
Implications for Adaptive Action

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Although reinforcement often leads to repetitive, even stereotyped responding, that is not a necessary outcome. When it depends on variations, reinforcement results in responding that is diverse, novel, indeed unpredictable, with distributions sometimes approaching those of a random process. This article reviews evidence for the powerful and precise control by reinforcement over behavioral variability, evidence obtained from human and animal-model studies, and implications of such control. For example, reinforcement of variability facilitates learning of complete responses, aids problem solving, and may contribute to creativity. Depression and autism are characterized by abnormal repetitive behaviors, but individuals afflicted with such psychopathologies can learn to vary their behaviors when reinforced for so doing. And reinforced variability may help to solve a basic puzzle concerning the nature of voluntary action.

Variability

Much research on the effects of reinforcement on behavior has focused on the control of response rates and the acquisition of specific responses. However, reinforcement can also influence the variability of behavior. In particular, reinforcement of variability can lead to more diverse and novel responses. This is evident in studies of human and animal learning, where reinforcement of variability facilitates learning of complete responses, aids problem solving, and may contribute to creativity. For example, in a study of human learning, subjects were reinforced for producing a wide range of responses, and this led to more complete learning of the task. Similarly, in animal studies, reinforcement of variability has been shown to facilitate learning of complex tasks and to increase the variability of responses. These findings have important implications for understanding the nature of voluntary action and for developing interventions for individuals with repetitive behaviors, such as those seen in depression and autism. In particular, these findings suggest that reinforcement of variability may be a useful strategy for promoting more adaptive and creative behavior in these individuals.

operant variability



A e
Ne 8 e

Musical score consisting of ten staves with various notes and rests.

Musical score consisting of ten staves with various notes and rests.

superposition

do

Va 88 I F c 8 a

Musical score consisting of ten staves with various notes and rests.

Unbestimmtheit

Zufall

Inde-

termination

indeterminist

respondant

instrumental

A single musical staff with a few notes and rests.

FB e 1

E de ce f S c a c Re, d b P e

1000

MEAN



Q e a Va 8b88

Operant responses



abilit

Vari-

N e T a d a B (1966) d
 d a a c d (), ca a ac
 a a S a a b (RESPS) d ac
 a c d (HALF-SEC) (IRT) b a a
 c d a c a c d F T R c L a F
 l T b D. S. B., 1966, J. a f e e a
 A a f B e a , 9, 587. C 1966 b S c E
 a. A. a. B a. Ada d
 T b .2(2()-40 .2) T J -25-48 E 2 E R . 2 .

Random

Random

stochastic
random

U

I T Va, ab,

U

U

U

1. $\int_0^1 x^2 dx = \frac{1}{3}$

2. $\int_0^1 x^3 dx = \frac{1}{4}$

3. $\int_0^1 x^4 dx = \frac{1}{5}$

4. $\int_0^1 x^5 dx = \frac{1}{6}$

5. $\int_0^1 x^6 dx = \frac{1}{7}$

6. $\int_0^1 x^7 dx = \frac{1}{8}$

7. $\int_0^1 x^8 dx = \frac{1}{9}$

8. $\int_0^1 x^9 dx = \frac{1}{10}$

9. $\int_0^1 x^{10} dx = \frac{1}{11}$

10. $\int_0^1 x^{11} dx = \frac{1}{12}$

11. $\int_0^1 x^{12} dx = \frac{1}{13}$

12. $\int_0^1 x^{13} dx = \frac{1}{14}$

13. $\int_0^1 x^{14} dx = \frac{1}{15}$

14. $\int_0^1 x^{15} dx = \frac{1}{16}$

15. $\int_0^1 x^{16} dx = \frac{1}{17}$

16. $\int_0^1 x^{17} dx = \frac{1}{18}$

17. $\int_0^1 x^{18} dx = \frac{1}{19}$

18. $\int_0^1 x^{19} dx = \frac{1}{20}$

19. $\int_0^1 x^{20} dx = \frac{1}{21}$

20. $\int_0^1 x^{21} dx = \frac{1}{22}$

21. $\int_0^1 x^{22} dx = \frac{1}{23}$

22. $\int_0^1 x^{23} dx = \frac{1}{24}$

23. $\int_0^1 x^{24} dx = \frac{1}{25}$

24. $\int_0^1 x^{25} dx = \frac{1}{26}$

Musical score for the first system, consisting of ten staves. The notation includes various note values, rests, and bar lines, typical of a musical manuscript.

S c e f Q. e a V a 81b88

Musical score for the second system, consisting of ten staves. The notation includes various note values, rests, and bar lines, typical of a musical manuscript.

