

BEHAVIOR OF ORGANISMS AT 80:  
WHAT MAKES IT RELEVANT

# Operants

2018 - III

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The Name of  
the Game:  
**Behavior  
Analysis  
Defined  
and  
Redefined**



RAT LAB IN THE XXI CENTURY



**I**N 1938, B. F. SKINNER PUBLISHED HIS FIRST BOOK, *THE BEHAVIOR OF ORGANISMS*. HE PRESENTED YEARS OF PIONEERING RESEARCH ON OPERANT CONDITIONING. HIS COLLEAGUE, FRED KELLER, CALLED HIS DISCOVERY “A BRAND NEW SCIENCE OF BEHAVIOR.” EIGHTY YEARS LATER, THE BOOK STILL ACCURATELY PRESENTS THE BASIC SCIENCE. IT DOCUMENTS HOW EVENTS THAT IMMEDIATELY FOLLOW ACTIONS AFFECT THE FREQUENCY (OR RATE) OF SIMILAR ACTIONS IN THE FUTURE. SKINNER ALSO DISCUSSED ISSUES THAT ARE IMPORTANT TODAY. HIS ANALYSIS OF THE RELATION OF NEUROLOGY TO A SCIENCE OF BEHAVIOR REMAINS EVEN MORE RELEVANT IN 2018 THAN IT WAS IN 1938. THE B. F. SKINNER FOUNDATION PROVIDES SKINNER’S OWN WORDS IN AN EASILY ACCESSIBLE FORM. IT OFFERS *THE BEHAVIOR OF ORGANISMS* IN ITS ON-LINE BOOKSTORE AS A NAME-YOUR-PRICE PDF. YOU CAN DOWNLOAD IT FOR FREE, OR ADD ANY AMOUNT TO SUPPORT PUBLICATION AND ARCHIVAL PROGRAMS, STUDENT RESEARCH, AND THE PRODUCTION OF *OPERANTS*.

**Julie S. Vargas, Ph.D.**  
**President, B. F. Skinner Foundation**

### Chinese Translated by Karena Lee

1938年, B.F. Skinner出版了他的第一本書「生物的行為」。他介紹了多年來關於操作制約的開創性研究。他的同事Fred Keller稱他的發現是「一種全新的行為科學」。八十年後, 這本書仍然準確地介紹了基礎科學。它記錄了緊接動作的事件如何影響將來類似行為的頻率(或速率)。Skinner還討論了今天重要的問題。他對神經學與行為科學的關係分析在2018年比1938年更為重要。B.F. Skinner基金會以便利的形式分享了Skinner本人的話。它在其網上書店中以自由定價的方式提供《生物行為》這本書。您可以免費下載, 或付任何金額以支持其出版和檔案計劃、學生研究和Operants的製作。

### Czech Translated by Helena Vaďurová

V roce 1938 vydal B. F. Skinner svou první knihu Chování organismů. Představil v ní roky průkopnického výzkumu operantního podmiňování. Jeho kolega Fred Keller jeho objev označil za „zcela novou vědu o chování“. I po osmdesáti letech tato kniha představuje vědecké základy. Dokládá, jak události, které bezprostředně následují po chování, ovlivňují frekvenci podobného chování v budoucnosti. Skinner se věnoval i tématům, která jsou v současnosti aktuální. Jeho analýza vztahu mezi neurologií a behaviorální vědou je v roce 2018 aktuálnější, než byla v roce 1938. Nadace B. F. Skinnera zprostředkovává jeho slova ve snadno přístupné podobě. Chování organismů nabízí v on-line knihkupectví jako PDF, jehož cenu si určujete sami. Můžete si ho stáhnout zdarma nebo zvolit jakoukoli částku na podporu publikačních a archivačních programů, studentského výzkumu a vydávání časopisu Operants.

### Dutch Translated by Frans van Haaren

In 1938 publiceerde B.F. Skinner zijn eerste boek 'The Behavior of Organisms'. In dat boek beschreef hij het baanbrekende resultaat van jarenlang onderzoek op het gebied van de operante conditionering. Zijn collega, Fred Keller, noemde zijn ontdekking 'een geheel nieuwe gedragswetenschap'. Tachtig jaar later beschrijft het boek nog heel precies de basis van die wetenschap. Er staat in hoe gebeurtenissen die onmiddellijk volgen op bepaald gedrag de toekomstige frequentie (of snelheid) van gelijksoortig gedrag bepalen. Skinner bediscussieerde zaken die ook vandaag nog belangrijk zijn. Zijn analyse van de relatie tussen neurologie en de gedragswetenschap is zelfs meer relevant in 2018 dan het was in 1938. De B.F. Skinner Foundation maakt Skinner's eigen woorden op een eenvoudige manier toegankelijk. The Behavior of Organisms is verkrijgbaar in de on-line boekhandel waarbij je zelf bepaalt wat je ervoor wilt betalen. Je kunt het gratis downloaden, of je kunt iets betalen ter ondersteuning van publicaties, het archief, onderzoek van studenten of de publicatie van Operants.

### French Translated by MarieCéline Clemenceau

En 1938, B. F. Skinner a publié son premier livre, The Behavior of Organisms. Il a présenté des années de recherches pionnières sur le conditionnement opérant. Son collègue, Fred Keller, a qualifié sa découverte de "nouvelle science du comportement". Quatre-vingts ans plus tard, le livre présente toujours avec précision la science fondamentale. Il documente comment les événements qui suivent immédiatement les actions affectent la fréquence (ou le taux) d'actions similaires dans le futur. Skinner a également discuté de questions importantes aujourd'hui. Son analyse de la relation entre la neurologie et une science du comportement reste encore plus pertinente en 2018 qu'en 1938. La Fondation B. F. Skinner fournit les propres mots de Skinner sous une forme facilement accessible. Elle propose The Behavior of Organisms dans sa librairie en ligne sous forme de fichier PDF à votre prix. Vous pouvez le télécharger gratuitement ou ajouter un montant pour financer des programmes de publication et d'archivage, des recherches pour des étudiants et la production d'Operants.

### German Translated by Natalie Werner

1938 veröffentlichte B.F. Skinner sein erstes Buch, The Behavior of Organisms. Er stellte darin Jahre bahnbrechender Forschung zu Operanter Konditionierung vor. Sein Kollege, Fred Keller, nannte seine Entdeckung "eine brandneue Wissenschaft des Verhaltens". Achtzig Jahre später gibt das Buch immer noch akkurat die Grundlagenforschung wieder. Es dokumentiert, wie Ereignisse, die direkt auf Handlungen folgen, die Häufigkeit (oder Rate) ähnlicher Handlungen in der Zukunft beeinflussen. Seine Analyse von der Beziehung zwischen Neurologie und der Wissenschaft des Verhaltens ist in 2018 relevanter, als sie 1938 war. Die B.F. Skinner Foundation stellt einen einfachen Zugang zu Skinners Werk. Sie bietet The Behavior of Organism in ihrem Online-Bookstore als ein "name-your-price" PDF an. Sie können es kostenlos herunterladen, oder einen beliebig hohen Betrag bezahlen, um Veröffentlichungen Archivierungsprogramme, Forschung durch Studierende und die Produktion von Operants zu unterstützen.

### Greek Translated by Katerina Dounavi

To 1983, ο B. F. Skinner δημοσίευσε το πρώτο του βιβλίο, Η Συμπεριφορά των Οργανισμών. Παρουσίασε χρόνια καινοτόμου έρευνας στη συντελεστική μάθηση. Ο συνάδελφός του, Fred Keller, ονόμασε την ανακάλυψή του "μια ολοκαίνουρια επιστήμη της συμπεριφοράς". Ογδόντα χρόνια αργότερα, το βιβλίο εξακολουθεί να παρουσιάζει με ακρίβεια τη βασική επιστήμη. Καταγράφει πώς τα γεγονότα που ακολουθούν αμέσως τις ενέργειες επηρεάζουν τη συχνότητα (ή την τιμή) παρόμοιων ενεργειών στο μέλλον. Ο Skinner συζήτησε επίσης θέματα που είναι σημαντικά σήμερα. Η ανάλυσή του σχετικά με τη σχέση της νευρολογίας με την επιστήμη της συμπεριφοράς παραμένει πιο επίκαιρη το 2018 απ' ό,τι το 1938. Το Ίδρυμα B. F. Skinner παρέχει τα λόγια του Skinner σε μια εύκολα προσβάσιμη μορφή. Προσφέρει την Συμπεριφορά των Οργανισμών στο ηλεκτρονικό του βιβλιοπωλείο ως PDF με τιμή που προτείνει ο αγοραστής. Μπορείτε να το κατεβάσετε δωρεάν ή να προσθέσετε οποιοδήποτε ποσό για να υποστηρίξετε τα προγράμματα δημοσίευσης και αρχειοθέτησης, την έρευνα των φοιτητών και την παραγωγή του περιοδικού Operants.

### Hebrew Translated by Shiri Ayzazo

בשנת 1938, ב.פ. סקינר פרסם את הספר הראשון שלו, התנהגותם של אורגניזמים. הספר הציג שנים של מחקר חלוצי על התנהגות אופרנטית. הקולגה שלו, פרד קלר, קרא לתגלית שלו "מדע חדש לחלוטין של התנהגות". שמונים שנים לאחר מכן, הספר עדיין מייצג במדויק את המחקר הבסיסי. הוא מתעד כיצד אירועים שעוקבים מיד לאחר התנהגות משפיעים על התדירות (או הקצב) של פעולות דומות בעתיד. סקינר גם דן בסוגיות שחשובות אפילו היום. הניתוח שלו את הקשרים של נוירולוגיה למדע התנהגות נשאר רלוונטי ב-2018 אף יותר מאשר היה ב-1938. הקרן של ב.פ. סקינר מספקת את מילותיו של סקינר בצורה נגישה וקלה. היא מציעה את התנהגותם של אורגניזמים בחנות הספרים המקוונת שלה כקובץ PDF קבע-את-מחירך. תוכלו להוריד אותו בחינם, או להוסיף כל סכום כדי לתמוך בתוכניות פרסום וארכיב, מחקרי סטודנטים והייצור של אופרנטס.

### Icelandic Translated by Kristjan Gudmundsson

Árið 1938 gaf B. F. Skinner út sína fyrstu bók, The Behavior of Organisms. Þar birtir hann frumkvöðla rannsóknastarf sitt á virkri skilyrðingu. Vinur hans og félagi, Fred Keller, kallaði uppgötvun hans: "alveg ný vísindi atferlis." Áttatíu árum seinna þá er bókin enn nákvæm birtingarmynd grunnvísindanna. Hún sýnir hvernig atburðir sem eiga sér stað strax á eftir hegðun breyta líkindum á (eða tíðni) sambærilegrar hegðunar í framtíðinni. Skinner ræddi líka efni sem eru sérstaklega mikilvæg í dag. Greining hans á tengslum taugafræði við atferlisfræði er enn mikilvægari 2018 heldur en árið 1938. B. F. Skinner Foundation býður fram orð Skinners á aðgengilegan máta. Stofnunin býður The Behavior of Organisms í net- búðinni á name-your-price PDF formi. Þú getur halað henni niður ókeypis, eða bætti við hvaða upphæð sem er til að styðja átak í útgáfu og varðveislu, nemenda rannsóknir og útgáfu nettimaritans: Operants.

### Italian Translated by Anna Luzi

Nel 1938, B. F. Skinner pubblicò il suo primo libro, The Behavior of Organisms, nel quale vennero presentati anni di ricerche pionieristiche sul condizionamento operante. Il suo collega, Fred Keller, definì la sua scoperta "una nuova scienza del comportamento". Ottant'anni dopo, possiamo dire che il libro descriva e presenti ancora in modo molto attuale ed accurato la scienza di base. In particolare, il testo documenta in che modo gli eventi che seguono immediatamente le azioni influenzino la frequenza (o la probabilità) di azioni simili in futuro. Skinner ha anche discusso questioni che sono oggi ritenute molto importanti. La sua analisi della relazione tra neurologia e scienza del comportamento è ancora più rilevante oggi, nel 2018 di quanto non lo fosse nel 1938. La B. F. Skinner Foundation propone la divulgazione del pensiero e delle parole di Skinner in una forma facilmente accessibile. Offre infatti "The Behavior of Organisms" nella sua libreria on-line in formato PDF in cambio di un'offerta economica libera. Puoi scaricarlo gratuitamente o aggiungere un importo a tua scelta per supportare i programmi di pubblicazione e archiviazione delle opere di Skinner, nonché le attività di ricerca degli studenti e la produzione e pubblicazione della rivista Operants.

