

Chapter X

Daniel E. Berlyne: The Conflict of Belief and Desire

Marissa E. Barnes
York University, Canada

SUMMARY

Berlyne was part of the North American neobehaviorist and experimentalist movement of the 1950s through the 1970s. He studied a diversity of topics: curiosity, play, humor, and aesthetics. Despite a breadth in topic his methods and theoretical commitments remained fixed. He retained a behaviorist-positivist approach to the study of human phenomena and he had a very specific belief system about science and behavior. Berlyne's collative theory of motivation developed out of comparative research on exploratory behavior and the search for a physiological mechanism (arousal) to explain motivated behavior. His theory and research in exploratory behavior provided the foundation for his experimental aesthetics. The purpose of this paper is to discuss the conflict between a belief in science yet a desire to study topics that were difficult to study scientifically.

DANIEL E. BERLYNE

Daniel E. Berlyne (1924-1976) was a motivational theorist. He was an active participant in the North American neobehaviorist and experimentalist movement from the 1950s through the 1970s. Throughout his career, Berlyne remained committed to the study of motivated behavior within psychology conceived of as "behavioral science" and from an explicitly adopted "psychobiological" perspective. His research and his theory were anchored to that which he believed could be verified scientifically. This scientific verification was achieved by observation of behavior, quantitative statistics, and legitimacy by use of the technology available to the experimentalists of his time.

Berlyne held his longest academic tenure as Professor of Psychology at the University of Toronto (1962-1976). During the 1970s, he developed a large-scale research program devoted to the study of aesthetics. The legacy left from this era secured Berlyne's position as one of the most frequently cited individuals in the psychology of the arts. This area is currently represented in the American Psychological Association (APA) by Division 10 (Society for the Psychology of Aesthetics, Creativity and the Arts). Berlyne's psychobiological aesthetic theory has in contemporary circles, been evaluated, disputed and re-constructed in a variety of forms. However, his contributions are still felt by contemporaries in the field. Berlyne achieved eminence and respect, both as scholar and researcher, despite his untimely death at 52.

Topics of Research

In the early part of his career, Berlyne was actively engaged in rat research associated with the Hullian neobehavioral movement of the 1950s. According to this movement, *drive* was the main motivational concept of inquiry. Despite the fact that his first publication "'Interest' as a Psychological Concept" (1949) deviated from the

typical neobehavioral publications by being a theoretical paper, most of his work in the early 1950s was characteristic of the dominant trends in learning and motivation theory. His research on attention was comparative and experimental, and in 1954, he proposed curiosity as a special kind of drive. Throughout the 1950s, most of Berlyne's research on exploratory behavior did conform to the prevalent drive-reduction theories of the time. Despite deviation from the typical S-R lexicon, the mechanisms by which he proposed the concept of curiosity to work were grounded in the theoretical premises of drive theory.

In contrast to his early research, towards the end of his career, Berlyne developed a research program devoted to the study of aesthetics. He coined this program "the new experimental aesthetics". The intention of this research was to pioneer a new experimental method for studying aesthetic behavior. Berlyne's last book, *Studies in the New Experimental Aesthetics: Steps toward an Objective Psychology of Aesthetic Appreciation* (1974), presents a series of experiments carried out at the University of Toronto in the 1970s by himself, his students, and colleagues. The research program led by Berlyne was Fechnerian-inspired; he hoped to build on the foundation laid down in Fechner's experimental aesthetics of 1876. Experimental aesthetics is typically cited as having emerged as a field of study with the classic golden section and preference research conducted by Fechner. Yet many of the founders such as Wundt, Fechner, Witmer, Külpe, and Titchener studied traditionally philosophical topics and did work in the spirit of experimental psychology that contributed to development of the field known as experimental aesthetics.

From a curiosity drive in rats to aesthetic responses in humans, one might ask: How and why did he move from comparative research in the beginning to arrive at the end of his career to studying why people prefer certain artistic encounters? The answer to this question found in his theory. Exploratory behavior, aesthetic behavior and the other phenomenon he studied could all be explained by his theory of "collative motivation".

