



Sequential dependencies produced when learning response sequences

Jenny Amsden, Kelley Crawford, Tom Glazebrook,
and Chelsea Nill

Man with the whip: Dr. Alliston Reid

Purpose

- Identify
- Quantify

- Sequential analysis allows us to determine what information was actually used when learning and maintaining adaptive patterns of behavior

Introduction

- Eight rats were trained on 3 different 3 response sequences: AAB, ABB, ABA.

Training

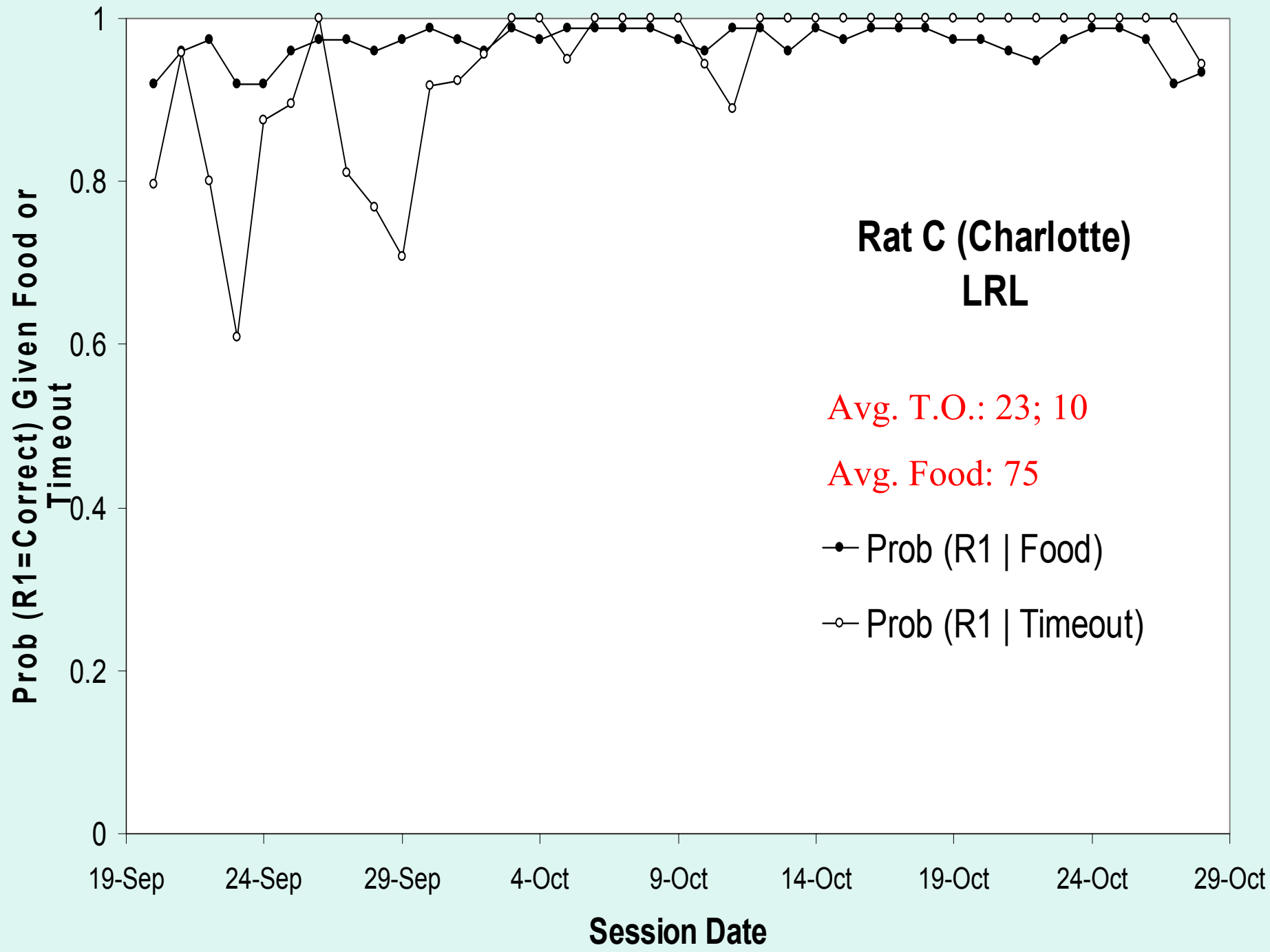
Sequence	1 Lever	2 Levers	3 Levers
AAB	A	AA	AAB
ABA	A	AB	ABA
ABB	B	AB	ABB

Experimental Procedure

- .5 sec. Tone after 1st response
 - In alternating trials
- 5 sec. immediate Timeout
 - Levers withdrawn
- Reinforcement received immediately after correct 3rd response.

The R1 Acquisition Curves

- The probability of a correct 1st response given food delivery or timeout in a 3 response sequence
- Initial separation of probability given timeout or food

