Face Recognition

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(Based on Roth & Bruce)

Why is it important to psychology?

- It involves ‘within-category’ discrimination.
  - i.e. discrimination between members of the same basic-level category.
  - discrimination of patterns which share the same essential features, i.e. eyes, mouth, nose etc.
- Errors in face-recognition can have catastrophic consequences
  - Eye witness testimony (e.g. Devlin, 1976).
- Working models may provide very useful security systems...

Representing individual faces

- Evidence for feature lists
  - Bradshaw and Wallace (1971) asked participants to decide whether mug-shots were different. They found that decisions were faster if more differences were present.
  - *They argued for a sequential process.*

Representing individual faces

- Evidence for configural representations
  - Sargent (1984) found that chins differences were detected first.
  - Despite this fact, additional differences still led to faster decisions.
    - *Suggesting interactions occurred between features.*
  - However, these interactions disappeared when the faces were inverted.

Further evidence for *holistic* processing

- Tanaka and Farah (1993) asked participants to learn faces.
- They then tested the recall of individual features in normal and scrambled faces.

- The location had an important effect upon performance.
- This effect disappeared when faces were inverted and when images represented houses.

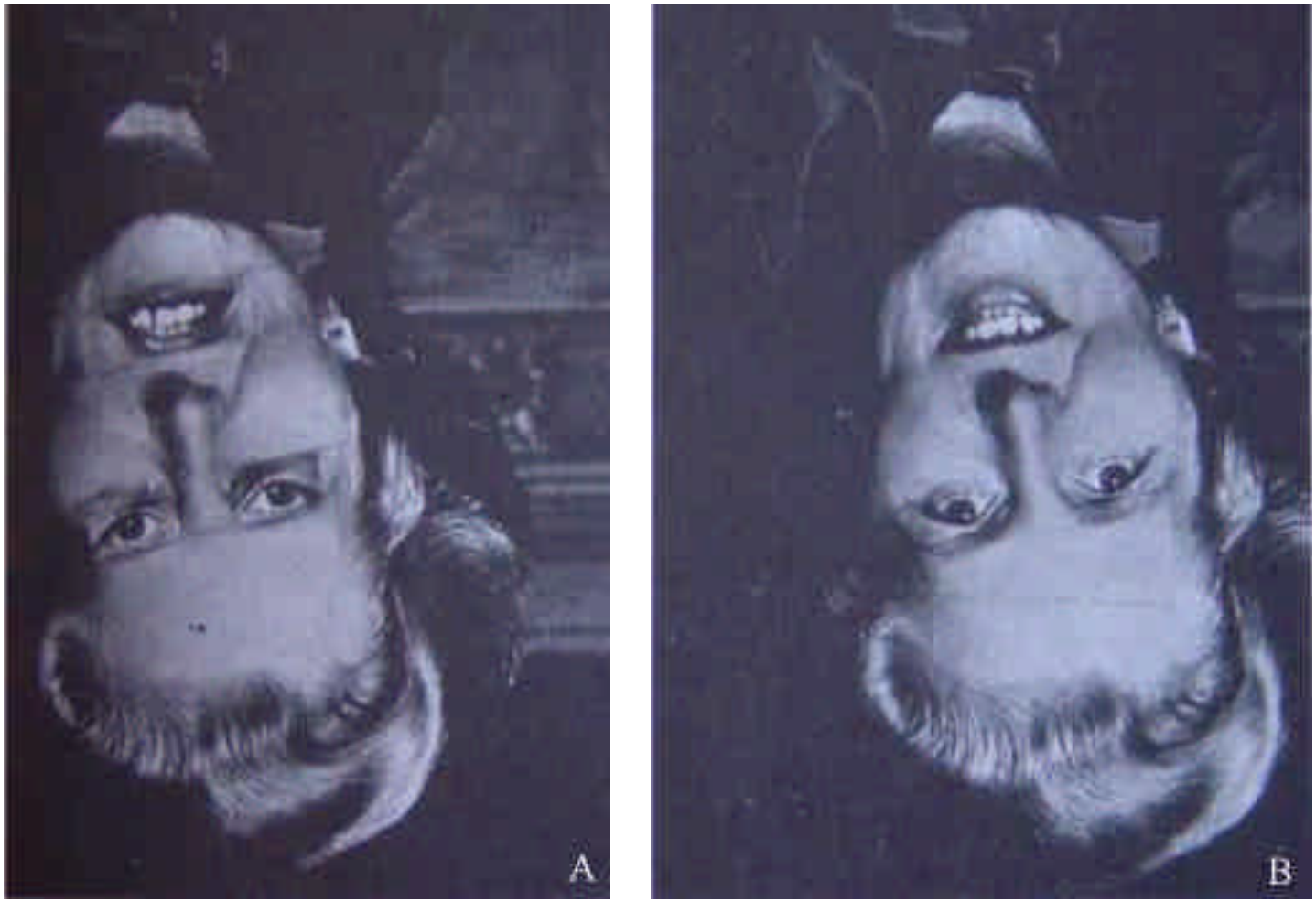
Orientation is important

- Yin (1969) found that whilst people are generally better at recognising upright faces than they are other objects. They are worse for inverted faces than they are for other inverted objects.
- *This suggests that the processing underlying normal face recognition is different from those underlying object recognition.*