Background Research on Berlyne

The focus of this paper stems from a larger historical-biographical research project on the life and career of Berlyne. At York University, I have access a collection of archival material related to and containing the work of Berlyne. This material includes: letters, academic correspondence, childhood memorabilia, published and unpublished work, and all of Berlyne's research articles and references. I have reviewed over 200 unpublished letters written to Berlyne's life-long friend Jack Goldberg, whom he remained in correspondence with from 1942 to 1952. In addition, I reviewed taped interviews conducted by John and Christine Furedy from 1977 into the 1980s. Lastly, I made extensive use an interview with Berlyne conducted by Roger Myers in 1973.

The primary focus of my research has been focused on a biographical and historical analysis of Berlyne. Examining both the historical antecedents and the context with in which he worked. However the focus of this paper is to impart a sense of the constraints placed on Berlyne's theorizing by virtue of his beliefs in what was (was not) considered inside the scope of the study of a psychological science. I will discuss Berlyne's theory and how his philosophy of science (his meta-science) influenced and shaped his theory and most importantly how it anchored him methodologically.

The Conflict: A Belief in Scientific Knowledge and the Desire to Understand?

The working assumption implicit within the scope of this paper is that Berlyne did ultimately have a *desire* to get at everyday understanding of the topics he studied. Specifically, to have a logical and reality-based understanding of the concept of interest, curiosity, or motivations to seek an object considered aesthetically pleasing. However, despite what I infer to be his desires, Berlyne was unable to get at this real world or practical application because he was locked in by his *beliefs*. Specifically, he was very explicit and definitive as to what was considered scientific knowledge and what the criteria for scientific progress entailed.

Berlyne explicitly avowed a commitment to the principles of behavior and learning theory, and considered psychology, a psychobiological and scientific discipline. With this commitment came an epistemological assumption that certain aspects of human experience were not subject to scientific study. Yet, it seems he wanted to study topics that typically fell outside of the scope of simple behavior. A focus on subject-matter such as, interest, curiosity, activities engaged in for their own sake, why people seek pleasure in certain art experiences over others; these are common of every-day experiences. However, how he studied these topics, are in most instances, far removed from lay association with such concepts. This lack of ecological validity can be understood as a consequence of the unfulfilled and undeveloped application of his research outside of the laboratory.

Art, interest, and humor are topics that have been primarily studied outside the realm of science (i.e. the study of the arts and the aesthetic has a long history as a philosophical discipline). Neither have these topics typically been the focus of the behaviorist's work. Aesthetics, interest, these are not phenomena that Berlyne believed to be *easily* subjected to the rigors of scientific method and inquiry. For example, Berlyne believed the concept of interest or thought held no independent or ontological status. Therefore, it was inferred from the observation of certain defined characteristic behaviors, such as exploratory-type behavior. Despite his topics of study and his very large aim to study scientifically that, which had typically been addressed otherwise, he was very locked in and rigid about how he studied.

He proposed unconventional and novel concepts (such as a "perceptual curiosity drive", the "collative properties of stimuli", and "arousal potential") to explain observable behavior. He studied a diversity of topics (ranging from the orienting response in animals to entertainment and humor). However, his work both theoretically and methodologically remained firmly dictated by his meta-science. These beliefs metaphorically created a theoretical and methodological prison and prevented Berlyne from exploring alternate "non-scientific" explanations and methods. Did this commitment to orthodox scientific principles and a sense of what was and amenable to proper scientific study debilitate his ability to truly get at what he was looking to understand? The central thesis of this paper is: Berlyne was theoretically and methodologically constrained by his metascience.

Early Intellectual Development: Origins of a Belief System

Daniel Ellis Berlyne was born on April 25, 1924 in Salford, a suburb of Manchester in England. At age 17 he went to study modern languages at Cambridge University. His second year was interrupted by military service, from 1942 to 1945. Upon return to

Cambridge in 1946, he decided to switch from modern languages to psychology. Berlyne's early grade school ideas about psychology were that it was a science of the Freudian genre. His interest in psychoanalytic theory persisted into his university years. During this time he believed "Freud was dealing with important questions... motivational questions". Furthermore, he believed that the neobehaviorists in America were using science to do this:

[T]his American group... the Yale group... who were doing animal experiments, were sympathetic in a critical way to Freudian psychology. They were doing rat experiments that purported to be about some of the same processes that Freud was talking about in the human being (Berlyne, 1973, p. 82).