### Japanese Translated by Naoki Yamagishi

1938年、B. F. スキナーは最初の書籍「生体の行動」を出版しました。彼は何年にもわたるオペラント条件づけに関する先駆的な研究を発表しました。彼の同僚フレッド・ケラーは彼の発見を「真新しい行動の科学」と呼びました。その80年後、その書籍はその基本的な科学を正確に提示し続けています。行為の直後に発生した出来事がどのようにして類似した行為の将来の頻度(あるいは率)に影響を与えるのかを記述しています。スキナーは今日においても依然重要な問題について考察していました。神経科学と行動の科学の関係について彼の分析は1938年よりも2018年において適切であり続けています。B. F. スキナー財団はスキナー自身の言葉を入手しやすい形で提供しています。そして「生体の行動」をオンライン書店で言い値のPDFで提供しています。あなた方は無料でそれをダウンロードすることができ、あるいは、出版や記録保管事業、学生の研究、広報誌Operantsの出版を支援するための寄付を追加することができます。

### Korean Translated by Theresa Yunhee Shin

1938년, B.F. Skinner는 그의 첫 저서인 'The Behavior of Organism'을 발간했다. 그는 조작적 조건에 대한 선구적인 다년간의 연구를 발표했다. 그의 동료인 Fred Keller는 그의 발견을 "완전히 새로운 행동의 과학"이라고 불렀다. 8년 후, 그 책은 여전히 정확하게 기초과학으로 대표된다. 여기에는 즉각적으로 일어나는 행동들이 미래에 유사한 행동들의 빈도(또는 비율)에 영향을 준다는 어떤 사건들에 대해 기록되어있다. Skinner는 또한 오늘날 중요하다고 여기는 이슈에 대해서도 논의했었다. 그의 행동 과학에서의 신경에 대한 관계 분석은 1938년보다 2018년 더욱 관련있는 것으로 남아있다. B.F. Skinner 재단은 Skinner 자신의 글을 쉽게 접근가능한 형태로 제공하고 있다. 'The Behavior of Organism'은 판매자가 값을 매기는 방식으로 온라인 서점에서 제공되고 있다. 무료로도 다운로드 가능하며, 또는 저서출판이나 기록보관용 프로그램 및 학생연구와 Operant 매거진의 발간을 지원하기 위해 값을 지불할 수도 있다.

### Norwegian Translated by Karoline Giæver Helgesen

I 1938 ble B.F. Skinner sin første bok The Behavior of Organisms publisert. Her presenterte han resultater av år med banebrytende forskning på operant betinging. Hans kollega, Fred Keller, refererte til arbeidet som "a brand new science of behavior". Åtti år senere er boken fremdeles presis i sin fremstilling. Den dokumenterer hvordan hendelser som umiddelbart følger handlinger påvirker frekvensen (eller raten) av liknende handlinger i fremtiden. Skinner diskuterte også temaer som er viktige i dag. Hans analyse av relasjonen mellom nevrologi og atferdsvitenskap står seg som mer relevant i 2018 enn hva den var i 1938. B. F. Skinner Foundation formidler Skinners egne ord i et lett tilgjengelig format. Stiftelsen har lagt ut The Behavior of Organisms som PDF i nettbokhandelen til en pris du kan sette selv. Du kan laste den ned gratis, eller legge ved et selvvalgt beløp for å støtte publikasjons- og arkivarbeid, studentforskning og produksjonen av Operants.



### **Portuguese Translated by Monalisa Leão**

Em 1938, B. F. Skinner publicou seu primeiro livro, O Comportamento dos Organismos. Ele apresentou anos de pesquisa pioneira sobre condicionamento operante. Seu colega, Fred Keller, chamou sua descoberta de “uma nova ciência do comportamento”. Oitenta anos depois, o livro ainda apresenta com precisão a ciência básica. Ele documenta como os eventos que seguem imediatamente as ações afetam a frequência (ou taxa) de ações semelhantes no futuro. Skinner também discutiu questões que são importantes hoje. Sua análise da relação da neurologia com a ciência do comportamento se mostra ainda mais relevante em 2018 do que em 1938. A Fundação B.F. Skinner fornece as próprias palavras de Skinner em um formato de fácil acesso. Ela oferece O Comportamento dos Organismos em sua livreria on-line em formato PDF. Você pode baixá-lo gratuitamente ou adicionar qualquer quantia para apoiar programas de publicação e arquivamento, pesquisa de alunos e a produção de Operantes.

### **Russian Translated by Alexander Fedorov**

В 1938 г. Б.Ф. Скиннер опубликовал свою первую книгу – «Поведение организмов». В ней он представил годы своих пионерских исследований оперантного обусловливания. Его коллега, Фред Келлер, назвал его открытие «совершенно новой наукой о поведении». Восемьдесят лет спустя эта книга по-прежнему точно представляет базовую науку. В ней задокументировано, как события, которые следуют непосредственно за действиями, влияют на частоту (или скорость) похожих действий в будущем. Скиннер также обсуждает ряд вопросов, имеющих значение и в наше время. Его анализ связей между неврологией и наукой о поведении является даже более значимым в 2018 г., чем он был в 1938 г. Фонд Б.Ф. Скиннера предоставляет весьма простой доступ к словам самого Скиннера. В своем книжном онлайн-магазине он предлагает «Поведение организмов» в виде «назови-свою-цену» PDF-фала. Вы можете скачать его бесплатно или же за некоторую сумму, которая пойдет на поддержку публикационных и архивных программ, студенческих исследований и выпуск «Оперантов».

### **Spanish Translated by Kenneth Madrigal and Gonzalo Fernández**

En 1938 B.F. Skinner publicó su primer libro, La Conducta de los Organismos, en el cual presenta años de investigación pionera sobre condicionamiento operante. Su colega, Fred Keller, llamó a su descubrimiento “una nueva ciencia del comportamiento”. Ochenta años después, el libro sigue delineando de manera precisa los principios de esta ciencia, en el cual se documenta cómo eventos que siguen a ciertas acciones de manera inmediata, afectan la frecuencia (o tasa) de acciones similares en el futuro. Skinner también discutió problemas que son importantes hoy en día. Ejemplo de ello es su análisis de la relación entre la neurología y la ciencia del comportamiento, el cual es aún más relevante en 2018 de lo que fue en 1938. La B.F. Skinner Foundation proporciona las propias palabras de Skinner de una forma fácilmente accesible; ofreciendo el libro La Conducta de los Organismos en su librería online como un PDF, con una modalidad de pago a consideración del interesado. De tal manera que puedes descargarlo gratuitamente o, incluso, agregar cualquier cantidad para apoyar publicaciones y programas de archivo, investigación de estudiantes, así como la producción de Operants.

### **Swedish Translated by Dag Strömberg**

År 1938 gav B. F. Skinner ut sin första bok, The Behavior of Organisms. Han presenterade årtals banbrytande forskning om operant betingning. Hans kollega, Fred Keller, kallade upptäckten “en splitter ny vetenskap om beteende”. Ättio år senare är boken fortfarande en precis introduktion till den grundläggande vetenskapen. Den dokumenterar hur händelser som omedelbart följer handlingar påverkar frekvensen av liknande handlingar i framtiden. Skinner diskuterade också frågor som är viktiga i dag. Hans analys av neurologins relation till en vetenskap om beteende förblir till och med relevantare år 2018 än vad den var 1938. B. F. Skinner Foundation tillhandahåller Skinners egna ord i ett lättillgängligt format. Den erbjuder The Behavior of Organisms i sin nätbokhandel som en nämn-ditt-pris-PDF. Man kan ladda ned den gratis, eller lägga till vilken summa som helst för att stödja publicering och arkivprogram, studentforskning och produktionen av Operants.

### **Turkish Translated by Yeşim Güleç-Aslan**

B. F. Skinner, 1938 yılında “The Behavior of Organisms” adlı ilk kitabını yayınladı. Edimsel koşullanma üzerine yıllarca süren öncü araştırmalarını sundu. Onun meslektaşı Fred Keller, onun buluşunu “yepyeni bir davranış bilimi” olarak nitelendirdi. Seksen yıl sonra, bu kitap hala bu temel bilimi doğru bir şekilde sunuyor. Eylemlerin hemen ardından gerçekleşen olayların, gelecekteki benzer eylemlerin sıklığını (ya da oranını) nasıl etkilediğini belgelemektedir. Skinner ayrıca bugün önemli olan konuları da tartıştı. Nörolojinin davranış bilimi ile olan ilişkisine yönelik analizleri, 2018 yılında 1938 yılında olduğundan daha önem kazanmıştır. B. F. Skinner Vakfı, Skinner’in kendi sözlerini kolay erişilebilir bir formda sunmaktadır. Çevrimiçi kitaplıkta “The Behavior of Organisms” kitabı PDF olarak sunulmaktadır. Kitabı ücretsiz olarak indirebilirsiniz ya da yayın ve arşiv programlarını, öğrenci araştırmalarını ve “Operants” dergisinin üretimini desteklemek için bir miktar bağış yapabilirsiniz.

## TABLE OF CONTENTS

FROM THE PRESIDENT .....	2
FROM THE EDITOR .....	7
<i>THE BEHAVIOR OF ORGANISMS AT 80</i>	
By William H. Morse .....	8



### RATS! THE BENEFITS AND CHALLENGES OF USING RATS IN A LEARNING COURSE

By Andrew Katayama, George Mastroianni, and John Blich .....

APPLYING THE ONE-MINUTE TIMING TO INNER BEHAVIOR'S SELF-STATEMENTS	
By Abigail Calkin .....	15

BEHAVIOR ANALYSIS FINALLY GOT DEFINED AND REDEFINED	
By John W. Eshleman .....	19

UNITS OF ANALYSIS IN A SCIENCE OF BEHAVIOR	
David C. Palmer interviewed by David Roth .....	23

POPULAR CULTURE: ZOMBIES	
By Darlene Crone-Todd .....	28

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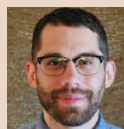
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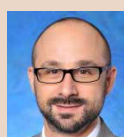
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*We would like to thank all contributors to this issue. Operants preserves the intellectual tradition of Skinner's writings — of interest to the field, but also written without heavy use of citations and references. In most articles intellectual credit to others is given, not by citing and referencing specific studies or articles/books, but rather through discussing the "big idea" or "concept", and naming the person/affiliation. In this way, then, the intellectual credit is provided while still writing for a wider audience. Especially today we would like to continue to advance the relationship between basic and applied science, and its theory, and make that available to the public.*

It is hard to believe that it has been 80 years since the publication of Skinner's first book, *The Behavior of Organisms*, in which he explored how behavior could be analyzed through direct observation: a method that led to the development of both the experimental analysis of behavior (EAB) and, later, behavior analysis and applied behavior analysis (ABA). Listed as one of the most influential psychologists in the 20th century, it is understandable how Skinner's book ushered in a new generation of scientists and scientist-practitioners who take seriously the science of behavior.

In this issue, we are pleased to provide you with a variety of articles that are possible because of the heritage and legacy of B. F. Skinner's work. Morse reminds us that *Behavior of Organisms* provided both a theoretical classification that underlies operant behavior and data to validate the classification. This was groundbreaking as it allowed for a physical analysis of what was previously regarded as mentalistic and unobservable. Morse asks us to imagine what *Behavior of Organisms* might have looked like if our later technology were available in the 1930s; however, one might argue that the science developed from Skinner's classification and experimental findings was partly responsible for the development of such technology. It certainly made our current science and associated applications possible!

Katamaya, Mastroianni, and Blitch provide us with a wonderful overview of "Rat Olympics" and its role in the history of the rat lab at the United States Airforce Academy (USAFA). Any reader who has spent time working with animals in an operant laboratory will recognize the description of how bonds developed between animals (e.g. humans and rats) are a natural outcome of many pairings with various reinforcers. It will be of interest to readers to learn that the evolution of the rat lab resulted in an increase in the students' varied repertoires, which incidentally led to a reduction in the number of apparatuses. Often, in experimental laboratories, there is a rush to build a new box when actually the current one will do nicely to create something new. The authors also make an interesting connection between "transactions" and transactional leadership: a necessary (but not sufficient) requirement for the emergence of "transformational" leadership. Since these are current buzzwords in organizational management practices it is refreshing to read how the students, as potential leaders, learn the importance of effective use of reinforcement. Currently there appears to be a need for developing ongoing variation in experimental research methods, however, the rats and the students are always right — as with *Behavior of Organisms*, time and data will tell the story.

Calkin's development of "1-minute timings" for positive statements creatively incorporate the techniques she learned as Og Lindsley's student with other principles and concepts she acquired from her own studies in behavior analysis. This would not have been possible without the theoretical backdrop of Skinner's original and later works. Anecdotal, my own students have incorporated Calkin's 1-minute timings as part of self-modification projects that have been successful in terms of reducing aversive self-statements.

Eshleman follows up on a previous publication by E. Vargas and comments on the use of labels to describe our science. What's in a name? As Skinner's *Behavior of Organisms* has far-reaching implications and applications, we can see how it has evolved. New terms have been developed, and not all members of the behavioral field feel represented by them. Eshleman argues the case for Vargas's term, *Behaviorology*, to encapsulate the basic theory and philosophy that underlies all of the various forms of behaviorism-related science and applications. Ultimately, the field will need to concern itself with the duplication of terms across disciplines, therefore it is an important consideration.

