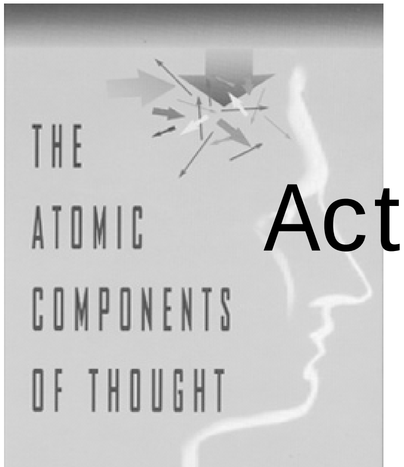

Activation,Latency, and the Fan Effect

ACT-R Post Graduate Summer School 2001

Coolfont Resort

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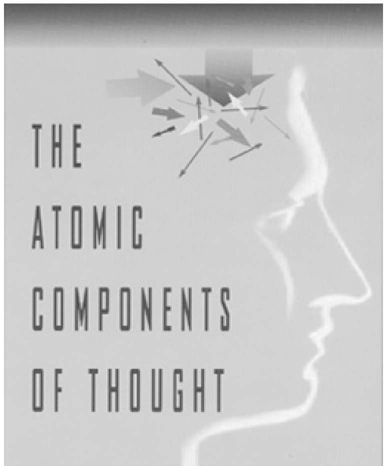
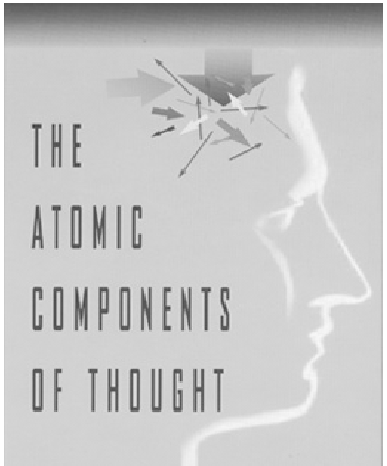


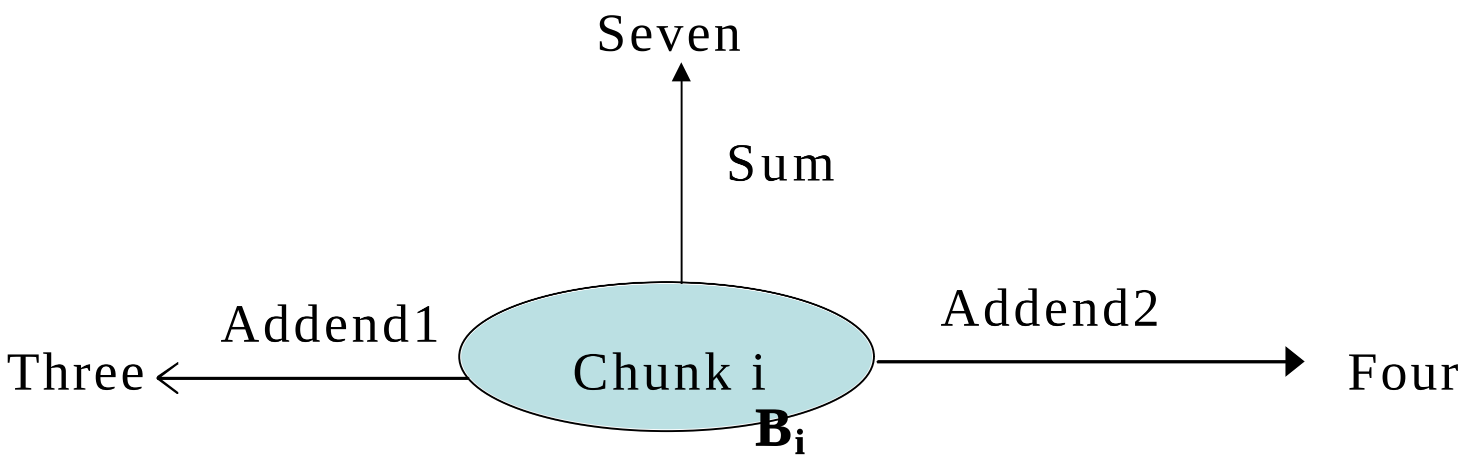
Comments on Activation, Latency, and the Fan Effect

