The Matching Law

Erik Arntzen
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Definitions

- The Matching Law states that responses are allocated to the richest reinforcement schedule.
- The Matching Law has been shown in both nonhumans and humans.

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Herrnstein (1961)

- Concurrent VI VI schedules of reinforcement.
- 1.5 s COD (Change over delay)

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The Matching Law

- Let rA be four reinforcers per min
  rB be one reinforcer per min

- What will the pigeon do?
  - Switching between the schedules at random? Spending all the time at A?
- The matching law predicts
  RA/RB= rA/rB = 4/1 =4.

  The pigeon should make Response A four times more than the Response B

Ulike formler

B = Behavior
R = reinforcers

$$B_a/(B_a + B_b) = R_a/(R_a + R_b)$$

B = Behavior
r = reinforcers

$$\frac{\mathbf{B_1}}{\mathbf{B_1 + B_2}} = \frac{\mathbf{r_1}}{\mathbf{r_1 + r_2}}$$

R = responses
r = reinforcers

$$\frac{R_1}{R_1 + R_2} = \frac{r_1}{r_1 + r_2}$$

Key	Schedule	Rft/h	Rsp/h	Relative reinforcement	Relative responses
A	VI 3-min	20.00	2000	0.50	0.50
B	VI 3-min	20.00	2000	0.50	0.50
A	VI 9-min	6.7	250	0.17	0.08
B	VI 1.8-min	33.30	3000	0.83	0.92
A	VI 1.5-min	40.00	4800	1.00	1.00
B	Extinction	0.00	0	0.00	0.00
A	VI 4.5-min	13.30	1750	0.33	0.31
B	VI 2.25-min	26.70	3900	0.66	0.69

FIG. 9.5 A table of schedule values and data. Reinforcement per hour (Rft/h), responses per hour (Rsp/h), relative reinforcement (proportions), and relative responses (proportions) are shown. Adapted from Fig. 1 (bird 231) and text of "Relative and Absolute Strength of Responses as a Function of Frequency of Reinforcement," by R. J. Herrnstein, 1961b, *Journal of the Experimental Analysis of Behavior*, *4*, 267–272.

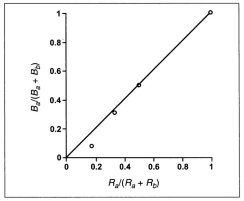

FIG. 9.6 Proportional matching of the response and reinforcement rates for bird 231. Figure is based on results from Herrnstein (1961b) and the data reported in Figure 9.5.

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Ulike mønstre ved matching

- Matching
  - Proporsjonen av responser matcher eller er lik proporsjonen av forsterkere.
- Undermatching
  - Proporsjonen av responser er lavere en proporsjonen av forsterkere.
- Overmatching
  - Proporsjonen av responser er høyere en proporsjonen av forsterkere

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Extension of the Matching Law

- Baum (1974)

$$\log(B_1/B_2) = a \log(r_1/r_2) + \log k$$

a= slope
k= intercept

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Rft/m A	Rft/m B	(R_A/R_B)	X value $\log (R_A/R_B)$	Slope (a)	Intercept (log k)	Y value $\log (B_A/B_B)$
			MATCHING			
5	5	1	0.00	1.00	0.00	0.00
30	5	6	0.78	1.00	0.00	0.78
100	5	20	1.30	1.00	0.00	1.30
600	5	120	2.08	1.00	0.00	2.08
			UNDERMATCHING			
5	5	1	0.00	0.50	0.00	0.00
30	5	6	0.78	0.50	0.00	0.39
100	5	20	1.30	0.50	0.00	0.65
600	5	120	2.08	0.50	0.00	0.13
			BIAS			
5	5	1	0.00	1.00	1.50	1.50
30	5	6	0.78	1.00	1.50	2.28
100	5	20	1.30	1.00	1.50	2.80
600	5	120	2.08	1.00	1.50	3.58

1.04

FIG. 9.15 Application of log-linear matching equation (Equation 9.5) to idealized experimental data. Shown are reinforcements per hour (Rft/h) for alternatives A and B, the ratio of the reinforcement rates (R_A/R_B), and the log ratio of the reinforcement rates (*X* values). The log ratios of the response rates (*Y* values) were obtained by setting the slope and intercept to values that produce matching, undermatching, or bias.

