1987

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Recommended Citation

Leary, David E. "From Act Psychology to Problematic Functionalism: The Place of Egon Brunswik in the History of Psychology." *Psychology in Twentieth-Century Thought and Society*. Ed. Mitchell G. Ash and William Ray Woodward. Cambridge: Cambridge UP, 1987. 115-42. Print.

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FROM ACT PSYCHOLOGY TO PROBABILISTIC FUNCTIONALISM: THE PLACE OF EGON BRUNSWIK IN THE HISTORY OF PSYCHOLOGY*

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In the coming years, Egon Brunswik will hold an ever increasingly significant and important position in the history of psychology.
(from Edward C. Tolman's eulogy, 1956)

Despite Tolman's prediction, Egon Brunswik's place in the history of psychology has yet to be firmly established. Although his name and his concepts are frequently invoked, they are rarely used in defense of positions that he would have recognized as his own. And although most contemporary psychologists have failed to comprehend either the details or the underlying rationale of his psychological theory, historians of psychology have done even less to clarify the context, development, and import of his life and work.[1]

This neglect is unfortunate. Brunswik deserves much greater attention, not only because he was one of the major twentieth-century theorists on the psychology of perception, or because he was unusually prescient about later developments in psychology, but because his life and work constitute an extremely useful case history for the study of a variety of

* This chapter is based on a much larger study of Egon Brunswik's life and work, which was partially supported by grants from the History of Psychology Foundation and the National Science Foundation. Different versions have been presented to the American Psychological Association, the Department of Psychology at the University of California at Berkeley, and Cheiron: The International Society for the History of the Behavioral and Social Sciences. I thank Kenneth R. Hammond for the invitation that initiated this research project; Marion White McPherson, John Popplestone, and John Miller of the Archives of the History of American Psychology, Akron, Ohio, for their help in locating materials relevant to this project; and the many former colleagues and students of Brunswik who shared letters, lecture notes, and memories of Brunswik. I also thank David Devonis for his assistance in drafting the two diagrams used in this chapter. I dedicate this essay to Leonard Krieger, in gratitude for his guidance of my first attempts to understand the German-language psychology of the past.

critical historical issues, including topics of interest to both intellectual and social historians.

My primary concern in this chapter will be the conceptual and methodological development of Brunswik's psychology over the course of his career and in the context of his migration from Vienna to Berkeley. Without discussing the individual doctrines of his psychological system in extensive detail, I will describe its basic foundations and the historical sequence by which it was constructed. In doing so, I will show how Brunswik's psychology was based on a very unusual blending of intellectual and scientific traditions.

In addition to reviewing the foundations and historical development of Brunswik's psychology, I will also review its historical impact and consider why it has not been more influential. In the course of this analysis I will discuss some factors intrinsic to his psychology, the significance of his migration from Europe to the United States, and the means by which he tried to disseminate his ideas. Together with the preceding analysis of his psychology, these considerations should help us understand why Brunswik's legacy remains undefined over thirty years after Tolman's eulogistic prediction.

AN OVERVIEW OF BRUNSWIK'S CAREER

Egon Brunswik was born in Budapest on March 18, 1903. From the age of eight he was educated in the best schools in Vienna. Then, in 1923, after two years as an engineering student, he transferred to the University of Vienna where he began to study psychology under Karl Bühler. At the time Bühler was one of the foremost psychologists in the world. In the exciting atmosphere of Bühler's Psychological Institute, Brunswik was immediately swept into his newfound discipline and became an active participant in Bühler's famous Wednesday evening discussion group.

As if this were not stimulation enough, Brunswik was soon a frequent participant in a Thursday evening discussion group held by Professor Moritz Schlick. During the years of Brunswik's participation this group was the seedbed from which the Vienna Circle of logical positivists emerged, and for the rest of his career Brunswik maintained personal, professional, and intellectual ties with the logical positivists and with the Unity of Science Movement that grew out of logical positivism. So from the very beginning of his career, we can see the formation of distinctive philosophical as well as psychological interests. The integration of these interests became an implicit goal of Brunswik's lifework.

Brunswik received his PhD in psychology in 1927, and he immediately became an assistant in Bühler's Institute. For the next seven years, with the exception of a year spent teaching in Ankara, Turkey, Brunswik directed research at the Psychological Institute and continued his own

research in the area of perception. In 1934 he published a major book, *Wahrnehmung und Gegenstandswelt,* which was based on his research of the preceding seven years. At the same time he became an associate professor, and soon thereafter he was invited by Edward C. Tolman to spend the 1935–36 academic year as a visiting lecturer and research fellow at the University of California, Berkeley. This invitation came as the result of a sabbatical that Tolman spent in Vienna in 1933–34. During this sabbatical he and Brunswik discovered that their psychological ideas were quite compatible and even complementary – so much so that the 47-year-old Tolman and 30-year-old Brunswik had co-authored an important theoretical article entitled "The Organism and the Causal Texture of the Environment."[2]

Brunswik's one-year stay in Berkeley was apparently mutually satisfactory, for in 1937, after an intervening year in Vienna, Brunswik returned to Berkeley as an assistant professor. He remained at Berkeley, advancing through the academic ranks, until his untimely death in 1955. Thus his career at Berkeley coincided almost exactly with the classical period in that department's history. During this time Brunswik was widely acknowledged to be, in essence, the department's intellectual conscience. His deep scholarship and meticulous research provided an exacting model of intellectual and methodological integrity for several generations of students and faculty.

THE FOURFOLD BASIS OF BRUNSWIK'S PSYCHOLOGY

This brief chronology has alluded to three primary bases of Brunswik's psychology, namely, the European functionalist tradition, represented by Bühler; the logical positivist movement, generated by and around Schlick; and American neo-behaviorism, as set forth by Tolman. The second and third of these bases – the positivist and behaviorist traditions – served to modify and extend the first. In turn, the psychology constructed on all three of these bases was extended and modified during Brunswik's years in the United States by a fourth and final tradition – the Anglo-American statistical tradition. As embodied in a succession of research assistants, such as Rheem Jarrett and Robert Rollin, this tradition helped Brunswik articulate a more sophisticated methodology for his emerging psychological system. With the elaboration of this methodology, Brunswik's psychology reached its mature form in the decade before his death.

The most important factor in the development of Brunswik's psychology was clearly the first of the four traditions I have pointed out – the European functionalist tradition as advanced by Karl Bühler and amended, as we will see, under the influence of Fritz Heider.

The ancestry of Bühler's psychology extended back through Oswald

Külpe, his mentor at Würzburg, to Franz Brentano, the founder of so-called act psychology. The fundamental postulate of Brentano's psychology is well known, even if the scope of its impact is not. The basic fact about psychological activities, according to Brentano, is that they always include a reference to some object. Consciousness, to take the most general case, is always consciousness *of something.* The practical result of this basic postulate was the dissolution of the philosophically worrisome dualism of subject and object, or knower and known. Külpe, Bühler and others accepted this postulate as a basic statement of a functional, or relational, theory of mind.[3]

Bühler's contribution consisted in pointing out and providing experimental corroboration of the fact that the fundamental unity of subject and object is not so definitive that each and every aspect of the object-world is related to one and only one psychic experience. Quite the contrary, in his groundbreaking studies in Gestalt psychology, he showed that the relationship between particular aspects of the object-world (sensations) and the experiential awareness of the subject (perception) is *fundamentally ambiguous.* Any given sensory stimulus, he showed, will be perceived differently when placed against a different contextual background.[4] Furthermore, Bühler found that the same principle could be applied in the study of language: no word has a single fixed meaning; rather, all words receive their meaning from the sentence and paragraph in which they are embedded. Any given word can mean several or more things, depending on the context in which it is uttered. Thus, the hearer of language must interpret – must infer the probable meaning of a word – based on the word's relation to its linguistic setting. This interpretation by the hearer is, of course, usually unconscious.