Roth's interview of Palmer on units of analysis may whet your appetite to read more of Skinner's original writings. Palmer's metaphor of the mechanic who only knows how to use the screwdriver is reminiscent of Plato's "Allegory of the Cave." Like the "prisoners" in Plato's cave, who only have limited experience upon which to base their view of the world, we must go beyond a limited view with a useful set of "tools" to change behavior at a simple level and instead explore the variety of and fullness of the fundamental concepts involved in more complex operant and respondent behaviors. For this reason, then, readers are encouraged to read the original writings of Skinner, as well as other contemporary works upon which this foundation is built.

To round out the influence of Skinner on modern culture, we continue our feature on pop culture with a piece on Zombies. After all, what are zombies, other than prisoners in Plato's cave? Understanding the history of the zombie genre, and using our concepts to understand the behavior of both the zombies and the humans within the fictional depictions is only possible as a result of the rich heritage offered through the theoretical basis provided by *Behavior of Organisms*.



Darlene E. Crone-Todd, PhD

# The Behavior of Organisms at 80

William H. Morse, PhD



William H. Morse received his doctorate in Psychology at Harvard where his advisor was B. F. Skinner. He was among Skinner's students and colleagues involved in research that culminated in publication of *Schedules of Reinforcement* in 1957. Morse co-authored several papers with B. F. Skinner.

Dr. Morse chose to remain in the Boston area when he took a position in the Department of Pharmacology at Harvard Medical School where he worked alongside Peter Dews and Roger Kelleher.

This article was originally published as a foreword to the e-book edition of *The Behavior of Organisms*, released by the B. F. Skinner Foundation in 2016.

*The Behavior of Organisms* was the antecedent that led to the use of the objective principles of operant behavior in many diverse disciplines ranging from education to pharmacology. It is arguably the most important book in the history of experimental psychology. Unlike other treatises written in the early 20th century (by Watson, Tolman, and Hull), B. F. Skinner's *The Behavior of Organisms* has endured. After 80 years some of the content is out of date, as Skinner himself acknowledged in the preface to the seventh edition in 1966, but its essential messages have stood the test of time. Two of these should be noted. First, it presented a theoretical classification of behavior that introduced the concept of operant behavior. Second, it described experimental findings that documented the validity of the concept of operant behavior in the physical terms of number and time without recourse to mentalistic terms.

Throughout his life Skinner was a devoted behaviorist. In emphatically emphasizing non-mentalistic explanations of behavior, the *The Behavior of Organisms* matches J. B. Watson's book *Behaviorism* in 1924. Watson's book was widely popular and influential when it was published, but the *The Behavior of Organisms* was not. One important difference in the books easily explains the difference in their reception. Pavlovian conditioning was actively being studied by many other experimenters at that time, and Watson used the concepts of conditioning to describe behavior. (For example, the complex behavior of "building skyscrapers" was postulated to be a series of conditioned reflexes chained together.) In contrast, the concept of operant behavior was a radical intrusion into contemporary 1930's experimental psychology, and had been studied only by Skinner himself.

To fully appreciate the magnitude of Skinner's contribution, it is useful to examine common experimental practice at that time. Most research on behavior in rats was conducted in discrete trials by individuals who actively participated in the course of the experiment by handling the rat. Skinner envisioned an approach to studying behavior in real time unencumbered by the experimenter's involvement. He designed and then built the equipment needed for this approach. In the initial experiment, he studied the gradual exponential decline in rate of eating uniform small bits of food by a food-deprived rat that uncovered a tray, which allowed access to a piece of food. Each movement of the tray cover operated a solenoid that moved a recording pen of a kymograph one unit vertically. His published report of the experiment noted that by recording the cover openings cumulatively, their rate of occurrence could be measured directly. Years later, he said that the cumulative recorder was his single greatest contribution. In later experiments a food pellet (reinforcer) was delivered into an open trough each time a horizontal lever was pressed down. In this set-up, the response of depressing the lever operated an electromechanical switch that, in turn, electrically operated the pellet dispenser. The pellet delivery was now arbitrarily related to the lever-pressing response,



a feature never previously studied scientifically. But now, in addition to each response electrically activating the pellet dispenser, it was possible to *not* activate the pellet dispenser, or to schedule other arbitrary contingencies, such as minimal time constraints, number requirements, and delays, all of which Skinner studied by recording on a cumulative recorder the rate of bar presses.

Beginning in 1930, reports on these experiments were published in the *Journal of General Psychology*. Skinner's close friend, Fred Keller, enthusiastically supported his research, but other psychologists had virtually no interest in the "Skinner box" experiments. Even after this extensive body of original research was summarized in *The Behavior of Organisms*, research following this line of work was not published by others. It was only in the 1940's, after Skinner and Keller had graduate students doing research on operant behavior that *The Behavior of Organisms* began to be more widely read and recognized for its brilliant insights.

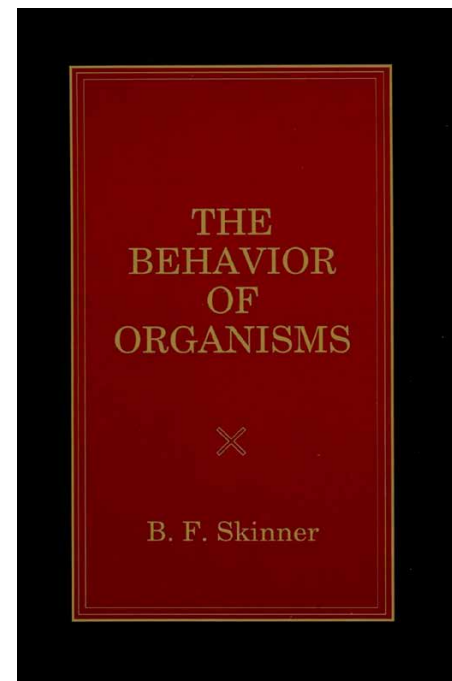
The basic experimental findings reported in *The Behavior of Organisms* have been replicated and extended thousands of times. In the 1950's, Skinner's joint work with C. B. Ferster, reported in *Schedules of Reinforcement*, further expanded the scope of operant behavior. Over a four-year period, they conducted wide-ranging experiments on the characteristic patterns of responding paired with different scheduling contingencies between responses and reinforcers. The discovery of multiple schedules was especially significant. A multiple schedule consists of two or more alternating schedules with a different distinctive stimulus associated with each schedule. The discriminative stimuli associated with different schedule conditions could, at any time, control disparate behavioral performances, and made explanations of behavior based on generalized motivational states untenable.

This increased understanding of behavior occurred some 20 years after Skinner's early experiments. As noted earlier, Skinner built the components to control the arbitrary contingencies between responses and a reinforcer. For example, he wound wire to make electromagnetic switches and built ratchet gearing to count responses. In the 1950's, the research reported in *Schedules of Reinforcement* used commercially available components to program the schedule contingencies. If such control equipment had been available in the 1930's, it seems possible that the ubiquity of schedule-controlled behavior would have been reported in *The Behavior of Organisms*. That would have been some book!

The language in parts of *The Behavior of Organisms* should be noted. Skinner presented *The Behavior of Organisms* as a reasonably exhaustive formulation of behavior (p. 46). The introductory chapter described the properties of elicited reflexes and of Pavlovian conditioning, and then introduced the concept of operant

behavior. Behavior elicited by stimuli (respondent) was distinguished from behavior that cannot be shown to be elicited (operant). Since Skinner's approach was in the context of a stimulus-response conception of behavior, it is understandable that an increase in bar-pressing responses that followed food presentation was described as a response-stimulus reflex. While much of the theoretical development and the terminology appear quaint today, it is historically useful in understanding the evolution of Skinner's conception of operant behavior.

*The Behavior of Organisms* began with the premise that "behavior may be treated as subject matter in its own right," and went on to describe how to go about it. The contention that there is behavior that does not appear to be elicited by stimuli led to a new class of behavior called "operant." Specific criteria were given for identifying and studying operant behavior quantitatively; the suitable equipment for studying operant behavior was described; and empirical quantitative results were presented that established the validity of operant behavior. The book is a lasting memorial to this achievement. ■



*The Behavior of Organisms* is available in hard cover, paperback, and e-book formats at [bfskinner.org](http://bfskinner.org). The PDF version is available for free.

# RATS! The Benefits and Challenges of Using Rats in a Learning Course

Andrew Katayama, George Mastroianni, and  
John Blich  
U. S. Air Force Academy



*This manuscript has been approved for public release by the office of Public Affairs and Dean of Faculty Research Office (DFRO) at the U.S. Air Force Academy.*

*The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the United States Air Force Academy, the Air Force, the Department of Defense, or the U.S. Government.*

*You can learn about the authors on p. 14*

Operating a live rat lab to accompany a learning course has its challenges as well as benefits. This article highlights both sides of such an endeavor and provides some history of how the rat lab has been used to help teach students (aka cadets) at the U.S. Air Force Academy (US-AFA) and the observed benefits cadets gained from applying operant principles with their rats. Further, this article provides some alternatives to delivering a learning course without having access to live rats. Currently at USAFA, the department of Behavioral Sciences is at somewhat of a crossroads with our live rat program. While we have maintained an accredited rat lab over several decades to assist with our learning course, we have recently had to discontinue the rats this past semester for a variety of reasons. Over the years, we have learned that while the benefits certainly outweigh the challenges, we have had to consider creative ways to secure and maintain the materials, equipment, and trained personnel to support and sustain a viable rat program. In many ways, this is similar to many institutions of higher learning where funding for such experiential programs (i.e., a rat lab) can be challenging. In addition, we have come to embrace the issues concerning cleaning, feeding, and maintaining strict regulations set forth by the Institutional Animal Care and Use Committee (IACUC) that need to be met on a regular basis. These challenges are part of the reason that virtual rat programs like *Sniffy*, the virtual rat, have become a popular alternative to live rats in many undergraduate classes. We recently adopted *Sniffy* the virtual rat to replace the live rats in our undergraduate Learning and Cognition course in the Fall of 2018. In this article, we reflect upon the history of our live rat program and how it was used to facilitate learning in our psychology classes, how we have taught the course without live rats, and how we are currently using a virtual rat program to augment the learning in our classes at USAFA.

## *The Era of Live Rats in Our Learning Class*

Dr. George Mastroianni taught in the Department of Behavioral Sciences and Leadership at the USAFA from 1990-1992 as a US Army officer and from 1997-2016 as a civilian professor. His history in the department is extensive: he taught Biopsychology and served as Laboratory Director during his Army tour, and taught Learning and Memory among other courses during his time as at USAFA. Live rats were used in both Biopsychology and Learning and Memory in the early 1990s, but when he returned to USAFA in 1997, live animals were no longer used in Biopsychology. They were however, still an active part of Learning and Memory, as part of the lab continuously from 1997 until his retirement in 2016.

Learning and Memory was a hybrid course that combined traditional animal learning (classical and operant conditioning) with

cognition and memory. Our curriculum did not include a stand-alone course in Cognition until 2002. Learning and Memory was a double-period lab class, which meant that it met for six rather than three hours per week. During the “lab” portion of the course, the extra three hours were devoted to student-animal interaction. Until 1997, the laboratory portion of the course was dominated by “Rat Olympics.” Pairs of students were first assigned rats, and then guided through the process of shaping bar-pressing in their animals, and then conditioning their animals to perform on simple schedules of reinforcement in the operant chamber which we referred to as the “Skinner Box”.

Rat Olympics was a backward-chaining project derivative of the feats of Barnabus, the “rat with college training.” Students were given a menu of different classes of responses they could include in their behavior chains, each of which carried with it a certain point value. Simple spatial discriminations carried a certain value, for example, while responses such as jumping a gap between two towers or climbing a rope might have a different value. Students used foam-board to construct complex apparati that they used to exercise



*Rat Olympics: “Long Jump”*

their animals in behavior chains that they could assemble and construct to achieve maximum point value. Rat Olympics was open-ended in the sense that students could construct more or less lengthy and complicated chains of behavior depending on their own ambition and effort. At the end of the semester, Rat Olympics became an event, in which the two-person cadet teams ran their animals through their paces in front of judges who scored the performance of the animals and declared the winner of Rat Olympics. The victorious rat and his cadet trainers were memorialized as winners of the “Golden Rat Award” by having their names added to the Golden Rat plaque, which still hangs in the Department of Behavioral Sciences and Leadership laboratory to this day.

One aspect of the “rat class”, as cadets call it, that was always striking was the intense attachment that formed between cadets and their rat during the lab portion of the class. Without indulging in excessive and

very un-Skinnerian armchair analysis, it seemed that cadets leading very regimented lives, far from home, under a great deal of stress, and unable to touch their own pets often, found in the rats a source of warmth and companionship. The rats would often perch on the cadets’ shoulders, crawl into their lab-coat pockets, and otherwise act as both pets and lab animals.