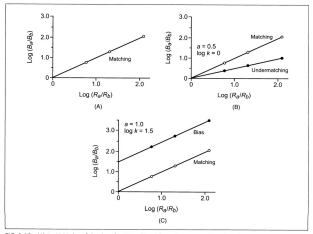
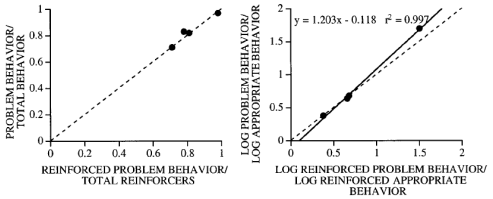


FIG. 9.16 (A) An X–Y plot of the data for "Matching" from Figure 9.15 The value of the slope is set at 1 (*a* = 1), and the intercept is set at zero (log *k* = 0). The matching line means that a unit increase in relative rate of reinforcement [$\log(R_A/R_B)$] produces a unit increase in relative rate of response [$\log(B_A/B_B)$]. (B) An X–Y plot of the data for "Undermatching" from Figure 9.15. The value of the slope is set at less than 1 (*a* = 0.5), and the intercept is set at zero (log *k* = 0). Undermatching with a slope of 0.5 means that a unit increase in relative rate of reinforcement [$\log(R_A/R_B)$] produces a half-unit increase in relative rate of response [$\log(B_A/B_B)$]. (C) An X–Y plot of the data for "Bias" from the data of Figure 9.15 The value of the slope is set at 1 (*a* = 1), and the intercept is more than zero (log *k* = 1.5). A bias of this amount indicates that the new plotted data on X–Y coordinates are deflected 1.5 units from the matching line.

From Barrero and Vollmer (2002)

- They are studying severe behavior problems in 4 individuals with varying degrees of developmental disabilities
  - Linda, a 14-year-old girl showing aggression and disruption.
  - Mandy, a 24-year-old woman with Sticklers syndrome showing self-injurious behavior as head banging, nose punching, chin punching, and head hitting.
  - Max, a 7-year-old boy diagnosed with autism. He was showing aggression, consisting of hitting, slapping, and pulling hear of others.
  - Dan, a 9-year-old boy showing aggression and disrupting behavior which consisted of hitting and kicking others, banging against walls, throwing materialism and property destruction.

From Barrero and Vollmer (2002)



Vollmer and Bouret (2000)

- They studied basketball and two- and three-point shots.
- The results showed that players allocated responding in accordance with relative reinforcement rate for two-and three-point shots.

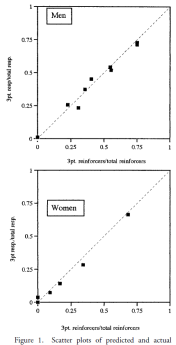
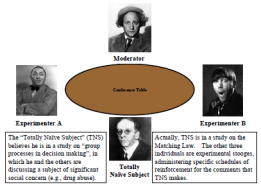


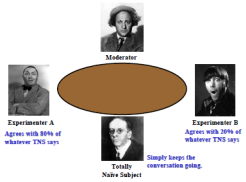
Figure 1. Scatter plots of predicted and actual three-point shot allocation for male (upper panel) and female (second panel) players on an individual basis for those players who attempted more than 100 shots. Data used to calculate predicted and actual shot allocation are taken from the entire season. The data are plotted against a diagonal line representing perfect matching.

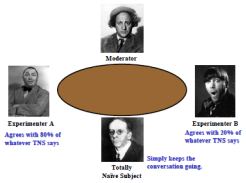
$$\frac{R_1}{R_1 + R_2} = \frac{r_1(A)}{r_1(A) + r_2}$$

$$\frac{R_1}{R_1 + R_2} = \frac{r_1(1.5)}{r_1(1.5) + r_2}$$

Conger and Killeen (1976)







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Questions about choice

Discuss the small and immediate and large and long term (delayed) consequences

- To study for the MALKA212 exam or watching ”soap” on TV.
- To go jogging or watching a soccer match on TV.
- To get up when the alarm clock rings or sleep in