Over several decades, based on such research, Bühler formulated his well-known principle of "representation" – a principle he applied to all psychological phenomena, but most explicitly to language. Words, Bühler maintained, represent things or thoughts; they are not the things or thoughts themselves. Just as words can have different meanings and thus represent different objects, so too can objects be represented by different words. There is, in other words, no invariant one-to-one relationship between representations or signs (whether these be perceptual cues or words) and the things they represent.[5]

This was the state of affairs when Brunswik became Bühler's student in 1923. He soon began to follow up on Bühler's previous work on perception, and in particular on perceptual constancy. The influence of Bühler on Brunswik was profound and lasting. Between 1927 and 1929 Brunswik confirmed and extended Bühler's previous research, showing that perception is not a simple function of sensation, that there are fundamental ambiguities in stimulus information, and that the perceiver can and usually does learn to resolve most of these ambiguities in a fairly

stable and reliable fashion. As a basic premise in all this work, Brunswik accepted Bühler's notion of perception as a subject-object relationship.[6]

Then, in 1929, Brunswik read Fritz Heider's paper on "Ding und Medium," and his thinking took a significant step forward. Heider, as a student of Alexius Meinong, was a member of the same functionalist tradition extending back to Brentano.[7] Not surprisingly, his article corroborated the relational framework Brunswik had inherited from Bühler. However, it also directed Brunswik's attention more forcefully toward the *object* side of the subject-object continuum. It did so by pointing out that most objects are not in immediate contact with the subject; rather, they are separated from the subject by a "medium" through which perception has to be *achieved.* The real issue for the psychology of perception, Brunswik came to see, was how the subject could use "proximal" (immediate) sensory cues to infer the nature of the "distal" (distant) objects that these cues represent. From this point on, Brunswik referred to his psychology as a "psychology in terms of the object." By this he meant that it was the task of psychology to determine how and to what degree individuals establish veridical contact with the world of objects. In his subsequent work, Brunswik understood proximal sensations (stimuli impinging directly on the sense organs) as representations of certain aspects of the distal object world, and he sought to discover how it is that perceivers achieve perceptions of objects on the basis of these representative sensory cues.[8]

At this point in the development of his psychological system, Brunswik's affiliation with the logical positivist group had a significant impact on his work. The impact was somewhat paradoxical. To date he had accepted the general conceptual framework of the European functionalist tradition and had begun to articulate his own distinctive version of functionalist theory, but he had not yet been converted to the probabilist assumptions that were to characterize his mature psychology. He came to accept these assumptions – and here is the paradox – through his allegiance to the logical positivist movement, and, specifically, as a result of a grave challenge posed by this movement to his Bühlerian heritage.

To understand this, we must recall that one of the major doctrines of the Vienna Circle was a theory of meaning and truth that was based on the contention that scientific language should and could be reducible to invariant sense-data referents.[9] Each term of scientific discourse, they claimed, must have one and only one sense datum (or set of sense data) as a referent. The problem was that Brunswik had corroborated Bühler's finding that the relationship between sense data and their objects – or between words and their referents – is fundamentally ambiguous, that is, uncertain. Not surprisingly, this contradiction between the epistemological premises of the Vienna Circle and the empirical results of his own experiments created an intellectual crisis for Brunswik, who was equally

attracted to both of the ventures – philosophical and psychological – in which he was a privileged participant.

Brunswik resolved this tension through the discovery of the work of Hans Reichenbach, the leader of the Berlin school of logical positivists, who proposed a probabilistic theory of human knowledge in opposition to the Vienna Circle's stipulative and nomothetic approach.[10] This theory allowed Brunswik to resolve the fundamental conflict between his psychological *findings* and his desire to achieve a philosophically sound psychological *theory.* Utilizing Reichenbach's argument that all human knowledge is probabilistic, Brunswik was able to rationalize the ambiguous relationship between sensory cues and their objective referents by speaking of this relationship as probabilistic in nature. In principle, he was able to argue, objects can be perceived and therefore known only probabilistically. There is no one-to-one relationship between sense data and the objective world, nor can there be a one-to-one relationship between sense data and language, as the Vienna Circle claimed at that time.

Because Reichenbach was so widely respected among members of the Vienna Circle, Brunswik was thus able to maintain his allegiance to the general logical positivist movement while also remaining true to the premises and results of his psychological research. At the same time, the self-conscious designation of functional relations as probabilistic *in principle* – and not simply in relation to our imperfect means of knowing about such relations – constituted a major step towards his eventual system of "probabilistic functionalism."

The next state in the development of Brunswik's psychology occurred under the influence of the American behaviorist Edward C. Tolman, who corroborated the logical positivist insistence on objectivistic methodology, and particularly on verifiable, physicalistic measurements. This insistence led Brunswik – ironically, in view of Tolman's own use of "intervening variables" – to begin thinking in terms of a "psychology without an organism." As a result, the subjective pole in the functional relationship between the subject and object receded from Brunswik's psychology for more than a decade.[11]

Tolman also stimulated Brunswik to broaden his psychological system to include behavioral as well as perceptual events. In this regard Brunswik had an equally important reciprocal influence on Tolman, who simultaneously expanded the scope of his psychological metatheory to treat sensation and perception more specifically than before. These mutual influences were first explicated in their classic article on "The Organism and the Causal Texture of the Environment."

At the beginning of this article Tolman and Brunswik noted that they had composed their joint publication because they discovered that "our previous separate investigations had led us quite independently of one

another to a common point of view as to the general nature of psychology." Indeed, the parallels in their "common point of view" were remarkable. These resulted, they said, from a shared vision of psychology as "primarily concerned with the methods of response of the organism to two characteristic features of the environment" – first, that the environment is a "causal texture" in which different events are regularly (but not invariably) linked with one another and, second, that these "causal couplings," because they are not absolutely invariant, are in any given instance "to some degree equivocal" or uncertain. The first characteristic, the regular linkages between different environmental events, had led each of them to the conclusion that certain events can serve as "signs" (Tolman) or "cues" (Brunswik) or "local representatives" (Tolman and Brunswik) from which other events or entities or goal states could be inferred and responded to, either behaviorally or perceptually. The second characteristic, that "local representatives" are "not connected in simply one-one univocal ... fashion" with these represented events, entities, and goal states, had led them to emphasize the significance of the "differing frequencies" – the relative probabilities – that characterize these relations and, therefore, characterize the "attainment" of behavioral "ends" (Tolman) and of perceptual "objects" (Brunswik).[12]

In other words, Tolman and Brunswik had independently arrived at the conviction that organisms operate on the basis of "hypotheses" that have "only a certain probability of being valid." Whether it is a rat trying to reach the food chamber of a T-maze (Tolman) or a human being trying to estimate the actual size of a distant object (Brunswik), the organism acts to achieve its distant goals by means of the immediate "signs" or "cues" at its disposal, and it continually adjusts its assumptions about the referents of these "local representives" on the basis of ongoing experience. The organism's task, Tolman and Brunswik said, "is to correct whatever hypotheses it brings with it to fit the real probabilities of the actually presented setup."[13]