In 1997, some changes were intentionally made in the lab portion of the class to help the classroom and laboratory components of the class mesh as they should. For instance, Rat Olympics certainly appealed to the cadets’ competitive spirit, and the process of creating elaborate backward chains certainly created opportunities to reinforce classroom concepts in the lab, but more could be done. Among the changes were two major modifications in the lab experience. First, some laboratory equipment was acquired that made it easy to train demonstration animals on various schedules of



*Rat Olympics: “Completing the Maze”*



*Rat Olympics: Winners in Front of the Board with Prior Champions’ Names*

reinforcement. In early lab meetings, we would place animals in the demo boxes, set them going on various schedules, and ask cadets to try to identify which animal was responding on which schedule. We used these early sessions to help bring life to basic concepts in operant learning. The second change was to modify Rat Olympics from an open-ended exercise, which sometimes led to cadets doing too much of the same thing in an effort to get more points, to a set of several fixed





*A Two-Person Team*

events. These included events such as a rope climb, long-jump between two towers, weight pull, speed race, and so on. Training the animals on these events meant that standard apparatus could be reused, saving much cadet time formerly spent constructing their custom apparatus. Because the events and scoring were standardized, performance could be compared year after year.

Dr. Mastroianni also instituted a change in the classroom portion of the course to accomplish two things: tie the lab material more tightly to the classroom material, and to draw some direct connections between the class and cadets' thinking about leadership. He modified one of the writing assignments in the class to achieve this. A term paper was added to the class that required students to reflect on their own lives identifying and describing an event or relationship involving leadership development that they could analyze and explain using learning and conditioning principles.

Bernard M. Bass elaborated the idea of transformational leadership, first introduced by James V. Downton and further developed by James MacGregor Burns. Transformational leadership is distinguished from transactional leadership. Transactional leadership is essentially operant conditioning: leadership and followership behaviors are subjected to a calculus of rewards and punishments. Naïve interpretations of these concepts often imply that transactional leadership is somehow primitive and bad, whereas transformational leadership, which involves leaders inspiring followers with shared values and commitment to higher principles, is more sophisticated and mature. Leadership relationships naturally move from transactional to transformational levels, provided the transactional basis is done correctly. If followers perceive that leaders are inconsistent in their application of rewards and punishments, it will be difficult to build the trust essential to achieving a truly transformational relationship. Leaders who scrupulously apply good behavioral principles at the transactional level set the stage for deeper and more meaningful leadership relationships. Failing to think seriously about transactional leadership as a valid and necessary part of leadership, failing to think deeply about how to do the transactional part correctly, can jeopardize the potential for achieving the transforma-

tional leadership relationship many agree is so important.

Cadets' relationships with their rats (rampant anthropomorphizing notwithstanding) were transactional, of course. There is an ironic parallel between a cadet trying to communicate through contingencies with their rat about desired behaviors, and leaders using rules, rewards and punishments to get them to conform to desired standards of behavior. Cadets experiencing the complexity and frequent frustration of getting the behavioral part right with their rats invited natural analogies to the treatment they both meted out to others and received from others as cadets. We believe that the rats have helped cadets to think more clearly about leadership. Developing leaders was, and is, a primary objective at the USAFA.

### *A New Era: Teaching the Learning Class without Rats*

During the 2017-2018 academic year, the Department of Behavioral Science and Leadership at the USAFA was faced with a dilemma regarding a very popular course in Learning and Cognition that had previously been offered in conjunction with a laboratory session focused on Operant Conditioning with rats. The culmination project for this course had historically involved the very popular Rat Olympics in which cadets paired up with a rat to form a team that learned to perform various behaviors and stunts which reinforced concepts presented in textbook readings and classroom lectures. The course required two textbooks as the foundational learning component during the lectures: *Introduction to Learning and Behavior* by Powell, Honey, and Symbaluk (2013) and *Cognitive Psychology* by Goldstein (2013). Due to a number of circumstances that lie beyond the scope of this article, the rats were unavailable to cadets for the 2017-2018 academic year, thereby leaving a void in the Department's established curriculum. Currently, this void has continued on into the 2018-2019 academic year as this article is being prepared.

At the end of the Fall 2017 semester, the department reached out to a relatively new faculty member, Dr. John Blich who was on loan from the Air Force Research Laboratory (AFRL) to step in and attempt to fill this void with a different approach that sought



to substitute guest lecturers with a wealth of militar-



ily-relevant operant conditioning experience into the previously scheduled “Rat Lab” sessions. Falconers, canine handlers, and marine mammal were all involved in these periods with a focus on demonstrating militarily-relevant behaviors. This substitution was made clear to cadets before they signed up for the class and enrollment remained approximately the same as it had in previous semesters. These cadets were also told that they would be completing a culmination project at the end of the course which involved training animals to fight alongside military personnel against a futuristic threat in the form of Artificially Intelligent Military Robots (AIMRs). It was thought that this topic would be interesting and popular enough for the current generation of USAFA cadets to maintain sufficient focus and absorb presented material in a manner that adequately supported established academic goals and desired organizational outcomes.

Grading data collected at the end of the semester fell within <1% variance of the previous two cohorts of cadets taking the course, thereby providing evidence that the experimental substitution of military-relevant guest lectures had been a success. Course critique data collected immediately after the final project was completed, however, suggested that the effort had failed miserably. Not only did the end of course evaluation scores drop significantly below the mean score for DFBL major’s courses during this first semester without the rat lab, but insufficient learning value was noted as a consistent theme in the subjective commentary recorded by cadets. Based on rudimentary inspection of this student feedback and the above average scores Dr. Blitch received teaching other courses, it is reasonable to conclude that the absence of live rats in the laboratory may have caused cadets to rate the course lower than previous semesters. This, in turn, suggests that occasional demonstrations with live animals were insufficient to maintain student engagement — consistent contact with live animals on a weekly basis was necessary to fully absorb learning concepts and subsequently apply them to a real training/conditioning experience.

### ***The Way Forward: Teaching the Learning Class with Sniffy the Virtual Rat***

In the Fall semester of 2018, Dr. Andy Katayama implemented *Sniffy the Virtual Rat* by Alloway, Wilson, and Graham, published by Cengage, into our Behavioral Science Learning course. The purpose of implementing *Sniffy* for this academic year was to allow cadets an interactive yet controlled environment to condition a “rat” in the absence of conditioning live rats.

In essence, this would allow cadets to apply the behavioral concepts and theories learned in class to a virtual environment. Cadets installed the software onto their notebook computers and began work with conditioning their rat during the lab portion of class. This in some ways was procedurally similar to their introduction with live rats in that they had to patiently train *Sniffy* to press the bar to receive a food pellet. The image below is an example of *Sniffy* in the virtual operant chamber. Like with live rats, this process required cadets to be extremely patient and consistent in conditioning their rat to bar-press and receive food. However, after a while, cadets could choose the “control + i” option to expedite the training. During this process, the program would simulate multiple trials of the selected conditions while a cumulative bar and line graph are made available to track the behavioral patterns of *Sniffy* within these conditions. Even though these processes are not the same as training a live rat, they do demonstrate to our cadets similar virtual behavioral changes. In the same fashion when working with live rats, this *Sniffy* plat-

form also allows our cadets to gain a sense of control and ownership of training *Sniffy* to perform a variety of behaviors. For example, just like with a live rat, once *Sniffy* bar-pressed on a more “intentional” level, the cadets became excited to see the acquisition process and their rate of training increased along with their motivation levels. Subsequent lab exercises include extinction, spontaneous recovery, magazine training, shaping, secondary reinforcement, schedules of reinforcement, the effect of partial reinforcement on extinction, adjunctive behaviors, shaping *Sniffy* to beg, wipe his face, roll and perform other

behaviors per cadet’s choice. Since this is the first time that we are using the Virtual Rat interface in lieu of live rats, we decided to just grade on completion and not on any gradient of behavior. So far, the implementation of *Sniffy* seems to be going well. We will continue to assess how the implementation of *Sniffy* the virtual rat is going and if it is meeting the goals of the course. Part of this process will include feedback from the cadets as well as faculty. These data sources along with other considerations will help to determine whether or not we will be able to reinstate our live rat program at the USAFA. The consensus prior to this academic year has been cautious optimism that we would be able to bring the live rats back. However, if not, we will be ready to look to alternative programs to meet the needs and expectations of this course and it appears that *Sniffy* is bar pressing feverishly to succeed if all else fails. Only time will tell. ■



*Screenshot of Sniffy*

# About The Authors



*Andrew Darrel Katayama is a professor of Behavioral Sciences at the United States Air Force Academy in Colorado Springs. He teaches classes in Learning and Cognition, Educational Psychology, Research Methods, Statistics, and also teaches the Introduction to Behavioral Science course in the Academy Scholars Program. Andy has taught at the Air Force Academy since 2002. He has served as the Director of Academics, Director of Research, and Senior Scientist since coming to the Air Force Academy. Prior to the Academy, Andy taught at West Virginia University and Southern Illinois University Edwardsville. Andy currently lives in Colorado Springs with his wife Kelly and three children, Katelyn, Addie, and Kobe.*



*Dr. Mastroianni served twelve years as a US Army Research Psychologist, where he worked in a variety of biomedical laboratories and other military research settings. Dr. Mastroianni retired from the US Army Reserve as a Lieutenant Colonel. After leaving active duty Dr. Mastroianni worked as a defense contractor and then civil servant at an Army engineering and development laboratory. Dr. Mastroianni taught Biopsychology, Learning and Memory, Sensation and Perception, and Introduction to the Behavioral Sciences at the United States Air Force Academy until his retirement a few years ago. He also served as Chair of the Institutional Review Board and as Chair of the Institutional Animal Care and Use Committee. Dr Mastroianni recently published a book titled *Of Mind and Murder: Toward a More Comprehensive Psychology of the Holocaust*, by Oxford University Press.*



*Dr. John G. Blich is a senior research scientist at the U.S. Air Force Academy on loan from the Air Force Research Laboratory to the Warfighter's Edge Advanced Development Laboratory. His early work focused on the application of Operations Research and Artificial Intelligence principles to the selection, deployment, and dynamic control of adaptive mobile robots for denied area access and risk intensive rescue operations. More recent efforts seek to leverage progress in the realm of cognitive neuroscience against the daunting challenges posed by mechanical morality and dynamic object capture/manipulation in unpredictable, unstructured environments by relatively unconstrained "free flying" mobile robots.*

# Applying the One-Minute Timing to Inner Behavior's Self-Statements

Abigail Calkin, PhD

On a drive up Oregon's McKenzie Highway in 1969, I realized I could count inner behavior. My now ex-husband had a way of making negative statements to me. I thought 'All right. I'm going to count his behavior and prove that he is very negative toward me.' I don't remember the exact count anymore but in an hour it was about 20 positives and 0 negative statements. His words made me realize that his behavior was a stimulus for me to have a negative feeling about myself. It was not what he said, but how he said it, or perhaps more, how I received it. The marriage didn't survive, but thus began my idea of counting inner behavior and that has survived. Within 3 years I had resolved the Cartesian dualism that the mind and body are two entities. They are not. All human behavior lies on a continuum from the most private thoughts and feelings through their expression to any outer behavior. I could count my inner behaviors.

Virginia Woolf's prescient comment in her 1929 book, *A Room of One's Own*, astonished me and then became a credo for me. "For surely it is time that the effect of discouragement upon the mind of the artist should be measured, as I have seen a dairy company measure the effect of ordinary milk and Grade A milk upon the body of a rat." She had the foresight to state something that most behavior analysts of the twenty-first century fail to see: we can measure the effect of discouragement on the behavior of an artist, a war veteran, a student, a spouse, anyone as clearly as a dairy company research department can measure the effect of different qualities of milk on a rat. Science was not her area, but her statement became my credo in the slow-turning wheel of scientific discovery. I identified with it and have incorporated it onto my professional mission.

While philosophical issues are important beginnings to solve scientific questions, we as behavior analysts need to stop asking the medieval monks' question of how many angels can dance on the head of a pin. Or, shall we continue to ask what are private events, how do they function, how can we change them, etc. I say no; instead, we must use the data we have gathered to see what we know about the behaviors of thoughts, feelings, and urges, and what is occurring with them.