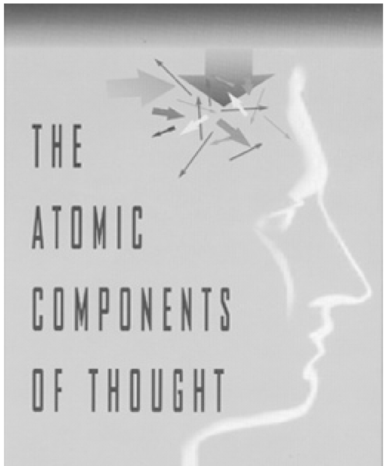
Note that in the 25 year history of ACT, activation has been the central concept, latency the central dependent measure, and the fan effect the central phenomenon.



Activation

$$A_i = B_i + \sum_j W_j S_{ji} + \sum_k P_k M_{ki}$$





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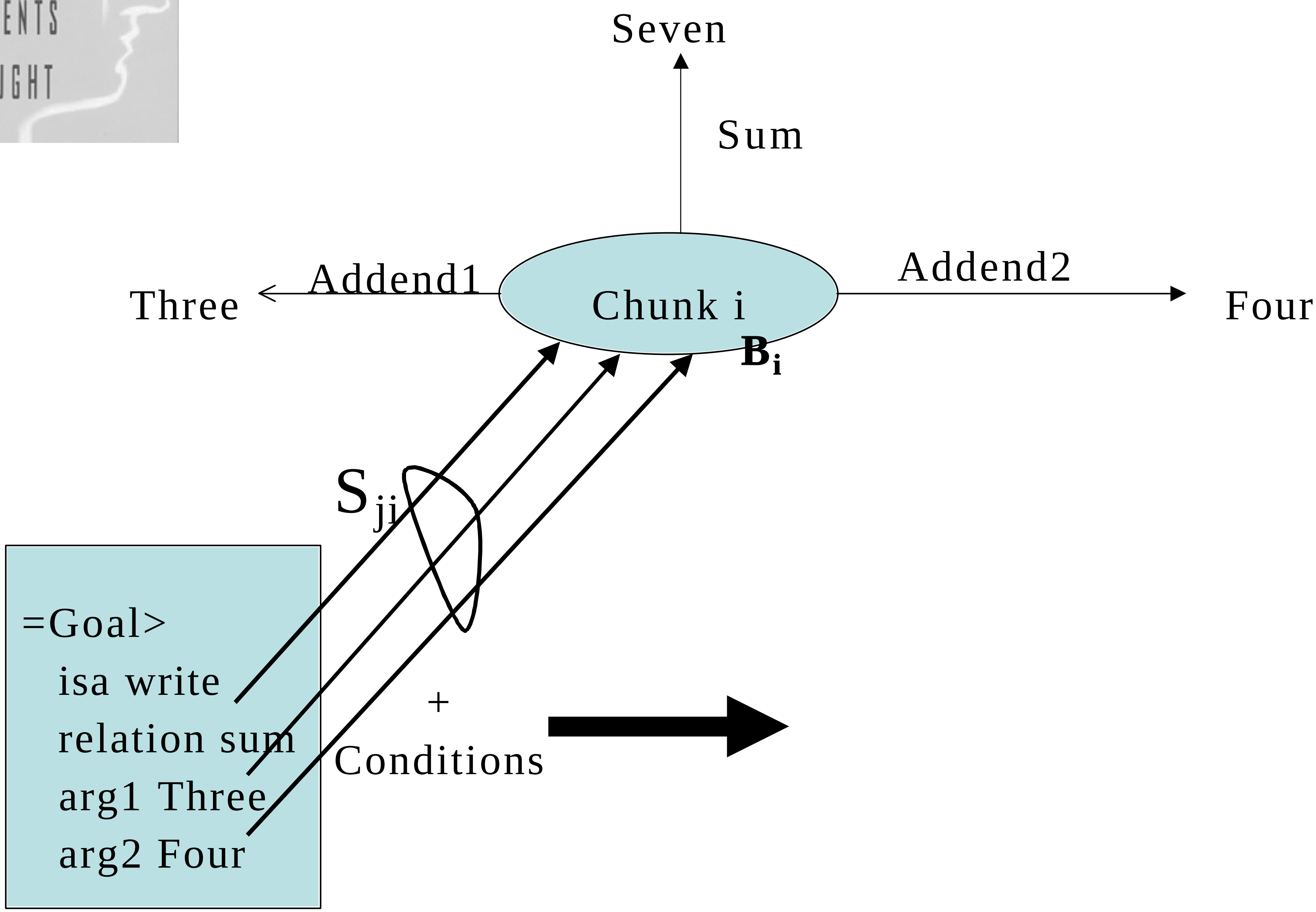