At this point two diagrams will help clarify and summarize the basic structure of Brunswik's perceptual theory and the expanded metapsychology that he produced together with Tolman. Under the impact of Heider's notion of mediated perception, Brunswik had developed what he called a "lens model" of perception (see Figure 5-1). The illustration of this model crystallizes the core of Brunswik's perceptual theory.[14]

According to Brunswik's lens model, the distal object occasions various proximal sensations in the peripheral senses of the organism. These peripheral senses serve as a "lens" that collects the various cues and directs them to a central "focal point" where they are selectively utilized by the organism in the production of a "central response." In the typical Brunswikian experiment, this response was a visual perception of an object's size, objectively measured by the subject's verbal estimate of the

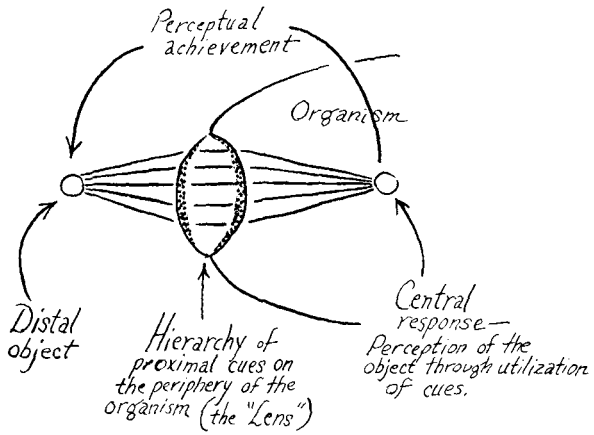

Figure 5-1. Bunswik's lens model of perception.

object's actual size. The degree of veridical accuracy of a given perception was, for Brunswik, the measure of its achievement, or what he later called its "functional validity."

The organism's perceptual achievements, according to Brunswik, depend on the selective use of an array of cues. In the course of experience, the organism learns that some cues are more likely than others to represent a given dimension of the external world. As a result, the organism places greater trust in these cues. (In Brunswik's later terminology, it comes to realize that these cues have greater "ecological validity," and it therefore gives them preeminence in its "hierarchy of cues.") However, since the relation between the organism and its environment is never completely static, the organism's expectations about the validity of cues are never absolutely certain and are continually subject to revision.

An expanded lens model can be used to represent the broadening of Brunswik's psychology that took place in collaboration with Tolman (see Figure 5-2). The extended portion of this model is a symmetrical, mirror image of the earlier model. On the new "motor" side of the diagram, an array of habits – alternate behaviors leading to any given goal – take the place of the hierarchy of cues on the sensory side of the model. Each potential behavior – each of the means at the organism's disposal – has a differential probability of leading to the intended goal. As in perception, the organism's behavioral responses are guided by hypotheses regarding the probable success of each of these alternative means. And again, the achievement of the organism's ends – for instance, the reaching of a food chamber in a T-maze – can be objectively measured. For the phenomena

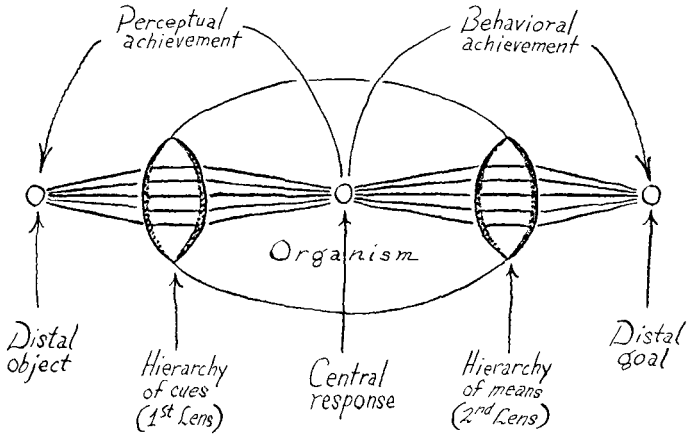

Figure 5-2. Extension of the lens model to behavior.

represented by this side of the diagram, Tolman's research on purposive behavior served as the prototypic illustration.[15]

Although their own investigations up to the mid-1930s had focused on a more restricted set of topics, Brunswik and Tolman concluded their classic article with the suggestion that

> *all* the problems of psychology — not only those of visual perception and of learning — but all the more general problems of instinct, insight, learning, intelligence, motivation, personality, and emotion all center around this one general feature of the given organism's abilities and tendencies for adjusting to these actual causal textures — these actual probabilities as to causal couplings.[16]

Thus, by the time he came to the United States in 1935, Brunswik had developed a distinctive theory of perception and had extended that theory, in collaboration with Tolman, to cover – at least in principle – the entire domain of psychology. But a theory, however comprehensive in scope, is one thing; a fully articulated psychology with an appropriate methodology and an adequate stock of data is something else. Up to this point Brunswik's research had concentrated almost exclusively on selected topics in the psychology of perception, and in this research he had utilized relatively unsophisticated modes of quantitative analysis. For instance, he used simple ratios, comparing estimated to actual object size, as a gauge of the accuracy of perception. This was an effective way to describe the phenomena of size constancy, which was the typical exper-

imental problem that he and his students studied, but in the United States Brunswik was soon exposed to much more powerful ways of interpreting his data. In good part through his interaction with a series of graduate assistants, Brunswik came to realize that his psychological theory could be expressed and tested much more persuasively through the language and use of correlation statistics.

Although the addition of statistical means of analysis may seem a trivial amendment of Brunswik's psychology, it was actually quite significant, for in matching his theoretical commitment to probabilism with a methodological commitment to probability-based analytical techniques, Brunswik completed the interlacing of a conceptual and methodological foundation on which he was now prepared to erect his mature system of probabilistic functionalism.

BRUNSWIK'S PROBABILISTIC FUNCTIONALISM

During his one-year stay in Berkeley in 1935–36, prior to his permanent move to the United States in 1937, Brunswik started to redeem his claim that behavioral as well as perceptual phenomena are probabilistic in nature. In a study of "Probability as a Determiner of Rat Behavior," Brunswik investigated behavioral-response learning in the context of varying probabilities of reward (or "goal achievement"), a context which as he said was more representative of "the natural environment of a living being" than the all-or-none reward schedules used in previous behavioral studies. When it was published in 1939, this study was noteworthy for its use of partial reinforcement and for being the first publication in which Brunswik applied correlation statistics.[17]

From this point on, Brunswik's distinctive approach to the study and understanding of psychological phenomena – and his realization of its far-reaching implications – unfolded at a rapid pace. Returning to the area of perception, he extended his use of correlation statistics in "Thing Constancy as Measured by Correlation Coefficients," published in 1940. This study advanced Brunswik's investigation of size constancy, demonstrating through a complex set of correlations that perceivers utilize sensory cues of relatively low degrees of reliability – having nowhere near one-to-one correspondence to reality – in the process of attaining remarkably high degrees of veridical perception (or "object achievement"). In other words, this study showed that the overarching functional relation between subject and object – the correlation between "central responses" and "distal objects" – was much greater than the correlation between "mediating proximal cues" and "distal objects." The clear implication was that perceivers make inferences about the object-world that go beyond the information provided by cues apparently on the basis of past experience with similarly ambiguous cues and distant objects.[18]