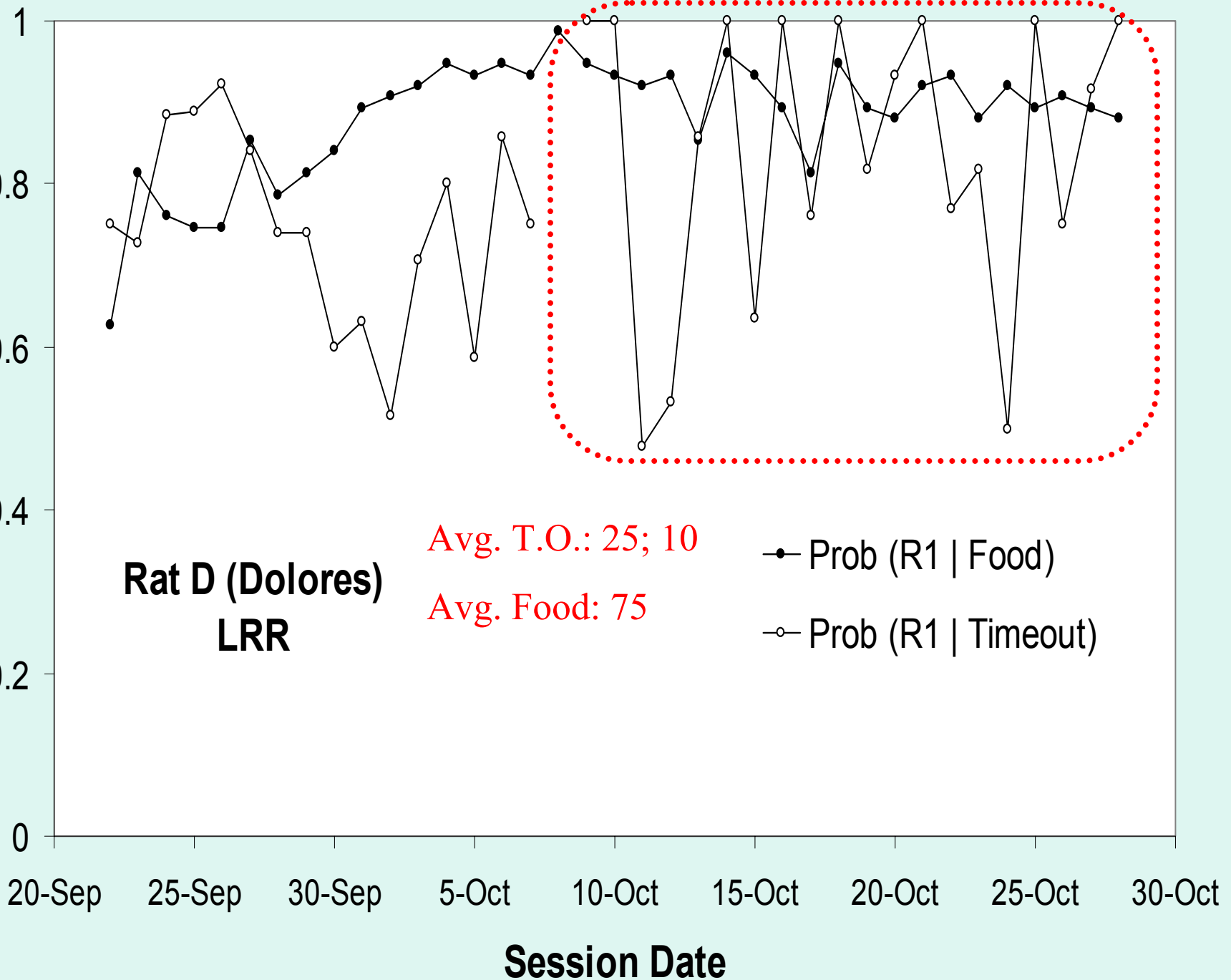


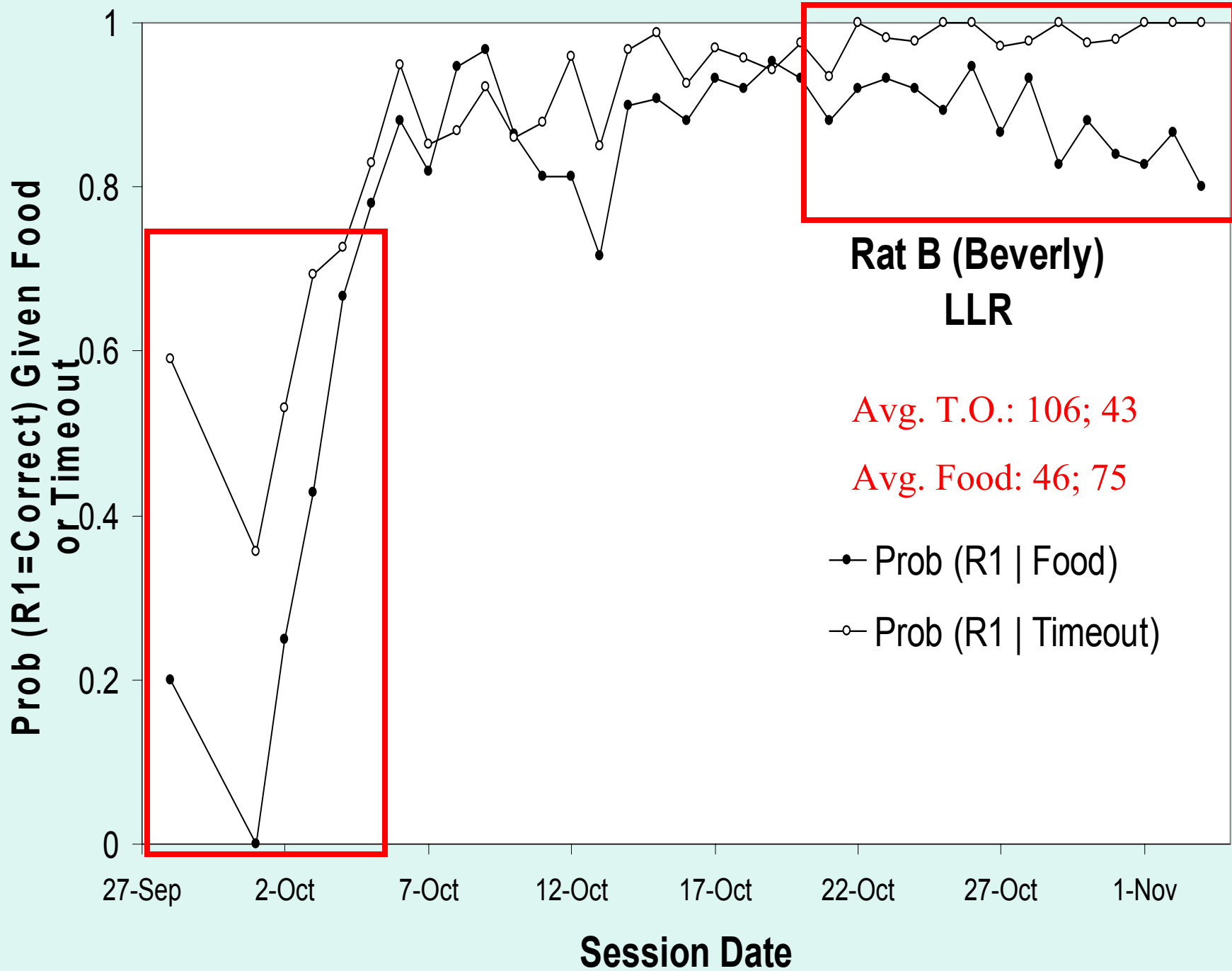
Prob (R1=Correct) Given Food
or Timeout

Rat D (Dolores)
LRR

Avg. T.O.: 25; 10
Avg. Food: 75

● Prob (R1 | Food)
○ Prob (R1 | Timeout)





