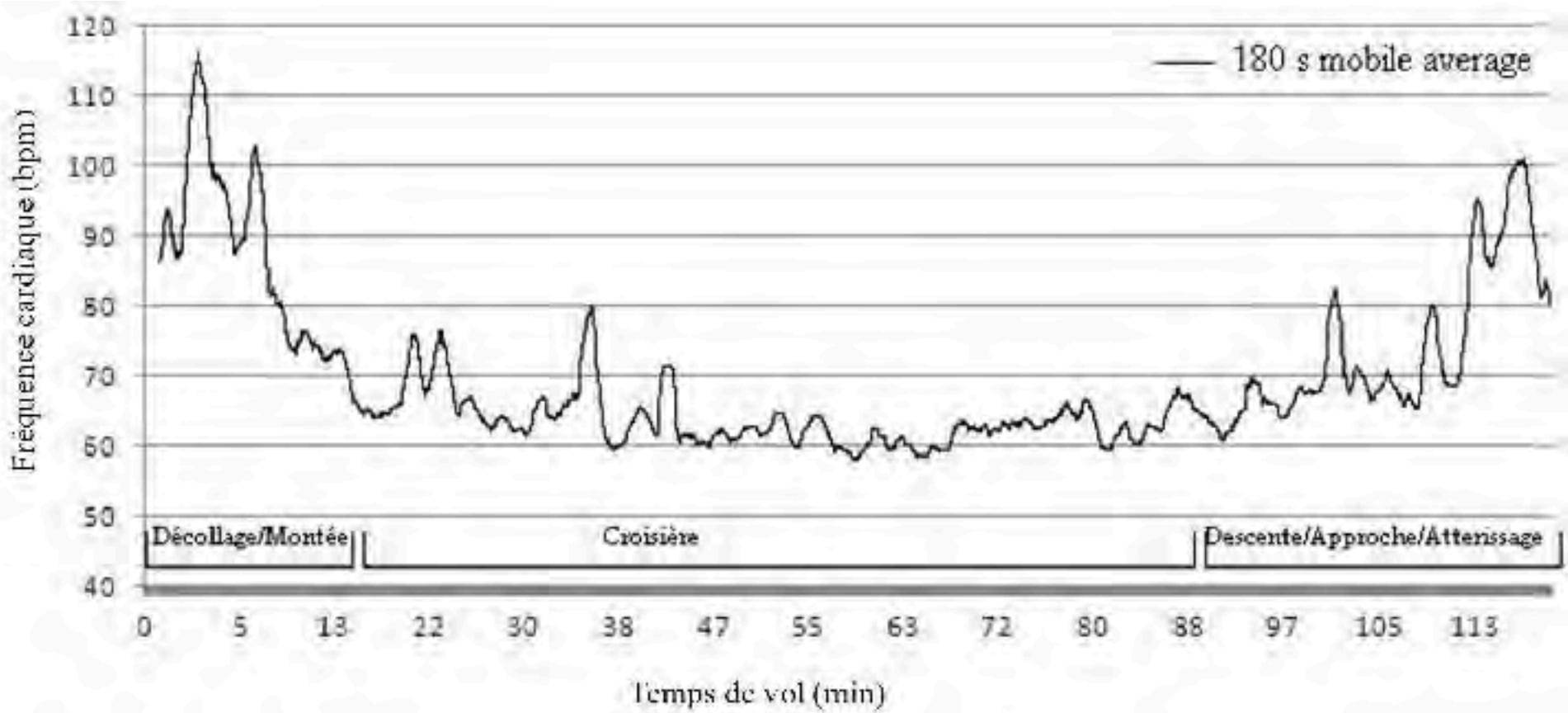
- EEG
- Fréquence cardiaque
- Mouvement oculaires
- Contractions musculaires
- ...

# Mesure de la charge cognitive par ‘eye tracking’

## Dilatation de la pupille

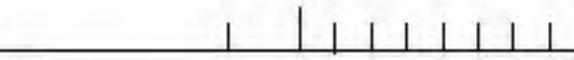
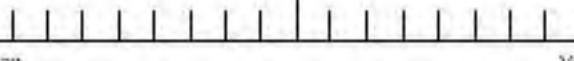
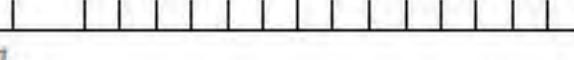
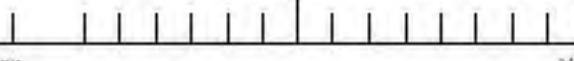


# Mesure de la charge cognitive par la fréquence cardiaque



NASA Task Load Index

Hart and Sieavelord's NASA Task Load Index (TLX) method assesses work load on five 7-point scales. Increases of high, medium and low estimates for each point result in 21 gradations on the scales.

Name	Task	Date
Mental Demand	How mentally demanding was the task?	
Physical Demand	How physically demanding was the task?	
Temporal Demand	How hurried or rushed was the pace of the task?	
Performance	How successful were you in accomplishing what you were asked to do?	
Effort	How hard did you have to work to accomplish your level of performance?	
Frustration	How insecure, discouraged, irritated, stressed, and annoyed were you?	

# Charge cognitive

## 2. Mesures subjectives

# Mesure de la charge cognitive par questionnaire

## (après la tâche)

# Charge cognitive

## 3. Mesures comportementales

- Taux d'erreurs
- Temps de réponses
- Tâche duale

# Méthode de la tâche duale

		Calcul			
		Correct	Incorrect		
Object	Fruit				
	Autre				

$$5 + 19 = 34$$

Pomme

# Méthode de la tâche duale

		Calcul			
		Correcte	Incorrecte		
			gauche	droite	
Object	Fruit				
	Autre				

$$35 + 58 = 83$$

Chien

# Méthode de la tâche duale

		Calcul			
		Correcte	Incorrecte		
Object	Fruit				
	Autre				

$$519 + 987 = 1506$$

Cerise

# Méthode de la tâche duale

		Calcul	
		Correcte	Incorrecte
Object	Fruit		
	Autre	 gauche droite	 gauche droite

$$314 - 167 = 137$$

Courge

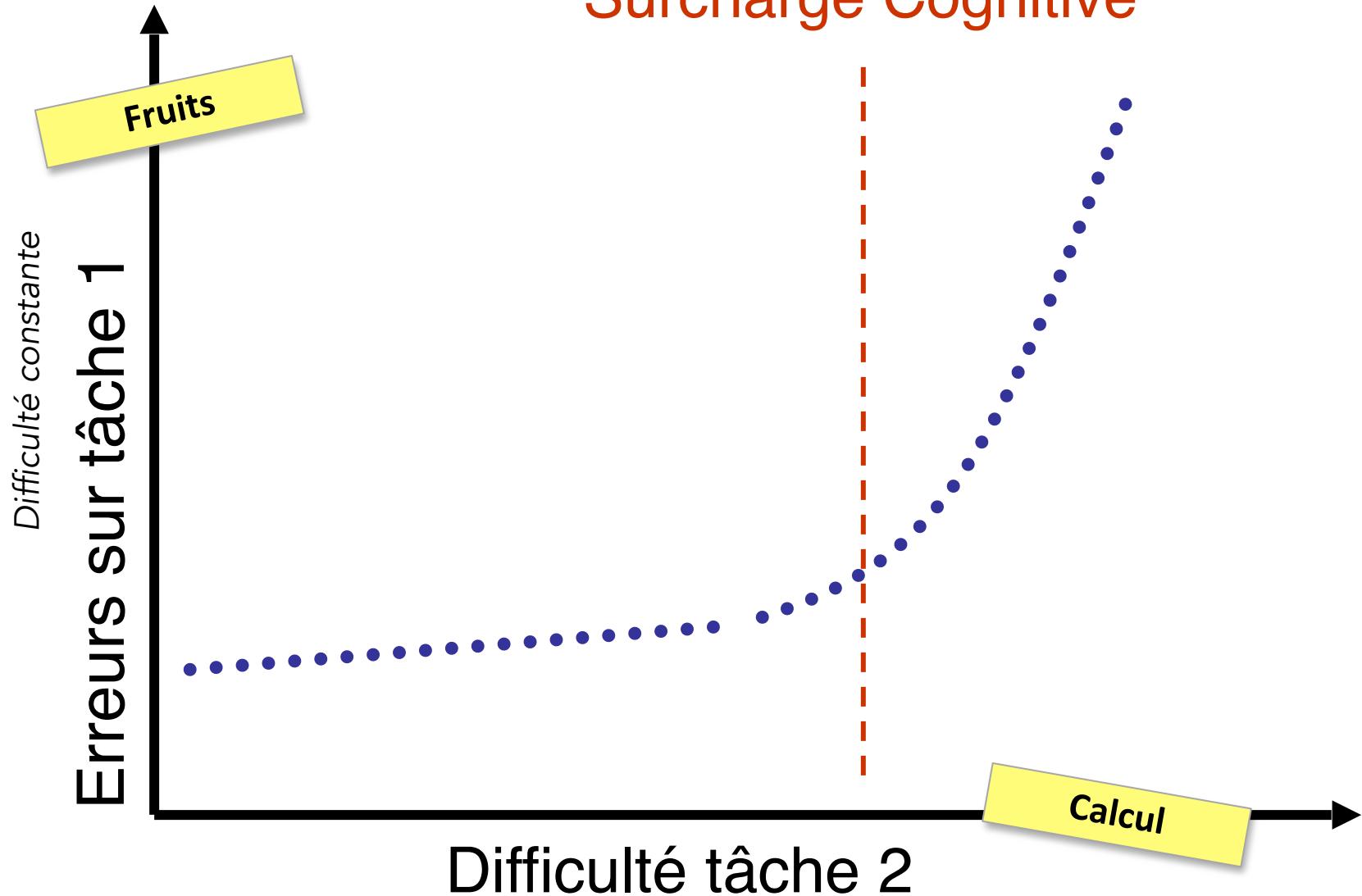
# Méthode de la tâche duale

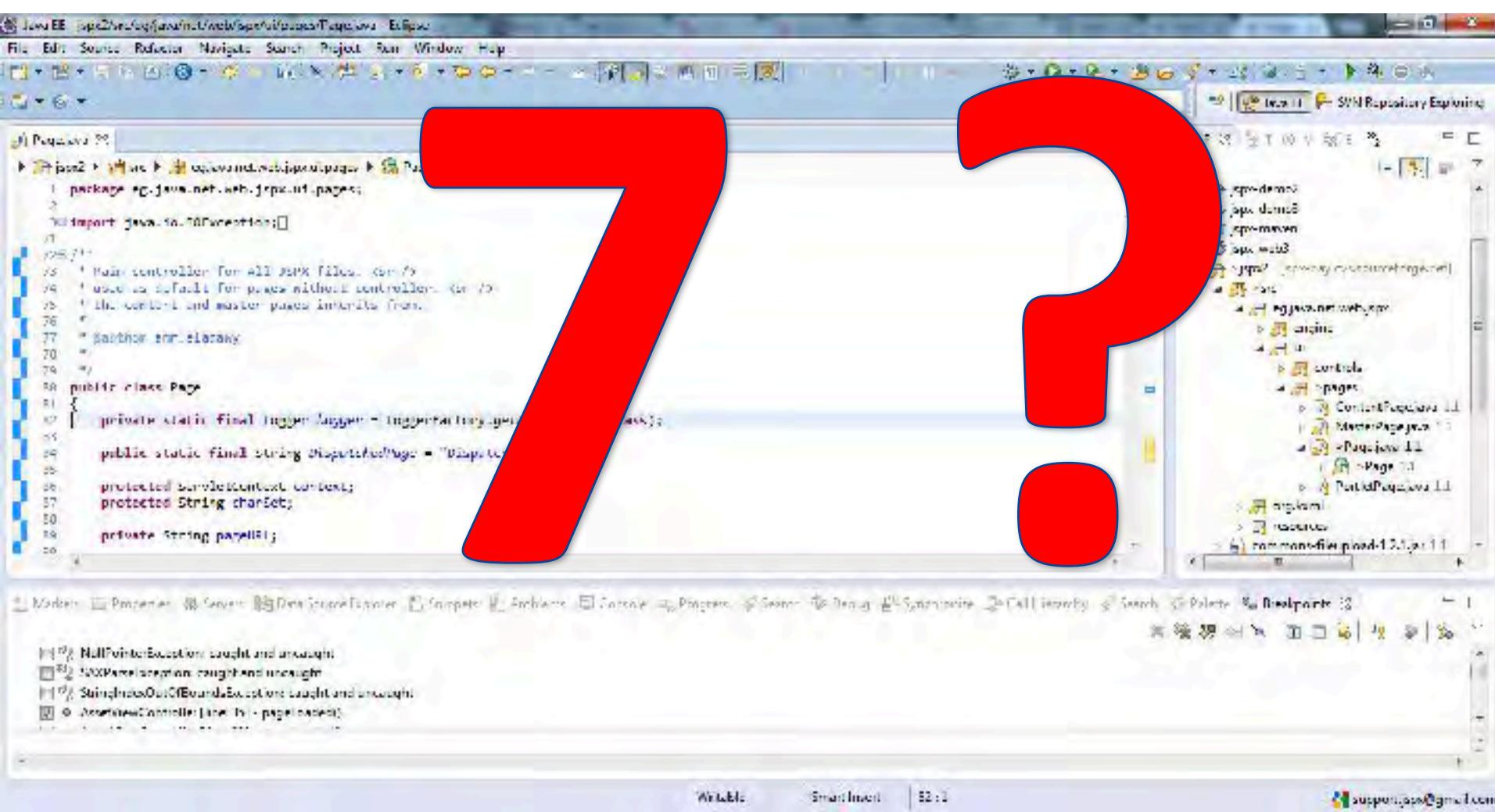
		Calcul			
		Correcte	Incorrecte		
Object	Fruit				
	Autre				

$$314 * 11 = 3455$$

Chaussette

# Surcharge Cognitive





KTM TO KUL FARE ON MH

KTM-KUL CXR-MH TBU 01AUG13 NPR  
9W 0/ 0/ 3 CL 0/ 0/ 3 EY 0/ 0/ 2 MH 1/ 0/ 0 QR 0/ 0/ 6  
TG 0/ 0/ 2 WY 0/ 0/ 1 RA 1/ 0/ 0