As important as this study was, it still relied on traditional experimental procedures. However, even before this study was in print, Brunswik realized that his psychological premises demanded a much more radical departure from traditional modes of investigation, and he set about designing a study of perceptual size constancy that would take place in a natural environment rather than a laboratory. Furthermore, instead of randomly varying subjects in this study, as was and still remains the standard procedure in experimental psychology, Brunswik opted to investigate the perceptions of only one individual across a variety of real-life situations, allowing the objects to be perceived to be randomly selected according to their chance occurrence in the subject's perceptual field at any given time.[19]

Clearly this was a radically new way of doing psychological research, and not surprisingly it aroused attention and debate among psychologists. In fact, as a result of a major address by Brunswik at the Sixth International Congress for the Unity of Science in 1941, the debate was under way long before he published his monograph-length report on this project in 1944. The original antagonists in this debate were Clark Hull and Kurt Lewin, Brunswik's distinguished co-symposiasts at the Congress. Their critical comments, published in 1943 along with Brunswik's address, started a controversy that continued throughout the final decade of Brunswik's life.[20]

We are already familiar with the fundamental notions underlying the position Brunswik advocated in his address, which he titled "Organismic Achievement and Environmental Probability." As we have seen, these notions were rooted deeply in Brunswik's intellectual history, but he expressed them now more forcefully than ever before. As in his classic article with Tolman, Brunswik emphasized that organismic achievement involves either the perception of distal objects or the attaining of behavioral goals, that the cues and means that facilitate perceptual and behavioral achievements are always "ambiguous," and that therefore the achievement of veridical perception and of behavioral goals is always to a certain degree probabilistic. Furthermore, Brunswik argued that such achievements are the result of the organism's "focusing" on distal objects and goals, albeit through the media of cues and means. This focusing of the organism on the ends of psychological processes – on distal objects and goals rather than on proximal cues and means – warrants, Brunswik said, a "molar" approach to psychological investigation. In other words, the primary concern of a functionalist psychology should be the correlation of the organism's perceptions and behaviors with their targeted objects and objectives, not the designation of less probable and replaceable "molecular" events.

To this molar functionalism Brunswik now added a thoroughgoing statistical probabilism. Psychology, he said,

> as long as it wishes to deal with the vitally relevant molar aspects of adjustment and achievement, has to become statistical throughout, instead of being statistical where it seems hopeless to be otherwise, and cherishing the nomothetic ideals of traditional experimental psychology as far as relationships between geographic stimulus variables and response variables are concerned.[21]

This was the challenge to which Brunswik's critics responded most vociferously. They realized that granting Brunswik's contentions would necessitate "the extension of such an instrument as correlation statistics from individual differences to stimulus-response relationships," the "representative sampling" of both perceptual objects and behavioral objectives, and the acceptance of statistical generalizations as the ultimate type of regularity that can be discovered by psychology.[22] For if the objects of perception and the objectives of behavior are the proper concerns of a functionalist or molar psychology, and if these objects and goals vary as much as – or even more than – the organisms that achieve them, then it is as important to sample the population of relevant natural objects and goals as it is to sample the population of relevant organisms – and for one and the same reason, so that individual differences among objects and goals can be taken into consideration, just as individual differences among organisms must be taken into consideration, in a properly statistical, which is to say, a thoroughly probabilistic analysis. Only then can psychologists make the kind of generalizations – statistical generalizations – that are worthy of a truly functionalist psychology.

The critical response to these contentions illustrated both the misunderstanding and the resistance that were to plague Brunswik in his remaining years. Clark Hull's critique can serve as an exemplar. After setting up a contrast between probability and natural law, he argued that "scientific theory is concerned with natural laws. These are conceived as being uniform. Do such isolable uniformities exist in the field of behavior? ... Lewin and I believe they do; Brunswik, on the other hand, is convinced that no such uniformities exist."[23] The confirmation of one or the other of these beliefs, Hull said, must await "prolonged effort directed specifically to this task" of discovering uniform natural laws. Brunswik, he implied, had given up the quest as hopeless before he had devoted adequate effort to the "laborious and time-consuming" task at hand. In any case, even an ideal science like physics must accept certain errors of measurement that are bound to occur because "it is impossible to know the exact conditions" surrounding a given phenomenon. As a result, even in physics empirical correlations among phenomena are bound to be less than 1.00. It should not be surprising, then, if correlations in psychology are less than perfect. Even more than in physics "we always lack absolutely exact knowledge concerning [the] *conditions*" surrounding psycho-

logical phenomena. But this does not mean that psychologists are doomed to live with probability rather than natural law, any more than it means that physicists are.[24]

Hull's response showed how much he "cherished the nomothetic ideals of traditional experimental psychology," as Brunswik had put it. It also showed a fundamental confusion that Brunswik had to suffer for the rest of his life. Brunswik was not concerned that "we" who observe someone else's behavior cannot make precise predictions because "we" lack complete information about the organism's environmental conditions; rather, as he put it in a later publication, Brunswik was convinced that "so long as *the organism* does not develop, or fails in a given context to utilize completely, the powers of a fullfledged physicist observer and analyst, his environment remains for all practical purposes a semierratic medium [*for him*]; it is no more than partially controlled and no more than probabilistically predictable" *from the point of view of the organism;* and it is *the organism* that must respond on the basis of its own, necessarily probabilistic knowledge.[25]

To give Hull his due, this rejoinder relies on an aspect of Brunswik's thought that had been de-emphasized – even suppressed – since 1934, when he had chosen to develop a "psychology without an organism." I am referring to the cognitive role of the subject in the subject-object relationship that formed the basic foundation of his approach. Under the influence of the logical positivist and behavioral movements, Brunswik had rejected the use of "intervening variables" and the study of mediational processes as a valid concern for a "psychology in terms of the object." But it is not easy to shuck basic aspects of a system of thought, and the later elaboration of his system demanded the resurrection of its "missing dimension."

Interestingly, Hull sensed the inconsistency of Brunswik's critique of intervening variables, or as Hull called them, "symbolic constructs," and he noted that Brunswik himself seemed "at certain moments at least to introduce perception as a variable intervening between the physical stimulation of his subjects and their verbal responses."[26] A glance at the lens model diagrams that portray the basic structure of Brunswik's theory (see Figures 5-1 and 5-2) confirms what Hull said. Even if Brunswik preferred to focus on organismic achievements, he had to admit that the achievements depended on some sort of mediational processes that he had represented, however schematically, in this model. In his desire to remain as objectivistic as possible, however, he had renounced further discussion of these processes. But his whole point about the organism actively calculating its own behavior, actively responding according to its own perceptual and behavioral expectations – its "hypotheses" about the objects, events, and possibilities in its environment – implicated a recognition of the organism as a cognizing subject.