The Role of Persistence

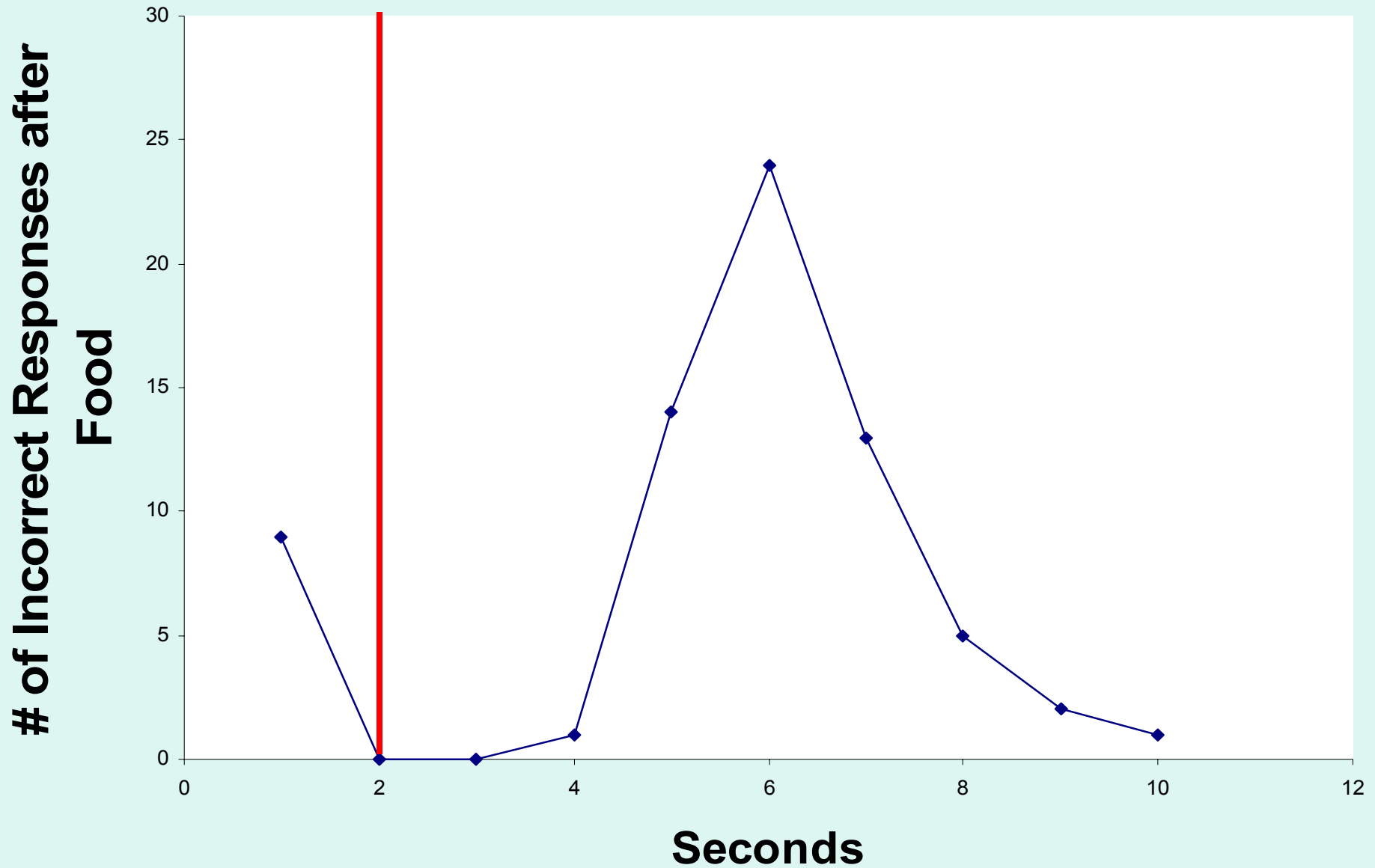
- The subjects of the AAB and ABB sequence types demonstrated an effect of timeout being a better predictor of a correct 1st response

Difference?

Persisting through food?

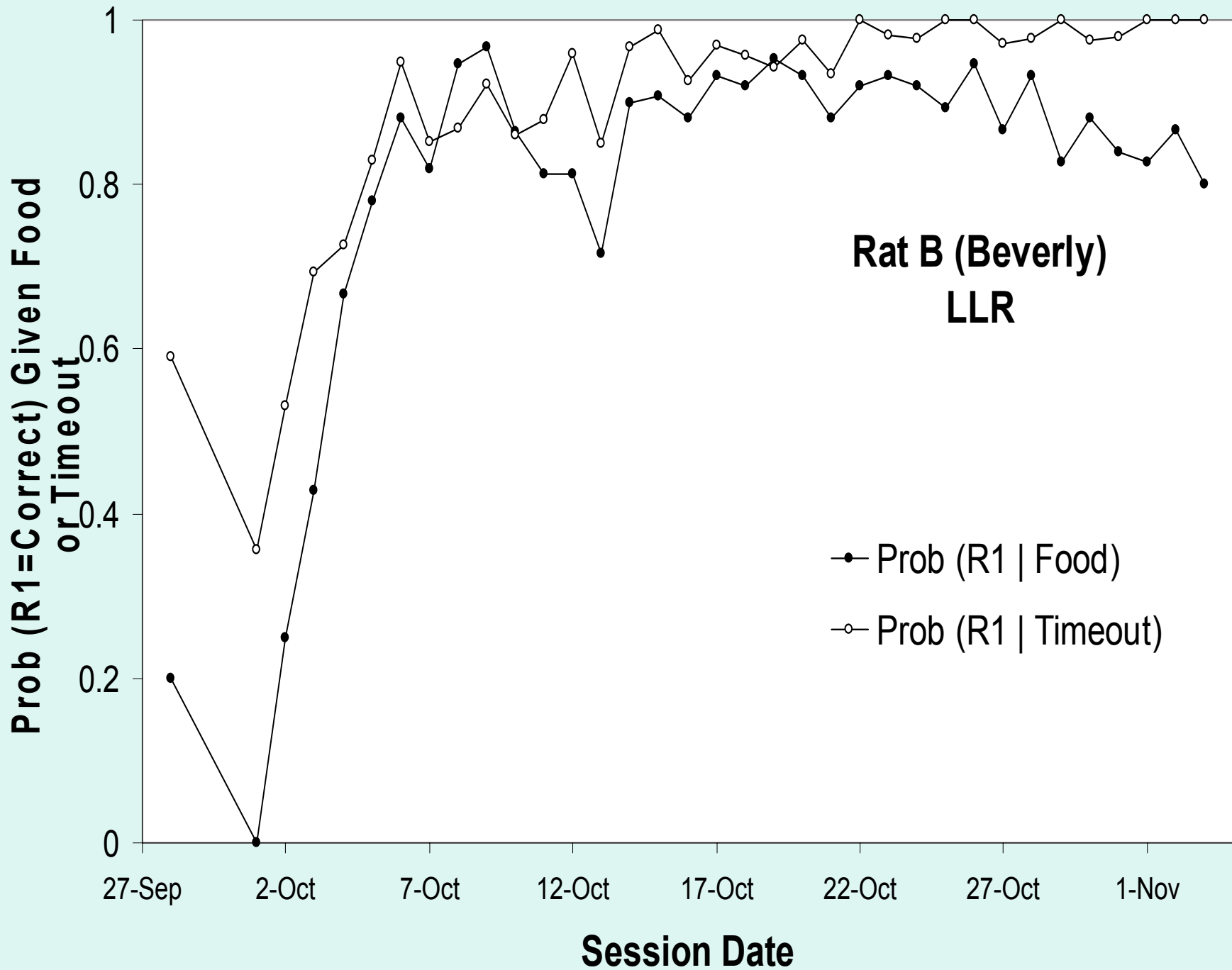
- A histogram was created to determine what times could be considered persisting through food. If there were two distinct groups, the earlier group would provide the range of times. Generally earlier times where from 0 to 2 seconds.