//SEE PQHELP FOR INFORMATION ABOUT THE NEW FARE DISPLAYS//

SURCHARGE FOR PAPER TICKET MAY BE ADDED WHEN ITIN PRICED

MH	KTMKUL,EN	01AUG13	NPR	2426	
V	FARE BASIS AP	FARE-QW	FARE-NP NK	SEASON	MINMAX RTG
1.	I QLTIINNP	-	37590 Q	-	-/-
2.	A VSTIYND	-	41190 V	-	-/-
3.	A LSTIYND	-	43190 L	-	-/-
4.	I QLTIPND	21675	Q	-	-/-
5.	A MSTIYNP	-	45190 M	-	-/-12M EHU
6.	I ZDTIINNP	-	45862 Z	-	-/- 1M EHU
7.	A VSTPND	23295	V	-	-/- - EP
8.	A KSTIYNP	-	47190 K	-	-/-12M E
9.	A HXLYNPD	-	49190 B	-	-/-12M E
10.	A BXLYNPD	-	51190 B	-	-/-12M E
11.	A LSTOWNE	26695	L	-	-/- -
12.	A YFXLYND	-	53190 Y	-	-/-12M E
13.	I ZDTOWNE	26781	Z	-	-/-
14.	A MSTOWNP	26895	M	-	-/-
15.	A ZBZLYND	-	54112 Z	-	3/-
16.	A KSTOWNE	28395	K	-	-/-

NO NAMES

1 MH 171Y 23AUG 5 KTMKUL 881 1220 1915 /DCMH /E  
2 MH 170Y 28AUG 3 KULKTM 881 0855 1130 /DCMH /E

TICKET RECORD - NOT PRICED

2ZED.2ZED\*ASS 2211/31JUL13

PRICING

PSGR TYPE ADT - 01

CXR RES DATE	FARE BASIS	NVB	NVA	BG
KTM				
KUL MH Q 23AUG QLTIINNP	23AUG 23AUG 30K			
KTM MH Q 28AUG QLTIINNP	28AUG 28AUG 30K			
FARE NPR 37590				
EAK NPR 565NQ NPR	1130NP NPR	2301XY		
TOTAL NPR 41586				

ADT-01 QLTIINNP

KTM MH KUL205.88MH KTM205.88NUC411.76END ROE91.2896

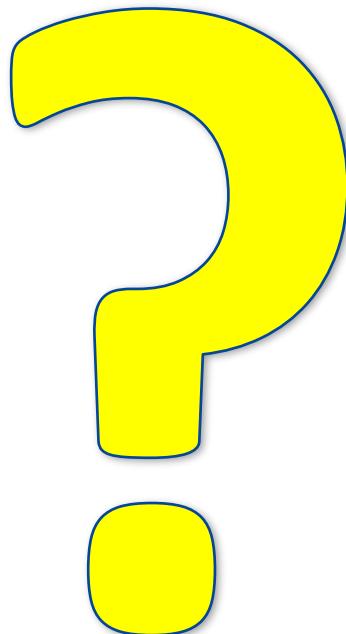
\*? NPR1921MY NPR380YR

ENDOS\*SEG1/2\*NONEND-CHRG APPLY

EAK/2L05AUG13/2359

ATTN\*VALIDATING CARRIER - MH

ATTN\*APPLICABLE BOOKING CLASS - 1Q 2Q



7?

Attendre la barrière

Stopper la radio

Parler

Ecouter

Prendre son badge

Changer de vitesse

Tourner

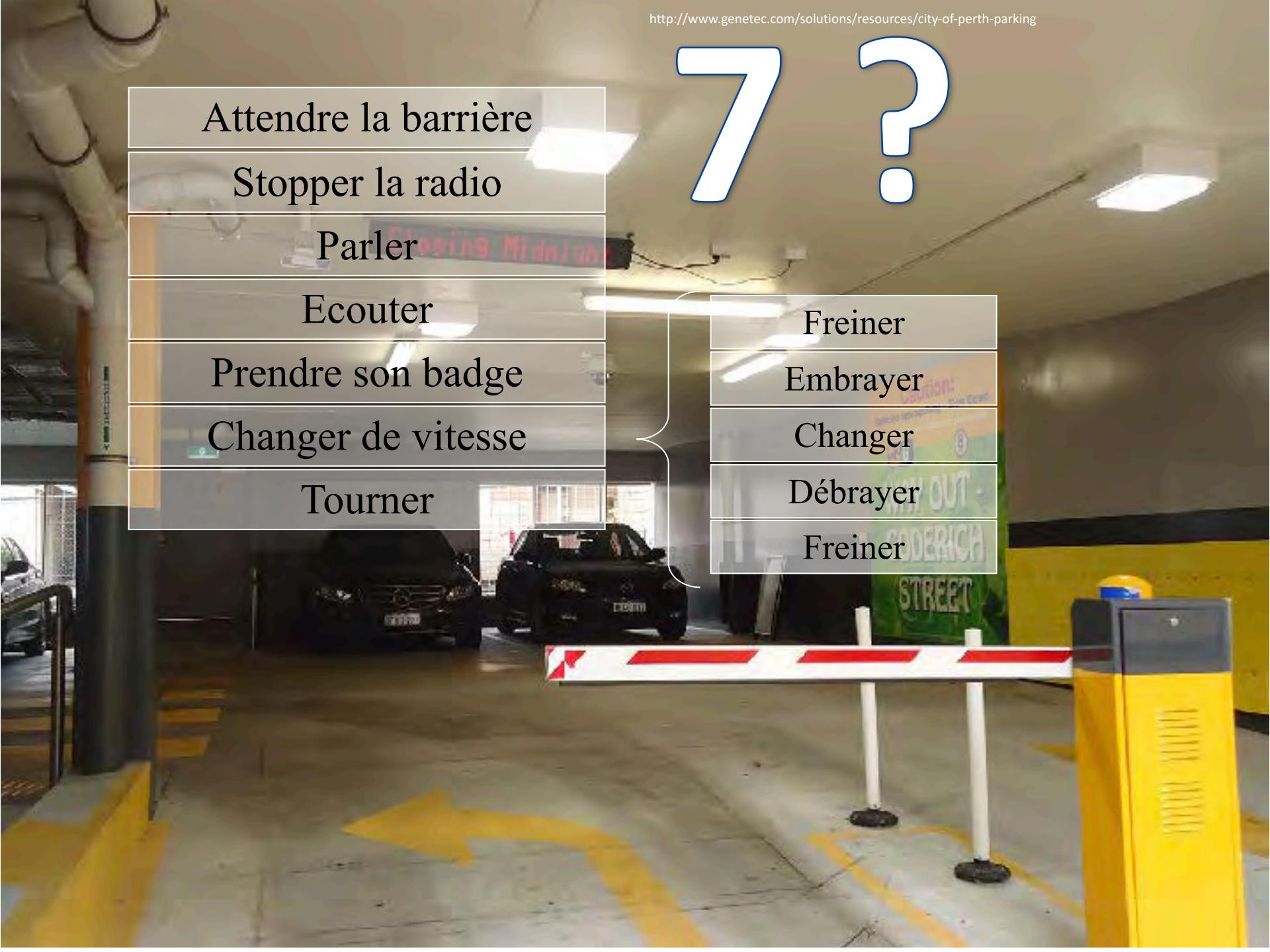
Freiner

Embrayer

Changer

Débrayer

Freiner



Attendre la barrière

Stopper la radio

Parler

Ecouter

Prendre son badge

Changer de vitesse

Tourner

Freiner

Embrayer

Changer

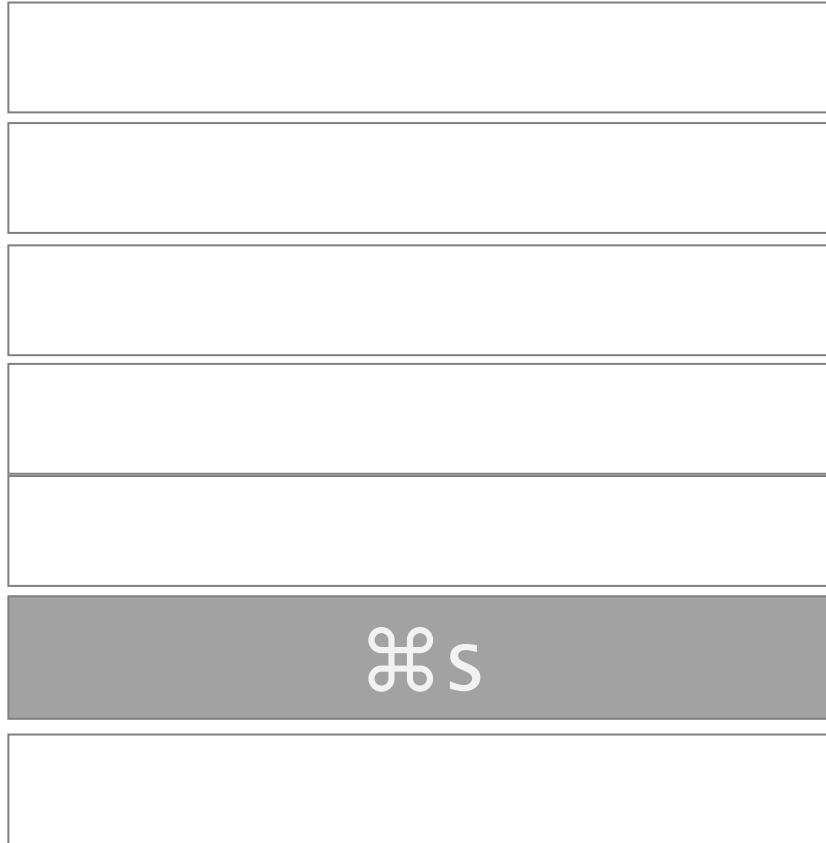
Débrayer

Freiner

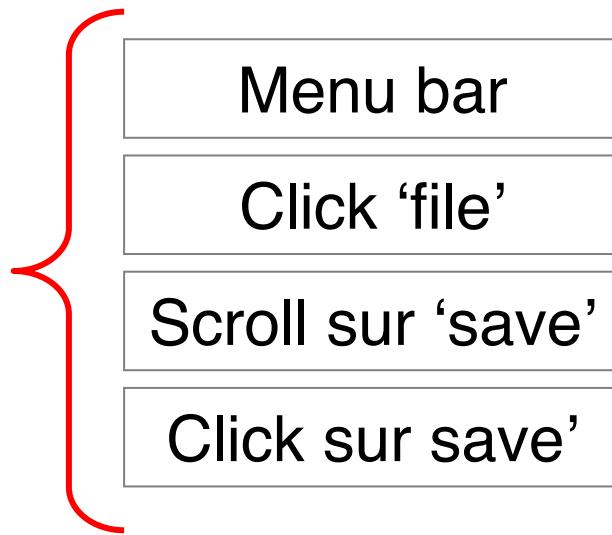
*Compilation*

**Expert**

**Novice**



**Expert**



**Novice**

## Implications pour le design des interfaces

1. Quelle quantité d'information en un écran ?

Un minimum

# Combien



Combien d'informations est-il optimal  
de présenter en une fois ?