Orientation is important

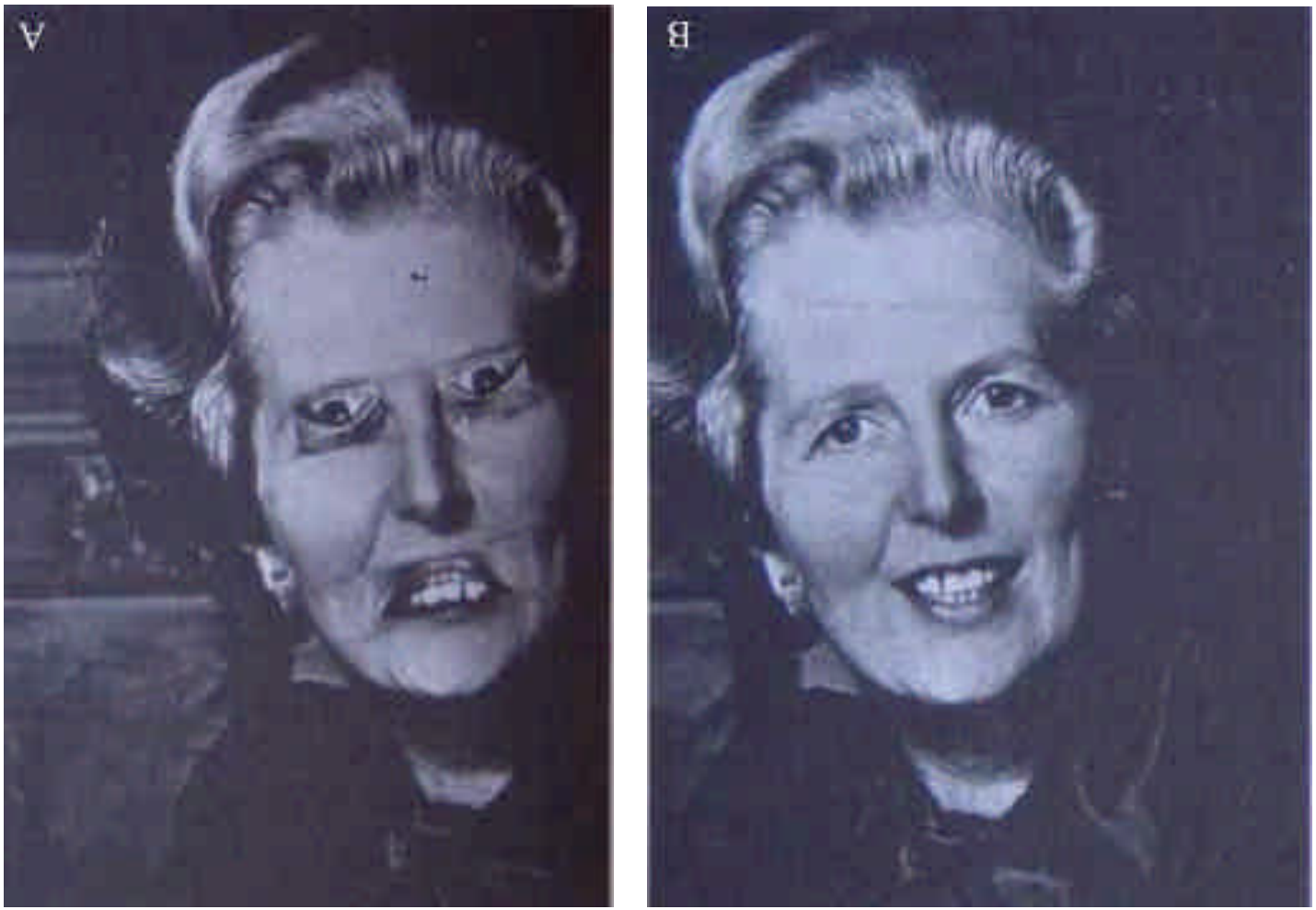
- Young et al. (1987) paired different top and bottom halves of faces.
- They found that recognition of top-halves was easier when faces were inverted. Where faces were upright performance was better when the new lower-half was omitted.
- *The joined-up upright face led to a 'new' configuration which interfered with the detection of individual halves.*

The ‘Thatcher Illusion’



(Thomson, 1980)

The ‘Thatcher Illusion’



(Thomson, 1980)

Why does the ‘Thatcher illusion’ occur?

- Bartlett and Searcy (1993) conducted experiments to measure face ‘grotesqueness’.
- Their results supported the “configural processing hypothesis”
  - *i.e. We have a difficulty in understanding the configuration of features when faces are inverted.*
  - *We aren’t aware of the odd configuration of elements within the inverted Thatcher image.*

Does the inversion effect suggest that face recognition is special?

- Diamond and Carey (1986) tested recognition for faces and dogs.
- They found that dog judges and breeders were relatively impaired for inverted faces compared to ‘normal’ individuals.
- *This suggests that frequent exposure results in the inversion effect. i.e. Configuration becomes important through practice?*

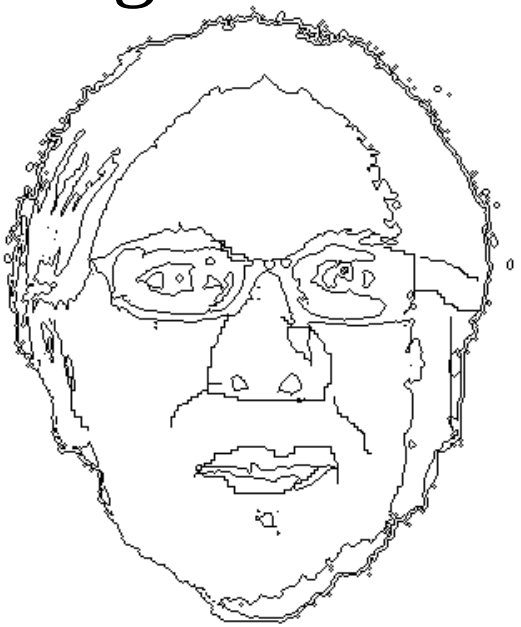
Pigmentation and shading is important in face recognition.

Photographic negation interferes with face recognition (Galper and Hochberg, 1971).

(Edge information is unaffected in negated images, undermining a

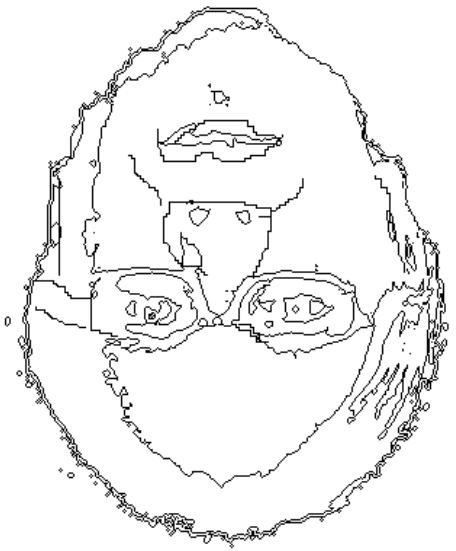
Pigmentation and shading is important in face recognition.

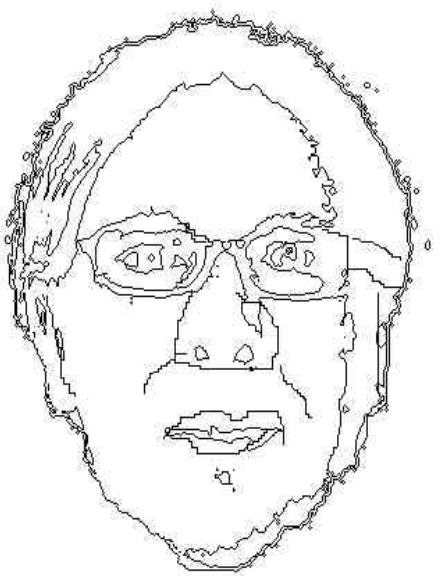
Davies et al. (1978) compared recognition of monochrome Vs traced-drawings (no shading). Recognition of the drawings was very poor.



Pigmentation and shading is important in face recognition.

Recognition of simple-line drawings of faces is worse when inverted (Hayes et al. 1986) - though performance is poor for both.





Cognitive neuropsychological evidence suggests for independent modules...