I stumbled on using the one-minute timing to change inner behavior by accident. My second husband (of now 47 years) and I were arguing a lot. One day, he declared that the problem with the marriage was 90% my fault. Like a petulant child, I said 'No, it's not. It's 50-50,' even though I knew he was right. I was in counseling, writing in my journal regularly, a PhD student of Ogden Lindsley's, counting my positive and negative thoughts about myself, my positive and negative feelings about myself and missed opportunities to have a positive or negative thought or feeling, and I set an aim of 40 per day for positive feelings. I wrote down my positive feelings and positive thoughts. My husband's birthday was in three weeks and I wanted to give him a bet-



*Abigail B. Calkin was born in Boston, Massachusetts and now lives with her husband in a coastal community in Alaska. She received her PhD in educational administration and school psychology from the University of Kansas under Ogden R. Lindsley. Dr. Calkin specializes in behavioral science, inner behavior, and precision teaching research. She is the chair of Ogden Lindsley's Archives Committee. Abigail is a member of the Standard Celeration Society, the Association for Behavior Analysis International, and the National Association of School Psychologists. Her published works include narrative nonfiction, novels, poems, and articles and books on education including behavior analysis.*



ter feeling me for a present. What to do? For 10 years I had been counting student learning and for 8 of them using the 1-min timing to accelerate reading, penmanship and math correct responses and to decelerate students' errors. My husband's birthday was now in two weeks and I was so miffed at myself for no change in my behavior that I decided to throw caution to the wind and use the 1-min timing on my positive thoughts and positive feelings.

In two weeks, I managed to get my positive from a range of 0 to 7 to my goal of 40 with two days to spare. The negative thoughts went from a range of 12 to 130 per day down to a range of 3 to 30 per day; I did not count positive thoughts until I started the intervention

pond. I tried to change that image because a farm pond is not where anyone wants to swim—it's filled with cow piss and manure. The image wouldn't go away so I just floated in that filthy pond with the blue sky above and enjoyed the bizarre consequence that stopped the negatives. When I got from 10 to 0, I then flooded myself with positives from my list, sometimes even reading from it at a red light.

Toward the end of October 1977, I had a meeting with Og on my dissertation proposal. I had tucked these charts in my notepad to show him. He handed me back my proposal, which I think included a pilot study, with written and spoken words of high praise. It was on the inner behaviors of perceived facts learned, fun and

Here are some clarifications for readers unfamiliar with Precision Teaching lingo and traditions. First of all, "**inners**" are thoughts or feelings specified precisely enough to be counted. Where Skinner would include physical pain that is accessible only to the person experiencing it, Calkin's "inners" excludes internal physical stimuli.

**Inner behavior** is more precise than Skinner's term "**private event**." "Private events" are not necessarily inside the observer. Many actions are observed only by one person. No one saw me typing this section. Was my typing a "private event"? To call it that would be confusing to those who think of private events as internal. Using **inner** and **outer behavior** makes the distinction clearer.

**One-minute timings** take a timed one-minute sample of an action, whether inner or outer actions. While Calkin counted inners, one-minute timings more often track written or spoken responses to academic targets. For example, a page might be full of multiplication problems for students to solve as fast as they can in one minute.

An **aim** is a rate. You could have a goal of 40 positive thoughts per minute or 40 positive thoughts per day. Calkin picked 40 per minute and timed herself every day. If you think that's a very modest goal, try it yourself. Write positive things about yourself without repeating any of them. For example after writing "I'm a good cook", you can't use "I cook pies well". Without practice, most people run out of unique positive attributes at about a dozen per minute.

For negative thoughts, Calkin used the number per day, using 1000 minutes as a day of roughly 16 hours. That's why she had time to consequent each negative thought with floating in a Kansas farm pond.

A **pinpoint** is a behaviorally stated action stated so that it can be counted.

Calkin's **Before phase** is equivalent to baseline, her **During phases** are the experimental treatment phases, and the **After phase** would be what behavior analysts typically call follow-up.

The **Standard Celeration Chart** (SCC) is a special graph developed mostly by Ogden Lindsley. It has a ratio scale up the left side with vertical lines for .001 (1 a day, or one in 1000 minutes) up to 1000 (1000 per minute). Vertical lines represent every day for 20 weeks.

**Think-say** refers to a topic (or pinpoint) to which you are to respond orally. A **Think-Tally** requires marking your count.

**Celeration** refers to the angle of a line of progress. A celeration of times 2 (written X2) indicates a doubling of performance per week.

By Julie S. Vargas, PhD

and then many of them were forced. I didn't care if some were forced; I enjoyed them and counted them. If I had a negative thought or feeling, I counted backwards from 10 to 1 and slid down a water slide into a Kansas farm

freedom felt while learning. Good. We were both happy I was investigating inner behavior. Then, with my heart pounding because I was sure he'd criticize my personal inner behavior project, I handed him the eight charts.



Initially, he had not been in favor of Eric Haughton and Harold Kunzelmann coming up with the 1-min timing on academic tasks, but the success of learning with the short timing quickly convinced him. What would he think of my using it to change inner behavior, that amorphous area where few dared venture? He was exuberant with excitement and praise. Whew, I thought, as he said, "You've just blown psychotherapy off the map." I thought that a bit of an exaggeration, and still do. He told me to change my dissertation topic. Oh Ogden, you've just given back to me a highly approved dissertation proposal that I've been working on for two years and now you want me to change it? I said no, but not because I was two years into my dissertation. I told him that the rest of my professional life would be spent in the realm of inner behavior and that my dissertation on facts, fun and freedom would become the pilot study for my more detailed work on inner behavior.

By the end of my inner behavior project, I had charted my counts on eight pinpoints daily for 133 days. I had a Before phase, 6 During phases (set aim, write a list of all positives, use 1-min timing, do no charting, was sick, and use the 1-min timing again) and an After phase.

I published an article on these charts in 1981. Six subsequent research studies ensued, none at my suggestion or with my prior knowledge. I remember Emma Douglas, the author of the sixth study, and I at one

ABAI annual meeting looking through the program and finding two presentations on our, by then, shared topic. We were thrilled and scurried off to hear them and introduce ourselves to the presenters. One later study used the 1-minute timing but did not use the Standard Celeration Chart (SCC) to chart behaviors; perhaps they thought counting was sufficient. However, the use of the 1-min timing on inner behavior charted on the SCC remains vital to the success of change.

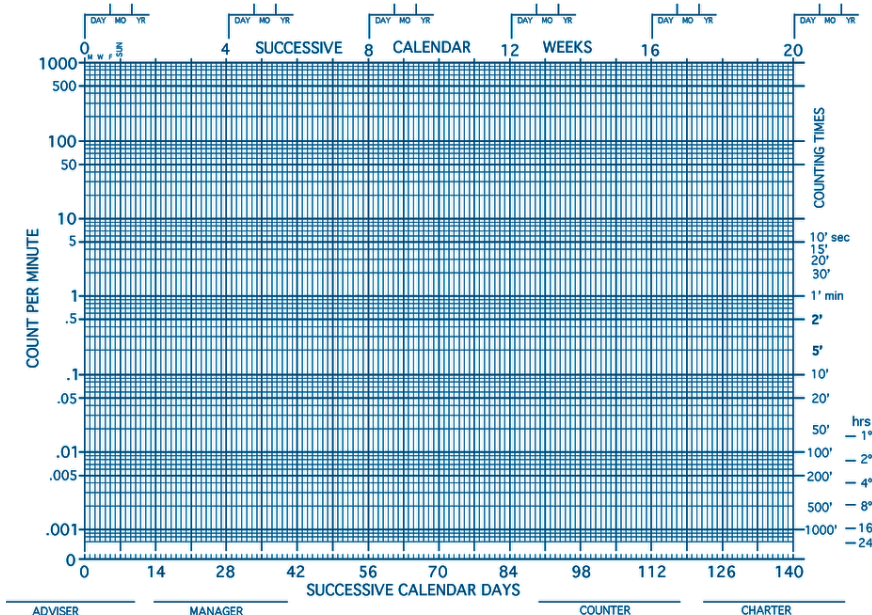
The 1-minute timing may be an inner or an outer behavior. I did mine as an outer behavior—I wrote my self-positive words, but to this day, 41 years later, no one has seen my list or any of my 1-min written timings. Others have done a Think-Say in private and some have done a Think-Tally.

How does all this fit with respondent and oper-

ant conditioning? If I may separate them for the moment, first, let's look at operant conditioning.

In case a behavior analyst wonders how a person can monitor and chart inner behavior, I'd like to make several points. As I mentioned, I struggled with this issue from 1969 to 1972. In the mid-1960s, Ogden had found that he and others could count inner behavior consistently across pinpoints and people. When teaching graduate school at Oregon College of Education (now Western Oregon University) in the 1970s, I had my students count an inner behavior. I also noticed that inner behavior was as consistent as outer behaviors, occurred in the bottom two cycles of the chart, from 1 to the low 100s per day (unless using a 1-min timing, of course), and students could pinpoint it. Thus, we had statistical consistency of frequency. Ogden and his students had found this in the mid-1960s; I merely confirmed it. I also found that inner behaviors had celerations and bounce (variability) just as outer behaviors do.

As of 2000, I had about 2,500 inner behavior charts from people of all ages and varied occupations. By then I had found about 700 of the present 1,060 charts from research projects. My aim had been to reach over 1,000 projects. By the time I found all of these 1,060 charts, we had research data on changing inner behaviors from over 500 people, some of whom did more than one project. There are 105 who have done



Standard Celeration Chart (SCC)

projects using the 1-min timing; of those 75 people charted their data on the SCC. We need to trust these data as we do any other data. It's hard to argue with that many projects gathered into research studies with different researchers. We also need to trust the individual charts that were not a part of research projects, but which have helped individuals change an inner behavior or behaviors.

At that time, I also strengthened my realization that inner and outer behavior were the same, just behaviors, because they lie on the continuum of human behavior. The only difference between the two was that with inner behavior we don't have, or need, a second observer. Why don't we need one? There are four reasons. 1) We now had well over 2,500 charts that have told us that inner behavior was in the bottom two cycles of the

chart, usually ranging somewhere from 0 to 100 per day. 2) These charts also tell us that the bounce of inner behavior is about the same as academic behavior for average students or those with behavior problems. 3) Just like academic and all other behaviors, inner behaviors also accelerated, maintained or decelerated. 4) Again, like academic behaviors, the 1-min timing had a statistically significant effect on inner behaviors. We cannot separate a person into what is inside and what is outside. We do not say that this is Abigail Calkin on the outside... or is it that this is Abigail Calkin on the inside? No, I am one and the same person, a continuum inside and out of my whole existence. Through the SCC, we now have the methodology to monitor inner behavior, and, if you're a radical behaviorist, to be able to say that inner behavior is a part of a continuum and not a duality of inner and outer behaviors.

To date, there are two effective ways to change inner behavior. Cognitive behavior therapy (CBT) began in the 1950s with Lindsley, Skinner and Solomon and what Lindsley had named behavior therapy and then with Wolpe's systematic desensitization. A second most effective way is the use of the 1-min timing with inner behavior data on the SCC, which began 25 years later.

I've come to think of the term private events as used to discuss the philosophical issues of inner behavior. Inner behavior, like CBT, looks at data and how to change people's thoughts, feelings, and urges. I spent three years in the formal study of philosophy before I grew tired of reading (i.e., studying) philosophy in the David Hume Tower at the University of Edinburgh, moved back to the States and heard of behavior modification in 1965. I've spent 51 years in the formal study and work of changing human behavior. Philosophy is good and I like it, but if we want to change people and the world, it is insufficient.

It is clear that we can and must change people's inner behavior. We can and must help battle-tested veterans who return with mild or serious post-traumatic stress. We must, and can, help parents and children in divorce and death situations. We must and can help people who have been abused. We must, and can, be objective and precise. Scales and self-reports are insufficient for these tasks. Self-counts of inner or outer behaviors are a counting and recording of the behavior; they are not a report, introspective or otherwise. Self-counting is a mark, tally, counter press of a behavior pinpoint. It is not a report that says 'I felt more depressed Tuesday than Wednesday' or Tom behaved better today than yesterday. We must be more specific than that.

When I talk about urges to behave, it becomes necessary to discuss respondent conditioning. I am not talking about hunger or pain, although I could talk about urges to eat or get an aspirin. The first time an urge occurs, it is an unconditioned response to an event within the environment. It is an inner event, one that occurs within a person's skin and that may or may not be observed in any display of outer or public behavior; how-

ever, it is still a behavior. After its first occurrence it becomes tied to the operant behaviors that occurred at the same time as the urge. No one has yet done a study on the use of the 1-min timing to change urges or the or the respondent-operant urge actions that occur at the same time.

Although I have never been in the military, the image that comes to my mind is a junction in a Middle Eastern neighborhood. A small group of 6 or 7 US soldiers, already highly trained but on their first in-country off-post duty, walk up one street, see the junction whose street ahead is not straight but goes off at an angle toward the left. What awaits them around the corner? A pile of trash indicating a possible IED? A child of 3 or 4 holding her mother's hand with the mother wearing a suicide vest? Two or three armed men with weapons at the ready? Nothing? The soldiers have been well trained to proceed, but even with that training they have an increased pulse rate, perspire, feel apprehensive, etc. As they come to the corner, the urge may be to shoot, to take cover, to back up. Around the corner they come, but there is nothing there. However, the respondent behavior still occurred. Or perhaps they come to the junction and all hell breaks loose. Their trained operant behaviors function and they move into action. From now on the conditioned respondent and the operant behaviors are so mixed that they cannot be separated when they come to the next junction. Or as Hank Pennypacker told me last week, operants and respondents are inseparable; neither can occur without the other. We should not wonder why people who return from battle areas have behaviors not needed in our civilian society. We would do them a favor to retrain them in a reverse boot camp. We might be able to reduce the number of people with PTSD by half.