Draughn, Matt - CorvoCity - ChinaCity - Prof-City - Env-City - R-Travel - R-Env - J-Env - IDEnv - EDP - Fantasy - MAT - Project - Minerva - POC

mutator =

12 DECEMBER

# Rassembler ou Diviser ?

VILLE DE PARTIR : PARIS  
VILLE D'ARRIVÉE : BORDEAUX

DATE DE PARTIE : 22/04/2015  
DATE D'ARRIVÉE : 24/04/2015

ADULTES : 1  
ENFANTS : 0  
BÉBÉS : 0

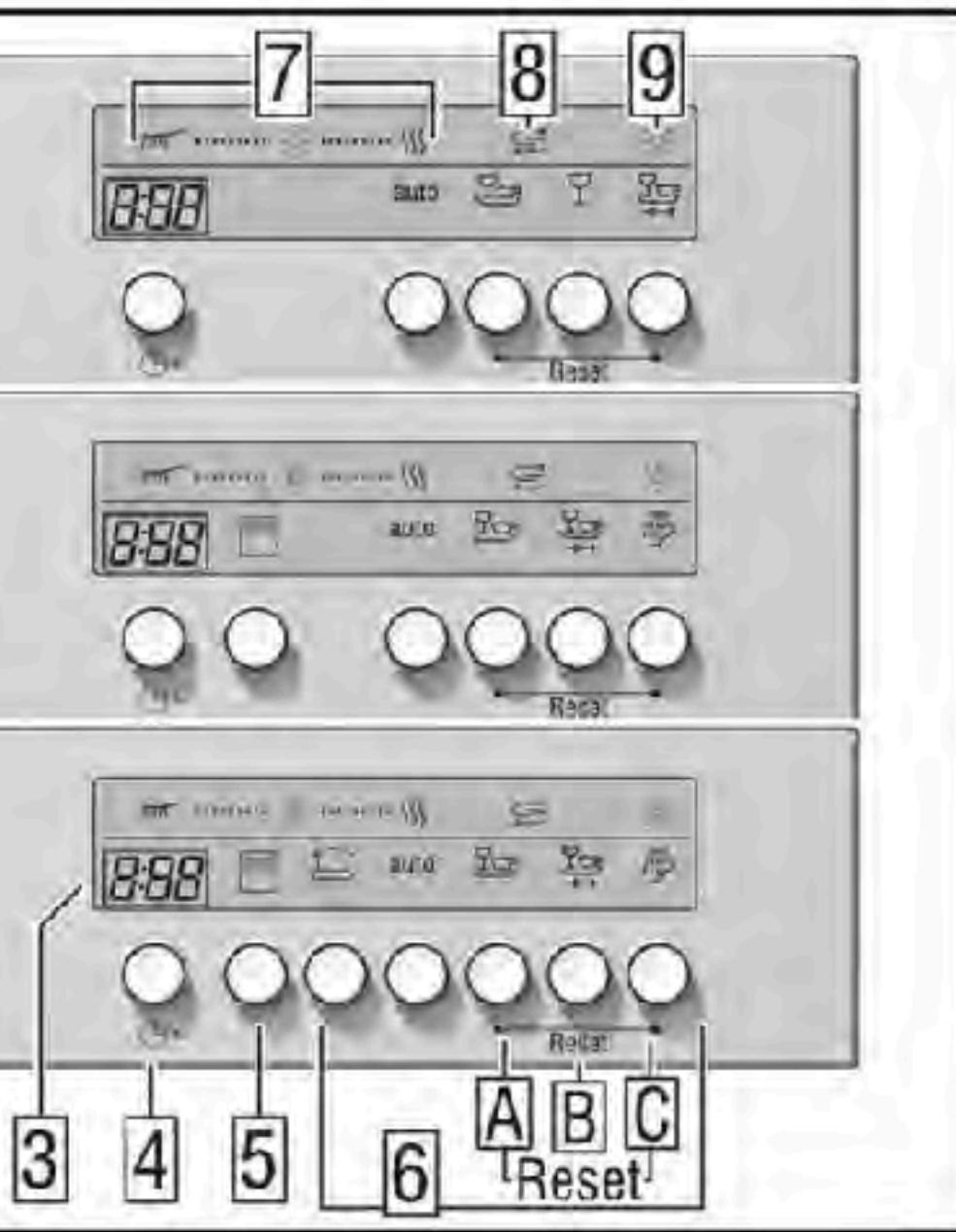
Assurance voyage

**AFFICHER LES VOUS >**

\* Informations régulées

Voyage aller		Geneve à Bordeaux	
12 personnes		connaissent actuellement tel	
itinéraire mar. 21 avr.	mer. 22 avr.	mer. 22 avr.	jeu. 23 avr.
TARIF LE PLUS BAS	25 <sup>e</sup> CHF DÉP 09:10 ARR 10:55	29 <sup>e</sup> CHF DÉP 09:40 ARR 10:55	32 <sup>e</sup> CHF DÉP 09:40 ARR 10:55
TARIF LE PLUS BAS	25 <sup>e</sup> CHF DÉP 19:55 ARR 20:45	29 <sup>e</sup> CHF DÉP 14:40 ARR 15:55	42 <sup>e</sup> CHF DÉP 19:40 ARR 20:55

<p>Mer. 22 avril 2015</p> <p>Genève à Bordeaux</p> <p>Dép. 09:10 - Arr. 10:55</p> <p>Vol EZY1371</p> <p>1 Adulée</p>	<p>1 x 29,02 CHF</p>
<p>ven. 24 avril 2015</p> <p>Bordeaux à Genève</p> <p>Dép. 17:15 - Arr. 19:05</p> <p>Vol EZS1374</p> <p>1 Adulée</p>	<p>1 x 86,23 CHF</p>



### Eteindre ou allumer l'indicateur de liquide de rinçage

Vous pouvez allumer ou éteindre l'indicateur de liquide de rinçage [ 9 ]. Pour modifier cette fonction, procédez comme suit :

- Fermez la porte.
- Maintenez la touche de programmation [ 1 ] enfoncée et appuyez sur [ 1 ] l'interrupteur principal jusqu'à ce que l'indicateur chiffré s'allume. Ensuite, relâchez ces touches.
- Relâchez ensuite les touches [ 3 ] s'affiche à l'indicateur numérique [ 10 ] (l'indicateur de liquide de rinçage est allumé).
- Le fait d'appuyer sur la touche de programmation [ 4 ] vous permet d'allumer [ 10 ] ou d'éteindre [ 10 ].
- Ramenez l'interrupteur principal [ 1 ] en position éclairée - le réglage reste mémorisé.

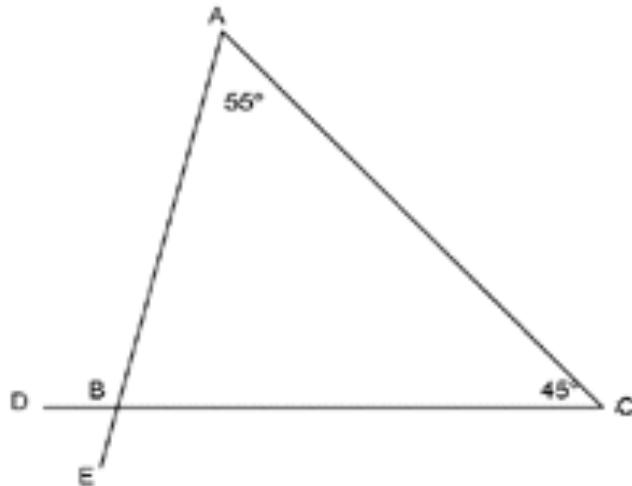


#### Remarque

N'éteignez l'indicateur de liquide de rinçage que si vous utilisez des détergents à produit de rinçage intégré.

# Le "Split Attention Effect" augmente la charge mentale

Example demonstrating split attention



In the above figure, find a value for Angle DBE

Solution:

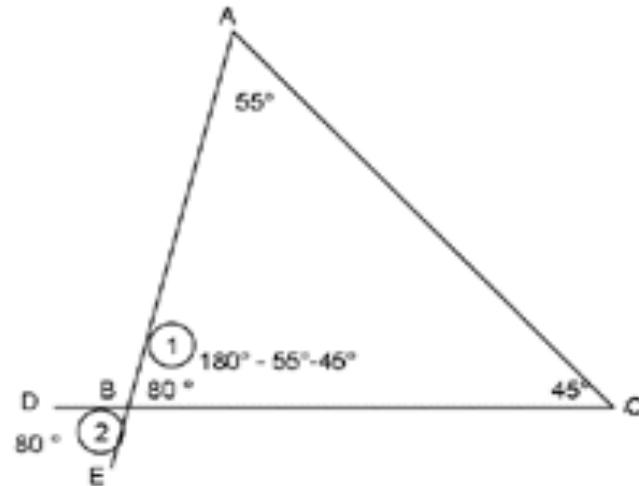
Angle ABC =  $180^\circ - \text{Angle BAC} - \text{Angle BCA}$  (internal angles of a triangle sum to  $180^\circ$ )

$$= 180^\circ - 55^\circ - 45^\circ$$

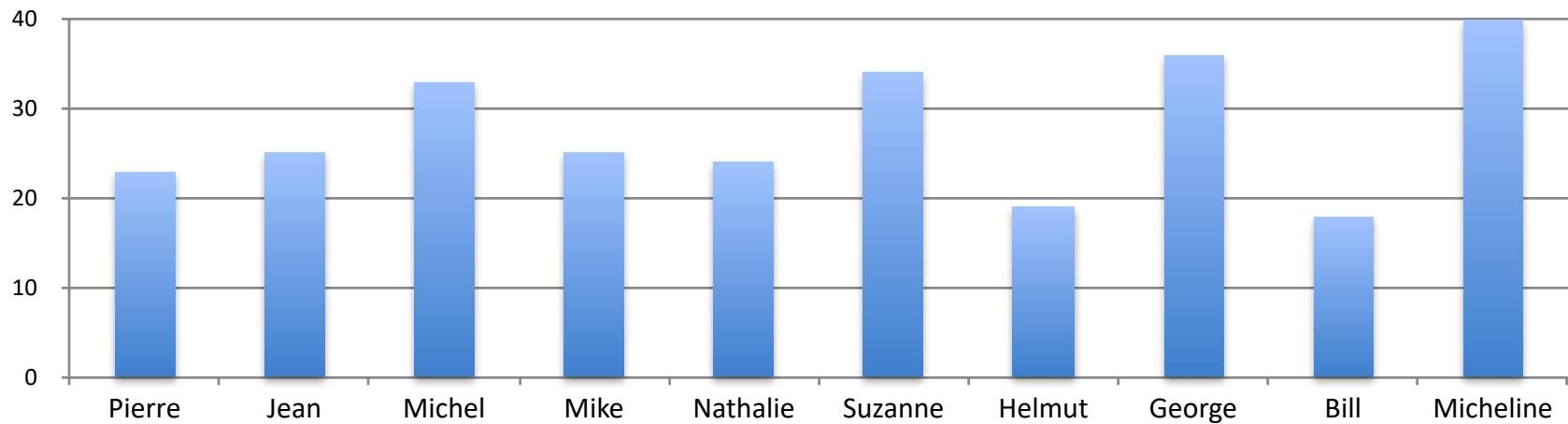
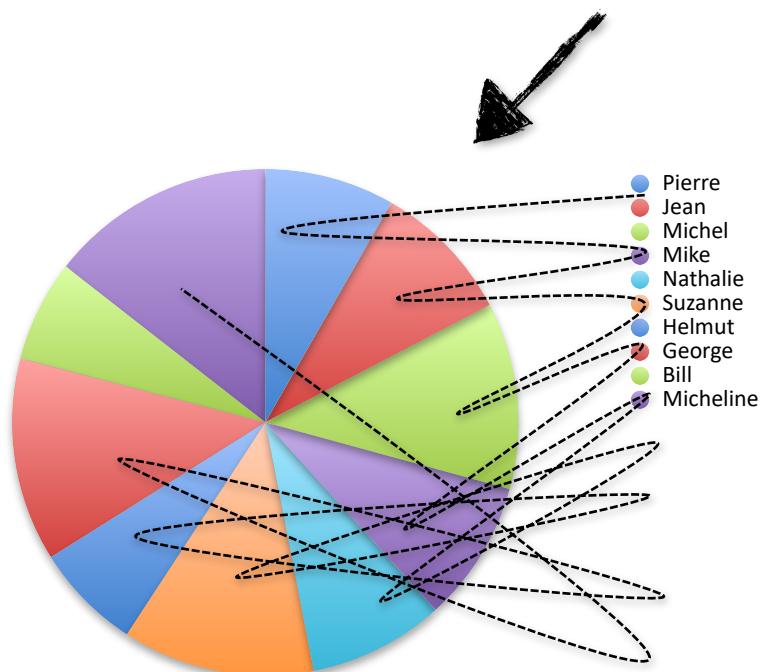
$$= 80^\circ$$

Angle DBE = Angle ABC (vertically opposite angles are equal)  
=  $80^\circ$

Integrated example



# Le “Split Attention Effect” augmente la charge mentale



Jones School room 3

Please vote for the best time(s) that work for you, and majority wins!

