


A Neural Network Model of Product Evaluation and Advertising

The title text is overlaid on a decorative arrangement of circles. There are five circles in total: one white circle with a light blue outline at the top center, two solid light blue circles at the bottom left, and two solid light blue circles at the top right. The text 'A Neural Network Model of Product Evaluation and Advertising' is centered across the top half of the slide.

Meghana Bhatt
Caltech

The author's name and affiliation are positioned to the right of the title. The text 'Meghana Bhatt' is on the top line and 'Caltech' is on the bottom line. This text is overlaid on the two solid light blue circles at the top right and the white circle with a light blue outline at the bottom right.

Economic Models of Advertising

- Informative - Money Burning (Nelson)
- Persuasive
- Complementary (Becker and Murphy)

Marketing Models



- Market response models
- Hierarchy Models
 - Cognition, Affect and Experience



Aims

- Create a process based formal model of advertising.
- Make statements about the importance of the content of an ad.

Definitions and Setup



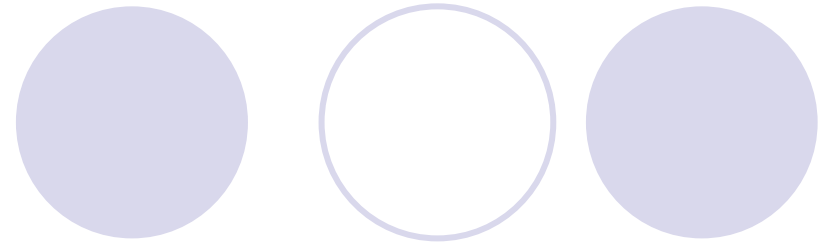
- Attributes: traits of the product, very broadly defined. Attributes can have value (-1, 0, or 1)
- Patterns: vectors of attributes
 - Lays Potato Chips = (Salty = 1, Sweet = -1, Crispy = 1, Snack = 1, ...)
- We represent products as patterns of attributes.

Hopfield Networks



- We can describe the space of possible attributes as a network where each attribute is a node. Each node will have some “activation threshold”.
- The weight between any two nodes is a number in $[-1, 1]$ describing how related the two attributes are.