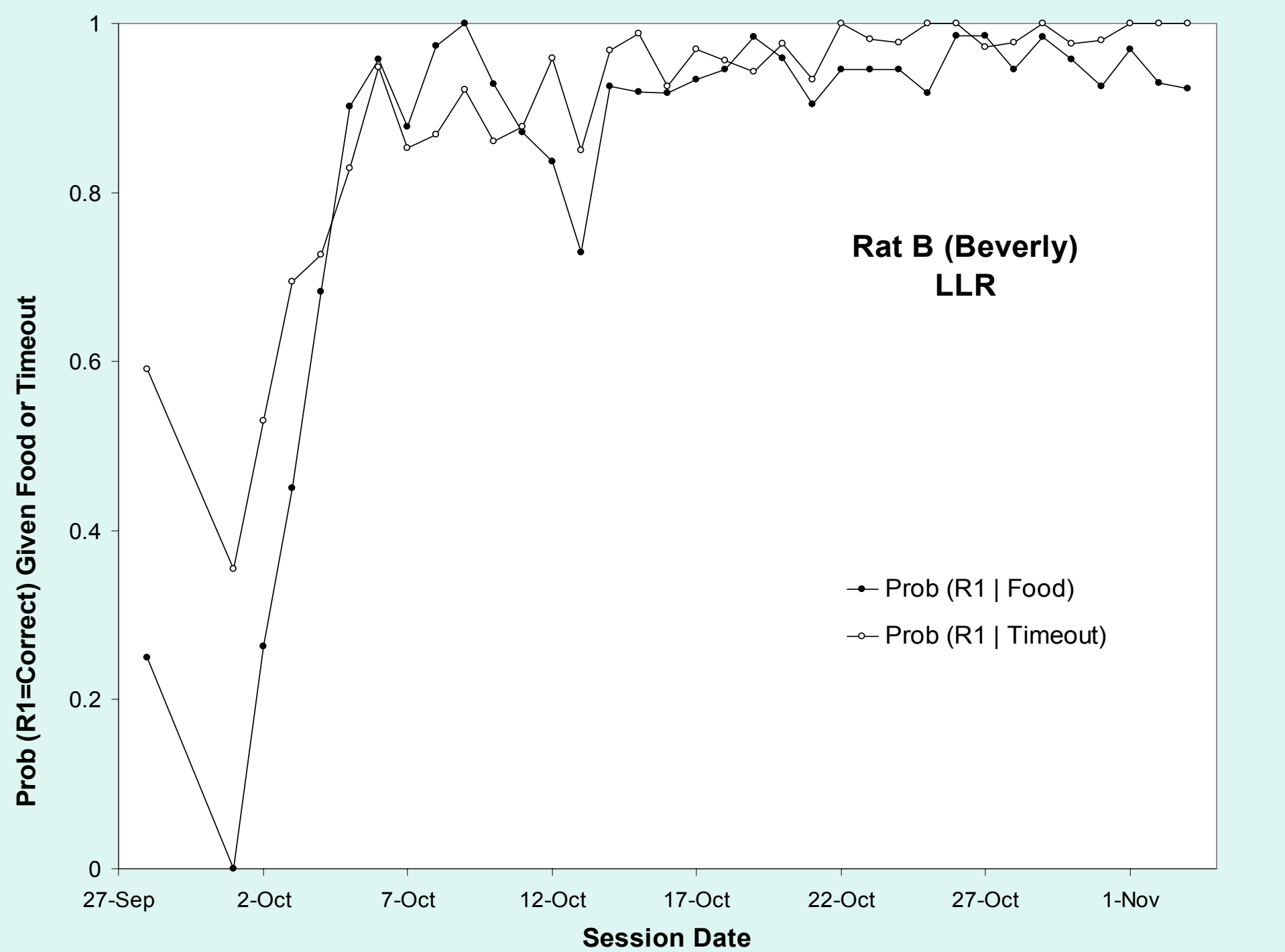
Example Histogram A from 11-Oct-2008



Result

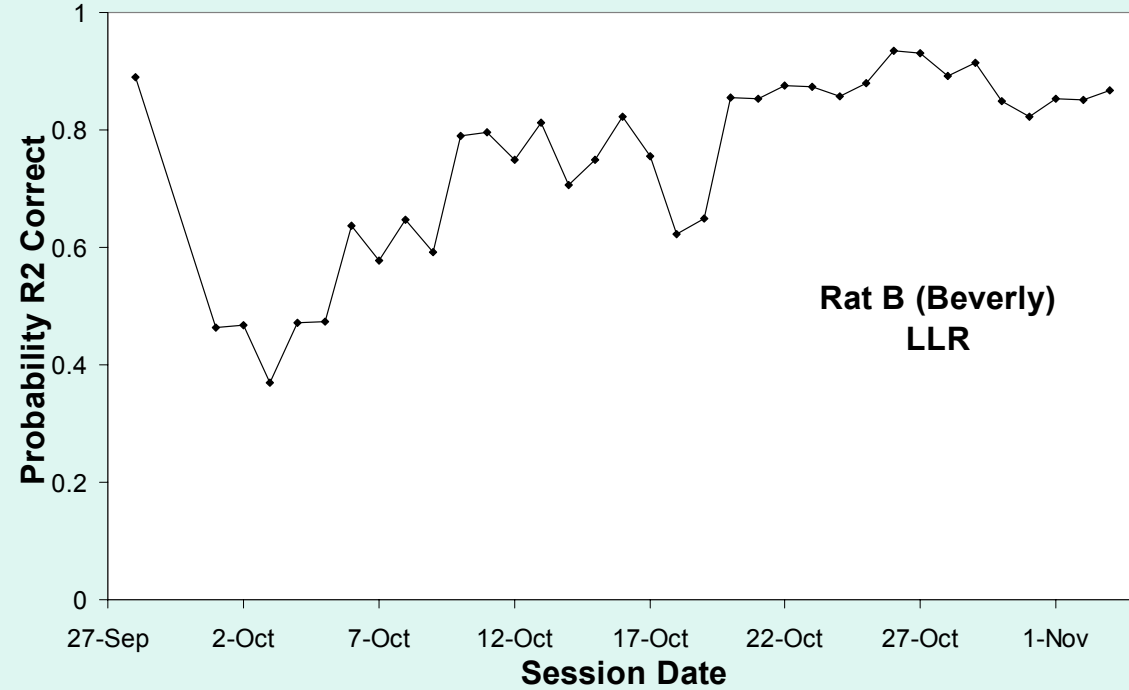
Possibly Significant
effect disappeared



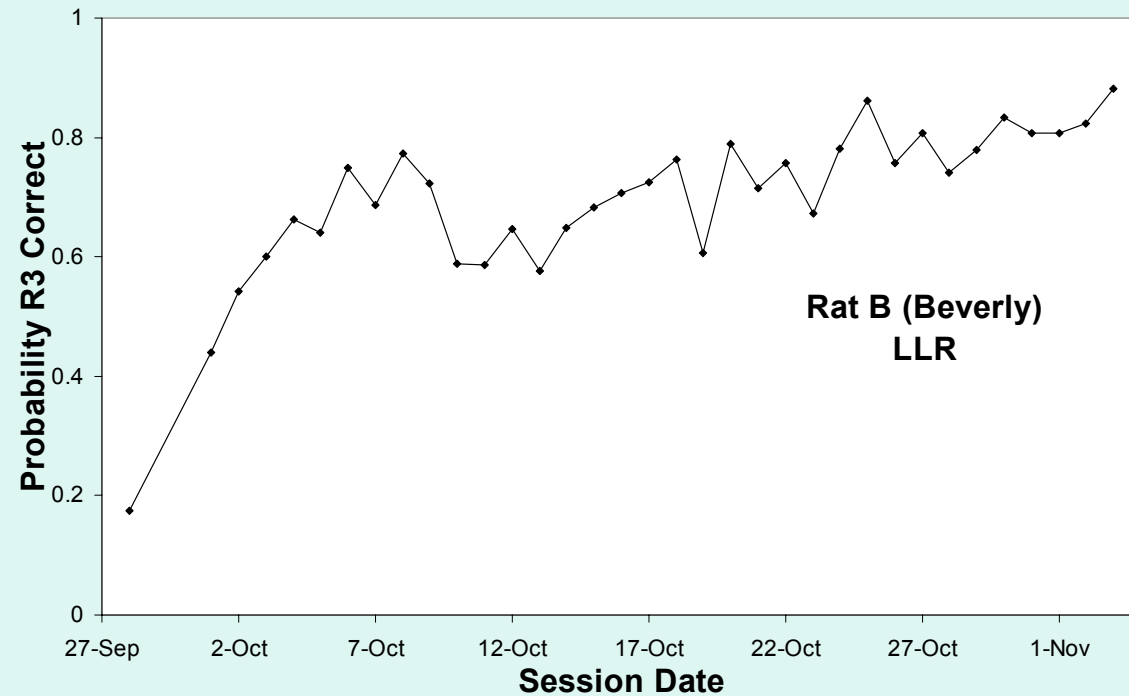


Sequence AAB

R2 Acquisition Curve

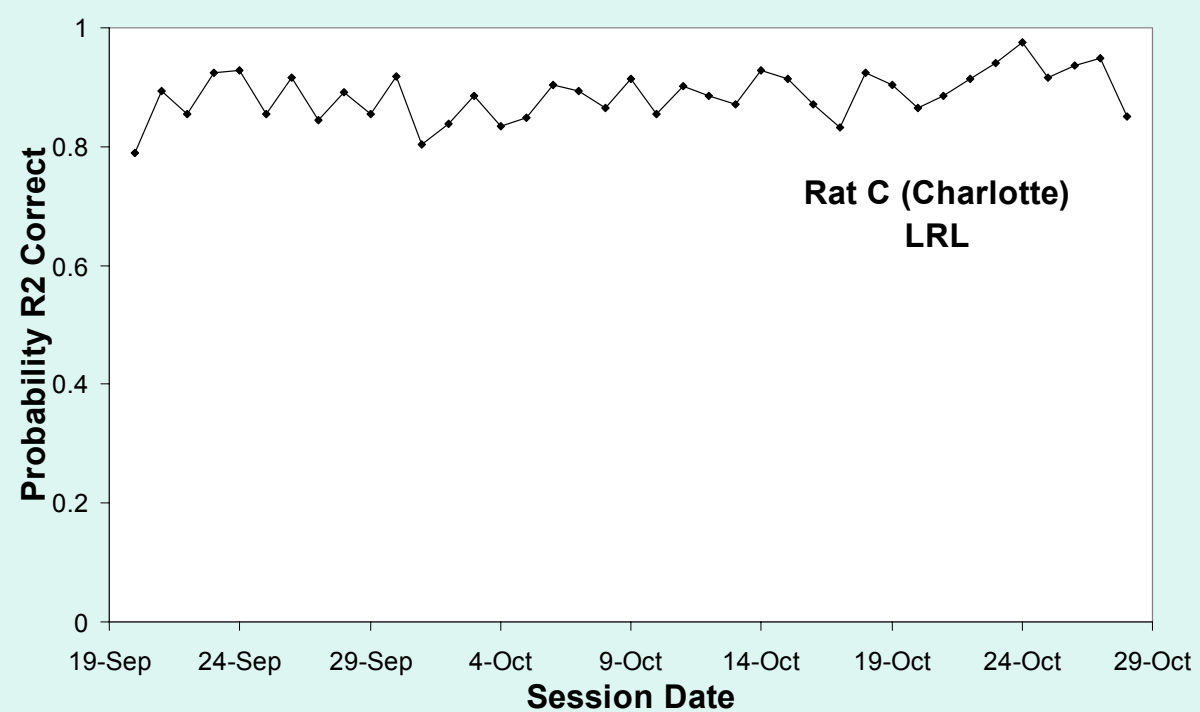


R3 Acquisition Curve

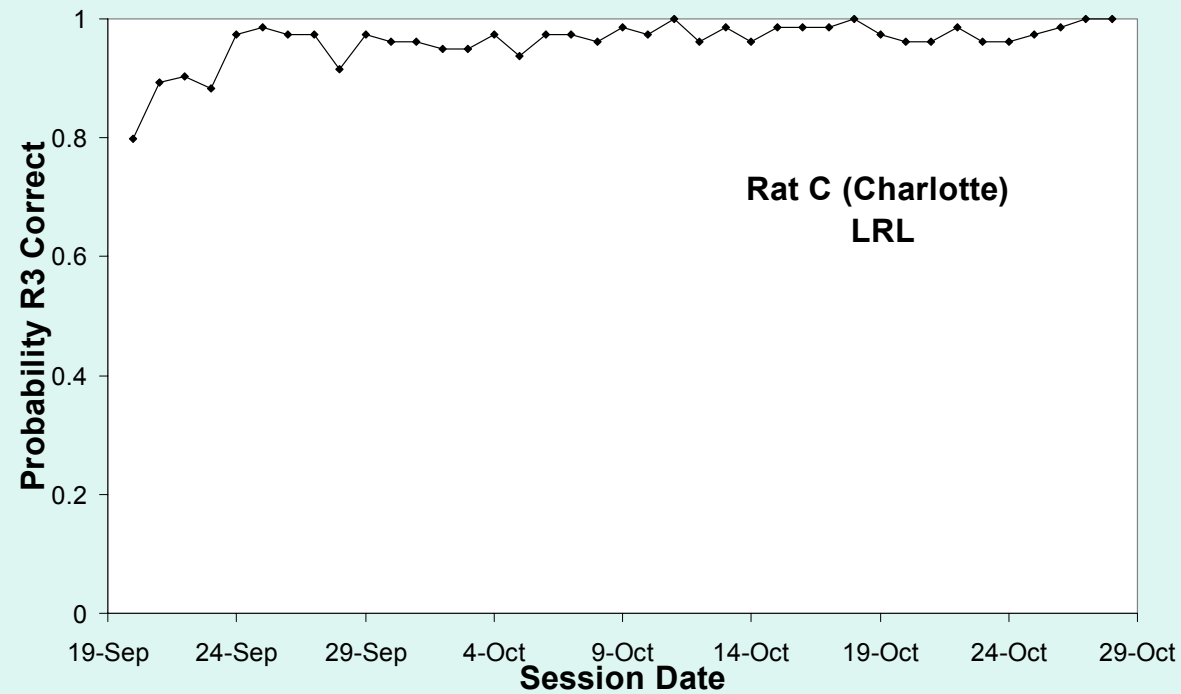


Sequence ABA

R2 Acquisition Curve