Table      Calendar

	Jul <b>12</b> WED	Jul <b>12</b> WED	Jul <b>12</b> WED	Jul <b>13</b> THU	Jul <b>14</b> FRI	Jul <b>14</b> FRI
9:00 AM	9:00 AM	11:00 AM	4:00 PM	4:00 PM	8:00 AM	1:00 PM
4 participants	+ 2	+ 4	+ 3	+ 2	+ 3	+ 3
Kathi Kerszn... <input checked="" type="checkbox"/>	✓	✓	✓	✓	✓	✓
Suzie Snow <input type="checkbox"/>		✓	✓		✓	
John Smith <input type="checkbox"/>		✓				✓
Kathi Kerszn... <input type="checkbox"/>	✓	✓	✓	✓	✓	✓





Today



View by Project

Jun 2022

Filter/Sort

More

Less

Wk 1

Wk 2

Wk 3

More

Less

Stuart McLachlan  
Marketing Manager

28 Jun 2022  
Social Media Strategy (SM36)  
Total TTC

10:00 - 10:30am

East in the Bay (BB58)  
Archetype Studios

11:00 - 12:00pm

Weekly Series Planning  
Busy

10:30 - 10:45am

Purple Rain  
Busy

11:00 - 11:15am

Gym W  
Free

28 Jun 2022  
Arkham Analysis (AA40)  
Gotham City | Kick-off meet!

10:00 - 10:30am

Interview with Bloomberg  
Busy

10:30 - 11:00am

Budget Review  
Busy

28 Jun 2022  
Samurai Show  
Busy

10:00 - 10:30am

Vanilla Sky (VS14)  
Metal Garden

10:30 - 11:00am

Brand Activation (BA05)  
BB20

28 Jun 2022  
Brad Whiting from NYC  
Free

10:00 - 10:30am

Frozen Tundra (FT06)  
Metal Garden

10:30 - 11:00am

Brand Activation (BA05)  
BB20

11:00 - 11:30am

Riddler Run (RP01)  
Medium City

29 Jun 2022 [All day]  
Vacation (personal)  
Scotland ↗

29 Jun 2022  
Arkham Analysis (AA40)  
Gotham City | Kick-off meet!

10:00 - 10:30am

Tiny Dancer (TD02)  
Archetype Studios

29 Jun 2022  
Dreadful Alien (DA01)  
Total TTC

10:00 - 10:30am

Website Optimization (WO01)  
Metal Garden

29 Jun 2022  
Website Optimization (WO01)  
Metal Garden

10:00 - 10:30am

Warrior Festival ↗

Tiffany Ibrahim  
Project Manager  
Archetype Studios

30 Jun 2022 [All day]  
Vacation (personal)  
Scotland ↗

30 Jun 2022  
Arkham Analysis (AA40)  
Gotham City | Kick-off meet!

10:00 - 10:30am

Gotham City | Kick-off meet!

30 Jun 2022  
Warrior Festival ↗

Zoe Kowalski  
UX Designer  
Archetype Studios

30 Jun 2022 [All day]  
Vacation (personal)  
Scotland ↗

30 Jun 2022  
Arkham Analysis (AA40)  
Gotham City | Kick-off meet!

10:00 - 10:30am

Gotham City | Kick-off meet!

30 Jun 2022  
Warrior Festival ↗

10:00 - 10:30am

Warrior Festival ↗

Nothing is really work unless you do

Resources Projects & Clients Reports

Jun 2022

Day by Project

Mon	Tue	Wed	Thu
9am - 10am Social Media Strategist (SM05) Total TTC	9am - 10am Archon Analyst (AA40) Gotham City   Kickoff meet! Busy	10am - 11am General Clerk Busy	10am - 11am Business Analyst (BA10) Metropolis Busy
11am - 12pm Events in the Bay (BD08) Archetype Studios Busy	11am - 12pm Purple Ninja Busy	1 - 2pm Interview with Bloomberg Busy	12 - 1pm Vortex Sky (VS14) Metal Centers Busy
12 - 1pm Weekly Series Planning Busy	12 - 1pm Gym X Free	3 - 4pm Budget Review Busy	2pm - 3pm Phylo Busy
2:30pm - 3pm Vacation (postponed) 6 Jun 2022 (All day) Scotland ✈		3pm - 4pm Archon Analyst (AA40) Gotham City   Kickoff meet! Busy	4pm - 5pm Hyperdry Demolis, Atom (DA51) Total TTC
3pm - 4pm Social Media Strategist (SM05) Total TTC		4pm - 5pm Archon Analyst (AA40) Gotham City   Kickoff meet! Busy	5pm - 6pm Tin Dancer (TD02) Archetype Studios Busy

Jones School room 3

≡ Please vote for the best time(s) that work for you, and majority wins!

	<u>Table</u>	<u>Calendar</u>				
	Jul <b>12</b> WED	Jul <b>12</b> WED	Jul <b>12</b> WED	Jul <b>13</b> THU	Jul <b>14</b> FRI	Jul <b>14</b> FRI
	9:00 AM	11:00 AM	4:00 PM	4:00 PM	8:00 AM	1:00 PM
4 participants	+	2	4	3	2	3
Kathi Kerszn...	✓	✓	✓	✓	✓	✓
Suzie Snow		✓	✓		✓	
John Smith		✓				✓
Kathi Kerszn...	✓	✓	✓	✓	✓	✓

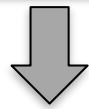


# Working Memory

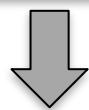


## External memory

Mémoire Sensorielle



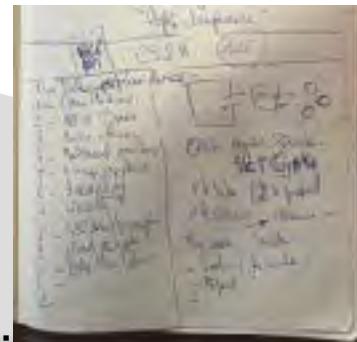
Mémoire de travail



Mémoire à long terme

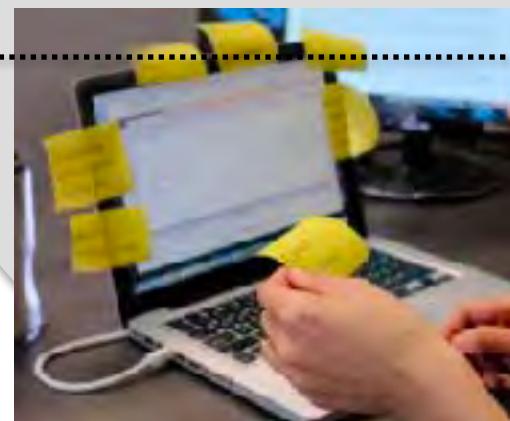


Traces



Notes

Mémoires externes



Post-its



Noeud

Ecran(s)

## Implications pour le design des interfaces

1. Quelle quantité d'information en un écran ?
2. Quelle structure de l'information réduit la charge cognitive ?

## Lausanne – Basel SBB

Dép.	Offre	Arr.	Changer à	Dép.	Offre	Arr.
4.45	IR	5.56	Bern	6.04	IC	6.59
5.39	ICN	6.41	Biel/Bienne	6.49	ICN	7.53
6.20	IC FA	7.26	Bern	7.34	IC FA	8.29
6.45	ICN					8.53
7.20	IC SCFA	8.26	Bern	8.34	IC	9.29
7.45	ICN	8.43	Biel/Bienne	8.49	ICN	9.53
8.20	IC FA	9.26	Bern	9.34	IC FA	10.29
8.45	ICN					10.53
9.20	IC FA	10.26	Bern	10.34	EC	11.29
9.45	ICN	10.43	Biel/Bienne	10.49	ICN	11.53
10.20	IC FA	11.26	Bern	11.34	IC (X) FA	12.29
10.45	ICN					12.39
11.20	IC FA	12.26	Bern	12.34	IC (X) FA	13.29
11.45	ICN	12.43	Biel/Bienne	12.49	ICN	13.53
12.20	IC FA	13.26	Bern	13.34	IC	14.29
12.45	ICN					14.53
13.20	IC FA	14.26	Bern	14.34	EC	15.29
13.45	ICN	14.43	Biel/Bienne	14.49	ICN	15.53
14.20	IC SCFA	15.26	Bern	15.34	IC	16.29
14.45	ICN					16.53
15.20	IC FA	16.26	Bern	16.34	IC	17.29
15.45	ICN	16.43	Biel/Bienne	16.49	ICN	17.53
16.20	IC SCFA	17.26	Bern	17.34	ICE	18.29
16.45	ICN					18.53
17.20	IC FA	18.26	Bern	18.34	IC (X) FA	19.29
17.45	ICN	18.43	Biel/Bienne	18.49	ICN	19.53

Suite page suivante

4.45 5.56 Bern 6.04 6.59 // 5.39 6.41 Biel/Bienne 6.49  
 7.53 /6.20 7.26 Bern 7.34 8.29 // 6.45 8.53 // 7.20 8.26  
 Bern 8.34 9.29// 7.45 8.43 Biel/Bienne 8.49 9.53//8.20  
 9.26 Bern 9.34 10.29// 8.45 10.53//9.20 10.26 Bern  
 10.34 11.29//9.45 10.43 Biel/Bienne 10.49 11.53//10.20  
 11.26 Bern 11.34 12.29//  
 10.45 12.53//11.20 12.26 Bern 12.34 13.29//11.45 12.43  
 Biel/Bienne 12.49 13.53//12.20 13.26 Bern 13.34  
 14.29//12.45 14.53//13.20 14.26 Bern 14.34  
 15.29//13.45 14.43 Biel/Bienne 14.49 15.53//14.20 15.26  
 Bern 15.34 16.29//14.45 16.53// 15.20 16.26 Bern 16.34  
 17.29//15.45 16.43 Biel/Bienne 16.49 17.53//16.20  
 17.26 Bern 17.34 18.2916.45 18.53//17.20 18.26 Bern  
 18.34 19.29//17.45 18.43 Biel/Bienne 18.49 19.53

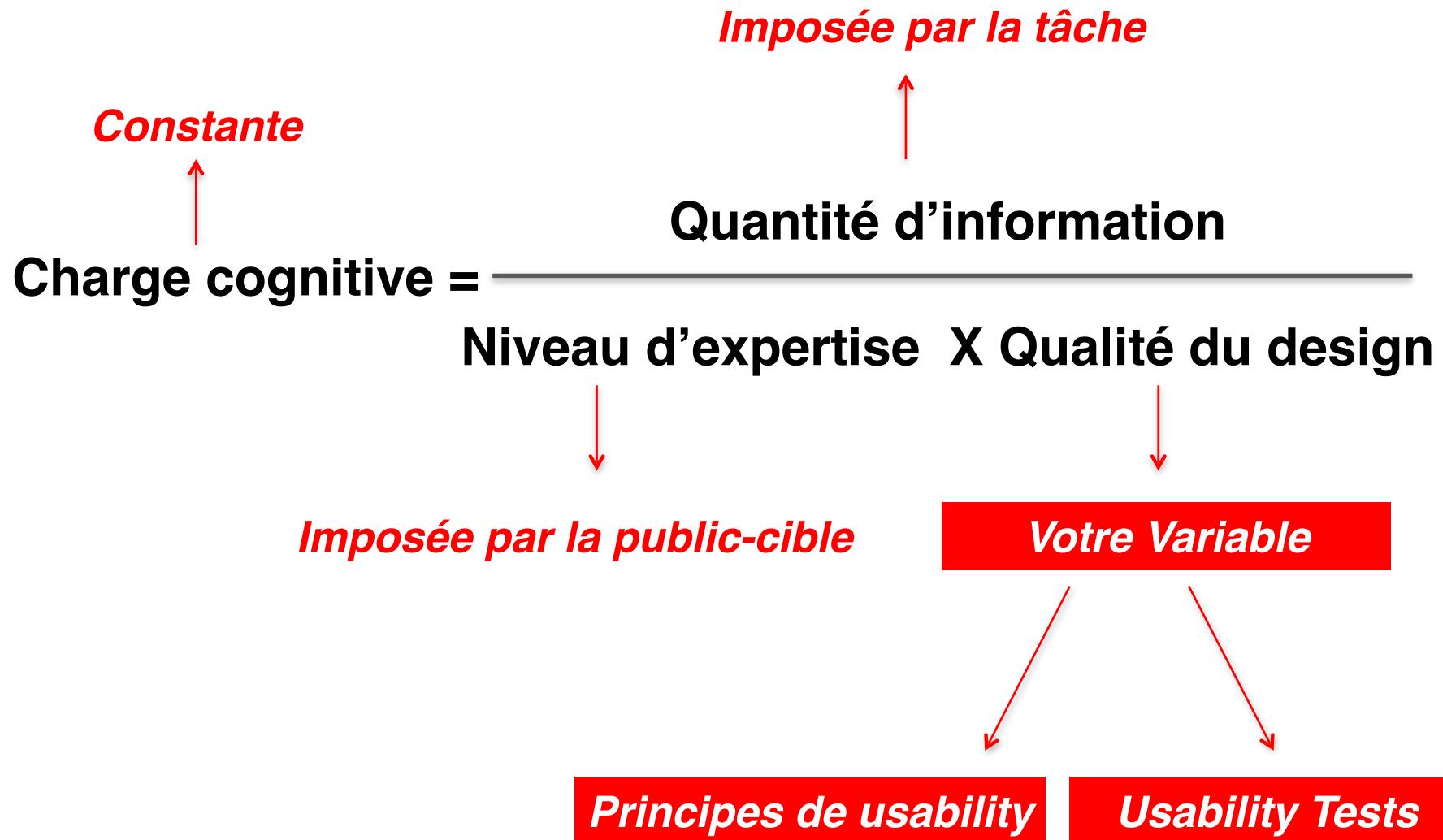
OU

La structure de l'information  
 réduit la charge cognitive

[http://commons.wikimedia.org/wiki/File:Boeing\\_NKC-135A\\_Airborne\\_Laser\\_Lab\\_cockpit\\_3\\_USAF.jpg](http://commons.wikimedia.org/wiki/File:Boeing_NKC-135A_Airborne_Laser_Lab_cockpit_3_USAF.jpg)



**La structure de l'information réduit la charge cognitive**



Mémoire Sensorielle  
(< 1 s)



Mémoire à court terme  
(< 10 min)