Stemming from an interest in motivation, Berlyne was intrigued by the research and the type of psychology being practiced by the neobehaviorists. At this time Berlyne he conceded Freudian theory and psychoanalysis "weren't very scientific" and its statements "unverifiable" (Berlyne, 1973, p. 82). Therefore, he was excited that the neobehaviorists in America were using scientific methods to deal with these motivational questions.

After completing his BA in psychology Berlyne independently read on learning and behavior theory (e.g. Mowrer, Hull, and Miller). He believed that the behaviorists in America were onto something new and important. Berlyne (1973) believed that the learning theory researchers of the Yale-Hull-Mowrer variety had sensibly synthesized Hull and Freud, and developed a convincing theoretical system that was just about in the finishing stages. He believed there were just a few things, such as the topic of attention, interest and curiosity that had not been taken care of sufficiently.

Berlyne went to Yale to study with Hull. However, Hull was ailing and passed away in 1952. Berlyne was assigned to work with Carl Hovland, who became his thesis advisor (Irvin L. Child and Neal E. Miller served as the other committee members), and he received his PhD (1953) from Yale University. The title of his doctoral dissertation: "Some Aspects of Human Curiosity". Berlyne's beginnings in the psychological sciences were clearly influenced by Hull and the learning theory movement. Beyond youthful or naïve enchantment Berlyne still felt admiration for Hull's theoretical approach as late as 1975.

GENERAL THEORY OF COLLATIVE MOTIVATION

Berlyne's first book, *Conflict, Arousal and Curiosity* (1960), lays the foundation of his general theory of collative motivation. According to Berlyne (1960), *curiosity* is caused by various *conflicts* and the intervening variable mediating this relationship is *arousal*. Curiosity is observed as a form of exploratory behavior, and internally conceptualized as drive/arousal. Conflict, in the sense that Berlyne (1960) is using the term refers to the situation in which "two or more incompatible responses are aroused simultaneously in an organism" (p. 10). Arousal, according to Berlyne (1960) is a function of the reticular activating system (RAS), and is a preferable construct to use as opposed to drive. Berlyne stated that one of the working assumptions of Hullian drive theory is that general drive (*D*) can be clearly identified. As debated by the neobehaviorists of this time, *D* was not so easy to pin down. Therefore, arousal became Berlyne's central motivational concept. He believed it could be identified physiologically, and it was measurable. According to Berlyne's, 'arousal is synonymous with drive' conception and

consistent with Hull's drive-reduction theory of motivation, high arousal (drive) is aversive and is something to be reduced. Therefore, conflict, which is proposed arousal-inducing, needs resolution. This resolution is arousal-reduction, and this reduction is reinforcing.

In 1960, Berlyne described arousal in terms of *arousal jags*, which is Hullian inspired terminology. He discussed the state of boredom as drive inducing and proposed that contrary to intuition, the boredom drive works through *arousal-induction*. According to Berlyne the torments of boredom promote an increase in arousal level. After this increase of arousal occurs it is subsequently rewarded by its cancellation or reduction (Berlyne, 1960). By 1967 Berlyne changed his position on reinforcement and adopted an optimal level conception. According to this view, which had generally been accepted by his neobehavioral cohort, the organism seeks equilibrium and an optimum level of moderate arousal. Therefore, reinforcement could come in the form of an *arousal-boast* or *arousal-reduction*, dependent on the arousal level of the organism at the time of its encounter with the stimulus.

Berlyne's theory places emphasis on the stimulus side of the S-R sequence. Stimulus selection and the perception of stimulus objects are given the highest degree of focus in his theory. According to Berlyne each stimulus situation attains a measurable or determinable degree of arousal potential. According to Berlyne *arousal* refers to a neurophysiological concept, whereas as *arousal potential* is the aggregate of all the stimulus properties that increase arousal. Arousal potential includes psychophysical properties, previous associations, and *collation* of certain factors in the stimulus situation. According to Berlyne, arousal potential denotes something like "psychological strength" or the potential impact of the stimulus.

According to Berlyne, the impact of objects can be measured along three different dimensions: The *psychophysical dimension*, (e.g., proto-typical psychophysics experiment measuring an ability to discriminate between stimuli of varying tone, pitch, etc.). Psychophysical research has led the observation that people differ in perception and expressed preferences produced by objects of varying intensity, size, color, etc. According to Berlyne psychophysical data related to arousal confirms that brighter lights, louder sounds, and abruptly changing stimuli are most arousing. The *ecological dimension*, refer to stimuli that are associated with noxious or beneficial conditions. Lastly, and most significant, according to Berlyne are the *collative variables*. The most commonly referred to are, *novelty, surprisingness, change, complexity, uncertainty, conflict, and incongruity*.

Collative variables were proposed in 1960 by Berlyne in order to group together the many variables influencing the motivational impact of a given stimulus pattern. He referred to them collectively as collative variables. He suggested in the stimulus selection process or in assessing for example, "how surprising or novel" a pattern is, the organism collates (compares and gathers) the properties of stimuli. Perhaps the best way to give a flavor for these concepts and describe the relations is to quote Berlyne (1960). The concepts and relations are described as follows:

[B]etween a present stimulus and stimuli that have been experienced (novelty and change), between one element of a pattern and other elements that accompany it (complexity), between simultaneously aroused responses (conflict), between stimuli and expectations (surprisingness), or between simultaneously aroused expectations (uncertainty) (Berlyne, 1960, p. 44).

To give these concepts some measurement legitimacy Berlyne appealed to quantification. Variables, such as novelty, were more straightforward due to a temporal basis. The variable uncertainty is of particular interest. In order to attempt to quantify this factor, Berlyne appealed to what is now referred to as *information theory* proposed by Shannon & Weaver (1949). This quantitative theory of communication refers to communication in terms of probabilities for information transmission, signals, channels, bits of information, and input-output.

To explain the theory Berlyne (1960) referred to a telephone line with an observer at the receiving end. According to Berlyne (1960) the observer is waiting at the receiving end of a telephone line for a signal to reach him, before it arrives, he has a list of classes to which the signal could belong, and he knows the probability of its belonging to each. According to information theory we can calculate a quantity called *entropy* (H), also referred to as *uncertainty*. The observer will have a degree of uncertainty about the received signal at the end of the channel and a separate calculated value for the degree of uncertainty at the input end. Berlyne (1960) applied this idea of calculating input and output uncertainty values to his variables. He suggested in psychology we have two information spaces analogous to input and output: the *Stimulus Space* and *Response Space* (S-R). To calculate uncertainty or apply information theory there must be a list of potential S-R relations determined and probabilities assigned to each potential S-R occurrence (Berlyne, 1963).

The theoretical structure was in place: a physiological measure of motivation (arousal), a psychological assessment of the predicted impact of the various stimuli on the organisms' arousal levels (arousal potential), the motivating properties of the stimuli (the collative variables), and a useful means by which to quantify these variables (information theory). In the early part of his career and in the last few chapters of his first book, Berlyne endeavored to apply this theory beyond the orienting reflex or exploration in animals. He moved into the world of human experience: of humor and art (aesthetic behavior), and of knowledge acquisition and directed thinking (epistemic behavior).

From Exploratory Responses to the Study of Aesthetic Ones

The most well-known extension of Berlyne's collative motivation was into a comprehensive theory of aesthetics. Aesthetic behavior in Berlyne's theoretical framework is an intrinsically motivated form of exploratory behavior. According to Berlyne, if seeking encounters with aesthetic stimuli and if treating it as a form of exploration the aesthetic response can be examined in relation to the same determining concepts, specifically collative factors and arousal.

In *Psychobiology and Aesthetics*, Berlyne (1971) detailed the sources of theoretical influence on his views of the aesthetics process, the role of physiology in aesthetic pleasures, and how aesthetics can be studied empirically. According to Berlyne the motivating effects of the art work resided in the collative properties and the impact of these properties on arousal. On a physiological level, Berlyne retained the use of his explanatory construct of arousal and continued to measure this concept physiologically by use of such things as the Galvanic Skin Reactance (GSR).

Proposals about arousal, its measurement, and the mechanisms governing it, were continually evolving and being debated. However despite unstable grounds, Berlyne (1971) appealed to a neurophysiological distinction between a primary reward system

and primary pain center to generate a modified version of the *Inverted U* or *Wundt's curve*. Originally, Wundt's curve was used to depict a relationship where an optimal level of such things as expressed pleasantness is attained at an intermediate level. According to this conception if stimulus intensity (e.g., pitch of musical note) is plotted along the X-axis and categorized as low, medium, high, and if the Y-axis increases in values of expressed pleasantness, the highest value of expressed pleasantness is at the medium level of stimulus intensity (e.g. medium pitch). This optimal level found at the intermediate level is contrasted to the expression of no pleasantness with extremely low levels of pitch or high levels of stimulus intensity. Berlyne appealed to this intermediate-optimal-level of stimulus encounter to explain his theory. However, Berlyne's use of Wundt's curve to explain pleasantness was altered: *arousal potential* was plotted along the X-axis and the Y-axis was termed at the high ends "positive hedonic value", at baseline "indifference", and below baseline "negative hedonic value".

According to Berlyne (1971), arousal potential (i.e., psychophysical, ecological and collative properties) and its relationship to hedonic value could be determined by taking "the algebraic sum of two curves" which was "hypothetical curves representing a degree of activity of the primary reward system and the aversion system as a function of arousal potential" (Berlyne, 1971, pp. 88-89). He generated this curve by combining the above mentioned systems and mechanisms into exponential equations: one for pleasure, one for pain, one positive in its effects and one negative. According to Walker (1980) this turned out to be an unsatisfactory explanation, a flawed mathematical solution of a two-process function, and an inadequate treatment of the neurophysiological primary pleasure and pain systems. Despite continued debate Berlyne maintained that there was an optimal level of arousal potential. With a horizontal axis representing arousal potential, and a vertical axis representing hedonic value attained from behavioral measures and verbal reports, he continued to measure preferences and present graphic legitimacy to his theory.

The idea of measuring quantitatively the collative variables was developed further. Berlyne argued it was crucial to find a means to measure the motivating (collative) properties of the art object. With the continued reliance on information theory (the uncertainty formula), Berlyne moved to validate his proposed measures of the collative properties. According to Berlyne location in a work of art whether temporal or spatial could be allotted uncertainty values. For example, in music each note possesses one set of a number of alternative pitches, timbres, durations, and intensities. Berlyne continued to apply information theory to the subjective perceptual preference reports about the collative variables. He attempted to provide logic of how it could be used. However, the practical application of this particular type of theoretical formulation to his theory was a formidable task. With the completion of *Psychobiology and Aesthetics* (1971), Berlyne had a theoretical package: a physiological correlate (arousal), a new factor into the study of the aesthetic object (collative properties), and a language to explain the perception of art (information-theory). With these theoretical assumptions in place, Berlyne proceeded to pioneer the new experimental aesthetics.

THE 'NEW EXPERIMENTAL' AESTHETICS

In accord with Fechner's emphasis on collecting concrete facts about aesthetics, Berlyne differentiated between *empirical aesthetics* referred to as "from below", in

contrast to *speculative aesthetics* referred to as “from above” (Berlyne, 1971, p. 11). He described speculative aesthetics as relying “heavily on deduction - from definitions of concepts, from self evident principles, from generally accepted propositions, from an author’s own beliefs, intuitions, and experience” (Berlyne, 1974, p. 2). Berlyne’s approach to psychological aesthetics was explicitly stated experimental. Berlyne contended that “Experimental aesthetics has had a long but not particularly distinguished history” (Berlyne, 1974, p. 5). His aim was to bring the field up-to-date.

A typical experiment involved subjects being presented with stimulus material, for example visual patterns on cards or sound sequences heard through headphones. These stimuli had been constructed to vary along dimensions (e.g., complexity). In this case, an item of high complexity would contain more elements (e.g., 36 per pattern), whereas an item of low complexity would contain less (e.g., 9 per pattern). After being presented with the stimuli, subjects rated such things as pleasingness or interestingness on a seven-point scale. During these procedures, a GSR electrode was attached to the subjects’ left hand to monitor and measure their physiological response relative to the presentation of different stimuli. Projects typically consisted of many experiments. In some experiments, after the initial stimuli presentation, subjects were given a choice of which they would prefer to see or hear again. For example, subjects listened to 10 seconds of one sound sequence followed by 10 seconds of a second sound sequence and then indicated which they would like to hear again. In other portions of the experiment, subjects were timed to see how long they would choose to view a pattern when given free time.

Berlyne’s (1974) research was primarily done with synthetic art objects in an experimental setting. He believed this was the first place to begin. Although the goal was ultimately to make statements about real-world artistic pieces most of his research remained laboratory-based. The notion of using measurement and experimentation as a means of advancing psychology as a science is attributable to Berlyne’s belief that science and experimentation were the cornerstones to higher level explanation. Therefore studying simple processes and uncovering the primary laws governing aesthetic reactions could, according to Berlyne, carve out “new frontiers” in aesthetics research. The reductionism here is noted: Berlyne clearly believed this approach held the most promise for progress in the human sciences. Berlyne’s hopes for his research program were large. He aimed to—as he had previously done by using his comparative research on curiosity in rats to explain aesthetics—extend his aesthetics experimental research beyond aesthetic preferences in the laboratory and into the real world.

CONCLUSIONS

Why Berlyne’s career, his theories, and his topics of inquiry changed and unfolded as they did have been explained in a number of different ways. Following Berlyne’s death, a number of his colleagues who respected and followed his work wrote expositions on his intellectual style, theoretical contributions and commemorated his career. Celebrations of this kind are not uncommon shortly after an individual’s death. Reflection on Berlyne’s legacy, however, has gone well beyond the norm. For example, numerous articles, chapters, a book in his honor, the publication of a commemorative symposium held at the APA convention in 1977. These are just some among much recognition found throughout the literature in the thirty years since his death.

Berlyne's quest was to answer big questions, specifically human motivation, curiosity, interest and pleasure in the arts. Thus, despite a critique of the theory and the methods utilized to study these topics, there is no doubt he was asking important questions. However, Berlyne insisted that to generate any scientifically meaningful findings, one must start at the basic level with a study of simple processes and the principles derived from this research. This position kept him locked into a narrow perspective about how to study his topics of interest. Thus, after a review of his statements and the theoretical legitimacy upon which he based his research, I believe he spent a great deal of time attempting to explain and legitimize the activities in which he engaged. Thus, the aim became scientific validity, not real world comprehensibility. His belief that scientific advancement held promise for true progress can nonetheless be cited as typical of the scientific zeitgeist that was common in experimental psychology among scientists of his time. However, this noted, I do not believe his way of conceiving his topics of study were intuitively driven. So does this constitute as a conflict?

I believe there must have been some conflict residing in Berlyne, latent or otherwise. I conclude that in the case of the conflict between his belief system and his desire to talk about real world experience that his belief system won. Specifically, his belief in science won out over his desire to have a real world understanding of the concepts he studied. Perhaps the conflict between "beliefs and desires" is better thought of as one that resides in me. The struggle may reside in my experience of the material and in my attempt to maintain historical sensibilities or transcend my own "personal horizons" After review of the material perhaps my interpretation that there existed a conflict within Berlyne is a stretch, and arguably a case of mere inference. Nevertheless, I find a sense of comfort in this explanation, as it allows me to project onto him, the explanations and answers to the issues that have pressed as I attempt to understand conceptually his theory. In the end it is neither here nor there. There are certain things that are true. Berlyne was an important figure in the history of experimental psychology and in particular an important contributor to experimental aesthetics. He was also respected and admired by those who knew him well, and by his colleagues with whom he worked. And for this reasons his activities merit historical analysis.

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