Fitting "Same"-"Different" data using a parallel race model:
A theory of priming.

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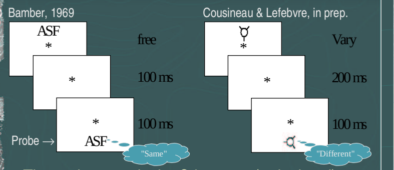
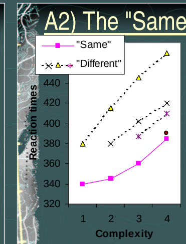
A1) The "Same"-"Different" task



- The probe complexity C is 1 to 4 (3 depicted);
- Duration of the first slide not controlled by Bamber
- If different, the probe has from 1 to C differences.

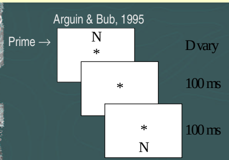
A2) The "Same"-"Different" results



- "Different" responses suggest a serial self-terminating search for the first difference.
- "Same" responses are convex and faster than "Different", rejecting any serial model (Sternberg,`98).

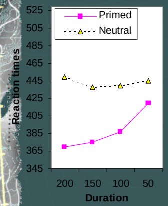
The simpler the object is, the easier the decision is.

B1) The "letter"-"non-letter" priming task



- The complexity C of the probe is always 1
- The duration of the prime D is varied (50..200 ms).

B2) The Identity-priming results



- With no prime (neutral), there is no effect of the duration D.
- With prime, responses are convex and faster than neutral or invalid (not shown) conditions.

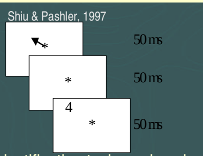
The longer the prime is seen, easier the decision is.

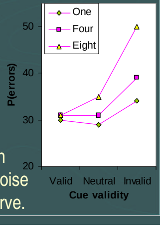
A & B commonalities:

- ➢The two tasks have identical procedure
  - ▪ A manipulates complexity C
  - ▪ B manipulates duration D
- ➢The two tasks have identical results
  - ▪ In A, simpler objects are better;
  - ▪ In B, longer presentation is better.

Are there other tasks with such a "signature" in the results? Yes.

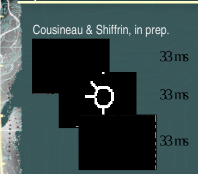
C) Cue validity and the number of cued locations in a cued detection task

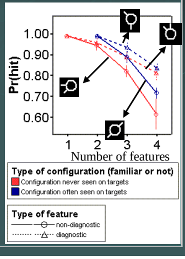




Identification task; easier when fewer mask, suggesting that noise is partly responsible for the curve.

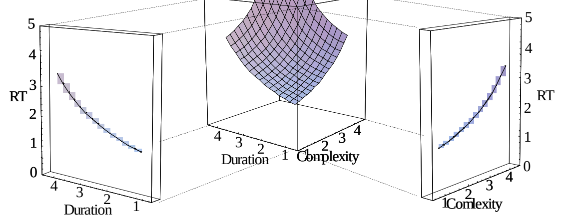
D) A feature detection task





Perceiving well-learned features and well-learned configuration is easier, suggesting that preactivation can be internalized.

<u>Hypothesis</u>: Duration effect and Complexity effect are but two aspects of the same phenomena: Priming.



Priming results from
a preactivation of relevant processors so that performance are better than baseline,
but also from
a rapid decay of that preactivation so that the concerned processors return to baseline performance.

A simple model of priming

Assumptions:

- Short duration or complex stimuli favor rapid but linear decay of the information.
- Thus, this form of "noise" makes some low-level detectors unable to respond.
- Low-level detectors are assumed to be legions, given by the ρ factor (redundancy conjecture).
- Response times are given by a counter model where the redundant detectors are racing (Cousineau, submitted).

Rejected models:

- Limited-capacity models (predicts concave curve);
- Strength of activation models (circular argument);
- Linear preactivation of the processors (predicts linear facilitation);
- Random-walk model with an increasing boundary (predicts concave curve);

Behavior of the model

- With noise (i.e. complex of brief stimulations), less racers are available to fill the counter. Thus, the average response (crossing the boundary) will be both slower and more variable (see Figure 1).
- Plotting the average response times as a function of available detectors yield the typical signature of priming (see Figure 2).
- It is important to note that this non-linear effect is obtained with a linear increase in noise.
- All the equations can be obtained in closed form.

Vulgarization of the model

- The model can be seen as a Random-Walk model (Ratcliff, 1977; see Figure 3).
- The drift rate is given by an angle θ. Any increase in noise (i.e. complexity or shorter duration) decreases the drift rate by a constant value Δθ.
- The average time ***t*** to cross the boundary is thus given by the cotangent ! This curve for θ values between 90 and 30 degrees turns out to be an EXCELLENT approximation to both the model (Figure 2) and the empirical data (A2 and B2).

Figure 1: RT distributions when the number of racers ρ varies

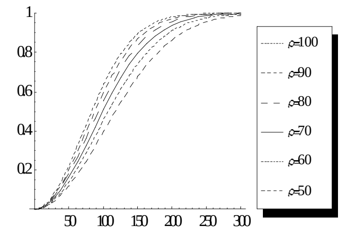


Figure 2: Predicted RT

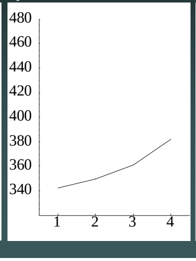
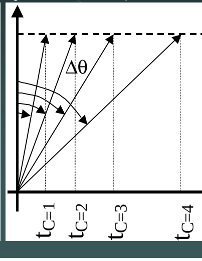


Figure 3: Random walk representation



I would like to thank C. Lefebvre and S. Hélie for their comments.

> «How can a massively parallel computer know which program to select at a given moment, if the programs are not ordered by priority?»
>
> - Hasbroucq, pers. com.

The Same-Different task (Bamber, 1969, Nickerson, 1967) is one of the simplest tasks used to study the recognition of visual patterns. Yet, the response times (RTs) obtained are among the most enigmatic in cognitive psychology (Sternberg, 1998). RTs to respond «different» seem to comply with a serial, self-terminating comparison model (because RTs are linearly longer for more complex objects and linearly shorter for dissimilar objects). However, RTs for «same» responses are shorter than any «different» responses. This rules out serial exhaustive processing when the two objects are identical. We present a model of priming that accounts simultaneously for both «same» and «different» responses. This approach shows that priming tasks and Same-Different judgment tasks are identical. Further, the results from a detection task (Townsend and his colleagues, 1984, 1981) are identical to Bamber's data. This suggests that priming, or decay of it, also explain these results. Finally, since priming was modeled with the use of a variable threshold, the various points along a ROC curve can correspond to various levels of priming. This approach thus synthesizes a large body of classic results in cognitive psychology.

Priming Recognition Recency effect Detection of diagnostic information Consistency of mapping Priming Recognition Recency effect Detection of diagnostic information Consistency of mapping Priming Recognition Recency effect Detection of diagnostic information Consistency of mapping Priming Recognition Recency effect Detection of diagnostic information Consistency of mapping Priming Recognition Recency effect Detection of diag

The
ubiquitous
presence
of priming

> «An optimal information-retrieval system should be biased to fetch frequently and recently encountered items.»
>
> - Pinker, 1997

> «L'amorçage, c'est super songé.»
>
> - Jean C. Rien, 1999