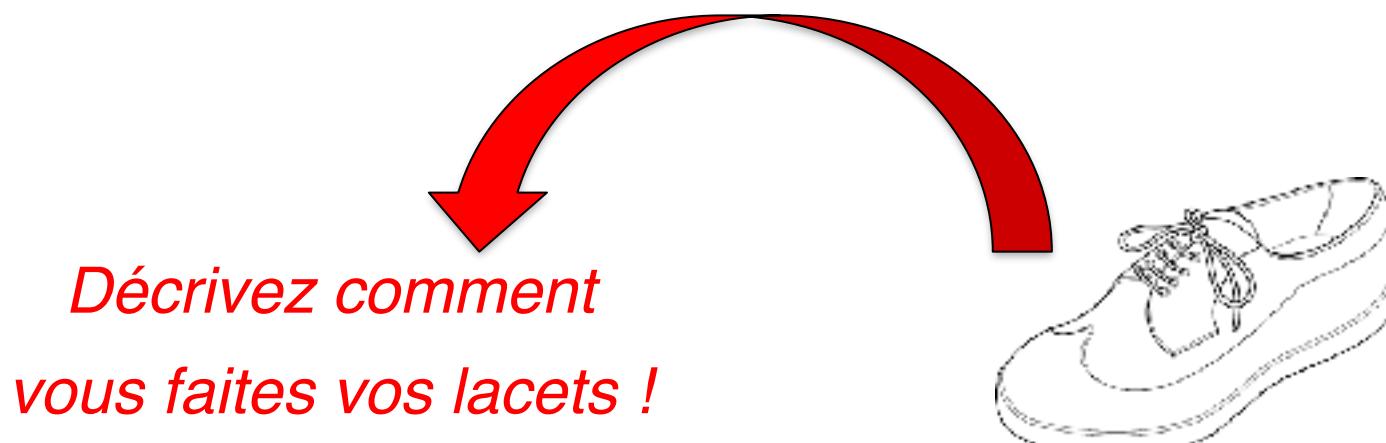
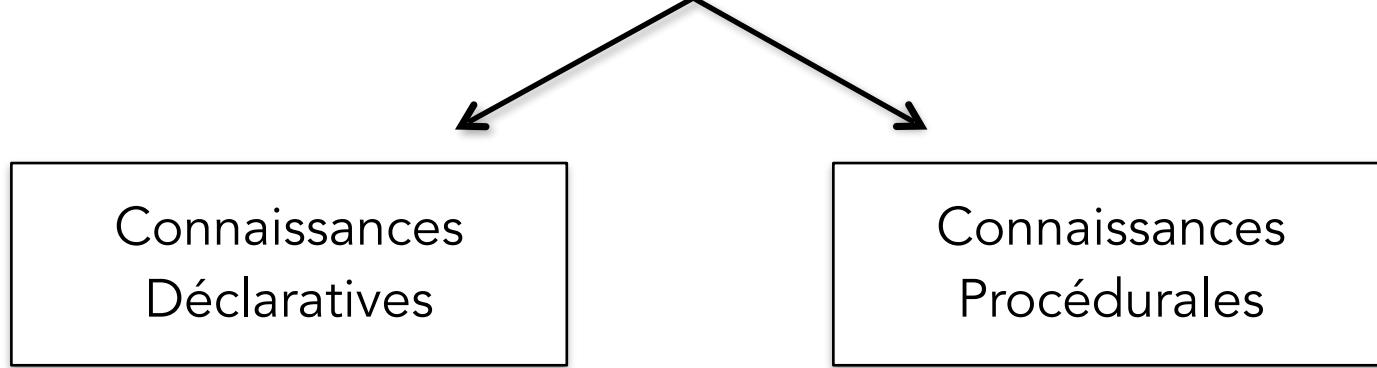
Mémoire à long terme  
(illimitée)

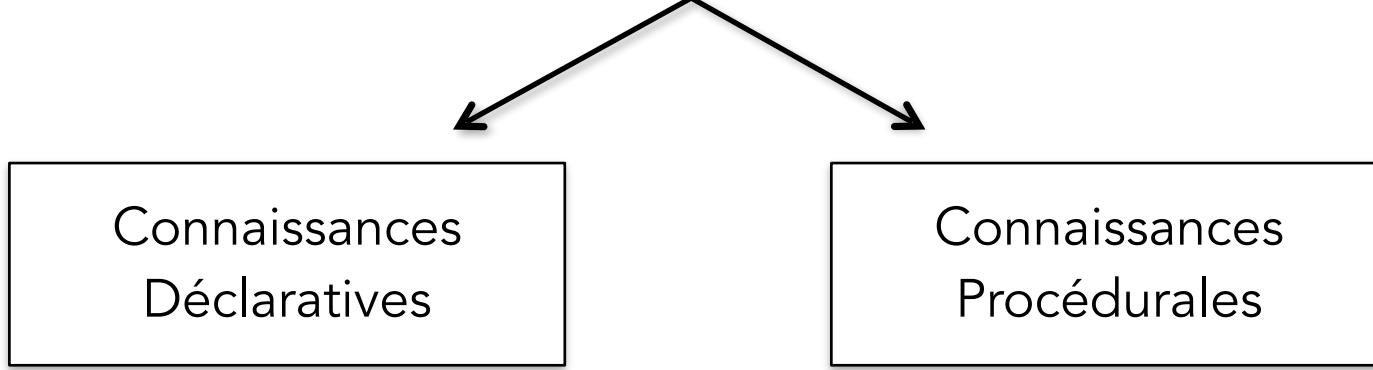


Connaissances  
Déclaratives

Connaissances  
Procédurales



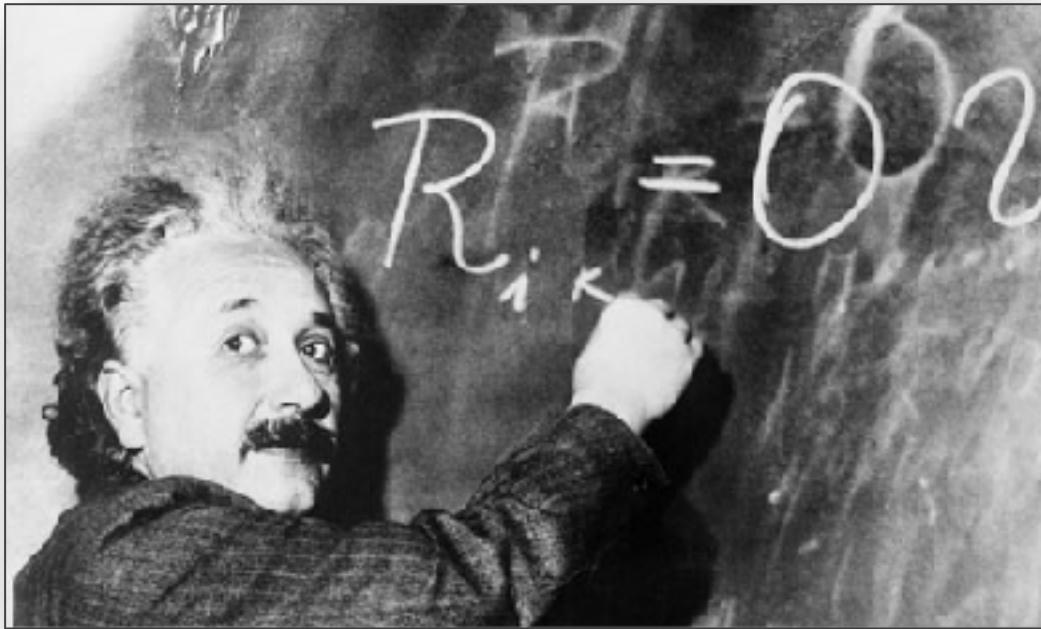




Le carré de l'hypothénuse d'un triangle carré égale la somme des carrés des deux autres côtés

Si on me donne la longueur du côté le plus court:

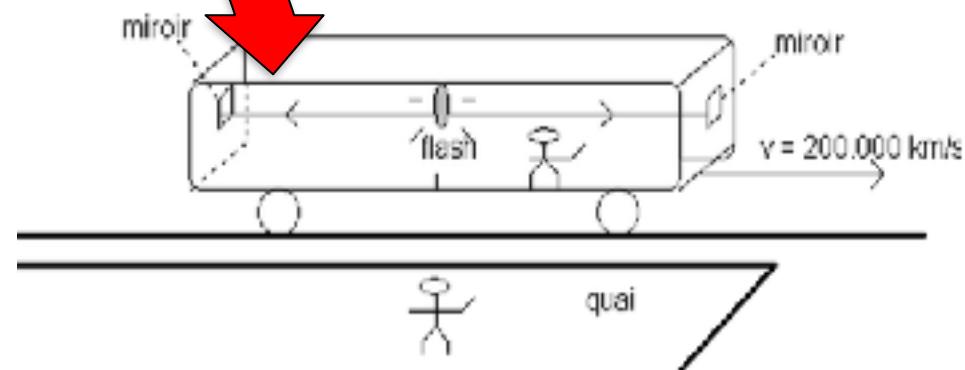
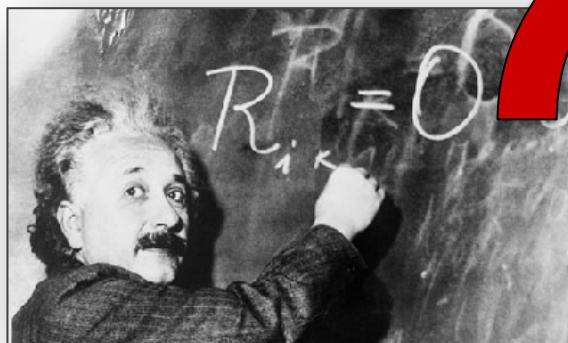
1. Je prends l'hypothénuse
2. Je l'élève au carré
3. Je prends le côté qui reste
4. Je l'élève au carré
5. Je calcule la différence
6. Je calcule la racine carrée



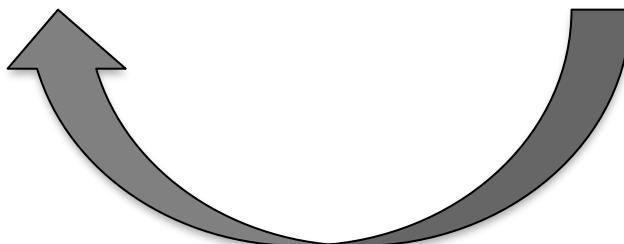
« Si la vitesse de la lumière est incompressible,  
c'est le temps qui est élastique »

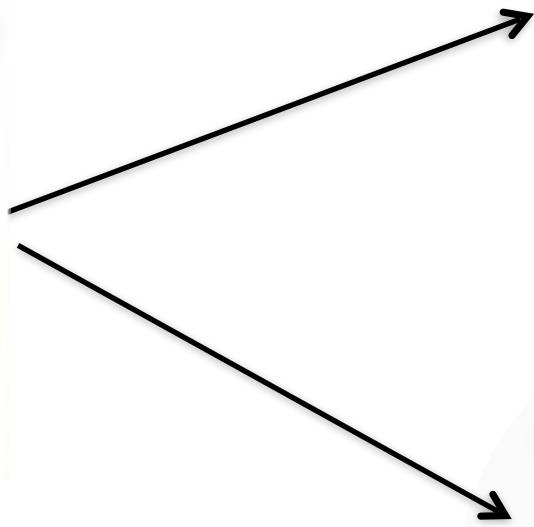
Connaissances  
Déclaratives

Connaissances  
Procédurales



« Si la vitesse de la lumière est incompressible, c'est le temps qui est élastique »





*Modèles mentaux*

## Modèles mentaux

tolerable state of order among nations. On the contrary, the political, economic, and military situation of the free world is already unsatisfactory and will become less favorable unless we act to reverse present trends.

This situation is one which militates against successful negotiations with the Kremlin—for the terms of agreements on important pending issues would reflect present realities and would therefore be unacceptable, if not disastrous, to the United States and the rest of the free world. Unless a decision had been made and action undertaken to build up the strength, in the broadest sense, of the United States and the free world, an attempt to negotiate a general settlement on terms acceptable to us would be ineffective and probably long drawn out, and might thereby seriously delay the necessary measures to build up our strength.

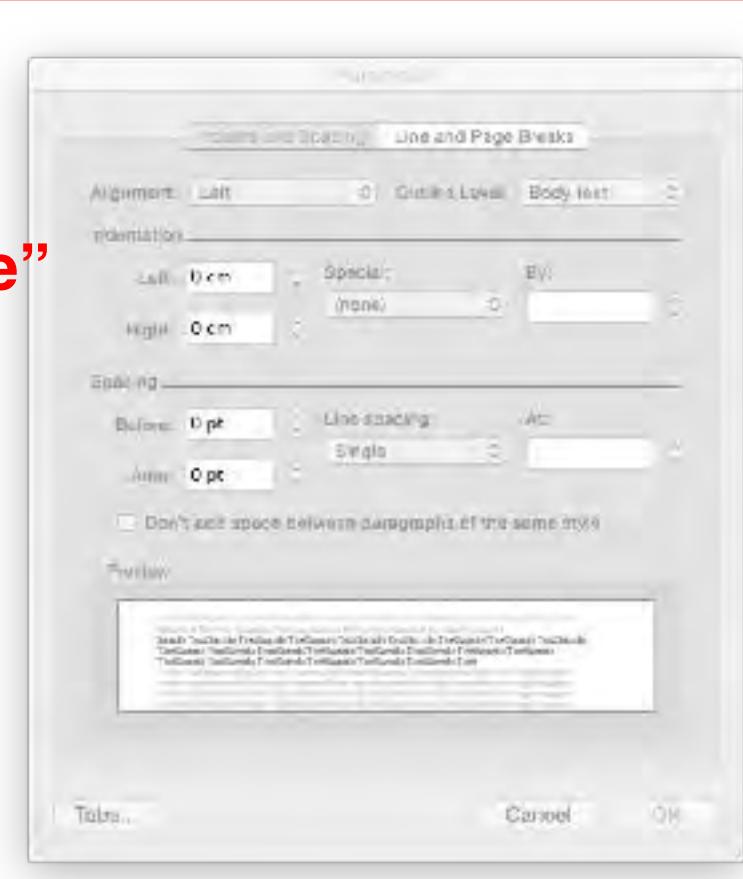
This is true despite the fact that the United States now has the capability of delivering a powerful blow against the Soviet Union in the event of war, for one of the present realities is that the United States is not prepared to threaten the use of our present atomic superiority to coerce the Soviet Union into acceptable agreements. In light of present trends, the Soviet Union will not withdraw and the only conceivable basis for a general settlement would be spheres of influence and of no influence—a "settlement" which the Kremlin could readily exploit to its great advantage. The idea that Germany or Japan or other important areas can exist as islands of neutrality in a divided world is unreal, given the Kremlin design for world domination.