- Facial expression/Face identification
  - Bruce (1986) Young et al. (1986). Expression identified independently of identity.
  - Prosopagnosics can identify facial emotion
  - Some patients with dementia cannot identify facial emotion, but could identify famous faces.

Cognitive neuropsychological evidence...

- Facial speech/Facial identity
  - The McGurk effect (McGurk and McDonald, 1976). i.e. the perceptual fusion of different lip-read and spoken syllables. This effect occurs even when the face is female and the sound male.
  - Campbell et al. (1986) reported a severely prosopagnosic patient that still experienced the McGurk effect. Could also identify speech sounds from photographs. A second patient showed the reverse pattern.

Evidence from unimpaired individuals

- Hay and Young (1982) outlined stages of face recognition. Face → Identity → Name
- Young et al. (1985) conducted a diary study.
  - Most common errors:-
    - A person was not recognised (i.e. ‘blanked’)
    - There was a feeling familiarity without identity
    - A person was recognised but no name was retrieved
    - A person was misidentified

Neuropsychological evidence also suggests stages of processing

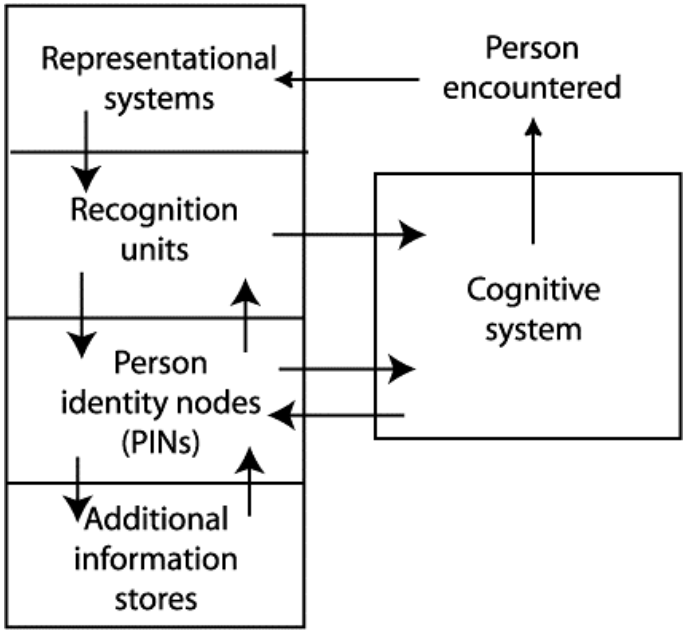
- ME could make familiarity decisions about presented faces, but could not decide *why* they were familiar (de Haan et al., 1991).
- EST could state occupations and nationalities of famous faces, but could not give names (Flude et al., 1989).

Models of face recognition...

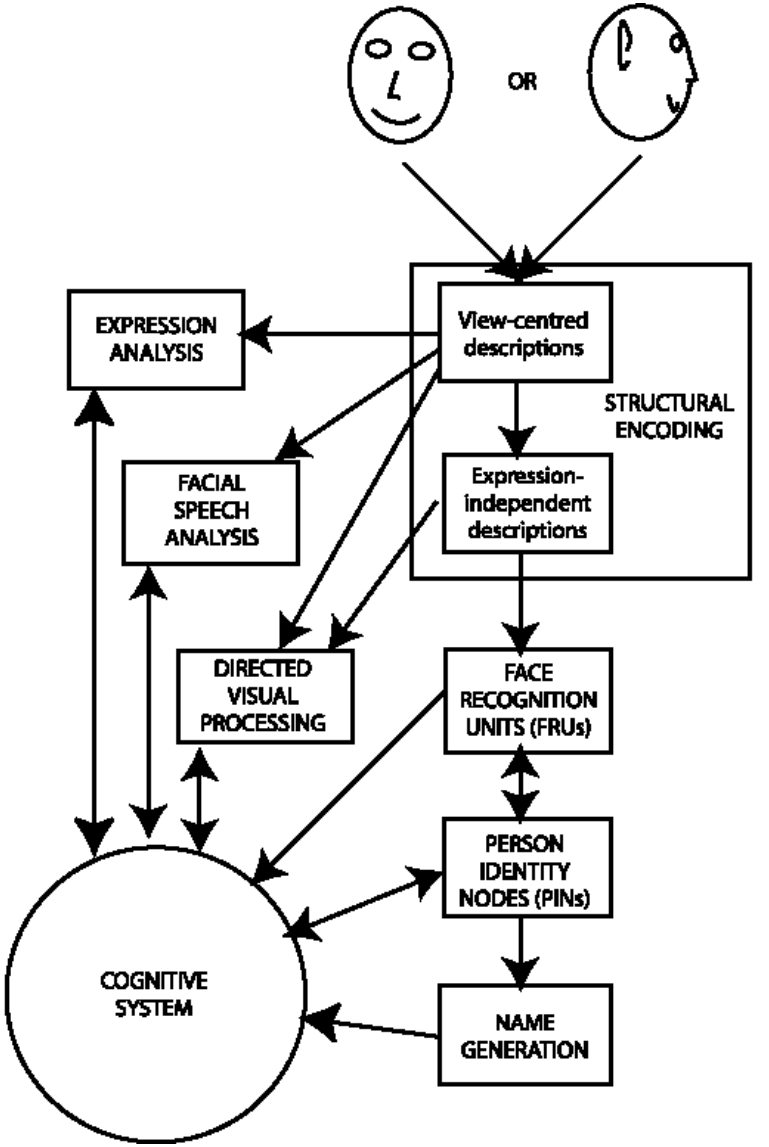
Different types of models

- Theoretical
  - Coarse-scale, ill defined, can be vague.
- Information Processing
  - Specifies individual components and relationships between them.
- Computational
  - Must be precise, specifies operations within individual boxes.

Information processing models



(Young et al. 1985, p. 518)



(Bruce and Young 1986, p. 312)

