TVA

# Agenda

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# Introduction

* Examines visual attention
* Which objects reach conscious awareness?
* What are the capacity and processing limits of visual attention?
* TVA views visual attention as a **race** between input/stimuli which can be influenced by executive functions by favouring targets and increasing the likelihood that they make it first to the finish line

**Parameters**

* *K*: Capacity of VSTM
* *C*: Processing speed
* : Selectivity – measures the ratio of distractors to targets (0-1, 0 = perfect selection)
* *T0:* Perceptual threshold at which stimuli are noticed (ms)
* *Windex: Attentional weight to each side of display (0-1, 0.5 = balanced)*

# Hypothesis

* Accuracy increases with display time
* Correlation between C and K parameters
* TVA-parameters are correlated with age but unaffected by sex
* Imperfect selectivity: distractors decrease correctly reported letters
* Windex = 0,5, no spatial bias in target recall

# Method

* Computer-based paradigm with both whole-report and partial-report, 9 blocks of 27 trials
* Participants have counter-balanced target and distractor colours (red and blue)
* Fixation 1000 ms -> up to 6 letters 10-200 ms -> letters masked 500 ms -> report targets

# Results

## Figure 1: Correctly reported letters at various display times

* Longer display time, means more correctly reported letters -> significant main effect
* Correctly reported letters seem to flatten out at the longest display times (200ms) -> The point where processing speed (C) is exchanged for capacity (K) as the limiting factor
* 2T4D (150ms): Reports more than half of the targets, implying good but imperfect selection.
* 2T4D: Fewer correctly reported letters than same display time for full-report -> distractor influence

## Figure 2: TVA plot for FPXXXXX

* *C* follows slope in datapoint for *t0*
* *t0* is about 15 ms
* *K* is slight above 3 items

## Figure 3: Correlation of C and K

* A positive correlation shows that participants with a higher processing speed (C), also have a higher VSTM capacity (K)
* Positive correlation between age and means that older individuals have poorer selection
* Age correlations with other TVA parameters were not found -> may be due to sample
* According to TVA, parameters are independent and should not correlate
  + This may be explained by alleging overlapping neural bases for the two factors/functions
  + Coincidentally, this is somewhat similar to the findings of Todd and Marois (2004) in which IPS/IOS was involved in both encoding and maintenance of VSTM and peaked in activity according to the VSTM capacity limit

## Table 1: Attentional weight and sex differences

* Only one significant difference between M and F: *Windex* is higher for F, meaning they weighted their attention more to the **left** while men had even attention -> same sample issue
* Looking at the entire sample, attention was weighted to the left

## Imperfect selectivity

* One-sample *t-*test of difference between mean number of correctly reported letters for 2T4D displays and 2 (maximum possible)
* Significant difference between mean reported items and 2 -> imperfect selection
* Bottom-up processes interject distractors into consciousness

# Conclusion

* More letters reported with longer display times
* Distractors reduce accuracy in partial report trials: >0 and fewer correct letters in 2T4D than full report 150 ms display
* *C* and *K* are correlated (possible neural overlap)
* Attention is not divided equally, rather shifted slightly left: *Windex* > 0.5

# Discussion

* **Left-weighted attention:** Reading direction, **Adelman** et al: all letters in word processed in parallel -> but we are still used to orienting to top left before anything else

# Grand perspective™

* **Todd & Marois (2004), article 3: Finds that ISP/IOS is the neural basis for VSTM capacity (C and K parameters), since these areas are active in encoding and maintaining VSTM-stimuli**
* **Neural basis of attention (Gondan slides): bilateral network of Frontal Eye Fields (FEF), intraparietal sulcus (IPS) and superior parietal lobule (LPL)**
* Overt vs covert attention
* Bottom-up/stimulus-driven attention vs top-down/controlled attention
* Stroop: Selective attention
* Feature search: Looking for the target colours
  + Pop out effect
* 100 ms temporal window for sensory modalities to affect each other (visual illusion, Shams)
* Hemispatial neglect: Problems with directing attention to a certain hemifield
* Dorsal (where) and ventral (what) streams of visual processing
* ADHD = Have a higher α due to limited attention inhibition: **Four types of inhibition (Purves):** Halting behaviours that are well trained or previously valid; preventing irrelevant information from interfering with other processing; restraining actions that are inappropriate in a given social context; removing irrelevant information from working memory
* **Baddeleys multi component model:** Visual sketchpad: Maintains visual information about form or colour
* **Funahashi:** Response of a single neuron in right DLPFC -> firing is strongest during the delay period, but only when the cue was located at the upper left corner -> This neuron is specialized in visual input from this area of our field of vision
* **Neural basis of STM/WM: Dorsolateral prefrontal cortex (DLPFC) (from Gondans STM slides):**
  + DLPFC’s role = active maintenance of information
  + Activation typically persists for the entire delay-period in memory tasks (few to 30 s)
  + Activation increases with amount of information that has to be maintained
  + Increased activation is associated with better WM performance
  + Increased activation is associated with resistance to distraction
  + Increased activation when the task requires manipulation of information instead of passive maintenance
* **Posner cueing task:** Participants must react to stimuli left or right of fixation without moving their eyes.
  + **Endogenous cues (arrows):** Valid, invalid, and neutral cues are given (arrows pointing in right, wrong or both directions). Valid cues facilitate for attention to be moved and processing of target to begin earlier.
  + **Exogenous cues (highlighting target box)**: Highlighting the target box or presenting an arrow outside the fovea creates exogenous cueing.
  + There are 3 mental operations that occur during covert orienting: **disengagement** of current focus, **movement** to selected target, and **engagement** of selected target.