### B. The Second Course—Isolation.

Continuation of present trends, it has been shown above, will lead progressively to the withdrawal of the United States from most of its present commitments in Europe and Asia and to our isolation in the Western Hemisphere and its approaches. This would result not from a conscious decision but from a failure to take the actions necessary to bring our capabilities into line with our commitments and thus to a withdrawal under pressure. This pressure might come from our present Allies, who will tend to seek other "solutions" unless they have confidence in our determination to accelerate our efforts to build a successfully functioning political and economic system in the free world.

There are some who advocate a deliberate decision to isolate ourselves. Superficially, this has some attractiveness as a course of action, for it appears to bring our commitments and capabilities into harmony by reducing the former and by concentrating our present, or perhaps even reduced, military expenditures on the defense of the United States.

"paragraphe"



## Modèles mentaux



## *Modèles mentaux...*

## *... utilisés comme métaphores pour interfaces*

- Souvent liés au contexte dans lequel ils ont été acquis
- Ni forcément corrects, ni complets
- Peuvent comprendre des contradictions
- Fournissent des explications simplifiées des phénomènes complexes
- Contiennent une estimation de leur validité qui permet de les utiliser malgré leur incertitude
- Permet de comprendre certaines erreurs des utilisateurs
- Le bureau
- La manipulation directe
- Effacer un fichier
- Vider la poubelle
- Trousseau de mots de passe
- Le panier d'achats
- ...

*ou l'inverse, le langage informatique fournit des métaphores ....*

- Je ne capte pas
- Garde ceci dans un buffer 1 minute
- J'imprime plus
- J'ai perdu le signal
- Y'a stack overflow
- attends, backtrack 2 minutes
- ...

# Psychologie

- Perception
- Cognition
- Emotion
- Motivation
- Social
- Motricité
- ...

- Attention
- Mémoire
- Raisonnement
- Langage
- Intelligence
- Compétences
- Connaissances
- Apprentissage
- ...

- Attention
- Mémoire
- Raisonnement → *raisonnement spatial*
- Langage
- Intelligence
- Compétences
- Connaissances
- Apprentissage
- ...

**Motor Area**

- Control of voluntary muscles

**Sensory Area**

- Skin sensations (temperature, pressure, pain)

**Broca's Area**

- Speech control

**Frontal Lobe**

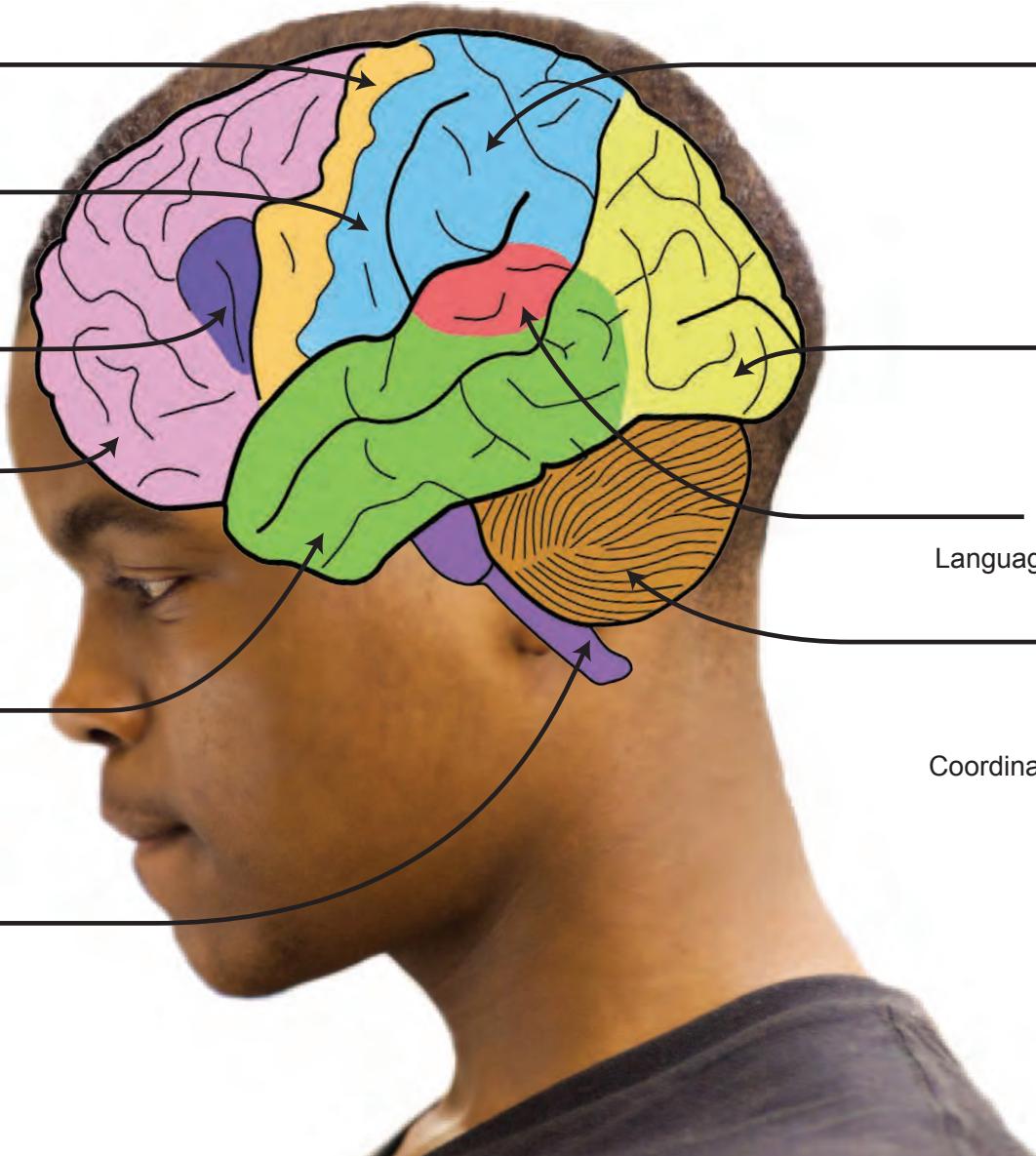
- Movement
- Problem solving
- Concentrating, thinking
- Behavior, personality, mood

**Temporal Lobe**

- Hearing
- Language
- Memory

**Brain Stem**

- Consciousness
- Breathing
- Heart rate

**Parietal Lobe**

- Sensations -
- Language -
- Perception -
- Body awareness -
- Attention -

**Occipital Lobe**

- Vision -
- Perception -

**Wernicke's Area**

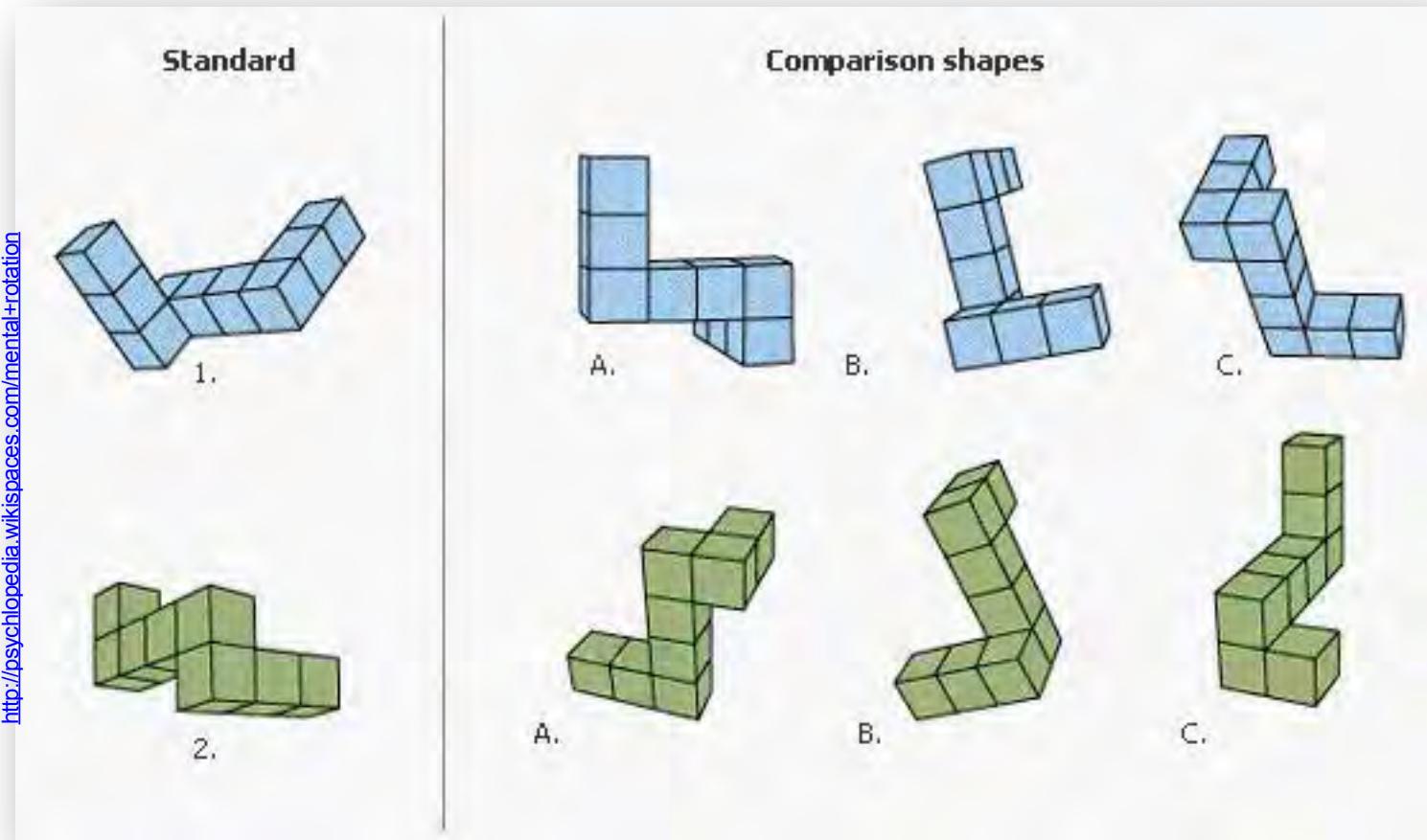
- Language comprehension -

**Cerebellum**

- Posture -
- Balance -
- Coordination of movement -

Simplified view of the brain

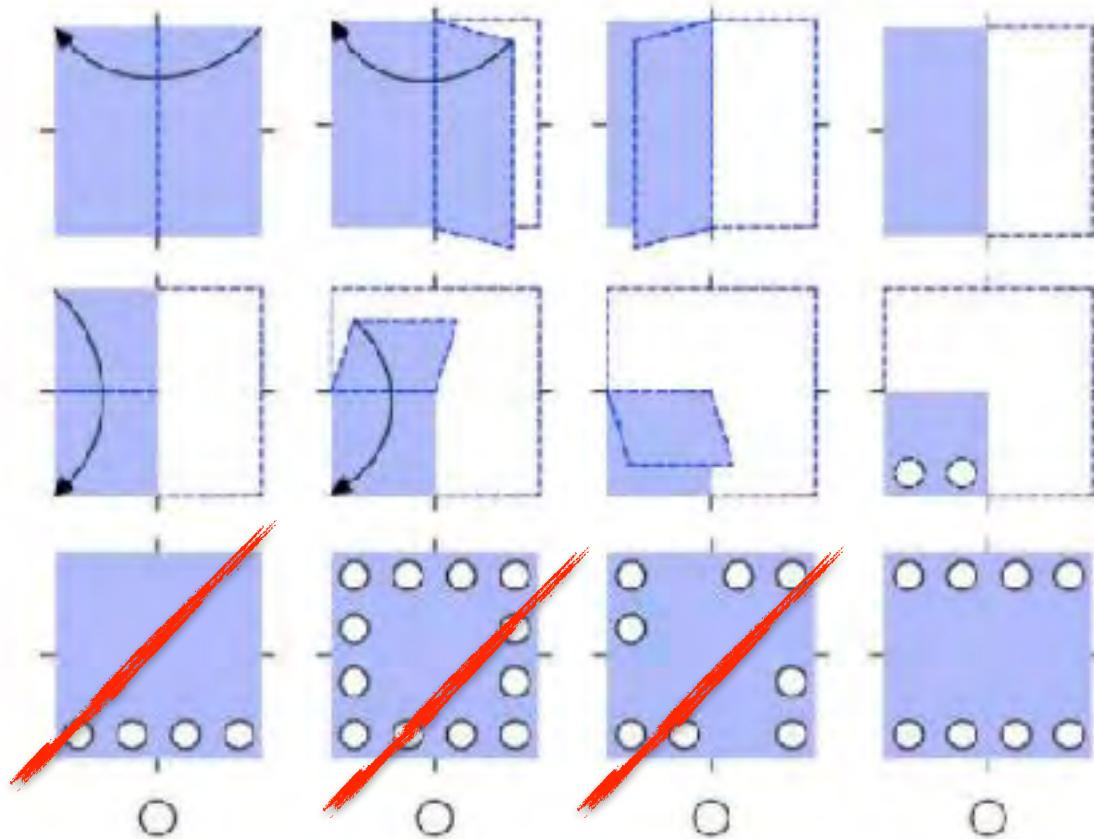
# Capacité d'orientation spatiale



Test de Rotation mentale

# Capacité d'orientation spatiale

<https://www.testingmom.com/>



Test du “Paper Folding”

# Capacité d'orientation spatiale

Immagine di essere il fantasma. Quale, tra le immagini piccole, è quella che vede il fantasma?

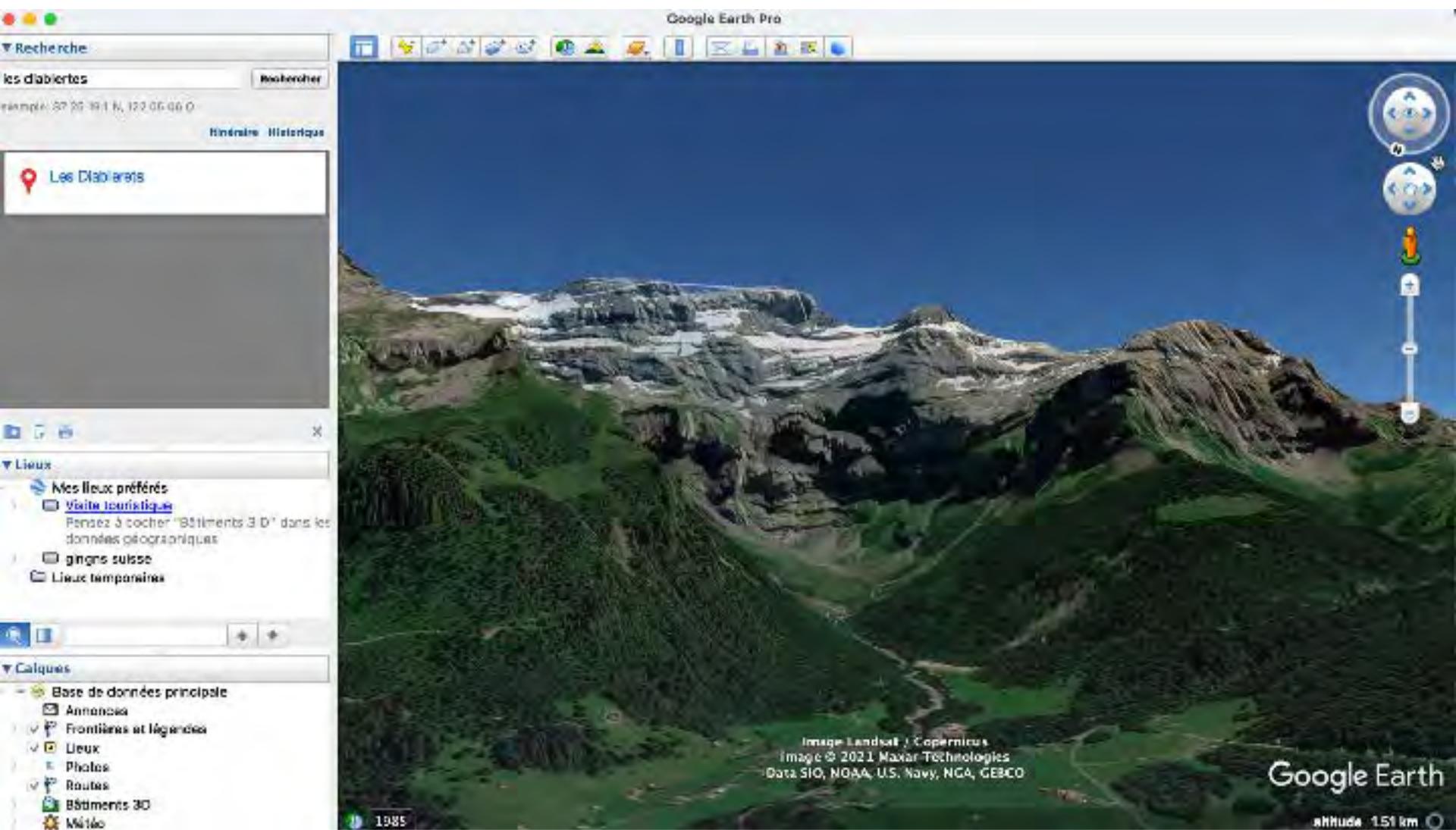
Immagine 5

Test du “Perspective taking”

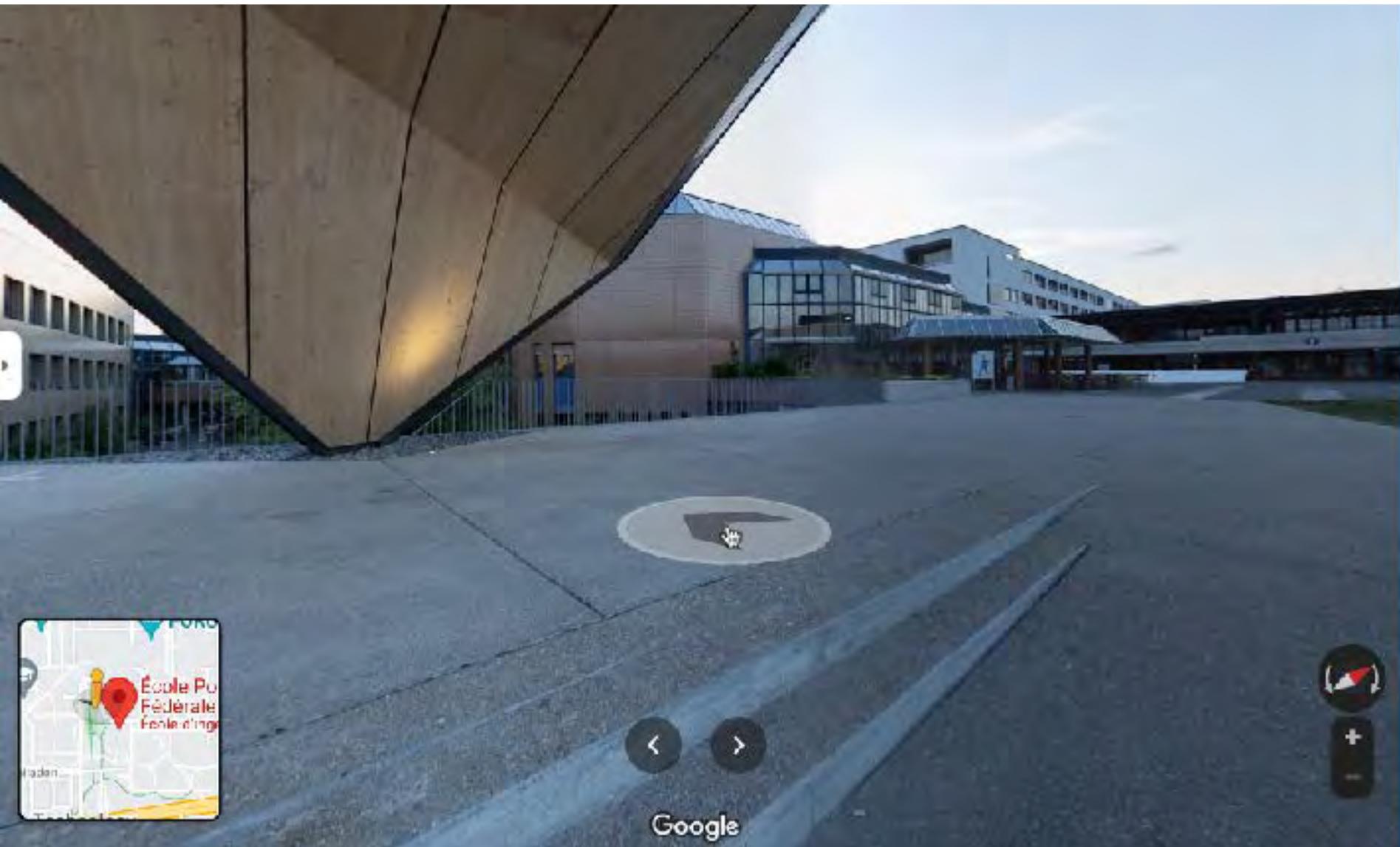
## Difficultés de navigation dans les espaces 3D: MineCRAFT



# Difficultés de navigation dans les espaces 3D: GoogleEarth

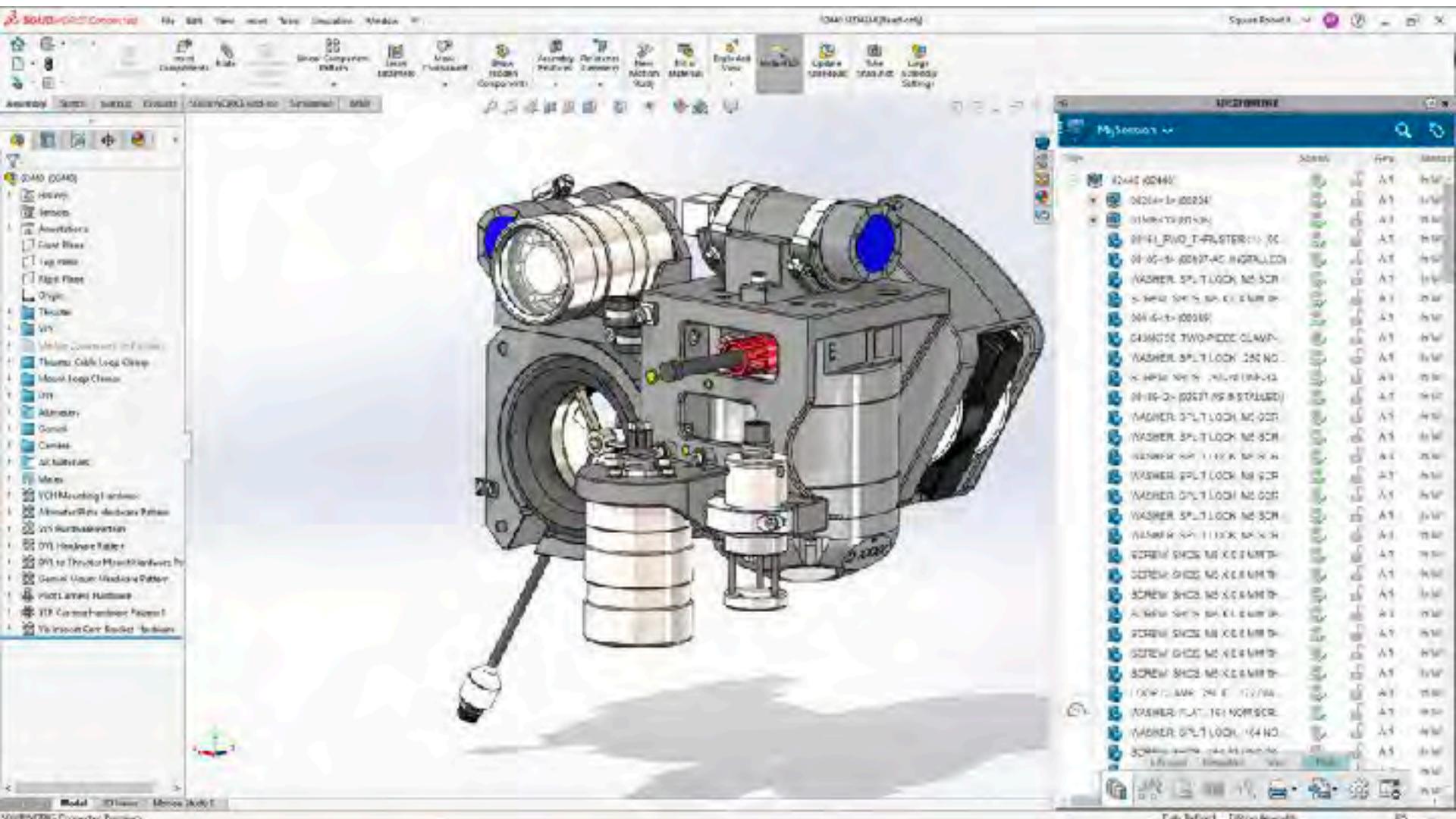


# Difficultés de navigation dans les espaces 3D : StreetView



## Difficultés dans les logical CAD:

*3D rotation, déplacement d'une pièce ou de la caméra, etc.*



# Contre-mouvement



Expérience

Différences  
Homme-Femme

Raisonnement  
Spatial

Problem  
Solving

Expérience

Différences

Homme-Femme

Raisonnement

Spatial



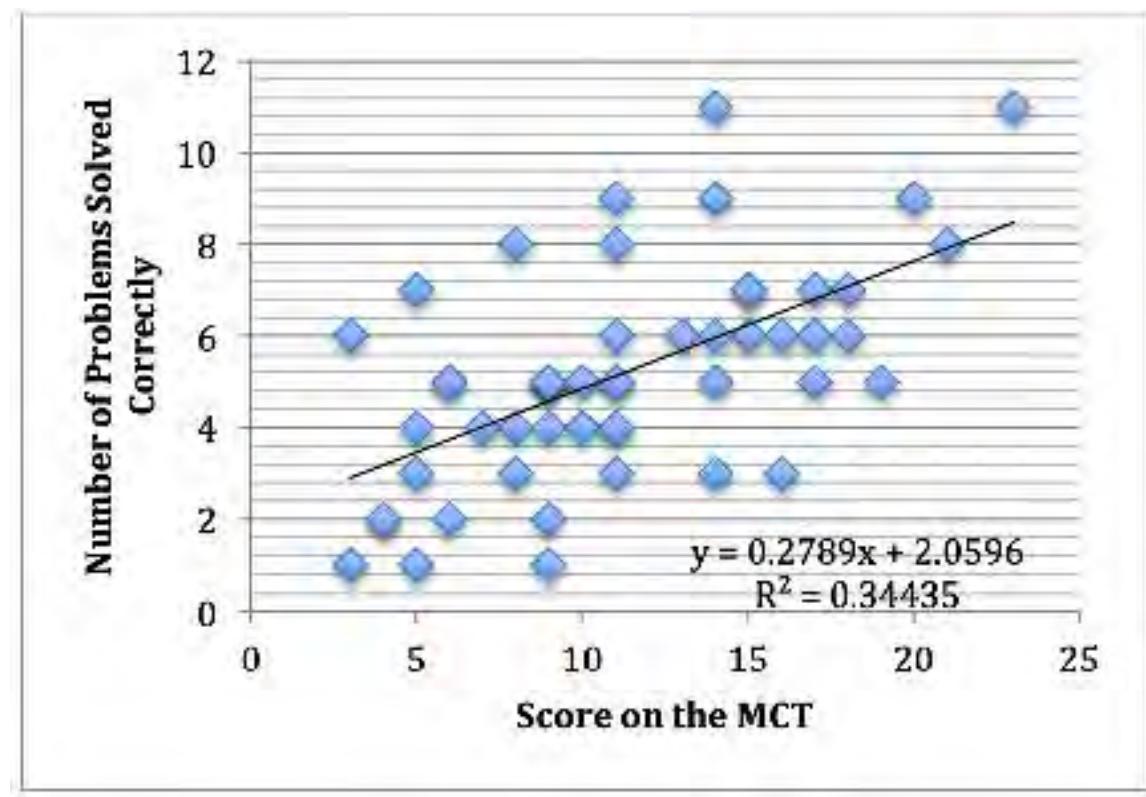
Problem

Solving

## Relation entre raisonnement spatial et études d'ingénierie

Différences

Homme-Femme

**Raisonnement  
Spatial****Problem  
Solving**

A strong positive correlation ( $R=0.59$ ,  $p<0.00001$ ) between spatial skills test scores and the number of problems successfully solved by the students was found.

Expérience

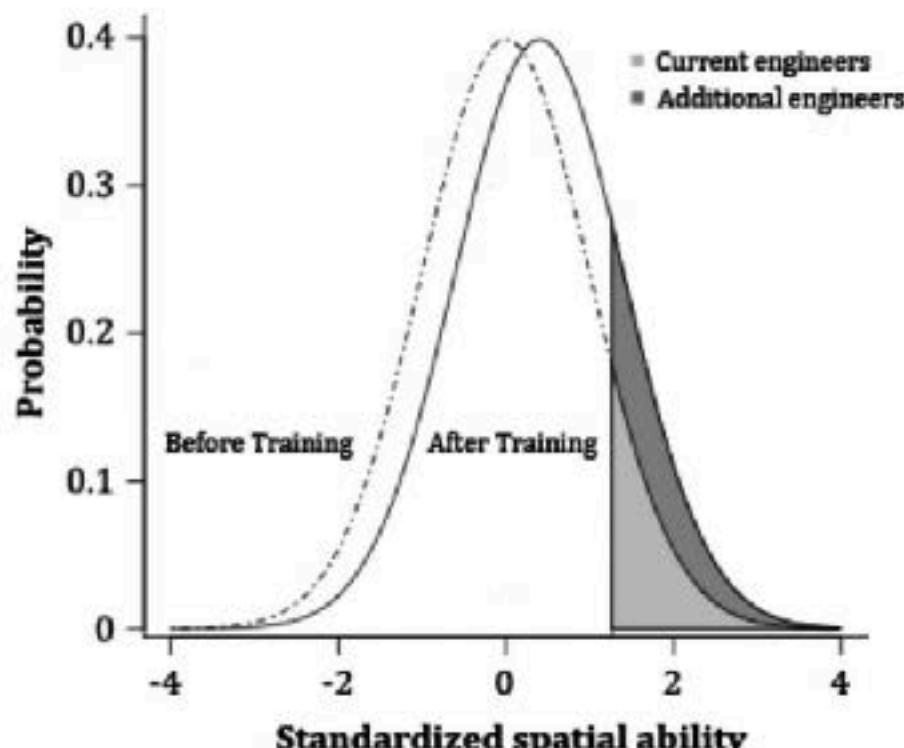
Différences

Homme-Femme

Raisonnement  
Spatial

On peut les  
développer

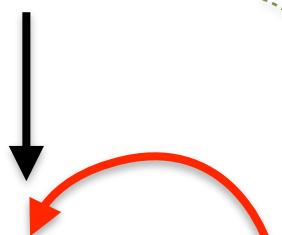
Problem  
Solving



*Figure 6.* Possible consequences of implementing spatial training on the percentage of individuals who would have the spatial skills associated with receiving a bachelor's degree in engineering. The dotted line represents the distribution of spatial skills in the population before training; the solid line represents the distribution after training. Shifting the distribution by .40 (the most conservative estimate of effect size in this meta-analysis) would approximately double the amount of people who have the level of spatial skills associated with receiving a bachelor's degree in engineering. Data based on Wai et al. (2009, 2010).

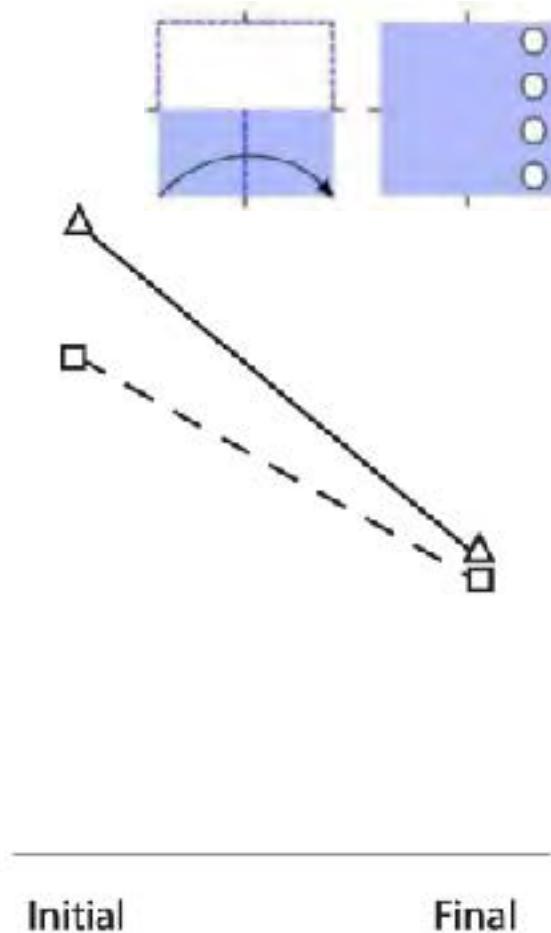
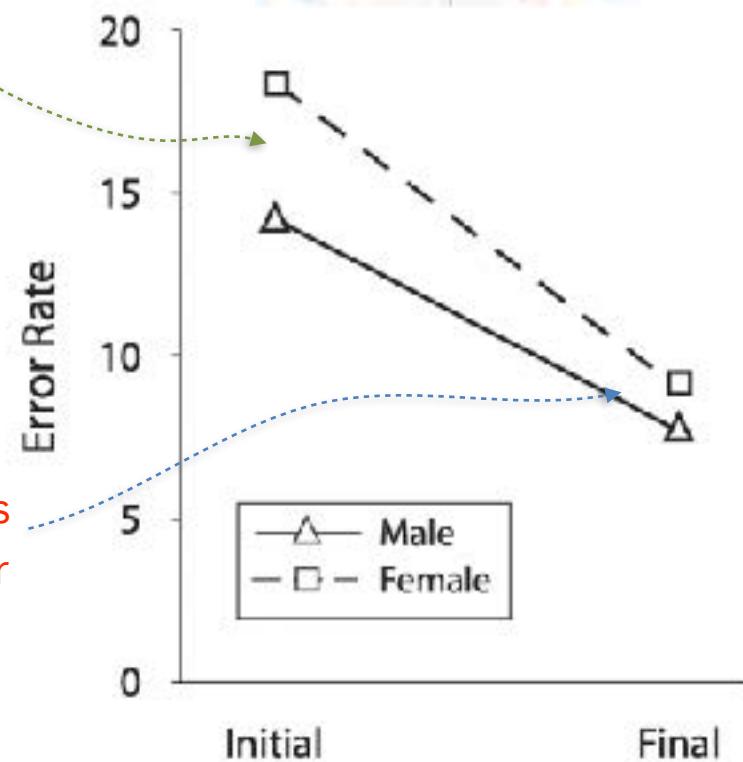
# Expérience

Differences  
Homme-Femme



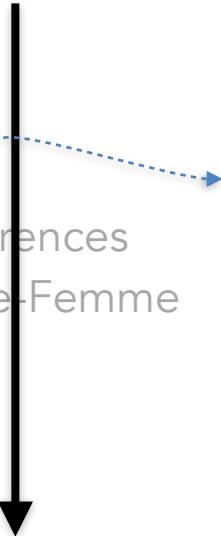
On peut les  
développer

Problem  
Solving



Expérience

# Carte ou GPS ?



Raisonnement  
Spatial

Problem  
Solving



<https://www.mototrip-tours.com/blog/stuff-we-use/gps-vs-paper-maps-on-a-motorcycle-tour/attachment/gps-versus-paper-maps-03/>

## Effet de l'utilisation du GPS sur le raisonnement spatial

*Any prothesis has an un-skilling effect*

Différences

Homme-Femme

Raisonnement  
SpatialProblem  
Solving**Table 1***Univariate correlations between study measures*

	1	2	3	4	5	6	7
1. Navigation Ability	—						
2. GPS Use	-.36**	—					
3. Mental Rotation	.21**	-.32**	—				
4. Perspective Taking	.27**	-.26**	.53**	—			
5. Within Pointing	.34**	-.20**	.23**	.26**	—		
6. Between Pointing	.25**	-.08	.12	.14*	.55**	—	
7. Distance	.26**	-.21**	.24**	.29**	.58**	.47**	—
8. Cog Map r <sup>2</sup>	.20*	-.16*	.20*	.23**	.56**	.50**	.59**
9. Daily Travel	.10	-.08	-.03	-.04	-.14*	-.03	-.01
10. Monthly Travel	.15*	.00	.02	.08	.03	.02	-.03
11. Utah Distance	.12	-.05	.14	.05	.07	-.03	-.01

*Note.* All variables have been transformed so that higher scores indicate more ability  
 indicates p < .05. \*\* indicates p < .01.

*Any prothesis has an un-skilling effect*

Combien de numéros de téléphone  
de proches connaissez-vous ?

# Questions d'examen

*Quelle est la capital du Groenland ?*

# Questions d'examen

## Question 7. Cognition

(4 points)

Les phénomènes de surcharge cognitive sont liés à la capacité limitée de l'un des types de mémoire. Lequel ? (une réponse correcte)

- La mémoire sensorielle
- La mémoire sémantique
- La mémoire de travail
- La mémoire épisodique

Justification facultative

## Question 8. Cognition

(4 points)

Un étudiant francophone rédige le rapport de son projet en anglais, dans un logiciel de traitement de texte. Quelles erreurs (écrites en rouge) correspondent à quelles causes (érites en colonnes) ? (une réponse correcte par ligne)

	Modèle mental inapproprié	Problème de métaconnaissance	Surcharge cognitive	Justification facultative
Il répète plusieurs fois le même argument dans le texte				
Il insère des lignes vides entre les paragraphes au lieu de régler l'espace inter-paragraphe				
Il ne se rend pas compte que ses phrases sont incompréhensibles pour celui qui n'a pas travaillé directement sur le projet				
Il a besoin de rédiger un brouillon en français avant de le traduire en anglais				