IAC Models

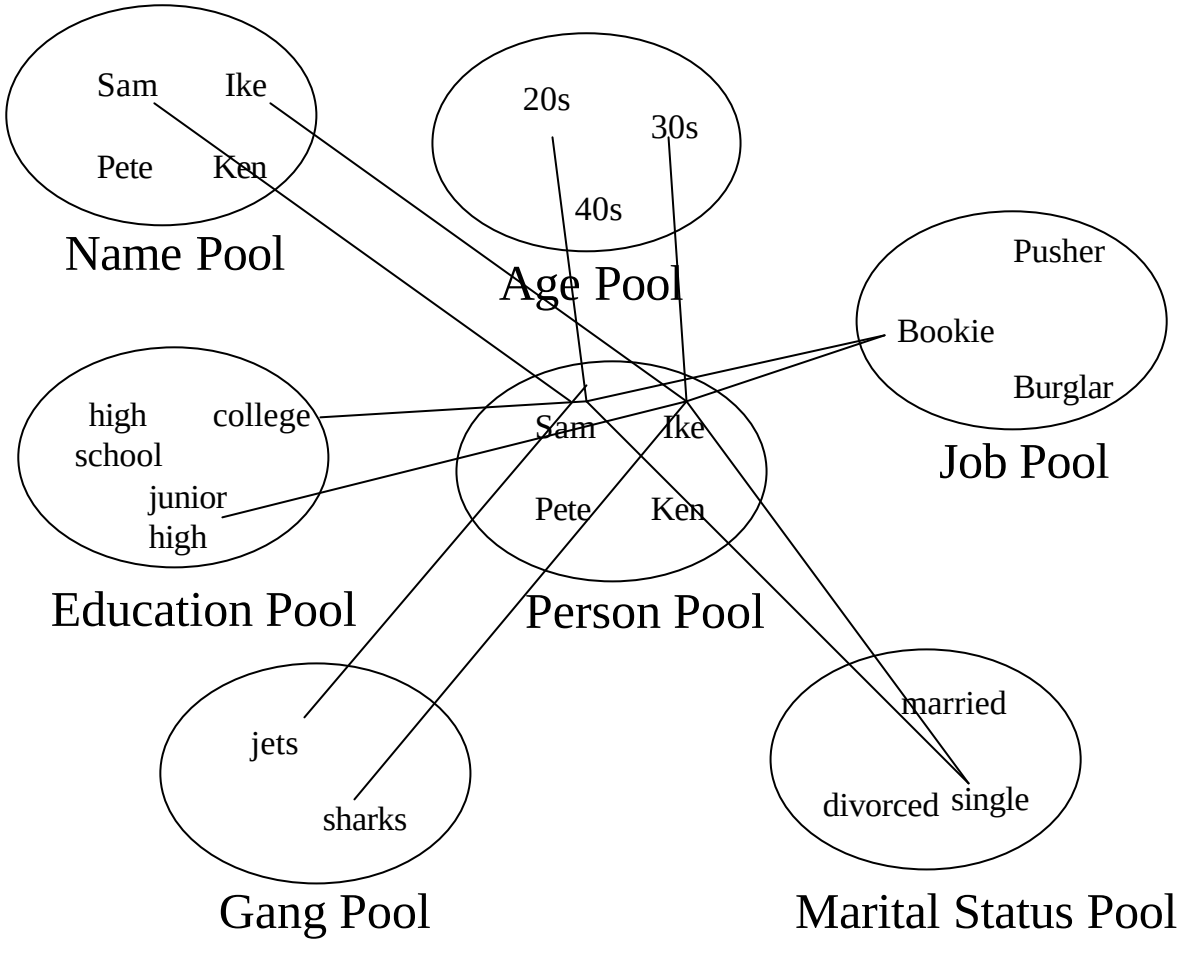
McClelland (1981) Offered an ‘Interactive Activation and Competition’ (IAC) model of concept learning.

He modelled the attributes of the Jets and Sharks characters of ‘West Side Story’.

For example :-

name	Sam	Ike	Pete	Ken
age	20s	30s	20s	20s
education	College	Junior high	High school	High school
marital status	single	single	single	single
job	bookie	bookie	bookie	burglar
gang	Jets	Sharks	Jets	Sharks

The IAC Jets and Sharks model



Semantic Information is 'pooled'

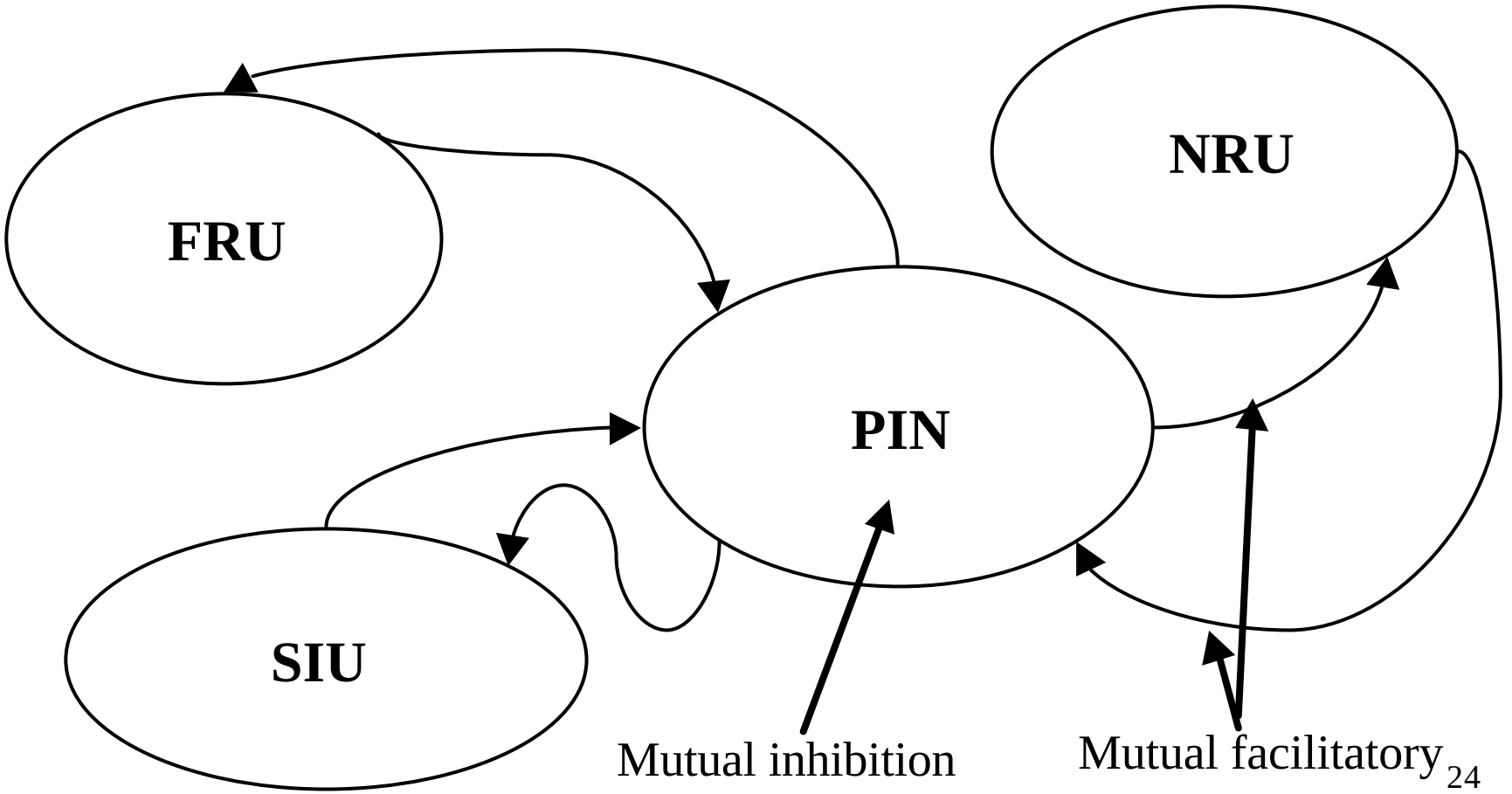
Knowledge is represented within these pools

Relationships between knowledge are represented as connections

'Clamping' a node give rise to a 'typical attribut representation.

(see Eysenck and Keane pg249-252 for further details)

The IAC model of face recognition (Burton et. al, 1990)



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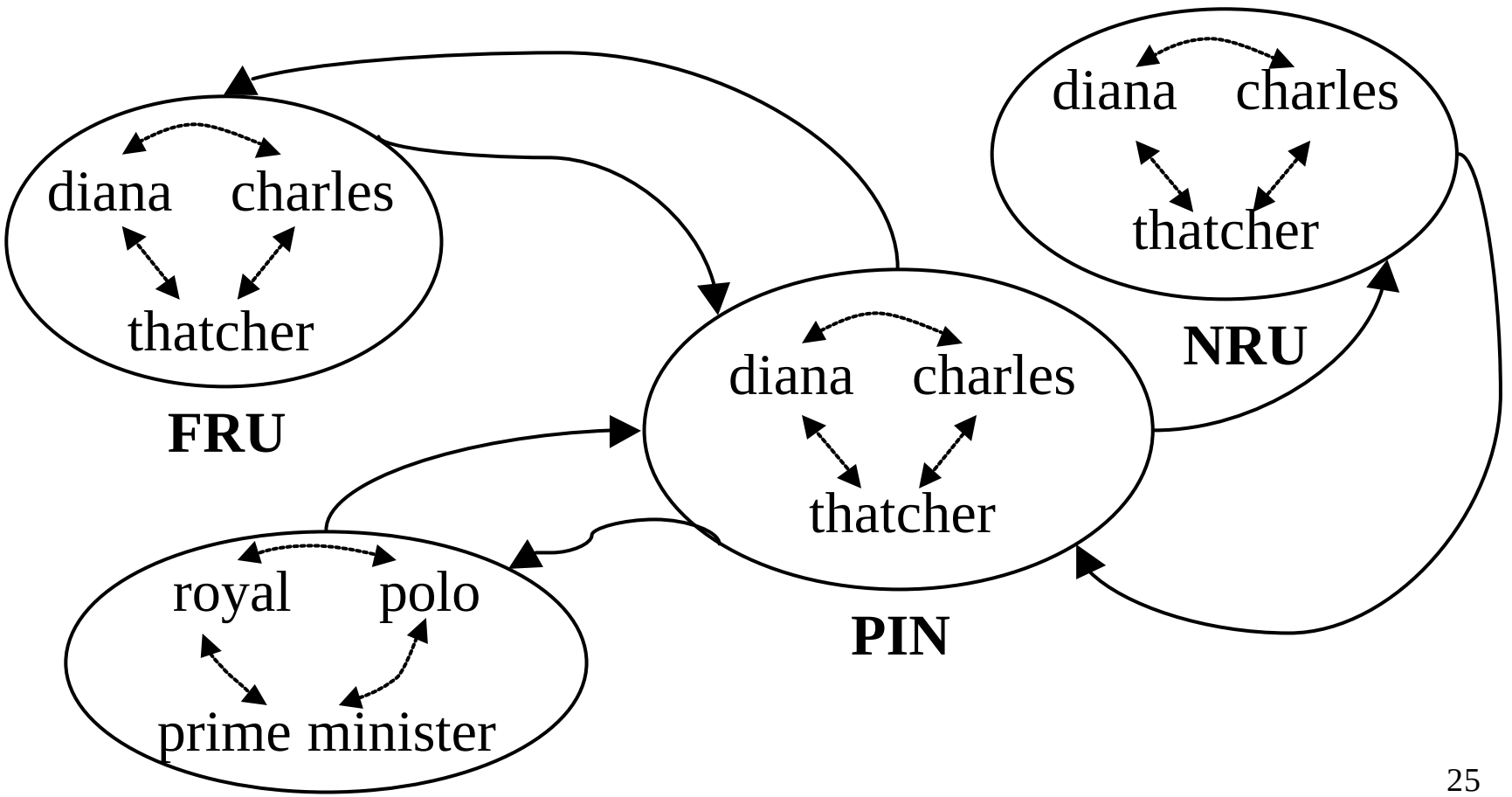

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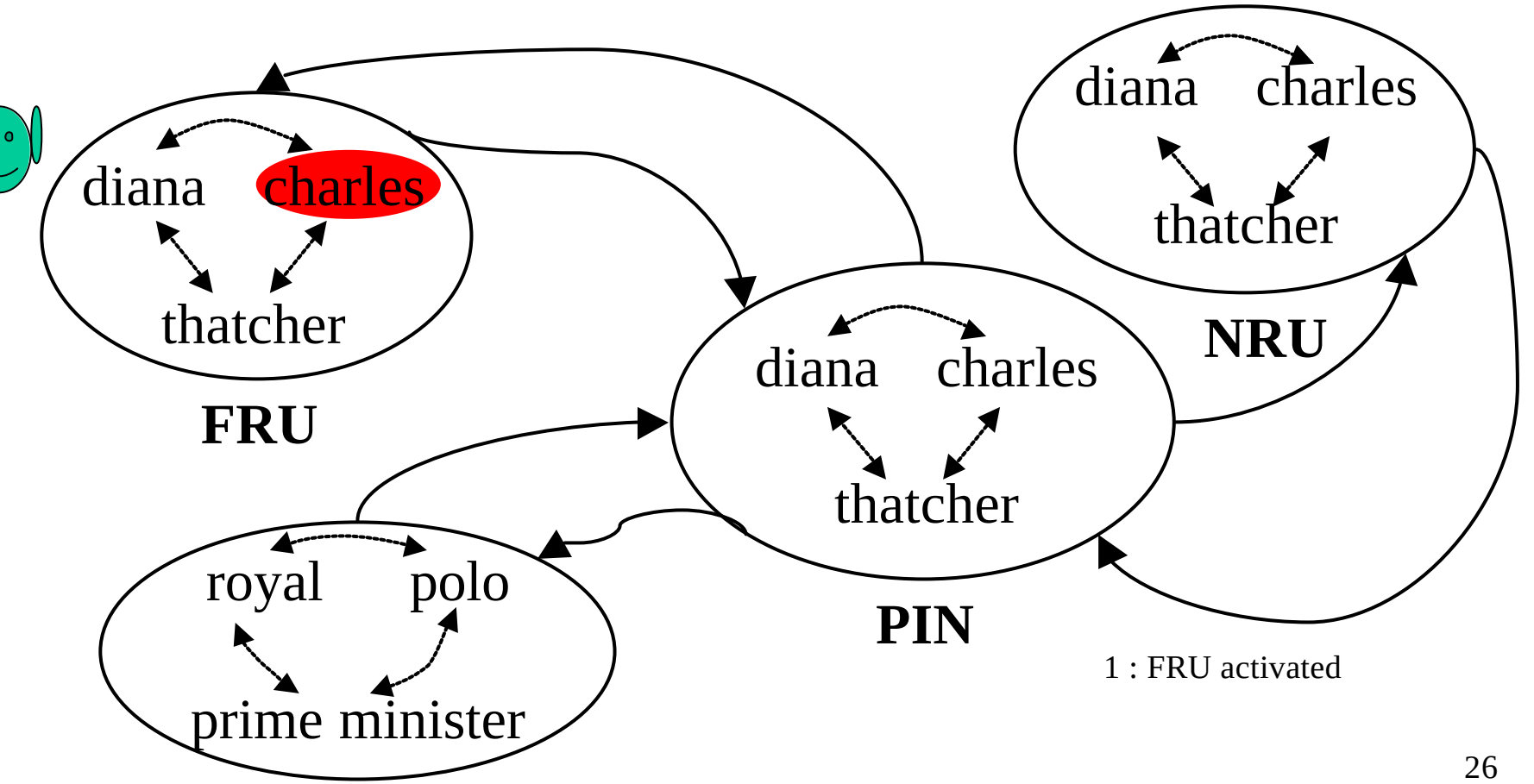

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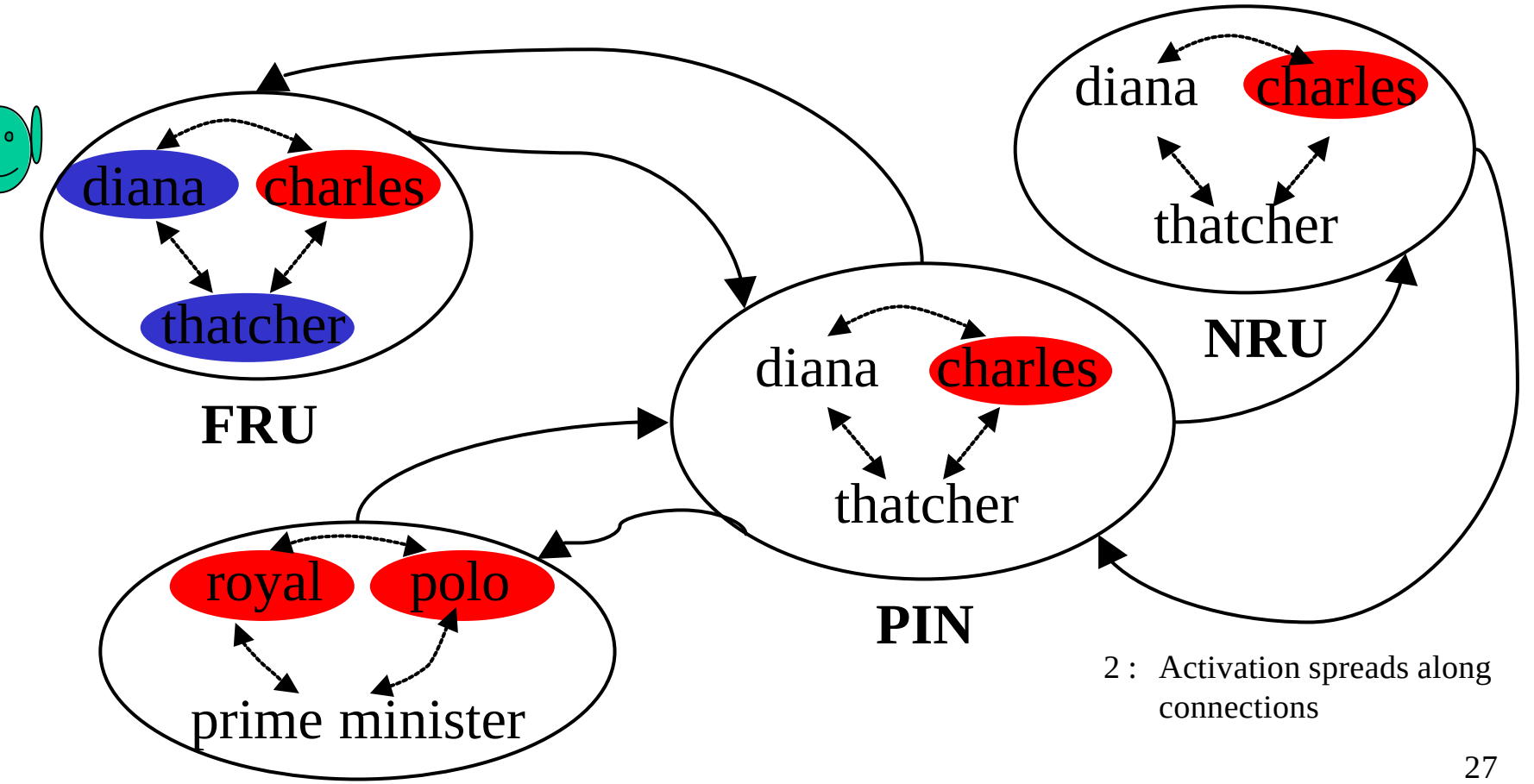
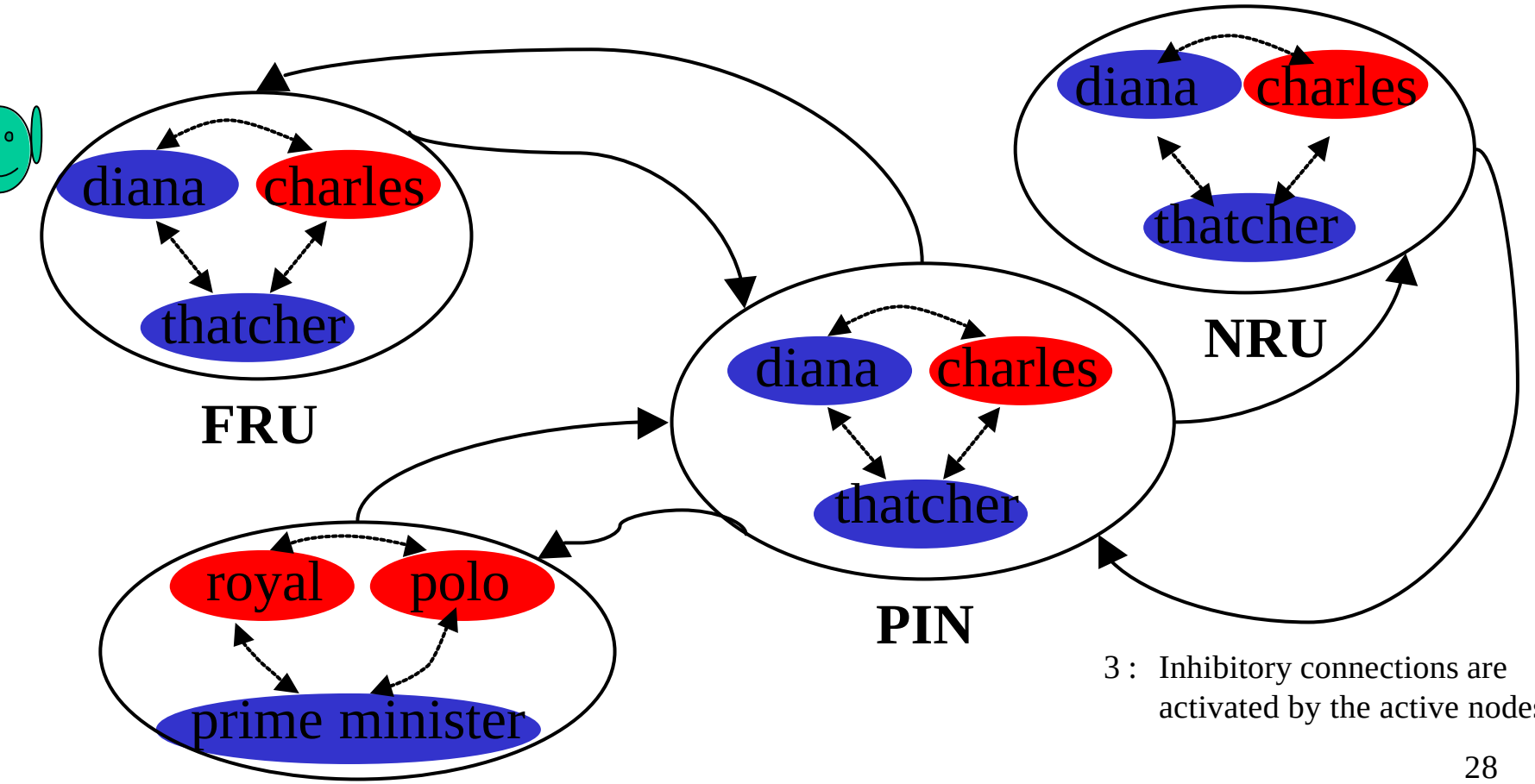


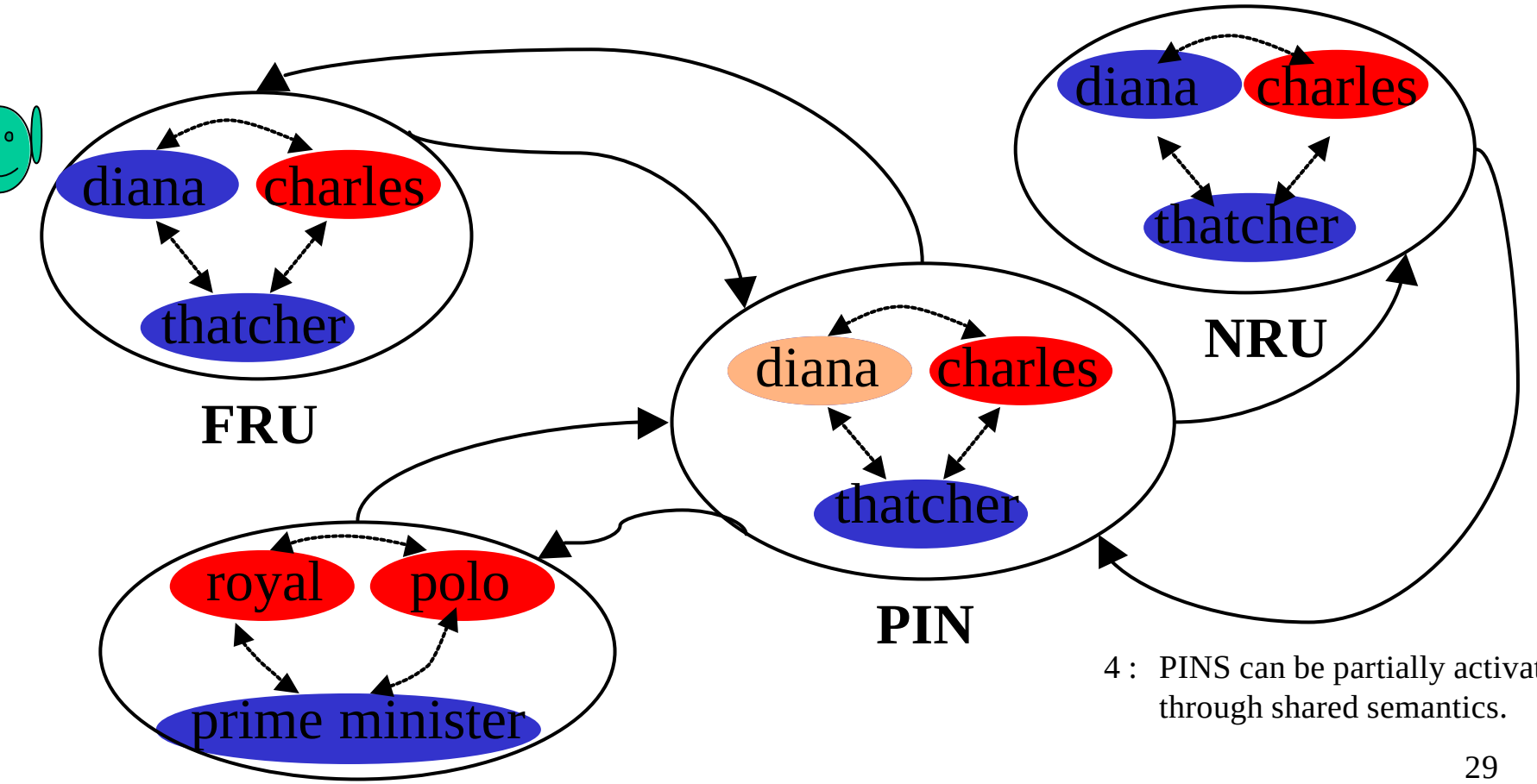
2 : Activation spreads along connections

The IAC model of face recognition (Burton et. al, 1990)