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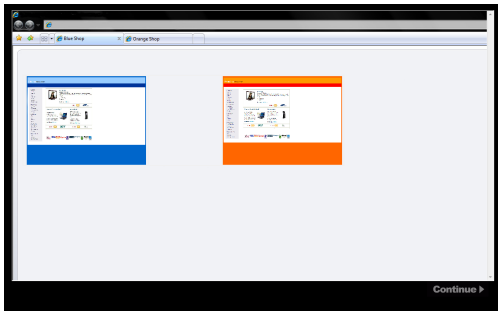
Example from Fagerstrom, Arntzen, and Foxall (in press)



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Forts

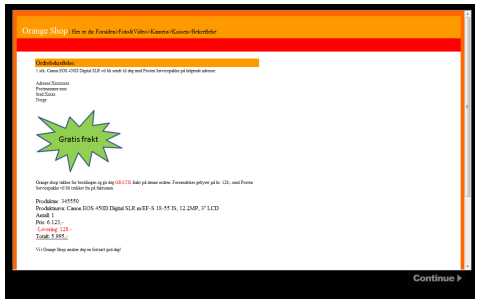
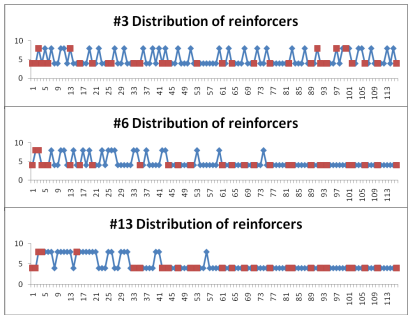


Table 1

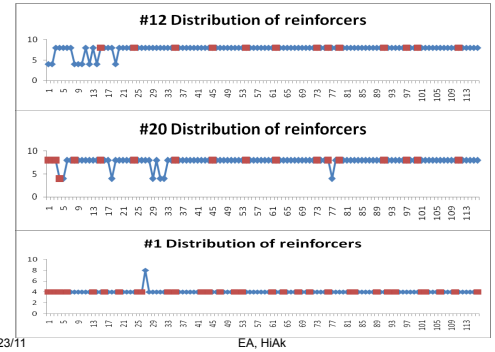
Proportion equation results

	Schedule	Total reinforcers	Total choices	Relative reinforcement	Relative choices
#1	VR4	28	111	0.67	0.99
	VR8	14	1	0.33	0.01
#2	VR4	28	95	0.67	0.85
	VR8	14	17	0.33	0.15
#3	VR4	28	80	0.67	0.71
	VR8	14	32	0.33	0.29
#4	VR4	28	91	0.67	0.81
	VR8	14	21	0.33	0.19
#5	VR4	28	61	0.67	0.54
	VR8	14	51	0.33	0.46
#6	VR4	28	94	0.67	0.84
	VR8	14	18	0.33	0.16
#7	VR4	28	62	0.67	0.55
	VR8	14	50	0.33	0.45
#8	VR4	28	97	0.67	0.87
	VR8	14	15	0.33	0.13

Examples



Examples



Self-control (From Rachlin and Green)

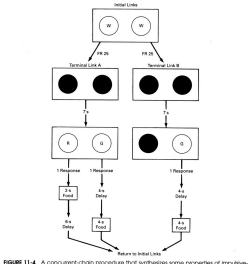
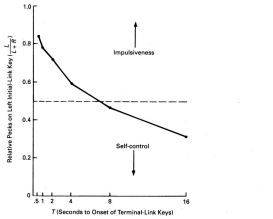


FIGURE 11-4 A concurrent-chain procedure that synthesizes some properties of impulsiveness, commitment and self-control. According to FR 25 schedules, pecks on white (W) initial-link keys are followed after *T* s by terminal links. In terminal-link A, red (R) and green (G) keys respectively make an immediate small reinforcer or a delayed large one available. In terminal-link B, the green key alone makes only the delayed large reinforcer available. (Adapted from Rachlin & Green, 1972)

FIGURE 11-5 Relative initial-link pecks producing terminal-link A (left initial-link pecks divided by total initial-link pecks) as a function of *T*, the time to the onset of the terminal-link keys. (Cf. Figure 11-4; adapted from Rachlin & Green, 1972, Table 1)



Fra Pierce og Cheney (2004)

$$\frac{\text{Barnets medgjørlighet til mor}}{\text{medgjørlighet mor + medgjørlighet til andre}} = \frac{\text{Sr fra mor}}{\text{Sr fra mor + Sr fra andre}}$$