In November 1987, I listened to a presentation by Joseph Wolpe and spoke to him afterwards. He became very excited as I described the research with inner behavior using the 1-min timing with the SCC, exclaiming that 'Yes, it is the antecedent event that changes these behaviors! Now, Joe Cautela will tell you differently and say it's the consequence, but it's not!' I left my talk with Wolpe to have lunch with Cautela and sure enough, he said it was the consequence that changed inner behavior and Wolpe was wrong. Pondering the contradictions, I eventually came to the conclusion that both were correct, but the use of one or the other depended on the situation.

I didn't come up with the idea or practice of the behavioral look at counting inner behavior, that was Ogden Lindsley, or with the use of the 1-min timing, that was Eric Haughton and Harold Kunzelmann, but I did come up with the idea of using the 1-min timing to change inner behavior. It was one of those serendipitous moments of combining elements that didn't seem to go together. With 10 other independent researchers, the most recent ones using the 1-min timing, it is obvious that we can now offer a way to change the inner behaviors of thoughts and feelings. Although we don't know this yet, it may also offer a way to change urges. ■

# Behavior Analysis Finally Got Defined and Redefined

John W. Eshleman, EdD, BCBA-D  
The Chicago School of Professional Psychology

An article *From Behaviorism to Selectionism* by E. A. Vargas, published originally in 1993, was reprinted in *Operants* in 2017. It was preceded by the statement: "We thought it would be interesting for *Operants* readers to see what has changed and what has not." I thought that I'd take up the implied invitation to discuss what has changed and what has not.

Vargas's article largely pertains to a discussion of behaviorism, and its relation to selectionism, in the context of also describing the rise of behaviorology, as it existed in that early 1990s era. From my perspective, the various issues regarding selectionism discussed by Vargas have not substantially changed. The points raised a quarter century ago remain as warranted and as salient as ever. What Vargas stated in the final two sections of the paper, those titled 'Effects of Contingencies upon Behavior' and 'The Prospects for Selectionism,' offer germane summaries and clear statements of the "basic science," relevant as much today as perhaps back then. My response here will not, therefore, cover the essentials of selectionism nor cover the growth, or lack thereof, of the basic science in terms of its scientific accomplishments made since 1993.

## *Planting the Feet of Behavior Analysis*

What has changed, however, are various points that Vargas made regarding behavior analysis, his observations and perhaps lamentations of the state of behavior analysis as of 1993 and where it then seemed to be headed. Let me take this opportunity to address some of those matters, simply because some of them no longer remain salient, other ones have changed, and new concerns have arisen.

Just a few short years after Vargas's (1993) article appeared, the Association for Behavior Analysis International (ABAI) initiated a Special Interest Group (SIG) pertaining to autism. This inauguration seemed to open up a whole new venue for a rather substantial increase in papers presented at the annual ABAI convention in general, as well as beginning a significant, long-term increase in the numbers of persons considering themselves to be behavior analysts. In 2004, I documented some of these changing celeration trends in an ABAI poster, albeit, which topic concerned the overall growth of presentations per year about or related to some aspect of Skinner's analysis of verbal behavior. Much of the upswing in such verbal behavior presentations clearly involved persons diagnosed with autism as research participants, and these increased levels and trends in published articles have pretty much consistently stayed elevated over the past 14 years.

Perhaps somewhat related, in 1998 the Behavior Analysis Certification Board (BACB) was incorporated as a credentialing body and soon its credentialing went national. The Board began vigorously pro-



*John Eshleman was born in Willows, California in 1955. He's lived in various states as well as in Victoria, British Columbia, Canada (for a couple of years back in the latter 1960s). He graduated from Youngstown State University (YSU) in 1977. At YSU he majored in Psychology, and Dr. Steve Graf was his advisor and mentor. John graduated with an EdD in Educational Psychology from West Virginia University in 1988, with a doctoral dissertation on celeration-based instruction. Since then he has held various jobs and positions in both business and academic environments. As of 1 July 2007, Dr. Eshleman has had a full-time faculty position in the Department of Applied Behavior Analysis at the Chicago campus of The Chicago School of Professional Psychology.*



moting its BCBA (Board Certified Behavior Analysis) certification. By the mid-2000s this certification had become ubiquitous and was becoming increasingly necessary as a job qualification. Indeed, I found myself scrambling to become a BCBA in 2005 while I could still be “grandfathered in” under some older eligibility requirements. Incredibly, as of September 2018 there are over 78,000 persons holding some kind of BACB certification (32,176 holding BCBA, BCBA-D, and BCaBA, plus 46,113 RBT (Registered Behavioral Technician) (<https://www.bacb.com/bacb-certificant-data/>).

What was the significance of the rise of the BACB? Apart from the founding and growth of an organization independent of ABAI, albeit with a different organizing structure, mission, and function, the arrival and common acceptance of the BCBA certification goes directly to one of Vargas’s points. On page 14 Vargas (2017) noted that “Behavioral analysis has one foot in psychology and the other firmly planted in midstride—elsewhere.” Well, a foot is no longer in midstride. As Vargas likewise noted in a couple of places, “no particular scientific subject matter has been specified for behavior analysis, at least by the association with that name.” [Vargas went on to lament, perhaps, the feeble effort, quickly backtracked at the time, by ABAI to offer a definition of behavior analysis.] Well, the BACB is not the ABAI (more about that later), and is a certifying body not a membership organization, but it has, for better or worse, defined a subject matter. Furthermore, this defined subject matter is explicitly labeled “Behavior Analysis.” A person who desires to become a “Behavior Analyst,” at least how the Board defines it, must meet its eligibility requirements and pass a BCBA Exam. Then, every couple of years the Certificant must accrue several dozen Continuing Education Units (CEUs) to recertify. This board-defined behavior analytic subject matter is presented and documented in the various BCBA Task Lists (see [www.bacb.org](http://www.bacb.org)) that the BACB, organized independently of ABAI, has promulgated over the past two decades. While from an instructional design perspective these Task List objectives could have been better written (many of them state that a behavior analyst should “use” something), they nonetheless specify what a person seeking to become board certified should know. The BACB has gone through at least four full iterations of this task list, and is moving to a 5th Edition, and some of whatever is meant by basic behavioral science, so to speak, has lingered through all of the changes.

The BCBA Task List probably represents at best a political accommodation, and I have heard it described as such. A comparison of the topics presented at the ABAI conventions over the years to the BCBA Task Lists will reveal some interesting disparities from each list as the various tasks evolve. Furthermore, an astute observer may notice that there are “behavior analytic” topics presented at the annual ABAI conventions that are not represented at all in the BACB Task Lists. Moreover, someone following all of these organizational perambulations over the decades will also know that there are topics and research areas of “behavior analysis” that at

one point were included in the Task List but which later on were removed, with the result that some areas or sub-fields of behavior analysis thereupon lost representation in the esteemed Task List and its big exam. Finally, a keen observer may take notice that a few of the BCBA objectives that have been included have little or no empirical research support.

Here are some topic areas or sub-fields, all of them arguably legitimate and empirically-based research and development sciences, and all of which have had many presentations at ABAI and other venues, and also have published literatures, that are excluded from the current BACB Task List: Relational Frame Theory (RFT), CABAS and the concept of the learn-unit, Goldiamond’s non-linear contingency analysis, Precision Teaching and its Standard Celeration Chart (SCC), and Direct Instruction. The latter two items, Precision Teaching (and the SCC) and Direct Instruction were represented on early versions of the BACB Task List, but will have been removed entirely by the time that the 5th Edition is enacted.

The current (4th Edition) Task List also contains objectives about various conditioned motivating operations. As S. Ormandy found in her dissertation research on CMO-S’s, this concept in particular has had virtually no empirical support behind it. I mention this as an example of a task being included on the task list even when the underlying empirical support is lacking. While I would certainly categorize this CMO-S concept worthy of empirical investigation, it seems rather presumptuous to include it as if it was firmly established knowledge. As tasks, these various CMO objectives may go away, however, as the 5th Edition’s paring down of the definition of “behavior analysis” continues apace.

### *Sometimes Chance Events Arise*

I had written an earlier version of this article back in September 2017. My earlier draft ran more than twice as long as what I’ve now written, and addressed many other issues. I set that paper aside as the Fall Semester began at my school. There, the paper languished for a few months. But sometimes events “overtake” us. Events occur and conditions take an unexpected turn. So it was in the case of this “reply.” When January 2018 rolled around, the latest issue of *The Behavior Analyst* journal arrived in the mail. Chance struck.

As I’ve written, Vargas’s “other foot,” the one planted in mid-air, has landed squarely as the definition of behavior analysis as now defined by the BACB. That other foot belongs not to ABAI, however, but to the BACB. But what about the first foot? Is it implanted in psychology, or somewhere else? Well, as noted, the issue of *The Behavior Analyst* was the last one: last as in last ever, not only most recent. A pair of editorials announced that the flagship journal of ABAI was henceforth immediately changing its name from *The Behavior Analyst* to *Perspectives on Behavior Science* (PBoS). Presented as a *fait accompli*, this change would seem to hold



considerable significance. Apparently, because the field of applied behavior analysis (ABA) has evolved into primarily a service-providing enterprise and thus manifests as a profession, which by all evidence it indeed has, the old journal title, and possibly the papers to be published under it now seemed irrelevant to behavior analysis the profession by the editors of the old journal. Lest that seem mind-boggling, it has to do with ABAI considering the renamed journal to be about “behavior science,” and ABAI being more explicitly positioned as a science, which astonishingly is apparently of uncertain relevance to persons in the behavior analysis profession. You can read their editorials to gain a full appreciation of their rationale behind this move. But running the numbers, in terms of membership, ABAI has maybe one-tenth the numbers of persons holding a BACB certificate. Clearly the latter are not signing up to ABAI in any appreciable numbers.

But one way to construe this change is that ABAI is abandoning the term Behavior Analysis. Otherwise, why change the name of the journal, especially a “flagship” journal? This action would be akin to Admiral Nelson for some odd reason changing the name of his flagship *HMS Victory* part way through the Battle of Trafalgar against Napoleon’s fleet! Not only that, but likewise having him re-purpose the ship into maybe more of an *HMS Beagle*, again in the midst of battle. In other words, one does not change the name of one’s flagship lightly or its purpose. So, here now is the situation we face: On the one hand, for better or for worse, the BACB has arrogated a power unto itself to define “behavior analysis,” and thus what it means to be a behavior analyst. That may hold true legally even, as the editorial in the last issue of *The Behavior Analyst* noted that with increasing national certification and state licensure, someone lacking the BCBA credential possibly may not legally be able to identify himself or herself as a “behavior analyst”! On the other hand, the ABAI, which at one time had that one foot in mid-air, now has that first foot repositioned. In fact, regarding the ABAI, the bizarre situation is that neither foot is planted necessarily on “behavior analysis,” either as a science or as a profession! Indeed, the two feet belong to two different entities. It’s not at all clear where ABAI’s feet are planted.

Think about the significance of the change to the name to *Perspectives on Behavior Science*. At least with *The Behavior Analyst* there seemed to be some continuing ties back to the science that B. F. Skinner was largely responsible for initiating. No other scientific discipline wanted that term or used it. Skinner referred to the basic science as the *Experimental Analysis of Behavior* (EAB; emphasis added), many times, in many places. The words “analysis” and “behavior” were always present. Even if the field of behavior analysis, however presumably defined years ago, had drifted away from Skinner’s science to some extent or another, there always seemed to remain some tie-in back to it. The erstwhile name of the flagship journal would always stand, if for nothing else at least, as a mute reminder of that old connection. That condition

is no longer true.

I remember conversations, sometimes ones where I was simply listening in on, where Dr. E. A. Vargas would note that the term “behavior science” could mean anything. It does not possess a clear nor exclusive link to Skinner’s EAB-based science. As of March 2018, when I typed in behavior science into the Google and Bing search engines, they both first autocorrected the term to “behavioral science.” This term with the added -al suffix then has those search listings presented. “Behavioral science” can refer to many fields or disciplines, and thus can include behavioral sciences far afield from anything Skinnerian. As defined at various sites produced by the search, “behavioral science” includes: psychology, political science, economics, sociology, anthropology, education, neurosciences of various kinds, and more. One field listed under this umbrella, criminology, even includes the name “behavioral analysis” (The United States’ Federal Bureau of Investigation (FBI) has a “Behavioral Analysis Unit,” which has nothing to do with Skinnerian science, to be sure.). Perhaps law, public health and history might fit under this somewhat ambiguous but expandable umbrella term. This situation is fine and dandy, because these disciplines all qualify indeed as “behavioral sciences.” I’m not sure that this is what Hantula, Critchfield and Rasmussen (2017) necessarily had in mind, but to continue with a ship metaphor, they have unmoored ABAI from the docks. Advocates of the name change remind us that the new term is “behavior science,” no -al. But that seems like an extremely fine discrimination to make from “behavioral science.” We can wish ABAI well in any efforts they make to teach that discrimination successfully.