Whether in response to Hull's point or not, Brunswik began in the early 1940s to reinsert into his research a distinction he used years before in Vienna, a distinction between "perception" and "thinking," or more specifically, between the kind of cognition that occurs when a subject is in a relaxed, uncritical mental attitude and the kind of cognition that occurs when a subject is in a "betting" or calculating mental attitude. He also began to think of the organism as "an intuitive statistician" that routinely makes probabilistic inferences about its surrounding environment without being self-conscious about it, and he became one of the first psychologists to note the relevance of cybernetics and communications theory for psychology, well before the wholesale revival of cognitivism in psychology.[27]

Still, Brunswik was clearly uncomfortable speculating about organismic processes, and it was not until he could offer a "statistical separation of perception, thinking, and attitude" in 1946 that he became more comfortable with this aspect of his metatheory.[28] Although his "statistical separation" was not adopted by other researchers, he continued to elaborate his "ratiomorphic models of perception," for which he was subsequently designated a forerunner of the cognitive movement in psychology. Fittingly, one of the last pieces that he completed before his death was a posthumously published paper on the "Scope and Aspects of the Cognitive Problem." True to his original functionalist insight, he concluded this paper by saying that "only by detailed analysis of ecological [i.e., environmental] textures can the cognitive problem be restored from mere utilization problems [regarding how organisms use cues and means] to its full scope of achievement problems and thus again become the key to the core problem of psychology, that of the adjustment of the organism to a complex environment."[29] For Brunswik the cognitive problem, like all other psychological problems, had to be approached within the context of the primary relationship between subject and object – between the organism and its environment.

Whether or not Hull's critique sparked Brunswik's reassertion of the organism's role in psychological dynamics, it did provide an incentive for a longer, more formal statement about probabilistic functionalism. Brunswik made that statement in 1947 in a monograph entitled *Systematic and Representative Design of Psychological Experiments.*[30] This treatise, one of the most remarkable works in twentieth-century psychology, is properly considered Brunswik's major manifesto. However, it is remembered primarily for its critique of traditional psychology and for various of its concepts that have been borrowed and used in other contexts. It has rarely been used as Brunswik intended – as a blueprint for a methodological revolution in psychology.

The central distinction that Brunswik drew in this work was between the "systematic" and "representative" design of psychological experi-

ments. In the systematic experiments typical of experimental psychology, Brunswik said, the organisms that serve as the subjects of investigation are sampled because their idiosyncratic characteristics cannot be separated and controlled, and their responses are then treated statistically so that generalizations can be made to other organisms that did not participate in the experiment. However, the environmental stimulus variables used in systematic experiments are typically separated and controlled to keep them constant or independent of one another, irrespective of how they covary, probabilistically, in the natural environment of the organism under investigation. As a result, many of these variables are artificially "tied" during the course of the experiment, and this "unnatural covariation of independent variables" destroys the grounds for logical inferences about the generalizability of experimental results. Consequently, it should not be surprising that generalizations from systematic experiments tend to break down across a variety of natural environments, just as they would for other organisms if the subject population had not been adequately sampled. In representative design, on the other hand, stimulus conditions would not be "unnaturally covaried," but would be sampled representatively just as subjects are in traditional experiments. Then the same logic of induction and the same statistical procedures could be performed on situational variables as are now performed on responses, and a thoroughgoing probabilism would establish psychology as a science of properly general results.

Rightly or not, Brunswik's arguments did not stimulate sustained attention, much less the conversion of large numbers of psychologists. In the absence of such success, Brunswik tried a different mode of publication. After many years of work, he completed and published his long-overdue historical treatise on *The Conceptual Framework of Psychology* in 1952.[31] This brilliant, if eccentric, work shows that Brunswik was not only a psychologist and philosopher of science; he was also a preeminent historian of psychology. Though his historical account is what we might call "presentistic" in that it leads inevitably up to his own probabilistic functionalism, his historical analyses are both profound and provocative, and they convey the rich historical context in which Brunswik situated his own work. Still, although it contributed to his reputation, Brunswik's monograph did not convert many psychologists to his point of view.

In July 1953, at the Berkeley Conference for the Unity of Science, Brunswik made his last major attempt to explain and defend probabilistic functionalism. Subsequently published in May 1955, Brunswik's exposition and reply to his critics – specifically to Herbert Feigl, Ernest R. Hilgard, David Krech, and Leo Postman – was literally his last stand.[32] Two months after its appearance, he committed suicide. Although ill health and several other factors were important incentives, there is little doubt that his final act was the tragic consequence of his deep depression over

his inability to convince his contemporaries that what he had to say was of fundamental importance.

BRUNSWICK'S LEGACY

No major psychologist fails to have some effect on the course of psychology, and by any account Egon Brunswik was a major psychologist. Still, the situation at the time of his death was pathetic. Kenneth Hammond, a former student of Brunswik recalled that

> During the spring of 1954 [a year before Brunswik's death], I visited Brunswik in his office at Berkeley. . . . During the visit, Brunswik opened a file drawer and showed me two folders – one labeled Hammond, the other, Smedslund – and with unmistakable pride indicated that there were now two psychologists who were doing Brunswikian research. . . . Apparently there was no one else.[33]

But Hammond persevered, and over the years the number of legitimately called Brunswikians has grown. It is still a relatively small body of researchers, but they form an active and dedicated group with remarkably diverse interests, covering the entire range of topics falling between the end-terms in Brunswik's double-lens model (see Figure 5-2). According to Hammond's count,

> Over 200 studies have been carried out within the Brunswikian framework since 1964 [up to 1980]. They include numerous studies of clinical judgment; multiple-cue probability learning, which produced the concepts of cognitive feedback in contrast to conventional outcome feedback, as well as cognitive control, and cognitive skill; studies of interpersonal learning and interpersonal conflict; the effects of psychotherapeutic drugs on all of these processes; interactive judgment analysis that provides immediate cognitive feedback regarding judgments, and thus makes it possible to apply the Brunswikian tradition to the study of policy formation, policy implementation, and the study of expert judgment, as well as animal behavior.[34]

It is symptomatic that Hammond's count of Brunswikian research begins in 1964, almost a decade after Brunswik's death. Before and even after that time, most of the influence that might be accorded to Brunswik has been of a more general sort, or of such a specific type that it does not constitute the benefactor a Brunswikian in any exacting sense. But even in these cases, the influence has sometimes been quite significant. Donald Campbell may serve as a prime example. Although his work has followed its own trajectory, he acknowledges that its distinctive thrust has come

from the early inspiration he received as a student and assistant of Brunswik at Berkeley. This inspiration, Campbell has written, was focused "at the levels of general perspective and of stating the problems which psychology must face." Furthermore, although Campbell has not been able to follow Brunswik on many points that Brunswik regarded as important, Brunswik's "stand" on such matters has served as "a major reference point" in Campbell's clarification of his own, different position. Beyond that, Campbell notes that his "total indebtedness to [Brunswik] is hard to estimate, since I learned from him primarily through lectures and conversations." He illustrates this point by reviewing several "discoveries" he made years after leaving Berkeley, only to find out later – when reviewing class notes from Brunswik's courses – that he had heard about these discoveries long before he made them.[35] Many other Berkeley students say the same thing.[36]

The list of those who were inspired by Brunswik in general, but meaningful ways could be extended to include those whose relation to Brunswik was mediated through his publications rather than through personal contact. Roger Barker and Jerome Bruner are only two of many well-known psychologists who have acknowledged some sort of "distal" debt to Brunswik – for general or partial inspiration rather than for his psychology as a whole. Similarly, references to Brunswik can be found scattered throughout the literature of recent decades on methodology, learning, thinking, decision processes, perception, communication, and psychological ecology. In addition, probabilism and the basic metaphor of the mind as an intuitive statistician have been gaining in popularity. But in most of the cases where Brunswik's work is cited as a precedent, it is generally a fairly routine citation, meant to confer a sense of authority and legitimacy to current theory and practice rather than to acknowledge an actual intellectual debt. As Herbert Simon has noted, Brunswik was a forerunner of a number of developments, but "did not, in fact, have much influence on what developed."[37]

Influence is an elusive thing. Even to corroborate some new developments – to serve as a legitimizing reference – is not without its significance. But it is clearly not what Brunswik had in mind. Given his generally acknowledged brilliance, why has so much of Brunswik's "influence" been of this nebulous, unfocused sort? And why have so many psychologists been uninfluenced by Brunswik, even in this rather generously construed form?