Network Dynamics

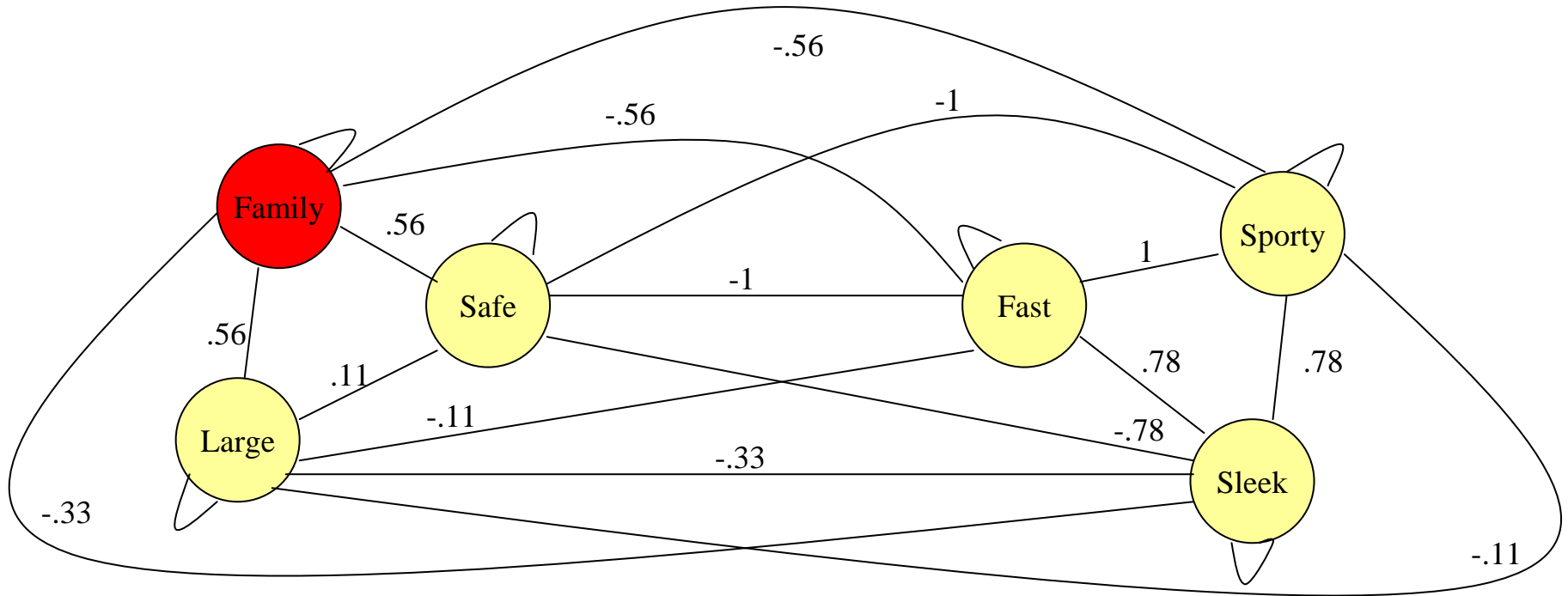


- The weights and activation thresholds define a transition function for the network.

$$T_i(W, v) = \begin{cases} -1, & \sum_j w_{ij}v_j < -\alpha_i \\ 0, & -\alpha_i \leq \sum_j w_{ij}v_j \leq \alpha_i \\ 1, & \alpha_i < \sum_j w_{ij}v_j \end{cases}$$

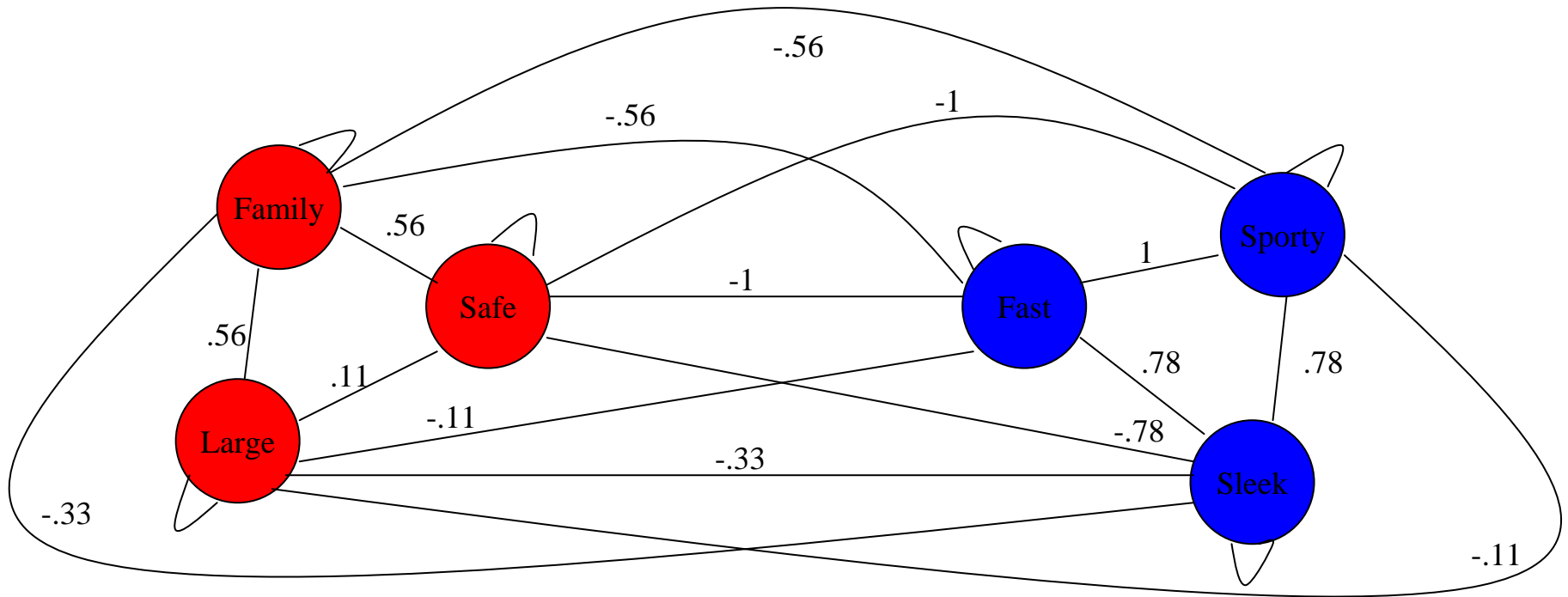
- These networks will converge to stable patterns (or small cycles).