What can a radical behaviorist response to all of this be? Well, simple. The term and concept of Behaviorology may have been “before its time” when first proposed a few decades ago. So, write, speak, advance, and promote Behaviorology as the term that defines a very clear scientific discipline and its underlying natural philosophy. Any earlier objections to the term are now completely irrelevant, that is, if one desires a science based on the radical behaviorist concepts and principles of what I otherwise sometimes call “Skinner’s science.” As we’ve seen, cultural events and conditions have changed. Now is the time for Behaviorology as both a name for a science and for the scientific discipline and associated behavioral engineering and technological enterprises to come to the forefront. There is no need for Behaviorologists to define behavior analysis, nor to concern themselves about its BACB definition. That profession definition is a done deal. Likewise, let ABAI publish whatever and however many perspectives on some amorphous “behavior science” that they want. That is a done deal, too. If it’s the basic science and philosophy derived from the pioneering work of B. F. Skinner that one seeks, then Behaviorology is the place for that. ■

# SINCE YOU'RE HERE...

... we have a favor to ask. Three years ago, the B. F. Skinner Foundation started [Skinner's Quote of the Day](#) on our website and on Facebook to deepen our relationship with the community of people who care about the science that Skinner started and work that is based on this science.

This project is a small sample of publishing, archival, and public outreach efforts by the

Foundation. We try to keep the results of our work open and accessible to everyone, regardless of where they live or what they can afford. The subscription to *Operants* magazine is free, so is the access to ever-growing Skinner's audio-, video-, photo-, and print archives at [bfskinner.org](http://bfskinner.org). All PDF versions of Skinner's books are offered through our bookstore as name-your-price product, starting at 99 cents. Better yet, each year we add books that you can download for free. Currently, *Science and Human Behavior*, *The Behavior of Organisms*, and *Schedules of Reinforcement* in PDF format are free and more titles will be added soon.

Thanks to all the people who have supported us through contributions and volunteer work, the B. F. Skinner Foundation is entering its 30th year of

operations. There are more Skinner's books to bring back to print, including his autobiography. Skinner's notes are waiting to be digitized and made available to the public in an annotated and searchable format. Online virtual museum is in the works. *Operants* correspondents, while conducting their interviews with Skinner's students, younger colleagues, and disciples are building an impressive collection of photographs and audio- and video recordings – we have to edit them and put them online. In the past three decades we have accomplished many things, and the future looks even brighter. But to have a fighting chance, we have to maintain and build on that level of support for every year to come.

Sustained support from people like you enables us to continue pursuing the ultimate goal – preserving B. F. Skinner's heritage in challenging times. The Foundation is independent. What we say or do is not influenced by billionaire donors, politicians, or industry groups. This is important because it enables you to hear Skinner's voice, understand his ideas, and appreciate his influence in the purest form, without any distortions. Your support means we can continue bringing Skinner's science and its applications to the world.

If everyone who reads *Operants*, who likes it, helps to support it, our future would be much more secure. For as little as \$1, you can support the B. F. Skinner Foundation – and it only takes a minute. Please go to [bfskinner.org](http://bfskinner.org) to donate and invite your friends and colleagues to do the same. Thank you.



# How Should We Determine Appropriate Units of Analysis in a Science of Behavior?

Dr. David C. Palmer interviewed by David Roth

The following interview is the third installment of an ongoing series of publications for this magazine in which we have aimed to uncover some of the overlooked conceptual foundations of our field as outlined by B. F. Skinner in his 1935 paper, *On the Generic Nature of the Concepts of Stimulus and Response*. Dr. David Palmer is among the leaders in the field of Behavior Analysis. As an expert in how the basic units of analysis in our field extend to areas of complex human behavior, we invited him to shed more light onto the critical topics presented by Skinner over 80 years ago.

*The purpose of this interview is to discuss the main points in a fundamental paper Skinner wrote in 1935, titled The Generic Nature of the Concepts of Stimulus and Response. However, before we get into that discussion I was wondering if you could tell us a little bit about where you were in your career as a behaviorist when you discovered the importance of Skinner's essay, and also what impact it had on your repertoire at the time?*

I read that paper as part of a seminar on Skinner's early writings in my first or second year of graduate school. I saw its implications for my critique of Chomsky, and it soon played an important role in my master's thesis. In 1992 John Donahoe and I wrote an article on selectionism and essentialism, the thesis of which was strongly supported by Skinner's paper. In 2004, I found it useful once again in critiquing relational frame theory. I now recognize that the paper is one of the most important in our field, for it addresses a fundamental question: How should we determine appropriate units of analysis in a science of behavior?

*Throughout my formal university training in behavior analysis, this paper was never assigned in the coursework, and I assume that to also be the case in various other university programs. Would you mind providing for the readers of Operants magazine an overall description of what this paper is all about?*

The paper is almost never read by students today, partly because it is difficult, partly because it is recapitulated in *Behavior of Organisms*, but mainly because its importance is not appreciated. The paper sets out a procedure by which appropriate units of stimulus and response in behavior analysis can be identified. In this regard, the paper is unique. So far as I know, no one else in any of the fields of behavioral or social science has ever addressed this problem. Most people are unaware that there even is a problem, because they use dependent and independent variables that have already been "validated" by others before them.

Specifically, Skinner argued that units of analysis should not be defined in advance. Rather, they should be determined by looking for orderly relations between behavior and its independent variables. We should adopt those definitions that yield maximal orderliness

*David C. Palmer studied interresponse times and conditioned reinforcement in pigeons at the University of Massachusetts under John Donahoe in the early 1980s. Upon graduation, he took a job teaching statistics and behavior analysis at Smith College, where he remains today.*

*His interests in behavior analysis are broad, but his main contributions have all been attempts to extend Skinner's interpretive accounts of human behavior, particularly in the domains of language, memory, problem solving, and private events. He remains convinced that behavioral principles offer an adequate foundation for interpreting such phenomena. Together with John Donahoe, he authored the text, Learning and Complex Behavior, which was an attempt to justify such optimism.*

*Dr. Palmer was the Invited Editor of a special edition of Operants in 2017.*

*David Roth is currently a behavior analyst consultant for the Pennsylvania Training and Technical Assistance Network (PATTAN) Autism Initiative supporting public school classrooms throughout the state of Pennsylvania. He received his master's degree in Behavior Analysis at California State University, Stanislaus. For over a decade, David has been a passionate student of B. F. Skinner's works, specifically his analysis of verbal behavior. His current interests in the field range from the application of behavioral programming for individuals with verbal deficits to the behavioral interpretations of complex issues that are currently on the fringes of our science. David is an Associate Editor of Operants.*

in our data. Suppose we are studying a rat pressing a lever on a continuous reinforcement schedule. What are we going to count as a unit of behavior? We might count every instance in which the rat simply orients toward the front of the chamber; alternatively, we might count lever presses with the left paw made to the 2 cm right-hand edge of the lever with a duration of .5 seconds and a force sufficient to lift a counterweight of 25 grams. That is, we could accept wide variations in response topography or almost no variation at all, and between those extremes lies a great range of possible response definitions. A corresponding case can be made for stimulus units. Skinner discovered that when he counted extreme candidate definitions (as above), that he found little order in his data, but when he settled on an intermediate definition, namely, any behavior that pressed the lever with sufficient force to operate the switch, his cumulative records were remarkably smooth. Presumably there is a fuzzy range of response definitions that are equally good for analytical purposes, at least given current technology.

Skinner initially assumed that every possible topography of lever pressing was a different unit of behavior, but as a practical matter, he could predict and control behavior best when it was defined in generic terms, not in completely restricted terms. His prescription, then, is that a researcher should titrate his definitions of both stimulus and response, alternately loosening and restricting them, until a relationship of maximum order emerges. In his own experience, that optimum was found at an intermediate level of specificity. We might call it a “Goldilocks zone”—not too specific; not too loose—but most importantly, the level of specificity should be defined empirically, not by fiat or intuition.

The concept of the operant includes all of the elements that hang together in an orderly way, so it includes not just the behavior itself but the controlling variables. The three-term contingency, generically defined, was Skinner’s interpretive work-horse.

In behavior analysis, most of us follow well-worn experimental paths, and we do not need to do this kind of exploratory work. Key-pecks, lever-presses, touching displays on screens, etc. have been thoroughly validated as useful units of analysis with pigeons, rats, and people, respectively, but we should not assume that because such units are generic in nature, any response definition we choose will be a valid unit of analysis.

As for everyday examples, the most troublesome I know of was Chomsky’s definition of the grammatical sentence as the fundamental unit of analysis in the study of verbal behavior. No matter how one attempts to operationalize such a definition, it does not capture the actual behavior of speakers in an orderly way. Chomsky led many hundreds of researchers down a blind alley because of his failure to appreciate the importance of defining his units of analysis empirically.

*Could you elaborate a bit on the role of induction and mutual replaceability as criteria for the inclu-*

*sion of an observed instance into our defined classes?*

In Skinner’s experience, individual variants within such generic units of behavior, so defined, rise and fall in probability together and are equally likely to occur. That is, they vary together as a class and need not be differentiated. For analytical purposes, the responses are “mutually replaceable.” A smooth cumulative record will be made up of a population of individual variants, in no systematic order. (However, he acknowledged that technical advances in methodology might reveal order at finer analytical grains.)

To put it another way, members of a response class will rise and fall together in probability as a function of reinforcement, extinction, and motivating operations.

*This is also related to the concept of response induction (i.e. generalization) and when we observe some slightly new variation in a member of the established class. Although there is topographical variation in the emerged form, its shared physical properties (i.e. response elements) with the previously established members permits us to explain its occurrence as an instance of induction from the previously established class. This is very different, however, from an observed instance of a new response having no shared topographical features with the already established class. Could you comment on that?*

The concept of a “class of responses constituting an operant” entails the assumption that strengthening one of them strengthens them all. Otherwise, we could not use the reinforcement of one to “explain” the appearance of a somewhat different form at a later time. Skinner’s concept of response elements accommodates this effect smoothly, because some of the elements of any given response would have been reinforced on a previous occasion. But the effect cannot apply to non-overlapping response elements without making some bizarre assumptions, at least for the first appearance of the non-overlapping topography.

Suppose a swinging door can be opened by pushing against it with your hand. Alternatively, taking advantage of the tools of modern technology, one can open it with a voice command to a computer-controlled device: “Please open the kitchen door.” If you are a wholly naive person with no experience opening doors or commanding technological servants, you might eventually stumble on the response of pushing on the door. If you have been deprived of water, and a glass of water is waiting on the other side of the door, you are likely to push on the door the next time you are deprived of water. This is standard operant conditioning, and we would predict that you might push on the door in slightly different ways on future occasions, provided that there is some overlap in response elements.

But if all responses that have the same consequence are members of the same operant, then the response “Please open the kitchen door” must also be equally strengthened by the reinforcer, even though you have had no experience with the use of computer



mediated voice commands to operate devices. Furthermore, when Alley Oop the cave man pushed on a rock to open the door of his cave and got a drink of water, the response “Please open the kitchen door” must have been strengthened as well, because you and Alley Oop have equivalent repertoires in the relevant respects. It’s true that voice commands had no effect on cave doors 50,000 years ago, but that is irrelevant, since we have assumed that you too know nothing of the use of voice commands to open doors. It would follow that any behavior of opening a door that is invented by future generations must also be strengthened when you first push on that door and get your glass of water. Obviously this is preposterous.

So clearly the first instance of a non-overlapping topography must have some cause that is independent of the reinforcer. That means that we cannot appeal to membership in a

response class as an explanation for the first appearance of a wholly novel topography of response.

*Now if the newly emerged response form (i.e., “Please open the kitchen door”) was to be reinforced in a similar manner to the already established class (i.e. pushing on the door), would the two topographically distinct classes be considered members of the same operant?*

This brings us back to the topic of synonymy discussed in the previous issue of *Operants*. All other things being equal, our second response will be under control of most of the same MOs and SDs as the first response, and it is logically possible that the two topographies would be intermingled in any record of reinforced behavior. For practical purposes, it might be harmless to call them members of a single class. But the full panorama of controlling variables will necessarily be slightly different for the two classes, and we would not expect one topography to vary in probability along with the other (except to the extent to which they share precursors or common elements). For example, if the electrical power were to go out, any voice command would be on extinction and would return to its baseline rate, but we would not expect door-pushing to extin-

guish as well.