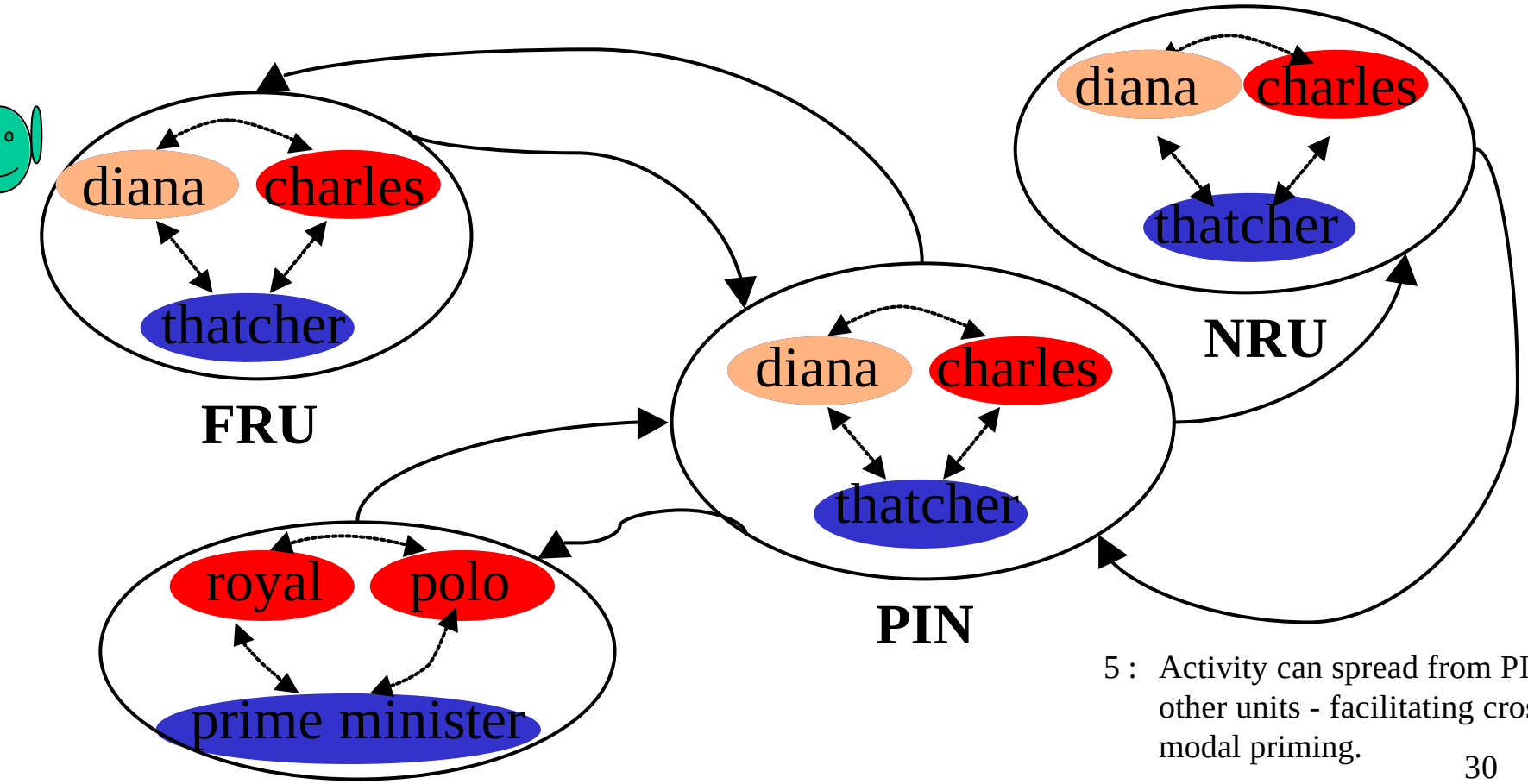
3 : Inhibitory connections are activated by the active nodes.

The IAC model of face recognition (Burton et. al, 1990)



4 : PINS can be partially activated through shared semantics.

The IAC model of face recognition (Burton et. al, 1990)



5 : Activity can spread from PINs other units - facilitating cross-modal priming.

How is this model different?

- FRUs signal face familiarity, PINs are modality-free gateways to semantic information.
- Details of connectivity and the spread of activity are clarified.
- No separate nodes for names, these are semantic information and are pooled accordingly. Names are poorly integrated with semantics.
  - Consequently “the butcher” is easier to recall than “Mr Butcher” (Sargent?)

Benefits of the Burton et al. model...

- The model successfully simulates a variety of phenomena:-
  - Relative timing of familiarity, semantic access and naming.
    - Familiarity *faster-than* Semantics *faster-than* Naming
  - Repetition priming
    - Bob Geldof's face primes Bob Geldof's face.
  - Semantic priming
    - Stan Laurel's face primes Oliver Hardy's face.
  - Cross-modal semantic priming
    - Diana Spencer's face primes Charles's name

Benefits of the Burton et al. model...

- Successfully accounts for covert recognition in prosopagnosia
  - PH (de Haan et al.,1987; Young et al., 1988) unable to overtly recognise famous people. Could not identify a famous face in a pair (18/36). But could choose the famous name from a pair (29/32).
  - PH could pair two pictures of the same famous person better than two unfamiliar people.
  - RTs slowed when asked the occupation of an individual when presented with a name + face from somebody with a different occupation.

Benefits of the Burton et al. model...

- Successfully accounts for covert recognition in prosopagnosia
  - PH (Young et al., 1988) also demonstrated associative priming.
  - Familiarity decisions to Ernie Wise's name were quicker when he had previously viewed Eric Morecombe's face.
  - PH could only recognise two of the faces he had viewed, confirming that priming must have occurred sub-consciously (covertly).

Benefits of the Burton et al. model...

- Successfully accounts for covert recognition in prosopagnosia
  - Weakening the connections between FRU's and PINs enabled them to simulate all of the phenomena demonstrated by PH.
  - The resultant 'sub-threshold' activity in PINs enable priming effects without overt recognition.

Predictions from the Burton et al. model.

- ME could judge familiarity, but could not retrieve autobiographical information.
  - This suggests that SIUs and PINs were disconnected.
  - However, Names and Faces could be paired, de Hann et al. (1991) tested this prediction and found it to be correct (23/26).
  - *In the IAC model activity doesn't have to pass through SIUs to reach names.*

Conclusions

- Is face recognition ‘special’?

  (i.e. is it independent of object recognition)

  – Johnson and Morton (1991) report that new-born babies will preferentially view faces.

  – Expression analysis seems to be innate (Meltzoff and Moore, 1977) - though we already accept that this is independent of recognition.

Conclusions

- Is face recognition ‘special’?
  - Specialised cells have been identified within the temporal lobe (Gross, 1992; Rolls, 1992).
  - Cognitive neuropsychological evidence suggests ‘dedicated processing’, i.e. that areas may be dedicated to faces, but that the processes are similar to those for other objects.

Conclusions

- Bruyer et al., 1983 report on a prosopagnosic farmer who could identify his cows.
- Another (Assal et al., 1984) could recognise faces but not cows.
- McNeill and Warrington (1993) describe a patient with prosopagnosia who could distinguish between his sheep.
- *Ellis and Young (1993) argue that these cases might simply reflect specialities in processing for many types of object.*