Even if Brunswik was properly understood – and this was frequently not the case – a number of reasons internal to his psychology help account for his limited, ambiguous legacy. Perhaps the major reason is that it is virtually impossible to implement Brunswik's methodology without some qualification. Even Brunswik never attempted, much less

accomplished, a completely Brunswikian study. His groundbreaking 1944 monograph on "Distal Focussing of Perception" was only "a methodological demonstration" of his approach, not a fully realized study based on representative design. As Brunswik himself admitted, he had not scrutinized the situational generality of this study's results, nor had he checked the representativeness of the subject's choices of objects to be perceived.[38]

Demonstration or not, however, this study took a great deal of effort beyond that demanded by a typical laboratory experiment, and so it did not help his case – at least for those who were reading closely – when Brunswik noted that "the general trend and proportion of results" in more traditional experiments "is quite similar to those of the present study." As a result, he conceded, "the major results of our study may seem commonplace. A checkup of this kind is, however, a methodological requirement."[39] If in fact Brunswik's admittedly more cumbersome approach confirmed the general results of much simpler laboratory experiments, it was certainly not clear that the extra effort was necessary, except perhaps as an occasional "checkup" on the validity of experimental methodology.

The other major study that might seem to qualify as a definitive application of Brunswik's methodology is the second part of *Perception and the Representative Design of Psychological Experiments,* entitled "Perception: The Ecological Generality of its Distal Aim." This was Brunswik's final, summary treatment of his research on the psychology of perception. But in the Preface to this work, written just five months before his death, Brunswik admitted that it had become increasingly clear to him that "hybrid designs combining features of both systematic and representative deisgn are likely to continue and even to increase in frequency within the near future"; and in fact his own research in this study reflected this move toward "such an intermediate area."[40]

Beyond the practical difficulties that led to this sort of methodological compromise were emotional and intellectual difficulties that had to be faced. It may seem odd to speak of emotional difficulties when considering the application of scientific method, but in this case, as in others, emotional factors seem to have played a very tangible role. In the 1940s and early 1950s the nomothetic ideal of discovering universal and absolute natural laws through the use of carefully controlled experiments was deeply ingrained in the cultural ethos of the scientific community. Perhaps nothing, other than complete intellectual and methodological anarchy, could have been so threatening to that community – and especially to the self-conscious subculture of scientific psychology – as Brunswik's espousal of a thoroughgoing probabilism combined with his radical critique of experimentalism. How difficult it could be to deal with Brun-

swik's probabilistic functionalism is poignantly conveyed by Brunswik's own confession:

> The present writer has in himself experienced the required shift of emphasis as very slow going and hard to maintain, especially so far as consistent concrete application is concerned. The difficulties he encountered ... have given him the impression of resistances approaching in intensity those encountered in the opening up of emotionally highly loaded topics, such as those dealt with in psychoanalysis.[41]

And so:

> It takes a certain courage, a neglect of some of the attitudes sacred to scientific tradition, to give up the safety of molecular correlations, cheap as they are, in favor of the equivocalities or "vaguenesses" of molar correlations. But we have to prefer vagueness focused upon essentials to security and strict univocality focussed upon non-essentials.[42]

Brunswik was not exaggerating his own personal difficulty. For someone as rationalistic as he was, it had taken an enormous amount of courage to follow the path he felt compelled to take. He did not *want* probabilistic "explanations" of psychological phenomena; rather, psychological phenomena – it seemed to him – *demanded* such treatment, in total disregard of his temperamental inclinations.[43] But, as we have seen, Brunswik's realization of this need for a thoroughgoing probabilistic functionalism took many years to develop and grew out of a unique interplay of intellectual and scientific traditions. Perhaps he should not have expected others, who had the benefit of neither the same amount of time nor the same intellectual context, to respond in the affirmative when he called for fundamental change in psychology. In addition to all else, he was making this call during one of the most self-assured and dogmatic periods in psychology's history. It was hardly a time when the dice were loaded in his favor.

Such factors account for some of the obstacles that Brunswik's psychology faced: His methods were "formidable"; his theory was "at variance with the more traditional notions"; and his probabilism was bound to elicit some "emotional resistance."[44] We might be satisfied with them as an explanation for Brunswik's clouded legacy *except that* so many psychologists seemed not to *understand* his methodological, theoretical, and probabilistic convictions. They did not reject Brunswik's psychology for emotional or even clearly defined intellectual reasons. They simply let it slip by, in ignorance of its meaning and import. These psychologists include not only those who lived beyond Brunswik's orbit, but also many

of his own students and colleagues. Here is the rub: Why have so many people simply not understood what Brunswik was saying? Why did Donald Campbell have to write in 1954 that "too few of us Berkeley students got what [Brunswik] had to say," even after attending his lectures and working with him as teaching and research assistants?[45] It is hardly surprising that others have failed to understand Brunswik's message if his own students and colleagues have admitted a considerable degree of incomprehension.

Derivation, Migration, Dissemination: Situating Brunswik in the History of Psychology

Three interrelated factors have contributed significantly to the misunderstanding and incomprehension from which Brunswik's psychology has suffered. These factors are, first, the constitution of Brunswik's psychology; second, the effects of Brunswik's move to the United States; and, third, the ways in which Brunswik tried to communicate his psychology.

Brunswik's psychology, as we have seen, was derived from a unique blend of intellectual and scientific traditions. The functionalist premises that Brunswik received from the European act-psychology tradition and the probabilist assumptions that he derived from a branch of the logical positivist movement were far from familiar to the majority of American psychologists. In addition, Brunswik's application of the statistical tools of differential psychology to the traditional subject matter of experimental psychology clashed with the mindset of American psychologists who had come to think of differential and experimental psychology as two quite distinct "disciplines" within psychology.[46]

The upshot, in colloquial terms, was that most American psychologists had difficulty understanding where Brunswik was coming from. At the same time most European psychologists, until the Anglo-American statistical tradition made greater inroads on the Continent in the 1960s and 1970s, had trouble comprehending, and so were not persuaded by, Brunswik's mature system of probabilistic functionalism.