*So, when there are novel changes to the established contingencies we can discover important differences between the controlling variables of the formally different members. Skinner seemed to address this problem in his paper. Since his data were the visual products of each depression of the lever in the operant chamber over time, the orderliness of the data could be demonstrated independently of any direct observations of the form or topography of the behavior. Skinner’s method of observation potentially invited the inclusion of topographically unique instances of “lever-pressing,” such as the occurrence of the rat accidentally bumping*

*into the lever when walking past it. To this point Skinner said: “There are pressings that are so unusual because of other properties that they do not fully count as such. It ought to be supposed that lesser differences would be*



David Roth (left) and David C. Palmer during the interview

*significant in a more sensitive test. I take this to mean that given some of the technological limitations within his experiment it would not have been possible to accurately identify the controlling variables responsible for “accidentally bumping into the lever” that were different from the variables responsible for an actual paw-press as an instance of induction. However, so long as the orderliness of the data is not disturbed we can ignore such outlying instances.” It appears that Skinner would have objections to an actual inclusion of the outlying members in an explanatory definition of our response class. Would you agree with this? If so, why? and if not, why not?*

I agree that there is no need to try to weed out occasional intrusions of nonmember responses, provided that they do not interfere with the orderliness of the relationship that is being experimentally analyzed. But they should be excluded if they mislead us as to the relationship under study. Skinner was taking a pragmatic stance, forced, in part, by the limits of his methodology. Some ways of pressing the lever might not “belong” in the class, and he acknowledged that his definition would not exclude them until refined tools became available. However, in his experience, for purposes of

prediction and control, such rogue responses could be neglected.

For example, suppose you and I are sitting side by side in an experimental room. I have been deprived of food, and I am pressing a lever and periodically getting peanuts. I am pressing at a moderate rate, and the cumulative record is smooth. A few times during the hour-long session, you reach over and press the lever, perhaps as a joke. You and I know that these responses don't count as units of my behavior, but the experimenter looking at the cumulative record in the other room can't see anything amiss, because your presses are swamped by my presses. As far as predicting and controlling my behavior is concerned, your intrusions can be neglected. So it is with "outlying members." Skinner would exclude them if he could, but as a practical matter they are too unusual to worry about. However, if you were to press the lever 10 times in a row very rapidly, you would disrupt my cumulative record, and if an "outlying response" by a rat were to frequently intrude into an otherwise orderly sequence of bar-presses, it would disrupt the cumulative record of typical bar-presses. This assumes that "outlying responses" are subject, at least in part, to other sources of control. A rat who leaps up into a corner of the chamber and lands on the lever presumably does so for reasons that are independent of those controlling other lever presses. (Again, the operant includes the controlling variables, not just the response itself.)

So yes, I believe Skinner would object to claiming that outlying members of a functionally defined class of behavior "fully count as such." In an early letter to Keller, he was explicit on this point, and I think the passages you quote require that interpretation as well. But his overriding goal was to find order, and he could make progress toward that goal without winnowing out unusual topographies of response from his data.

*There appear to be domains in behavior analysis that interpret a response class as including any responses having a common effect upon the environment. However, as discussed earlier, when the rat operates the lever by pressing down on it with its paws (or one opens a door by pushing it), this behavior is fundamentally different from the rat's behavior of operating the lever by accidentally bumping into it (or when one utters a voice command to do the work.). Therefore, topography does not appear to be wholly irrelevant in our identification of class members. Can you comment on this?*

It seems to be an axiom in our field that topography of response is irrelevant; all that matters is function. This goes much too far. The class of lever-presses that Skinner included in his empirical definition were all topographically related. There is a reason that topographically-related responses "hang together." Even a response as simple as a lever press is mediated by a population of thousands of muscle fibers and their associated motor neurons. This population varies somewhat from one instance to another, according to slight

variations in posture, angle of approach, fatigue, etc. We might call these units "response elements." As Skinner said in *Science and Human Behavior*:

The traditional explanation of transfer [between from one response to another] asserts that the second response is strengthened only insofar as the responses "possess identical elements." This is an effort to maintain the notion of a unit of response. A more useful way of putting it is to say that the elements are strengthened wherever they occur. This leads us to identify the element rather than the response as the unit of behavior. It is a sort of behavioral atom, which may never appear by itself upon any single occasion but is the essential ingredient or component of all observed instances. The reinforcement of a response increases the probability of all responses containing the same elements. (p. 94)

Reinforcement contingencies often entail sequences of behavior, sometimes quite complex, employing different response systems. In such cases, we might see induction occurring at multiple levels:

When we reinforce the final response in a sequence containing many precurrent members, we may strengthen all units which contain the same precurrent members. Our skill in manipulating tools and instruments transfers from one field of reinforcement to another. (p. 94)

Thus we might see transfer, or induction, from one domain to another, but only because of the reinforcement of common elements among the complex of behavioral events, including both the terminal behavior and precurrent behavior. Skinner does not assert that such "elements" must be topographical, but there are good physiological reasons for thinking so, and I am not aware of any physiological mechanism by which a reinforcing effect could be assigned to all responses that happen to serve the same function. One can solve math problems with a paper and pencil, or "in one's head," or by using a calculator, or by copying the work of the student sitting by one's side. It would be astonishing if the reinforcement of, say, calculator use somehow increased the tendency to do "mental arithmetic" or copying a friend's work.

*Stimulus equivalence procedures have demonstrated, particularly with verbal humans, that changes to a single member of a "functional response class" may produce observed changes to other topographically distinct members of that class. Skinner acknowledged in his paper that "some influence" can in fact be observed between such different members. That the phenomenon tends to be more robust with humans seems to indicate an important role in mediating verbal events. This is something you have talked a great deal about in your publications. Can you discuss a bit how the observed "order" in stimulus equivalence paradigms is different from the type of order Skinner addresses in his paper? Also, can you describe how this applies to similar*

*procedural observations such as derived relational responding?*

The tasks posed in matching-to-sample trials, and relating-to-sample trials are problems: Your task is to induce a rule from exposure to a number of examples and then apply the rule to a novel example. The rule might be, "Point to the comparison stimulus that 'goes with,' or 'is bigger than,' or 'is opposite to,' or 'is the square root of' the sample." Most humans have long histories of problem-solving behavior and will bring this repertoire to bear on the task at hand. By this interpretation, correct performance is an instance of context-controlled problem solving. It can be quite a complex performance, particularly when the web of relations is large.

The research shows how humans can apply their repertoires to complex webs of relations among terms, and it is interesting in that light. My objection is not to the demonstrations themselves, but to the conclusion that the performances can be understood without reference to the full panorama of behavioral events occurring within trials. To take an extreme example, if someone solves a math problem, they might do so, as I mentioned above, with paper and pencil, by doing "mental math," by using a calculator, by cheating, and so on. If my understanding of RFT is correct (and I am no expert on the subject), the various topographies of response that lead to the same end are considered members of a single "relational operant," and novel performance is explained as merely another instance of that operant. This permits the RFT theorist to neglect the sequence of mediating behaviors between the statement of the problem as posed and the statement of the answer. This is an incorrect use of the concept of the operant. The various "derived relations" in an experiment are not mutually replaceable, nor are they occasioned by the same set of controlling variables.

Of course, one might argue that Skinner's concept of the operant is inadequate and that a new formulation is required along the lines indicated above. That might be a worthwhile quest, but I doubt that it can succeed. Skinner's concept of the operant was derived from the observation of highly orderly and replicable behavior. In contrast, the behavior of subjects in experiments on derived stimulus relations is highly variable, both between and within subjects, despite similar training. Any revision in the concept of the operant must be able to account for variability in the face of constant contingencies, and I am skeptical that it can be done, or that any such concept would be as useful as Skinner's concept of the operant.

*One of the criticisms of Skinner's concept of the operant is that with respect to complex verbal behavior it requires the role of interpretation (rather than experimental analysis) to extend its reach in our attempts at explaining such phenomena. As someone who has devoted his career to carrying Skinner's torch of behavioral interpretation how would you address claims such as these?*

Scientific interpretation and experimental analysis are not competitive enterprises. To the contrary, interpretation typically suggests and guides experimental work and is gradually replaced by it. Experimental analyses are always preferable to scientific interpretations, and if an experimental analysis can be done, it should be done. However, many natural phenomena are not amenable to experimental analysis, and in such cases, scientific interpretation is our best alternative. (By scientific interpretation, I mean a plausible explanation of available data only in terms of principles that have been derived from an independent experimental analysis.) Most of what we call scientific fact is just an interpretation in this sense. Almost all of our understanding of evolutionary biology, astronomy, and geology is an interpretation, and most of Skinner's analyses of human behavior are interpretive as well.

Skinner expected the front of experimental analysis to advance and gradually replace his interpretations, and any such advance is welcome. But the histories of human subjects and the complexity of human behavior remain nearly as intractable as in Skinner's day. Despite advances in technology, much human behavior remains out of reach of direct observation, regardless of one's theoretical orientation. It is often complex and changes rapidly over the course of milliseconds. Consider the behavior of a person reading a novel. The observable portion of the person's behavior is a trivial fraction of the elements that comprise "understanding and responding to what is written." The cascades of discriminative responding of interest cannot be measured, at least with our current technology. Note also that an experimental analysis requires the measurement and control of all relevant variables in a domain, not just those that are convenient. Research that fails to control relevant variables will not advance our understanding.

*The field of behavior analysis is growing at a rapid rate and it is unclear how familiar newcomers to the field are with Skinner's 1935 paper. What would you say to any of these individuals regarding the importance of understanding these fundamental principles laid out by Skinner?*

A mechanic could have a workshop full of tools, but if he only knows how to use the screwdriver, he will only be able to fix things held together by screws. Likewise a behavior analyst might be able to do useful work with a subset of behavioral skills, but the more completely one understands fundamental concepts like Skinner's concept of the operant, the less likely one will encounter a problem that cannot be analyzed effectively. As long as one travels a well-worn path and studies familiar response classes, one is unlikely to encounter problems, but if one wants to study something new, it would be a mistake to ignore the methodological precepts in Skinner's paper. If Chomsky had done so, he would have avoided a half-century of misguided theorizing. ■



# Zombies and Clever Ways to Avoid Them



**Darlene E. Crone-Todd, PhD**  
**Salem State University**  
**Salem, MA**

One genre in popular culture is the “zombie”, popularized in 20th and 21st century movies, television shows, novels, and graphic novels. In such popular culture, a zombie is said to be either a living individual, or reanimated from the dead, who can move through the environment, but cannot actually engage in rational thought. Also, the zombie feeds off of human flesh.

The origin of zombies comes from voodoo culture in Haiti, and later, New Orleans. Zombies were said to be created based on a curse placed on them. So, in other words, this was an aversive contingency placed upon the individual who was turned into a zombie. Once “zombification” occurred, then the zombie was to serve the other undead creatures according to the legend. Clearly there is not only an aversive consequence for whatever misdeed one engaged in that led to such consequences, but then there is a kind of response cost or overcorrection needed for eternity (or until the zombie disintegrates).

Over the years, as the legend evolved in modern culture, zombies began to have origins in viruses that were unleashed, and then are spread through being bitten by a zombie. In fact, in the *Walking Dead* series, everyone is already infected with a virus. So, once a character “dies”, they in fact will turn into a zombie because of the way the virus “reanimates” the characters upon “death”. Of course, this process can be hastened by being bitten by someone who is already a zombie. In this scenario, then, the key is to keep away from zombies and to avoid death. In other words, escape and avoidance conditioning are crucial if a character is to remain alive.

For the zombies, their systems operate such that they continue to decompose despite the fact that they continue to move about in time and space, and feed off of

humans. As such, the effects of feeding dissipate quickly, leading to an unconditioned establishing operation for more flesh. So, flesh for zombies is always an effective reinforcer, and there is no need to conduct preference assessments. There is very little evidence that feeding is an abolishing operation that lasts very long.

Of course, this then suggests that living humans have to stay ahead of the zombies in order to survive, which means that there are several forms of avoidance behavior that we see exemplified in the genre. For example, hiding out in buildings or cars, or running through fields, forests, or other such geographical areas. One clever way in which some humans in the *Walking Dead* managed to escape the detection of zombies has been to cover themselves in zombie guts. As terrible as this sounds (remember: it’s fiction), in fact, it is a great example of covering up one’s scent to avoid a predator. So, here we have a concurrent schedule: The immediate, aversive event of being covered in zombie guts with a delayed consequence of staying alive, versus being eaten right away. What would you choose?

As I put the finishing touches on this article, I would like to dedicate it to Scott Wilson, who played the veterinarian, Herschel Greene, on the *Walking Dead*. During a trip to Montreal in 2015, my husband and I had the distinct pleasure of a happy coincidence: We shared coffee and a discussion of popular culture and behavior analysis with him at the restaurant in our hotel, as he was there as part of the Montreal Comic Con. As we discussed the ways in which one might talk about zombies and other such genres, he very humbly asked if my writing could include a character such as Herschel. While I have written generally in this piece, it is our conversation from just over three years ago that informs this piece. I trust that both Herschel Greene and Scott Wilson are resting in peace. ■



B.F. Skinner