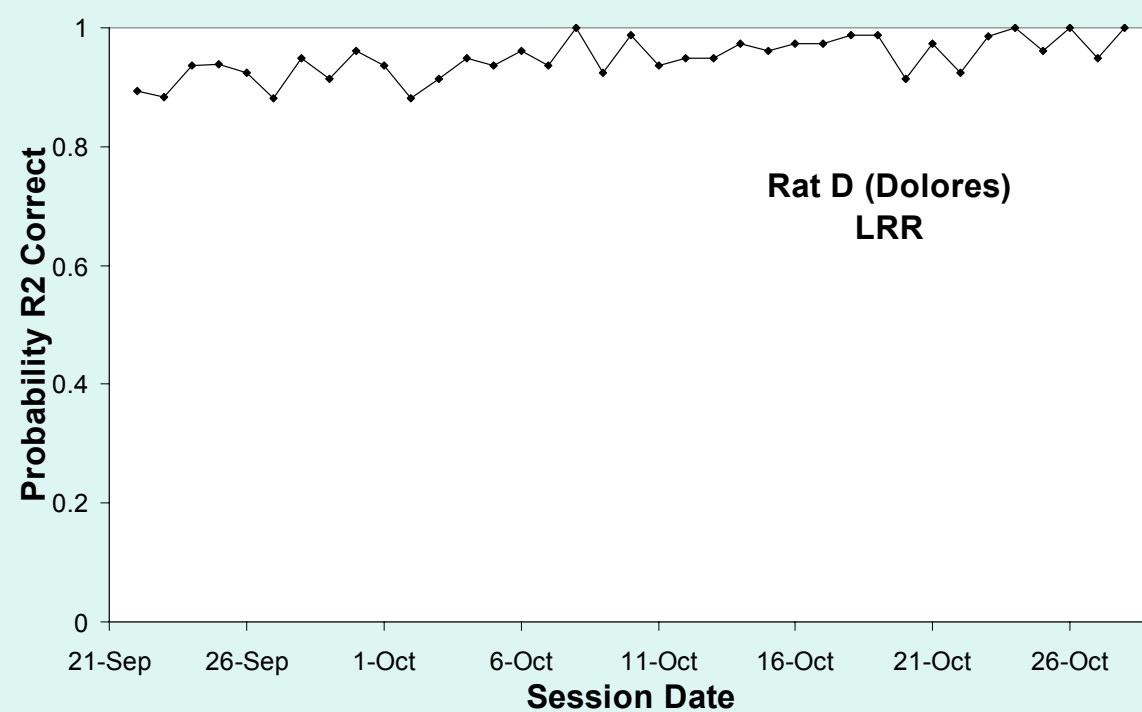


R3 Acquisition Curve

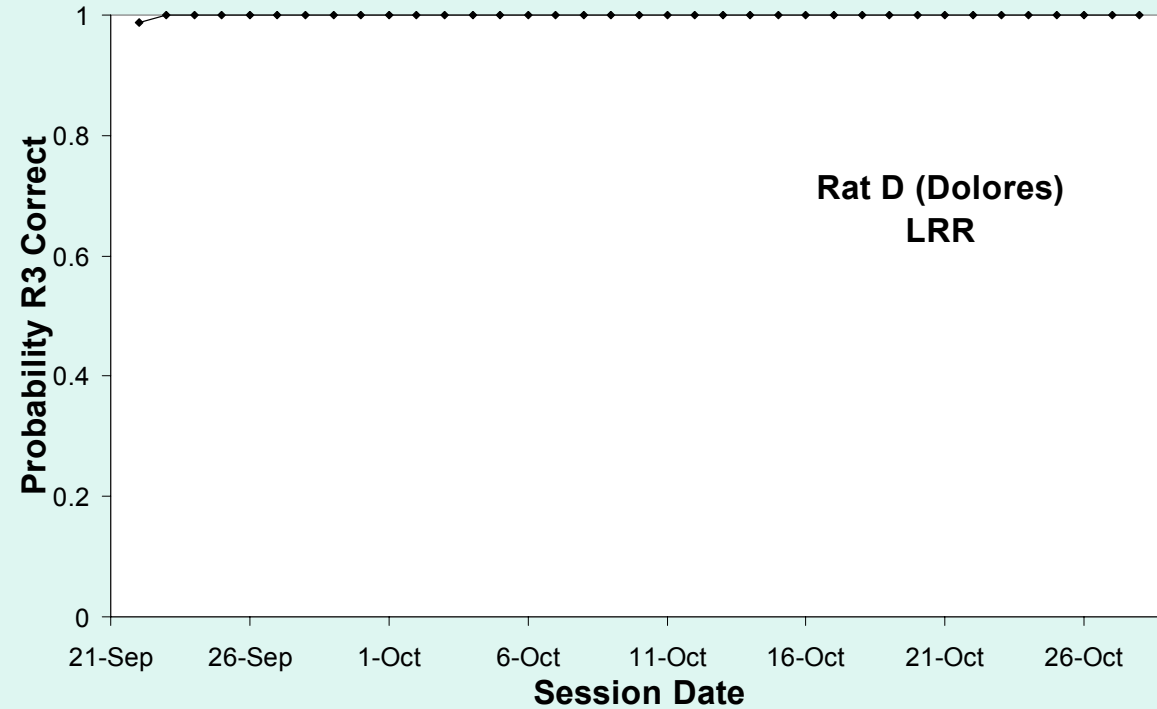


Sequence ABB

R2 Acquisition Curve



R3 Acquisition Curve



Questions:

- Do “hot streaks” occur among rats?
 - Does receiving food after completing a sequence correctly increase the probability that the rat will complete the next sequence correctly?