Network Dynamics - Example



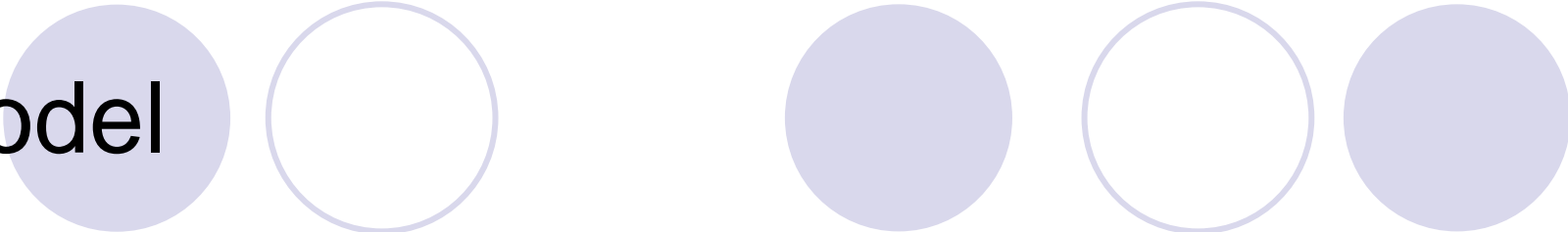
Red = 1
Blue = -1
Yellow = 0

Network Dynamics - Example



Red = 1
Blue = -1
Yellow = 0

Model

- 
- Exposure: weights are set →
 - Consumption:
 - Stimulus → Memory Recall → Evaluation → Decision →
 - Exposure (includes feedback from consumption): weights are reset

Exposure



- The consumer “sees” a set of patterns such that
The weights of the network for the consumption stage in period m are:

$$w_{ij} = \frac{\sum_{t \leq m} \sum_{p \in S_t} p_i p_j}{\sum_{t \leq m} |S_t|}$$

Consumption



- Stimulus: The consumer sees a stimulus that converges to a stable pattern.
- Recall: All brands in state 1 in this stable pattern are “recalled”.
- Evaluation: Each brand has the utility of the pattern generated by the brand and product nodes.
- Decision: The consumer chooses the brand with the highest net utility given the price.

