A Rational Analysis of Cultural Transmission

Mike Kalish
Institute of Cognitive Science
University of Louisiana at Lafayette
Learning mechanisms determine cultural dynamics

Genes shape learning mechanisms

Emergent structure affects fitness landscape
Learning
cognitive psychology
Learning languages from utterances

\[
\begin{align*}
\text{blicket toma} & \quad S \rightarrow X \ Y \\
\text{dax wug} & \quad X \rightarrow \{\text{blicket, dax}\} \\
\text{blicket wug} & \quad Y \rightarrow \{\text{toma, wug}\}
\end{align*}
\]

Learning categories from instances of their members

Learning functions from \((x, y)\) pairs
Objects of iterated learning

How does learning influence culture?
Learning

hypothesis
Cultural transmission

Iterated Learning (Kirby, 2001)
Contrasting Interpretations

Kirby (2001)
- Compositionality
- Emergence of new structure

Languages get big and bad, small and good
Contrasting Interpretations

Kirby (2001)
- Compositionality
- Emergence of new structure

Bartlett (1932)
- Conventionalization
- Emergence of pre-existing structures
Bayes’ theorem

\[ P(h | d) = \frac{P(d | h)P(h)}{\sum_{h' \in H} P(d | h')P(h')} \]

Posterior probability

Likelihood

Prior probability

Prior predictive distribution (summed over all possible hypotheses)

\( h \): hypothesis
\( d \): data
Bayesian Iterated Learning Hypothesis
Nontechnical Results

Kalish, Griffiths & Lewandowsky 2007
“Cultural Ratchet”

Beppu & Griffiths 2009
Conclusion

Iterated Learning reveals inductive biases

Cultural transmission of knowledge can lead to progress

Knowledge = prior + data
Truth = knowledge + (more) data