In referring to the American and European situations I have already trespassed on my second point, that Brunswik's migration from Vienna to Berkeley affected more than the final theoretical articulation of his psychology. In making the move to the United States, Brunswik lost an audience that shared much of his intellectual background, the aid of a number of talented and committed research assistants, and a professional context in which perception was seen as an important and attractive research problem. In the United States during the 1940s and early 1950s, perception was not a highly regarded research topic and did not attract the number of able young investigators that it had in Vienna. As a result, despite the general influence he had on many students, Brunswik never played

the active role in directing student research that he had enjoyed previously in Vienna. In all his years at Berkeley, he directed only four doctoral dissertations. Even Kenneth Hammond, his one true "disciple" at Berkeley, did not do his major research under Brunswik's direction. This loss of an institutional basis for a large-scale research program made it difficult for Brunswik to implement his theoretical insights as quickly and completely as he would have liked. As a result, he left behind much less research and fewer disciples than he might have in a more supportive context.[47]

The third factor I want to consider is Brunswik's style of communication – the means by which he sought to disseminate his ideas. I have not yet emphasized the number of important theoretical papers that Brunswik presented at philosophical conferences and published in philosophical journals. Never cutting his tie to the logical positivist and subsequent Unity of Science movements, Brunswik continued to scrutinize his psychological theory and methods – and to invite scrutiny – from the point of view of philosophical analysis. Although some American psychologists, such as Tolman and Hull, had peripheral associations with these movements, the majority of American psychologists were insulated from them and were therefore insulated from a certain number of Brunswik's important theoretical presentations.[48]

In addition, as mentioned previously in the brief discussion of his *Conceptual Framework of Psychology,* Brunswik was a careful student of the history of psychology, and he used his distinctive historical analyses to provide a context for explaining and defending his own probabilistic functionalism. Although his publications in this area were few in number, Brunswik frequently utilized historical analysis in his teaching, and his history of psychology course was one of the major means of communicating his approach to many Berkeley students. Unfortunately, there is evidence that these students were unprepared to profit from these analyses and hence missed the opportunity to learn what Brunswik was trying to convey.[49]

Matters were not helped by the fact that Brunswik was such a widely read scholar who continually referred to new developments in other sciences and disciplines that might have some significance for psychology. Many students heard for the first time about cybernetics, communications theory, econometrics, open system thermodynamics, biological systems theory, time series analysis and other developments in Brunswik's courses. His enthusiastic discussions of how these developments might be of service to psychologists were not always matched by the students' ability to follow what he was talking about.[50]

If the channels of communication that Brunswik used and the content of what he had to say often extended beyond the ken of his students and of most psychologists, Brunswik's writing style did little to balance the

situation. In lectures and in personal conversation he was more expansive, which was often a problem in its own right, especially when his listeners were unable to follow the connections he would make. But in his writings, Brunswik's style was brutally precise, succinct, and demanding. As Tolman put it, Brunswik "was never willing to oversimplify or restrict the actual complexities of the relationships with which he was concerned. This always makes the reading of whatever he wrote a difficult task but an exciting and stimulating challenge [at least for the sympathetic Tolman]."[51]

Perhaps the scale of difficulty is best conveyed by the "good news" and "bad news" comments made by Julian Hochberg and Gustav Bergmann on Brunswik's *Conceptual Framework of Psychology*. Hochberg noted that a "decrease in Brunswik's customary condensation [in this book] makes for an increase in ease of reading." True, but the increase in ease was relative to Brunswik's own austere standard, as indicated by Bergmann's assessment that "physically this is a slim volume, hardly a book, rather, a monograph of barely a hundred pages. Intellectually this is the equivalent of three books or, to put it conservatively, of one well-sized book and two monographs of about one hundred pages each."[52]

There is no question that the style of Brunswik's communication – his uncompromising efforts to say things just right and just once – had a deleterious effect on the understanding of his message.[53] Few readers were able to muster the time and effort to enjoy the "exciting and stimulating challenge" that Tolman promised. Those few who did – for instance, Robert Leeper – were likely to find Brunswik's work "more impressive and persuasive" with prolonged study. But as Leeper himself noted, "in an age like ours, where rapid reading is praised, his [work] is altogether unsuited to the mode of approach that most readers would tend to bring."[54] In other words, it was not likely that many readers would choose to slowly and laboriously decode Brunswik's full message, and they have not. Instead many have turned to Brunswik's work for brief periods of time and have taken away this or that piece of his message, either ignorant or uncaring about the larger, systematic context from which that piece was removed.

Where does that leave us – or rather, where does it leave Brunswik? It is too soon to say what place he may be assigned in the larger sweep of the history of psychology, but in his own period of time, as I have tried to show, he was clearly situated at a number of crossroads – between various intellectual and scientific traditions (European functionalism, logical positivism, American behaviorism, and Anglo-American statisticalism), between various cultures and national traditions (European and American) and between various modes of scholarly endeavor (philosophical, historical and scientific).

Perhaps because he was situated at so many crossroads, Brunswik was

more sensitive than most psychologists to the directions in which psychology was going. It may seem odd to suggest that Brunswik, the proponent of such a distinctive system, was representative of mid-twentieth-century psychology, but it is nevertheless the case that his system represented many of the major trends that have emerged more clearly into view in the years since Brunswik's death. Brunswik foresaw and advocated the emergence of probabilism, psychological ecology, perception, and cognition as key areas of psychological interest, increased scrutiny of the validity and reliability of psychological knowledge, greater historical and philosophical awareness, and the recognition of the "inextricable entanglement" of theory and method.[55] Brunswik was more than a weathervane, but he was that par excellence. If he did not create the weather patterns, he had an uncanny sense of which way the fresh breezes were blowing. Against the gales of opinion, he sought to give the breezes their due attention.

Edwin G. Boring, as the editor of *Contemporary Psychology,* appended the following quotation from John Morley to a 1957 review of Brunswik's posthumous *Perception and the Representative Design of Psychological Experiments:*

> There are some books which cannot be adequately reviewed for twenty or thirty years after they come out.[56]

In this instance at least, I believe that Boring was more prophetic than Tolman, whom I quoted at the beginning of this chapter. Thirty years after Brunswik's death, the time does seem ripe for more adequate reviews of Brunswik's life and works. I hope that this chapter will serve as a helpful starting point.

NOTES

1 The best sources on Brunswik's life and work are K. R. Hammond (ed.), *The Psychology of Egon Brunswik* (New York: Holt, Rinehart and Winston, 1966); K. R. Hammond, "Introduction to Brunswikian Theory and Methods," in K. R. Hammond and N. E. Wascoe (eds.), *Realizations of Brunswik's Representative Design* (San Francisco: Jossey-Bass, 1980), 1–11; L. Postman and E. C. Tolman, "Brunswik's Probabilistic Functionalism," in S. Koch (ed.), *Psychology: A Study of a Science,* vol. 1 (New York: McGraw-Hill, 1959), 502–564; and E. C. Tolman, "Egon Brunswik: 1903–1955," *American Journal of Psychology* 69 (1956):315–342 (reprinted in Hammond, *Psychology of Egon Brunswik,* 1–12).

2 E. Brunswik, *Wahrnehmung und Gegenstandswelt: Grundlinien einer Psychologie vom Gegenstand her* (Leipzig: Deuticke, 1934); E. C. Tolman and E. Brunswik, "The Organism and the Causal Texture of the Environment," *Psychological Review* 42 (1935):43–77.

3 Brentano is treated as the forerunner of the phenomenological movement in H. Spiegelberg, *The Phenomenological Movement,* 2nd ed., vol. 1 (The Hague:

Martinus Nijhoff, 1978), 27–52, and is placed within the European "movement toward objectivity" in J. Passmore, *A Hundred Years of Philosophy* (Harmondsworth: Penguin, 1968), ch. 8. Külpe is nicely treated in D. Lindenfeld, "Oswald Külpe and the Würzburg School," *Journal of the History of the Behavioral Sciences* 14 (1979):132–141. An introduction to Bühler's life and work is provided in J. F. T. Bugental (ed.), "Symposium on Karl Bühler's Contributions to Psychology," *Journal of General Psychology* 75 (1966):181–219. On the history of Bühler's institute, see Mitchell G. Ash, "Psychology and Politics in Interwar Vienna: The Vienna Psychological Institute, 1922–1942," in this volume.