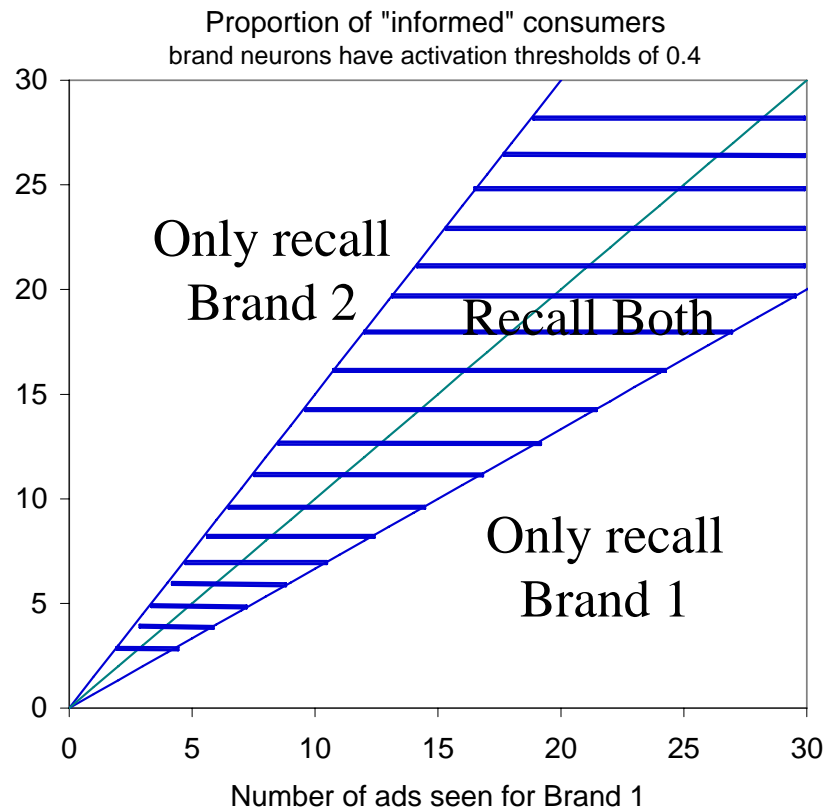
Implications



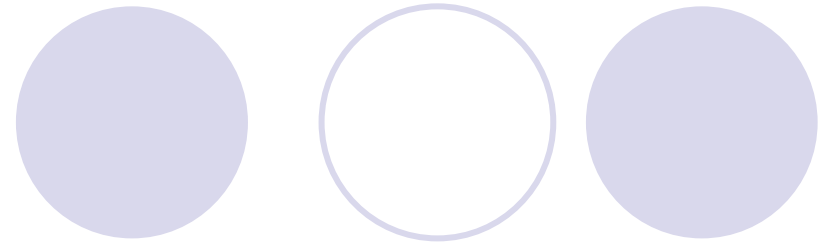
- Effect in period $m \propto 1/m$
 - Ads get have greater effect on the young/inexperienced.
- “Wear - in”
- Noise
 - Even established brands must always advertise (‘refresh memory’)

Brand Loyalty?

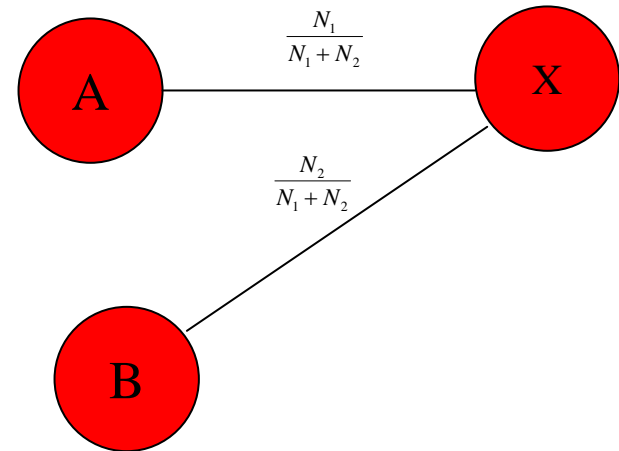
- Differential exposure to ads creates “informed” and “uninformed” consumers.



Trivial Attributes

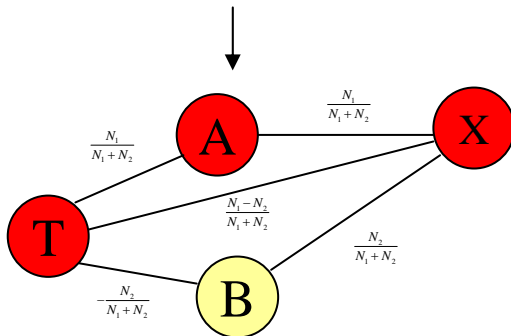
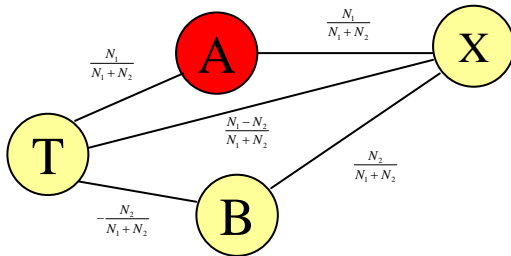


In this network, either both brands A and B are recalled or neither, regardless of the stimulus.

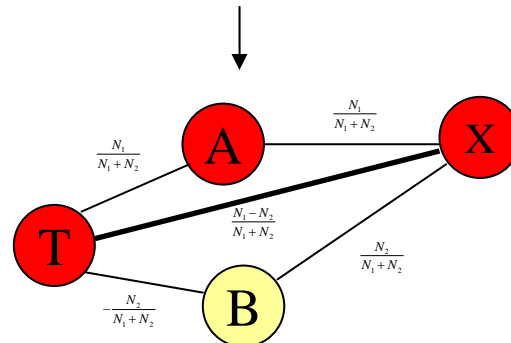
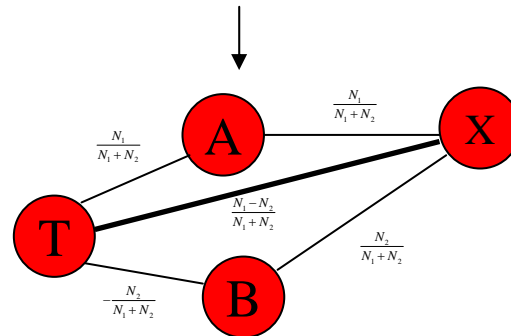
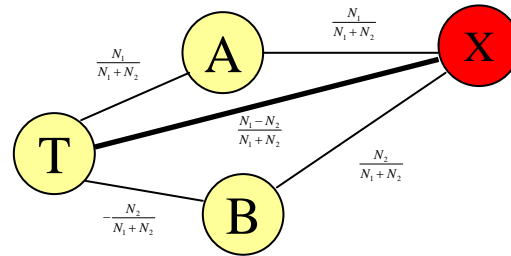