- Does reinforcement and punishment act on the sequence as a whole or on individual responses?
 - Is $P(\text{Correct Sequence}|\text{Food}) > \text{Unconditional}$?
 - Is $P(\text{Correct Sequence}|\text{TO}) > \text{Unconditional}$?

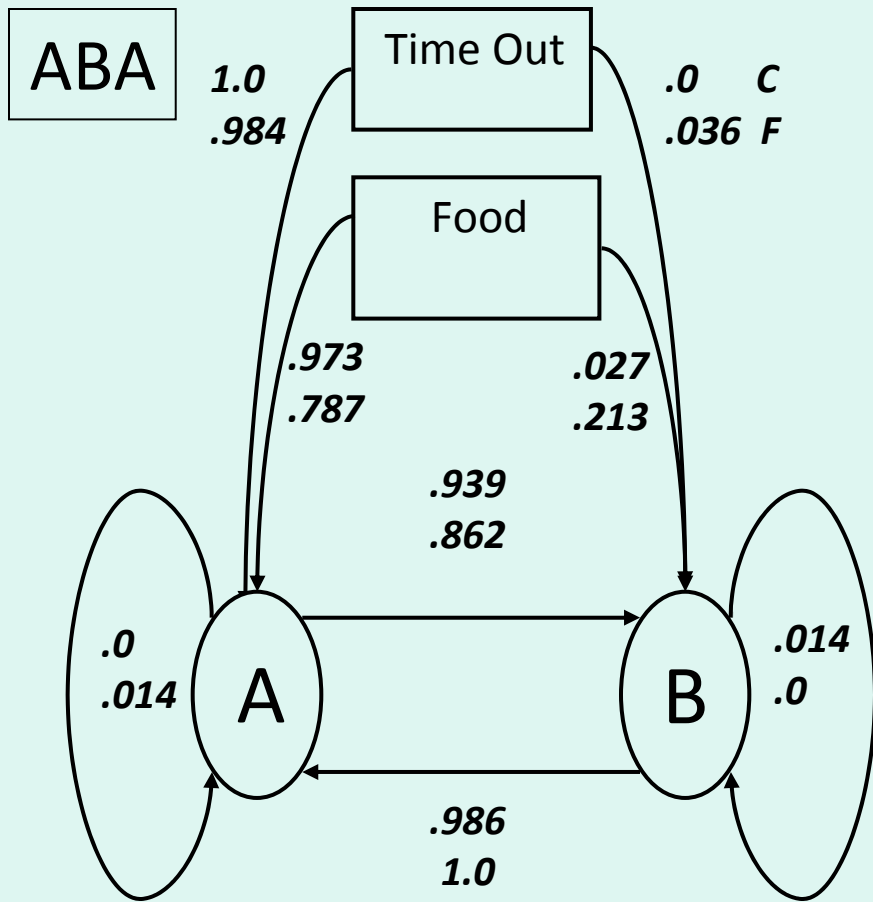
Results

Subject	Session Date	P(Correct Sequence Food)	P(Correct Sequence TO)	Unconditional Probabilities
Rat A	27-Sept	0.24	0.18	0.19
	30-Oct	0.58	0.49	0.54
Rat B	3-Oct	0.14	0.15	0.14
	25-Oct	0.73	0.63	0.70
Rat C	24-Sept	0.81	0.88	0.82
	20-Oct	0.80	0.94	0.82
Rat D	29-Sept	0.77	0.63	0.74
	23-Oct	0.88	0.82	0.87
Rat E	21-Sept	0.64	0.51	0.62
	23-Oct	0.83	0.92	0.83
Rat F	7-Oct	0.67	0.63	0.65
	26-Oct	0.81	0.65	0.79
Rat G	23-Sept	0.08	0.19	0.18
	24-Oct	0.81	0.73	0.80
Rat H	3-Oct	0.06	0.16	0.14
	29-Oct	0.69	0.79	0.60

Results

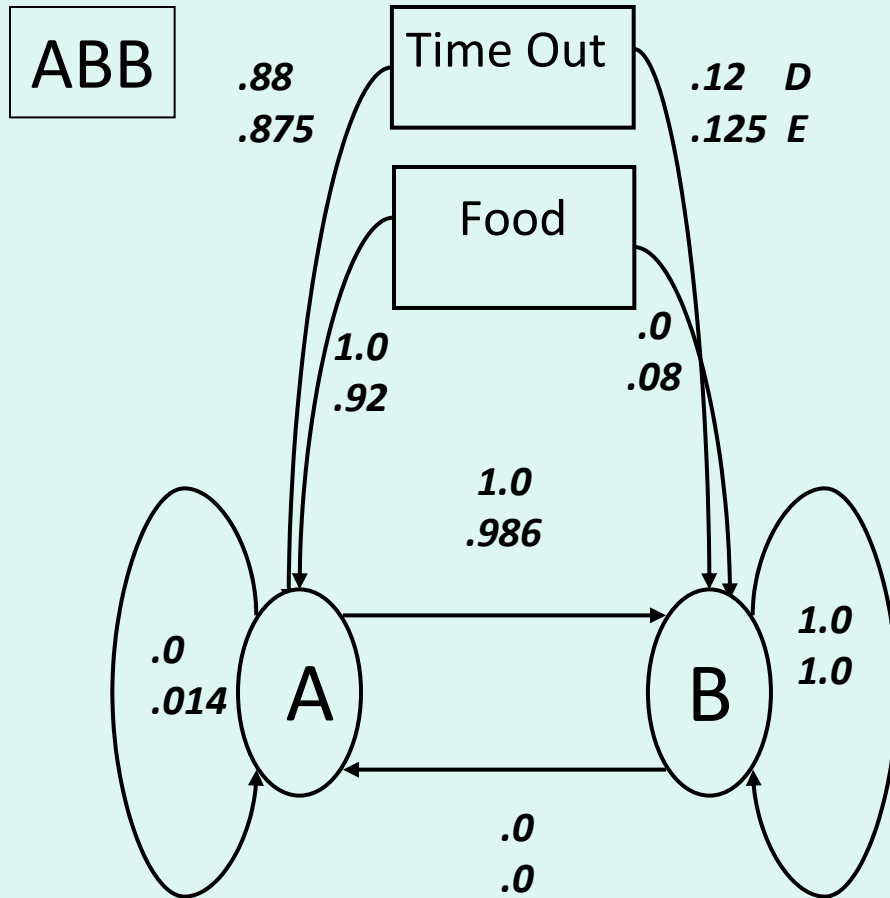
- The probabilities found showed that “hot streaks” did not occur in any of the 8 rats.
- Receiving food or a timeout did not increase the chances that the rat would perform the next sequence correctly.
- Sequential dependencies?
 - The probabilities do not show sequential dependencies.
 - Reinforcement and punishment did not seem to act on the sequence as a whole.

Markov Model ABA Sequence



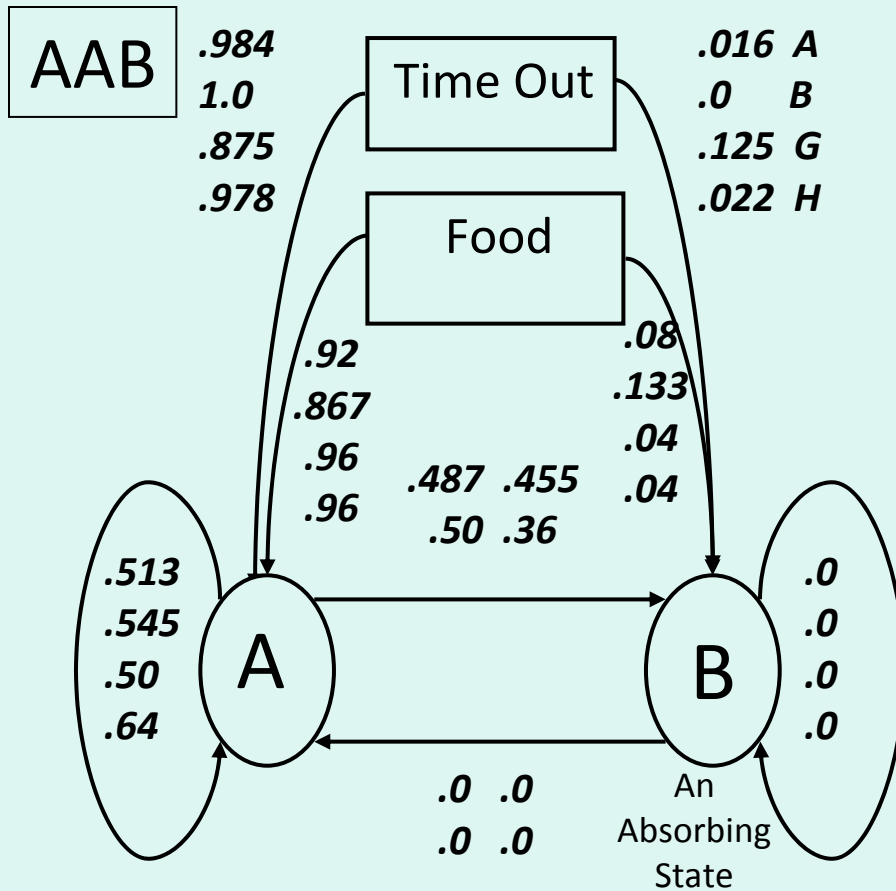
- 1st order Markov probabilities
- obtained after extensive training
- Accurate predictors of probabilities of correct responses
- Rat C- 92 % accuracy
- similar probabilities for Rat F following food and timeout

Markov Model ABB Sequence



- Repetition of B response

Markov Model AAB Sequence



- cannot use this to determine overall probabilities for the AAB sequence
- need a 2nd order Markov model

Purpose Revisited

- Identify
- Quantify
- Sequential Analysis:
 - Conditional probabilities
 - Markov models
- Allow us to determine what information was actually used when learning to know what to do next

THANKS

- DR. REID!
- Agnes, Beverly, Charlotte, Dolores, Ethel, Fanny, Gertrude, and Helga