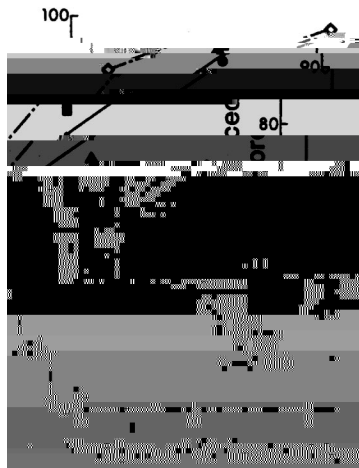
R a d E a E

Musical score for the third system, consisting of ten staves. The notation includes various note values, rests, and bar lines, typical of a musical manuscript.

The Dice Man,

F8 e 4

Le e fRe, e Va ab (S b Pe ce a e
fRe f cedT a) a N be fRe, e Pe T a
l c ea ed



N e. l d d a. . . d a a . . . b . . . d b . . .
a a (MED) . . . b . . . d . . . T b . . . d a a . . . a
. . . a . . . a d . . . a . . . (RND) . . . d . . . d d c a c . . .
F . . . Va ab . . . l a O a . . . b S. Pa . . . d d A. N . . . , 1985, J. . . a
f e . . . e a P c . . . : A a Be a P ce e , 11, . 440. C
1985 b A ca P c . . . ca. A . ca . . . R . . . d

Multiple staves of musical notation, likely representing a transcription of the audio signal. The notation includes notes, stems, and various symbols such as 'b' and '6' on the staves. The notation is dense and spans the right half of the page.

Multiple staves of musical notation, similar to the right side of the page. It includes notes, stems, and symbols. One staff contains the text *e perimental evidence* written in a cursive font. The notation is dense and spans the bottom half of the page.

F8, e 5

F, c 8 f Va 8b88

The first system of the musical score consists of five staves. The top staff contains a series of notes with stems pointing downwards, including a prominent sixteenth note. The second staff has a similar rhythmic pattern. The third staff features a sequence of notes with stems pointing upwards. The fourth and fifth staves continue the melodic and rhythmic development of the piece.

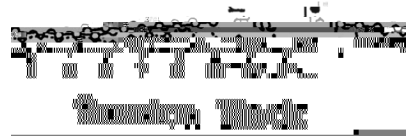
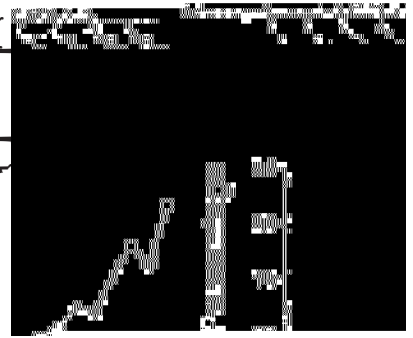
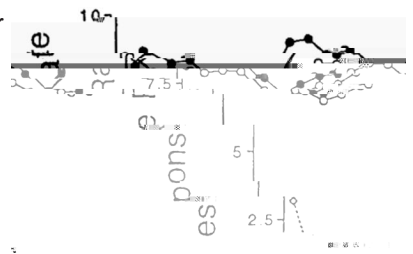
The second system of the musical score consists of five staves. It continues the musical material from the first system, with similar rhythmic patterns and melodic lines across the staves.

The third system of the musical score consists of ten staves, arranged in two groups of five. The notation is dense, with many notes and stems, indicating a complex musical texture. The staves are filled with rhythmic patterns and melodic lines, typical of a multi-measure rest or a complex rhythmic exercise.

Musical score consisting of multiple staves with notes and rests.

F8 e 6

Re f ce e f Va a Fac a e Ac.. f
a D f c Re e Se.. e ce



N e.T a a a a d (a) b
ac a ac b.c d.T b
a c a a c a c
d.T a b c c db
d c c a d a d b c c a d a d
a d a b c c a d a d .F. R c d
Va ab ad O a La b A.N. C.D ad G.O.
2000, J. a f e e a P c :A a Be q P ce e, 26,
102 103. C 2000 b A ca P c ca. A. ca. R-

P b S

Musical staff with notes and rests.

Musical score for Percussion 1 (Perc 1). The score consists of 12 staves. The notation includes various rhythmic patterns, rests, and dynamic markings such as **mf** and **f**. The music is written in a standard staff format with a treble clef and a key signature of one flat (B-flat). The score is dense with notes and rests, indicating a complex rhythmic piece.

Perc 1a

Musical score for Percussion 1a. The score consists of 2 staves. The notation includes various rhythmic patterns, rests, and dynamic markings such as **mf** and **f**. The music is written in a standard staff format with a treble clef and a key signature of one flat (B-flat).

ADHD.

Musical score for ADHD. The score consists of 1 staff. The notation includes various rhythmic patterns, rests, and dynamic markings such as **mf** and **f**. The music is written in a standard staff format with a treble clef and a key signature of one flat (B-flat).

A musical score for a string quartet, consisting of four staves. The notation includes various notes, rests, and dynamic markings such as 'b' and 'f'.

I. a 8

V. a Ac.

A single musical staff with notation, including notes and rests.

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