4 Bühler gathered his research together in *Die Gestaltwahrnehmungen: Experimentelle Untersuchungen zur psychologischen und ästhetischen Analyse der Raum- und Zeitanschauung* (Stuttgart: Spemann, 1913).

5 K. Bühler, "Über den Begriff der sprachlichen Darstellung," *Psychologische Forschung* 3 (1923):282–294; *Die Krise der Psychologie* (Jena: Fischer, 1927), ch. 6; and *Sprachtheorie: Die Darstellungsfunktion der Sprache* (Jena: 1934). See R. E. Innis, *Karl Bühler: Semiotic Foundations of Language Theory* (New York: Plenum, 1982).

6 This research was integrated with subsequent work by Brunswik and his students in Brunswik's *Wahrnehmung und Gegenstandswelt;* Brunswik provided a list of all these research projects on pp. vii–viii. A typical study in which Brunswik followed up on Bühler's earlier research is "Das Duplizitätsprinzip in der Theorie der Farbenwahrnehmung," *Zeitschrift für Psychologie* 3 (1929):307–320.

7 F. Heider, "Ding und Medium," *Symposion* 1 (1927):109–127. On Meinong see D. Lindenfeld, *The Transformation of Positivism: Alexius Meinong and European Thought, 1880–1920* (Berkeley: University of California Press, 1980).

8 Brunswik, like Hermann von Helmholtz, approached perception as an achievement accomplished by making inferences from available cues. However, Brunswik came to differ from Helmholtz on the form of these inferences, which Brunswik took to be "ratiomorphic" rather than "rational." See E. Brunswik, *Perception and the Representative Design of Psychological Experiments* (Berkeley: University of California Press, 1956), 141.

9 For a succinct review of the history and major doctrines of the Vienna Circle, see J. Joergensen, *The Development of Logical Empiricism* (Chicago: University of Chicago Press, 1951).

10 H. Reichenbach, "Metaphysik und Naturwissenschaft," *Symposion* 1 (1927):158–176. Interestingly, this key article is in the same issue as Heider's "Ding und Medium." On Reichenbach see W. C. Salmon, "The Philosophy of Hans Reichenbach," in W. C. Salmon (ed.), *Hans Reichenbach: Logical Positivist* (Boston: Reidel, 1979), 1–84. The work of Richard von Mises was also important to Brunswik as a general corroboration of probabilism.

11 See E. Brunswik, "Organismic Achievement and Environmental Probability," *Psychological Review* 50 (1943):271.

12 Tolman and Brunswik, "The Organism," 43–44 (italics deleted).

13 Ibid., 47, 75.

14 Brunswik's first rendition of his analogical lens model appeared in his *Wahrnehmung und Gegendstandswelt,* in a section translated by L. W. Brandt in Hammond, *Psychology of Egon Brunswik,* 519. Over the years Brunswik elaborated the model, adding more and more details. Figure 5-1 is an adaptation of Brunswik's standard rendition in many of his later works. (See Hammond, "Introduc-

tion," 6.) Figure 5-2 is an adaptation of R. W. Leeper's expansion of Brunswik's single-lens model in R. W. Leeper, "A Critical Consideration of Egon Brunswik's Probabilistic Functionalism," ibid., 423. I believe that Leeper was correct in representing Brunswik's thought in this way.

15 See E. C. Tolman, *Purposive Behavior in Animals and Men* (New York: Century, 1932).

16 Tolman and Brunswik, "The Organism," 73 (italics added).

17 E. Brunswik, "Probability as a Determiner of Rat Behavior," *Journal of Experimental Psychology* 25 (1939):175–197.

18 E. Brunswik, "Thing Constancy as Measured by Correlation Coefficients," *Psychological Review* 47 (1940):69–78.

19 A preliminary report of this study was made at a Western Psychological Association meeting, as summarized in E. Brunswik, "A Random Sample of Estimated Sizes and Their Relation to Corresponding Size Measurements," *Psychological Bulletin* 37 (1940):585–586. The definitive report is E. Brunswik, "Distal Focussing of Perception: Size-constancy in a Representative Sample of Situations," *Psychological Monographs* 56 (1944):1–49.

20 The revised symposium papers were E. Brunswik, "Organismic Achievement"; C. L. Hull, "The Problem of Intervening Variables in Molar Behavior Theory," *Psychological Review* 50 (1943):273–291; and K. Lewin, "Defining the 'Field at a Given Time,'" ibid., 292–310.

21 Brunswik, "Organismic Achievement," 262. It was in the context of Brunswik's move to the United States and his espousal of a molar approach to psychological investigation that he began to speak of his functionalist approach as "biological" or "Darwinian" rather than "physiological," that is concerned with the adjustment of the organism to its environment rather than with the physiological processes that mediate this adjustment. This later, overlaid "American" functionalism has sometimes obscured Brunswik's earlier and more fundamental "European" functionalism. Although the two functionalisms coexist peacefully in most instances, some of Brunswik's functionalist pronouncements make better sense if understood within a Bühlerian ("European") rather than Darwinian ("American") framework.

22 Ibid.

23 Hull, "The Problem on Intervening Variables," 273.

24 Ibid., 274.

25 E. Brunswik, "Historical and Thematic Relations of Psychology to Other Sciences," *Scientific Monthly* 83 (1956):158 (italics added).

26 Hull, "The Problem of Intervening Variables," 280.

27 Brunswik studied the perceptual results of the two mental attitudes in "Distal Focusing." He advanced the concept of "the perceptual system as an intuitive statistician" in *Perception and the Representative Design of Psychological Experiments,* 80; and he discussed cybernetics and communications theory in *The Conceptual Framework of Psychology* (Chicago: University of Chicago Press, 1952), ch. 5, sect. 23.

28 E. Brunswik, "Statistical Separation of Perception, Thinking, and Attitudes," *American Psychologist* 3 (1948):342. Brunswik elaborated the distinction in "Reasoning as a Universal Behavior Model and a Functional Differentiation Between 'Perception' and 'Thinking'" (paper read at the International Congress of Psy-

chology in Montreal, 1954), in Hammond, *Psychology of Egon Brunswik,* 487–494; see also *Perception and the Representative Design of Experiments,* ch. 14.

29 E. Brunswik, "Scope and Aspects of the Cognitive Problem," in H. Gruber, R. Jessor and K. R. Hammond (eds.), *Cognition: The Colorado Symposium* (Cambridge, MA: Harvard University Press, 1957), 30.

30 E. Brunswik, *Systematic and Representative Design of Psychological Experiments* (Berkeley: University of California Press, 1947). This work was reprinted in 1956 as Part One of *Perception and Representative Design of Psychological Experiments.*

31 This work was published as part of the *International Encyclopedia of Unified Science* (vol. 1, no. 10).

32 Brunswik's "Representative Design and Probabilistic Theory in a Functional Psychology" (pp. 193–217) and his "In Defense of Probabilistic Functionalism: A Reply" (pp. 236–242) appeared as the first and last contributions to a "Symposium on the Probability Approach in Psychology," *Psychological Review* 3 (1955):193–242.

33 Hammond, "Introduction," 9.

34 Ibid., 9–10 (reference citations interspersed throughout the original passage have been dropped). