INSTITUT FRANCAIS
DES SCIENCES
ET TECHNOLOGIES
DES TRANSPORTS,
DE L'AMENAGEMENT
ET DES RESEAUX

ATTENTIONAL PERTURBATIONS ENCOUNTERED IN DRIVING: EXPERIMENTAL EVALUATION OF COGNITIVE FACTORS

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IFSTTAR

Background of the study

- Attention
  - Control information processing
  - Resources that can process information but limited resources
  - Vigilance ≠ Attention
- Driving activity
  - Information processing of the environment in order to reach a diagnosis, a decision making and an action
  - Involves many concurrent tasks
  - Attentional mechanisms allow their regulation
- Attentional perturbations are one of the most important explicative elements for accidents
- But…
  - Results vary across studies
  - The object of study is too fuzzy (variability of definitions)

Attentional perturbations in road accidents: In-depth accident analysis

- Van Elslande et al. (2009): 3 attentional problems, according to the task that competes with the driving task:
  - Inattention: interference between a driving task and personal concerns and thoughts
  - Attentional competition: interference between several tasks relevant for driving (e.g. guide a vehicle and follow an itinerary)
  - Distraction: interference between a driving task (e.g. guide a vehicle) and a stimulation in the environment (in or out of the car) which has no link with driving (e.g. tune the radio)
- Hoel et al. (2011): Specificity in the accidental mechanism associated with each attentional perturbation
  - Different errors generated

    detection/diagnosis/prognosis/execution errors
  - Different impact

    higher impact for distraction than for inattention and attentional competition

Objectives

- To what extent does a perturbation in attentional processes actually lead to a decrease in performances?
  - evaluate experimentally what is directly attributable to a failure of attentional processes
    - Attentional competition vs distraction
    - Limit the sources of attentional perturbations (i.e. motor behaviors)
    - Visual search task: perceptual load paradigme (Lavie, 1995)

- Is there differences between individuals?
  - test if a factor internal to individuals modulates the inter-individual differences in attention
    - Working memory capacity: OSPAN (Unsworth et al., 2005)

Apparatus

31 participants: 16 females and 15 males (mean age = 26.8, range = 19-35).
All performed the visual search task and the WMC task.

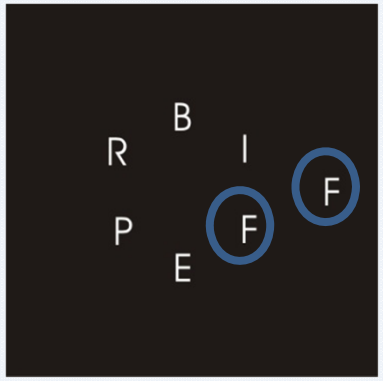
Visual search task

- Circle of six letters
- One target F or T
- Peripheral distractor letter F, T or S
- 3 variables
  - Distractor compatibility
  - Perceptual load
  - Discriminability