Trivial Attributes

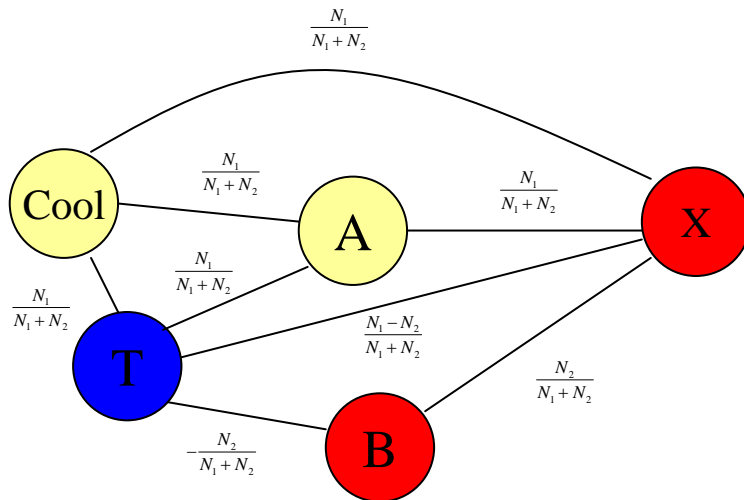
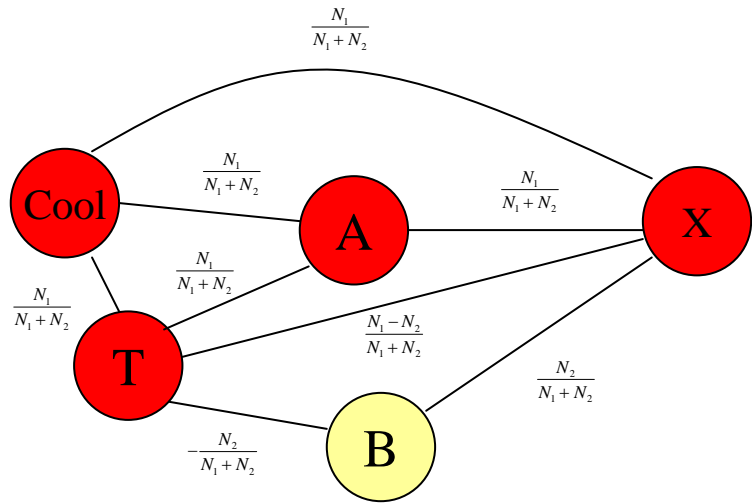
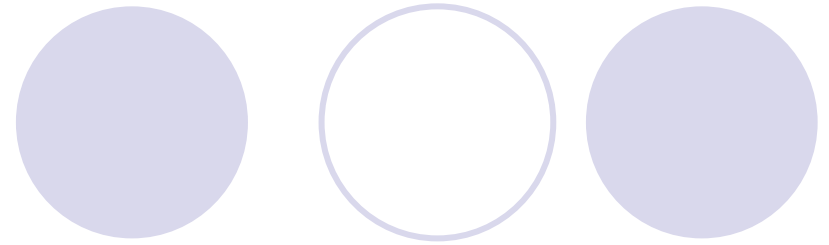
If we now add a trivial attribute T, a stimulus of A will not cue the recall of B (and vice versa).



Furthermore, if A advertises much more than B, a stimulus of X won't cue recall of B either.



Trivial Attributes



In addition the trivial attribute can help bind a positive attribute, “cool”, to the brand A and prevent B from gaining an advantage from that attribute.

Brand Extension

- Existing brand image will constrain possible brand extensions (“brand fit”)



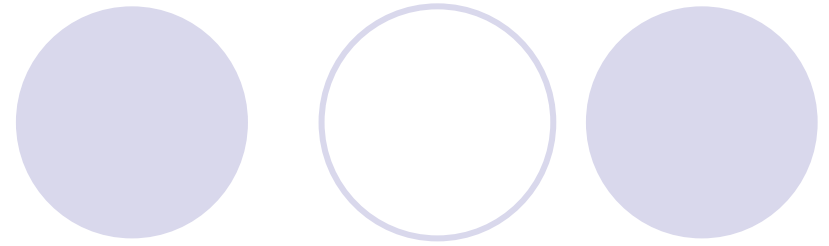
Image from www.skinz.org



Image from Business Week, July 2006

The Harley-Davidson image of tough guys on motorcycles was far from any pattern associated with pastry and cake decorating.

Brand Extension



- The same math implies that a single firm trying to sell two different versions of the same product type **must** create different brand names for each version.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

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Conclusions

- This model provides a formal framework that can explain a wide variety of phenomena.
- With appropriate data restrictions should be able to help predict the success of advertising campaigns.

Aknowledgements

The title 'Aknowledgements' is positioned at the top left. To its right, there are six circles arranged in a horizontal line. The first circle is solid light purple. The second circle is a light purple outline. The third circle is solid light purple. The fourth circle is a light purple outline. The fifth circle is solid light purple. The sixth circle is solid light purple.

- Colin Camerer, Antonio Rangel, Jacob Goeree, Jacob Berlin, Hilke Plassmann, Lauren Feiler, Harley-Davidson