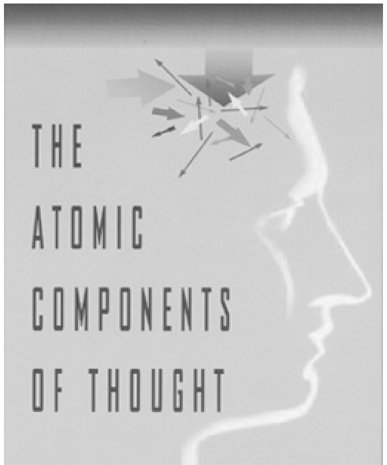

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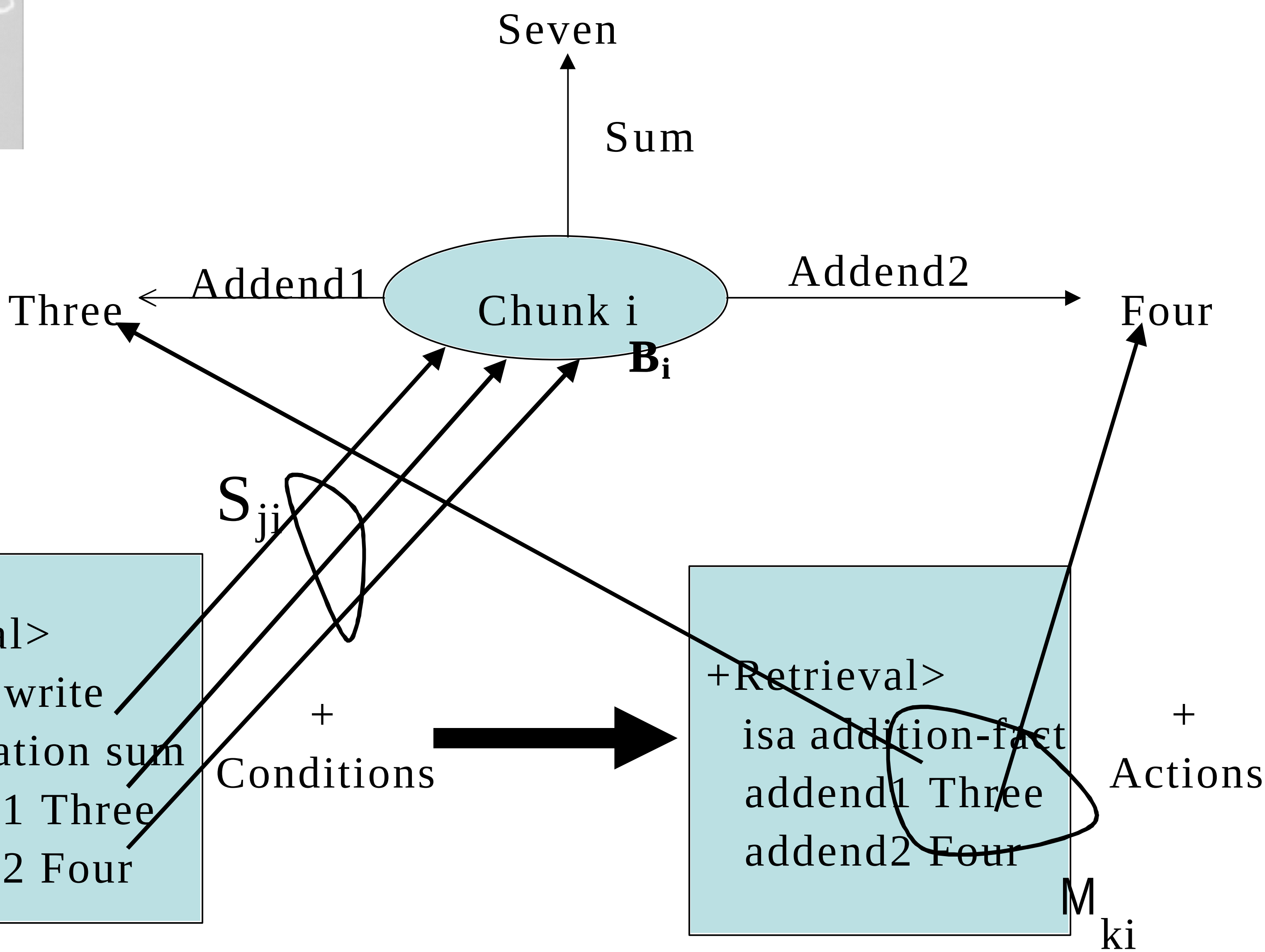
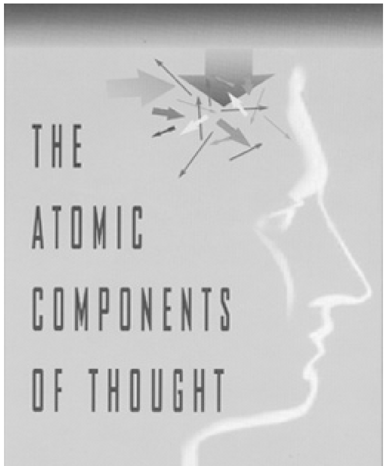




Comments on S_{ji}

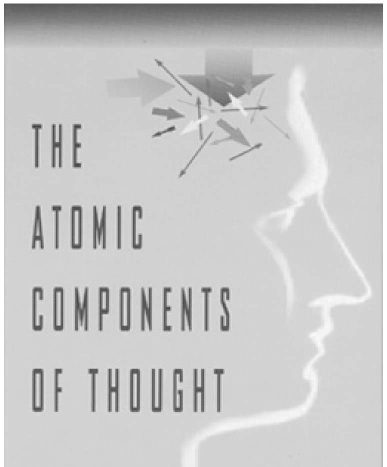
$S_{ji} = \ln(m/n) = \ln(m) - \ln(n)$ Prior Strength Equation 4.2

$$S_{ji} = \ln\left(\frac{assoc * R^{*}_{ji} + F(C_j)E_{ji}}{assoc + F(C_j)}\right)$$

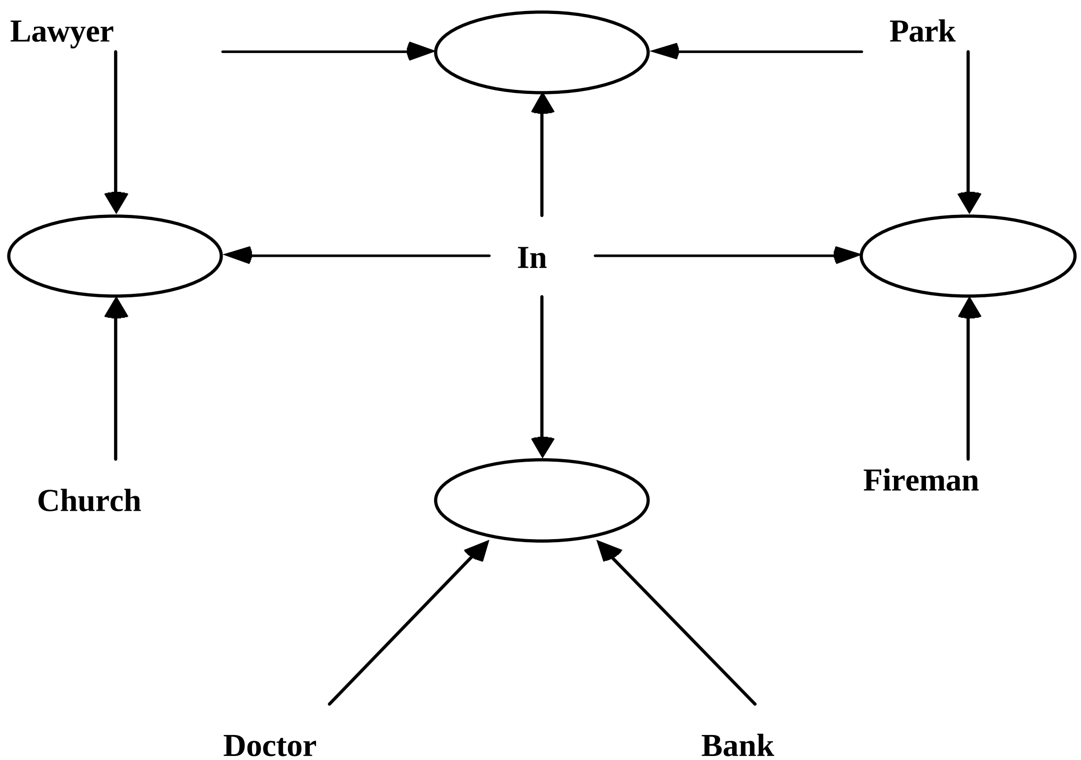
Posterior Strength Equation 4.3

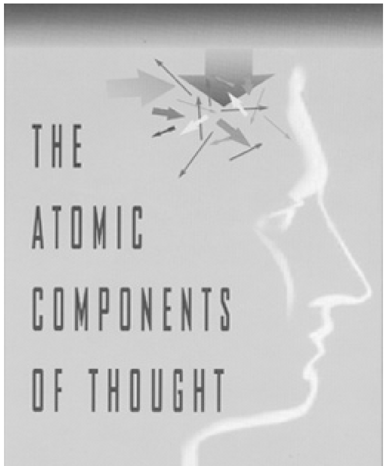
Learning definition (Posterior Strength Equation 4.3) is disastrous – produces all sorts of unwanted side effects. Because of the lack of control over m the prior strength equation is also often disastrous. The one that works is

$S_{ji} = S – \ln(n)$



The Fan Effect





S_{ji}'s and the Fan Effect

S_{ji} = S – ln(n)

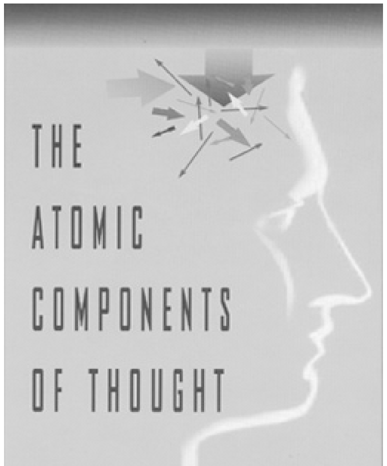
$$T = Fe^{-A_i}$$

$$= Fe^{-B_i - \sum W_j S_{ji}}$$

$$= F' e^{\sum W_j \ln(n_j)}$$

$$= F' \prod_j n_j^{W_j}$$

where n_j is fan of the jth element.



Competitive Latency Equation

Set partial matching off. Then

$$Time_i = F\frac{\sum_{j \neq i} e^{A_j} + e^t}{e^{A_i}}$$

$$= F\frac{e^t}{e^{A_i}} = I + F' e^{-A_i}$$

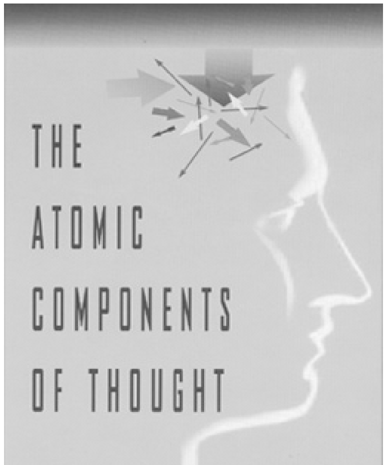
Therefore set $F = F' e^{-t}$

This also implies $F' = Fe^t$,

which we found with F = .35. This is a hopeful sign that we will at least get F being a constant under 1. The parameter τ may still vary with average activation values.

Other arguments for competitive latency

1. Explains of distracter priming and other short-term inhibition effects
2. Explains why all the prior facts do not produce huge interference.
3. Predicts similarity-based fan effects



Setting Goal Activation to Zero

(or a Constant independent of fan)

$$T = F^{\frac{\sum_{j \neq i} e^{A_j} + e^{t}}{e^{A_i}}}$$

$$= F^{\frac{\sum_{j \neq i} e^{B_j + \sum_k P_k M_{kj}} + e^{t}}{e^{B_i + \sum_k P_k M_{kj}}}}$$

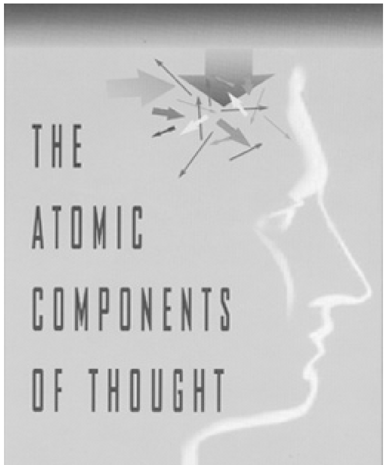
$$= F^{\frac{2(n-1)e^{H+L} + (m-2n+1)e^{L+L} + e^{t}}{e^{H+H}}}$$

$$= F\left[2(n-1)e^{-(H-L)} + (m-2n+1)e^{-2(H-L)} + e^{(2H-t)}\right]$$

where n is fan, m is the number of facts

H = $P_k M_{kj}$ for high similarity

L = $P_k M_{kj}$ for low similarity



Problems with Competitive Latency and Abandoning Strength of Associations

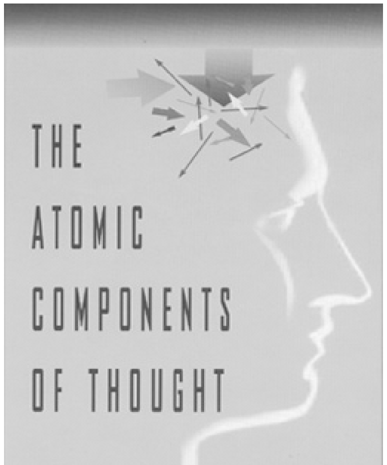
1. Competitive latency equation implies an linear effect of number of alternatives.

2. Competitive latency equation implies no effect of practice on fan effect.

3. Competitive latency equation implies an artificial bound on latency distribution if noise is added before competition.

4. The level of partial matching required to produce fan effects can lead to too high a level of misbehavior.

5. Without strengths lose ability to get non-specific priming of knowledge.



Proposal

(Based on Raluca Budiu's thesis)

$$S_{ji} = M_{ji}$$

This now just leave us with the task of defining similarities (but lets call them associations or S_{ji}). We want S_{ji} to be defined such that similar items of the same type have high S_{ji} (for partial matching) and items have high S_{ji} to the chunks they appear in (for priming).

1. S_{ji} may be predefined

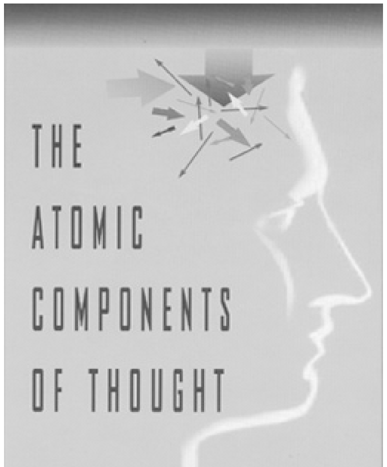
2. Otherwise, S_{ii} = maxsim

3. Association of "Hippie in Park" to "Debutante in Forest". S_{ji} is $\sum_{k}^{n} S_{j_k i_k} \Big/ n$

if i and j are of the same type and the summation is over components of i and j. If the association between a pair of components is not known it is maxdif by default.

4. Association of "hippie" to "hippie in park". S_{ji} is $\max - over - k(S_{ji_k}))$ if i and j are not of the same type j. The max is over slots k of i. Again unknown associations default to maxdif. This reflects probably the prototypical retrieval situation where one is trying to retrieve something from one of its elements. This is not slot-specific.

5. S_{ji} is maxdif otherwise.



Computational notes:

1. Association is maxdif in the componential case if there are no components.

2. This model does not require that all the S_{ji} be defined ahead of time. They can be computed on an as-need basis from the primitive S_{ji}.

3. One does not chase pointers in calculating associations one does not have to worry about circular decompositions.

4. In fact, this greatly reduces the need to store n^2 associations.