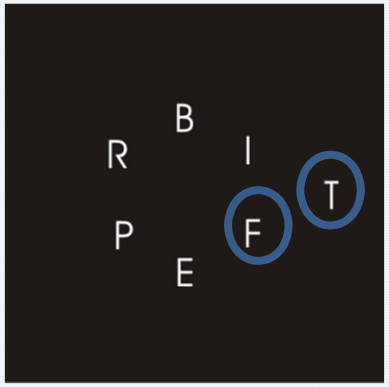
WMC task

- Math operation
- Letter to be recalled

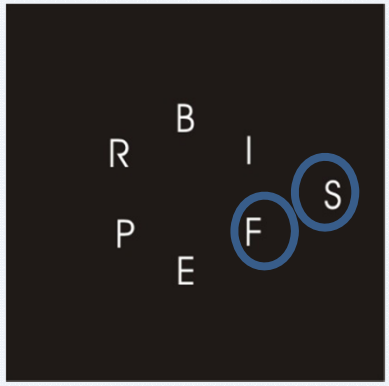
Distractor compatibility



Compatible condition

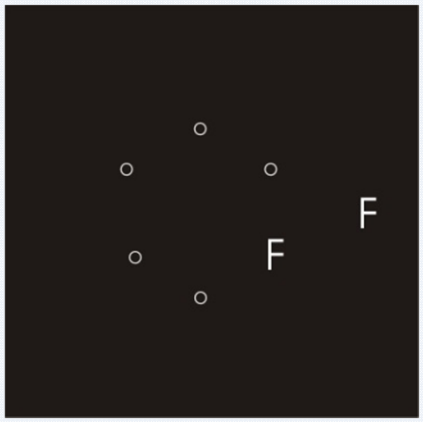


Incompatible condition ➔ ***Attentional competition***



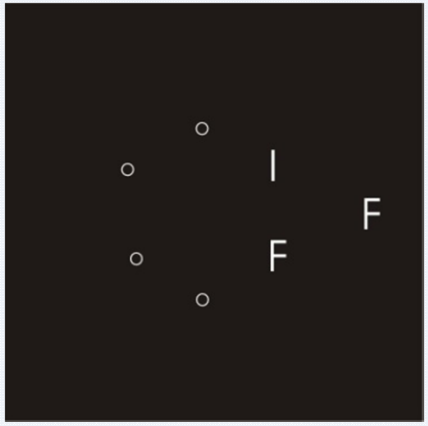
Neutral condition ➔ ***Distraction***

Perceptual load



Set size 1

Set size 4



Set size 2

Set size 6

Discriminability

Low discriminability

Intermediate discriminability

High discriminability

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  - *Perceptual load*
  - *Discriminability*

WMC task

- Math operation
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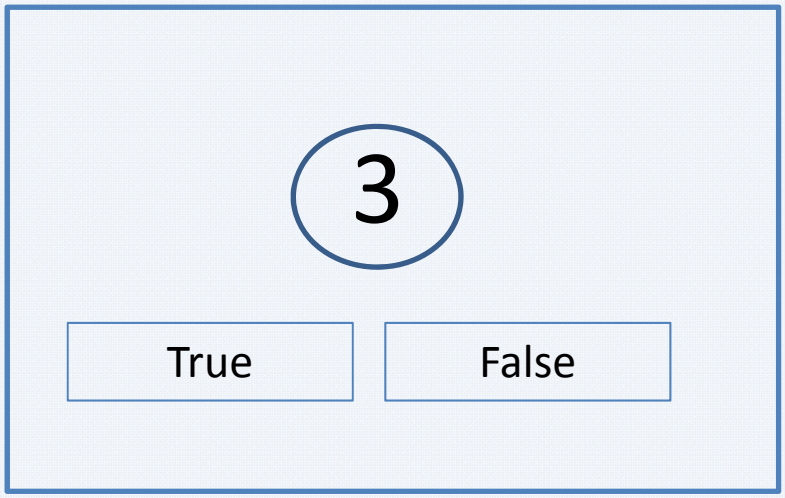
(1*2) + 1 = ?



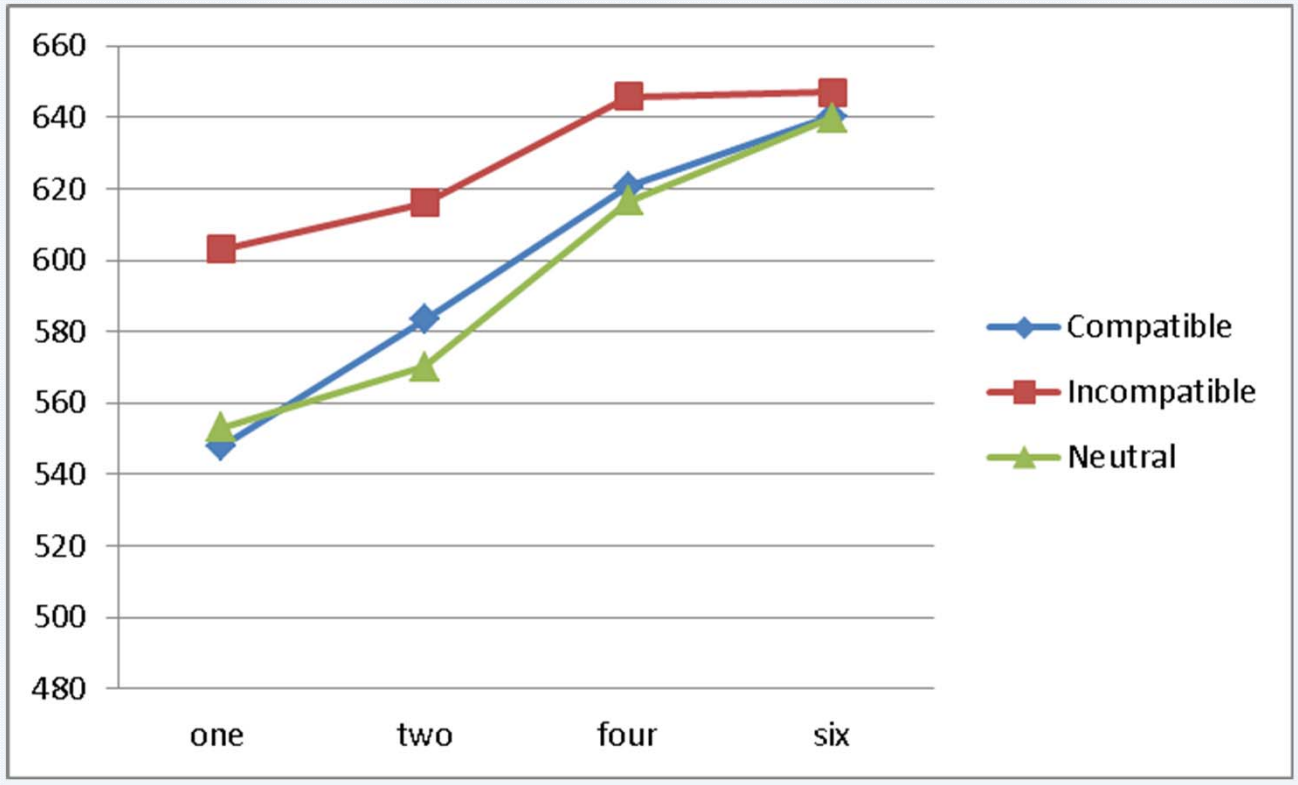
Results

Performances on the visual search task

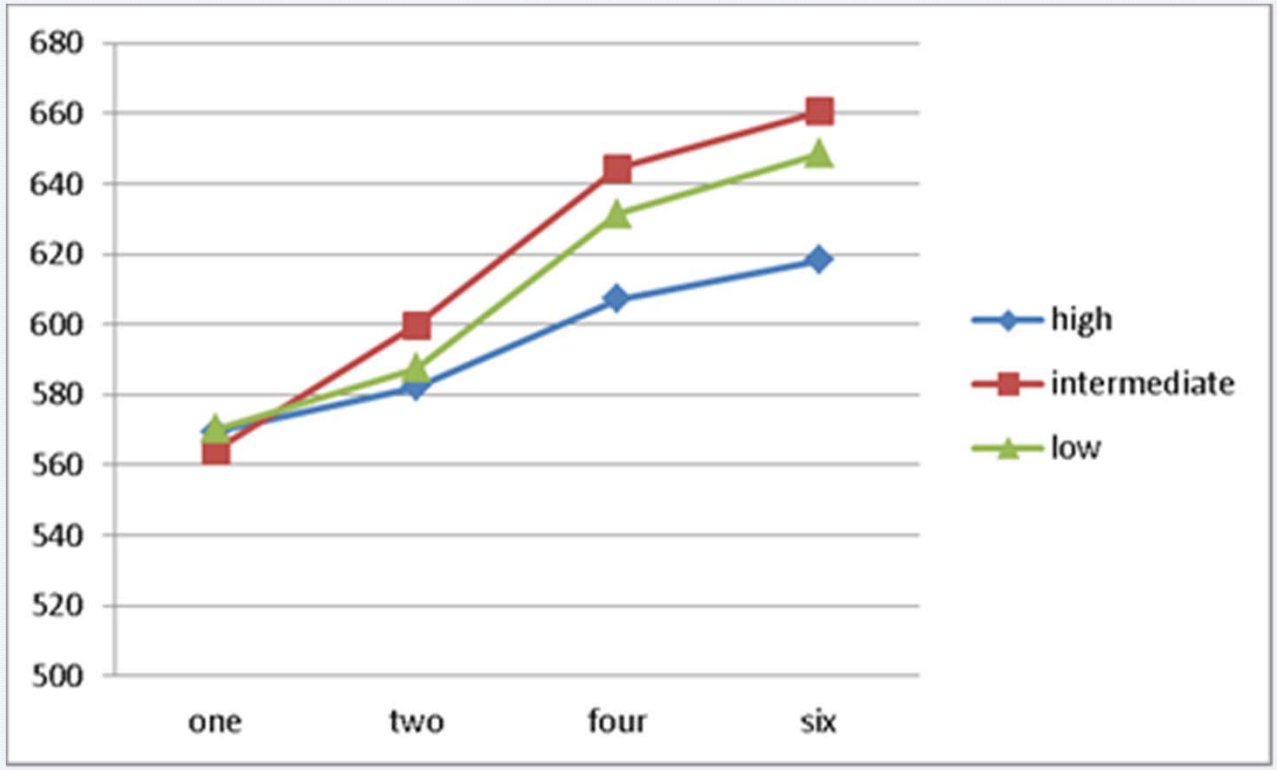
- Main effect
  - Compatibility
  - Perceptual load
  - Discriminability
- Interaction
  - Load and compatibility
  - Load and discriminability

Individual differences

- 10 high spans and 10 low spans
- No effect of span groups
- Interaction
  - *Compatibility, discriminability and span group*
- Trend
  - *Span group, load and compatibility*



Reaction time as a function of set sizes (perceptual load) and distractor compatibility



Reaction time as a function of set sizes (perceptual load) and discriminability.

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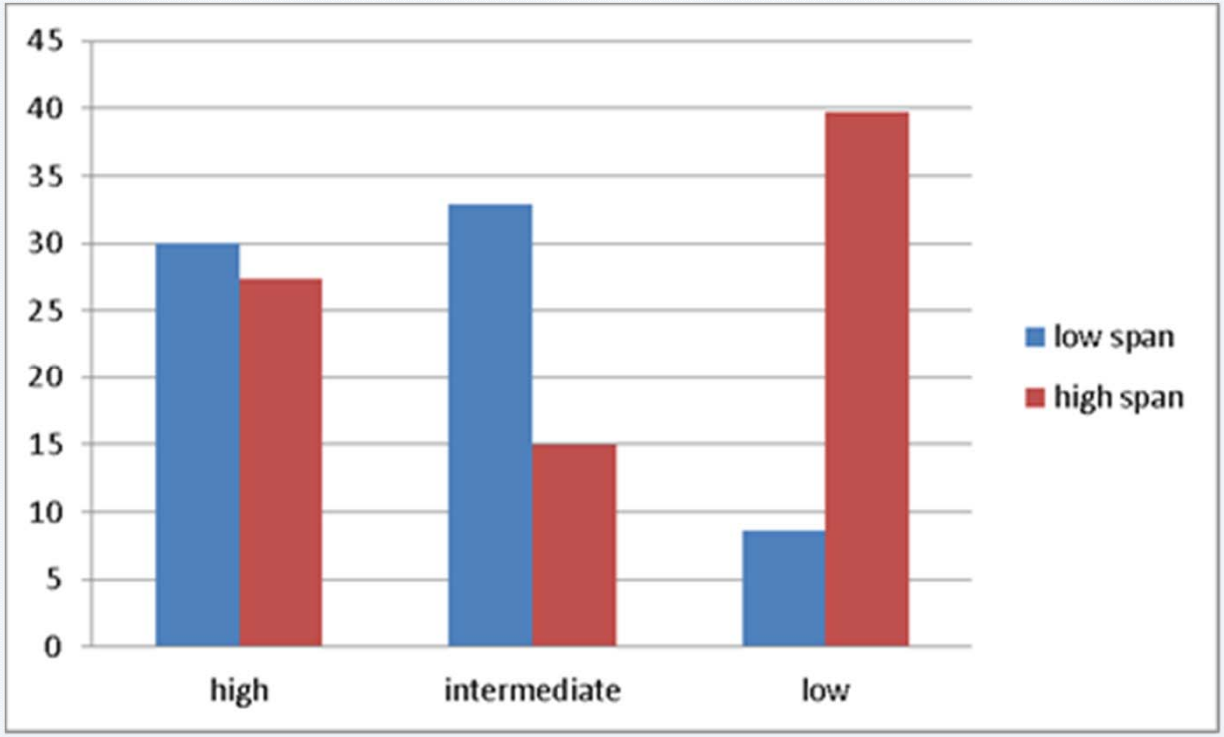
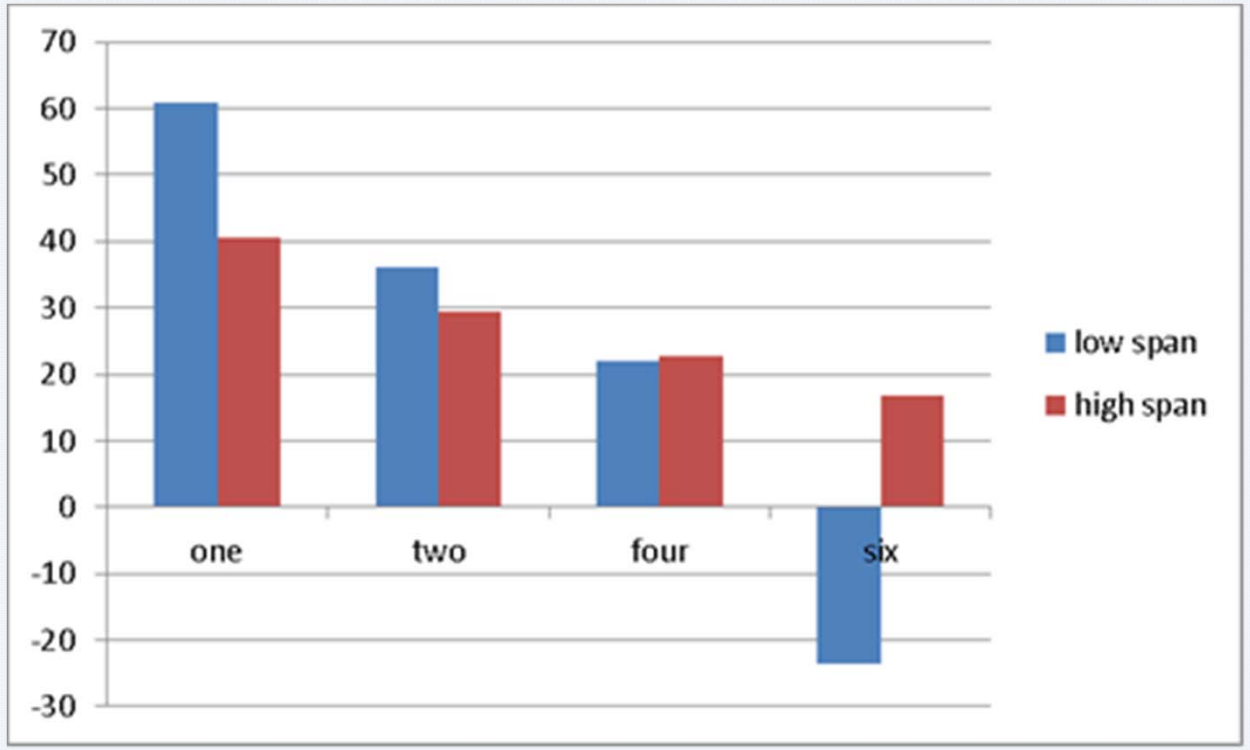


Distractor-compatibility effect on reaction time as a function of discriminability and span groups. Distractor cost was calculated as RTs on incompatible trials minus RTs on compatible trials.



Distractor-compatibility effect on reaction time as a function of set sizes and span groups. Distractor cost was calculated as RTs on incompatible trials minus RTs on compatible trials.

Discussion

- Perceptual load theory findings (Lavie, 1995; Lavie and Cox, 1997)
- Low-spans are better able to inhibit distractors when:
  - Large number of non-target letters (quantitative level)
  - Visual resemblance between target letter and non-target letters (qualitative level)
- Connections with driving
  - On a purely cognitive level, attentional competition have a stronger impact than distraction
  - But this impact is reduced under high percetual load conditions
  - Not the same as in-depth accident analysis
- Driving assistance systems…

Thank you for your attention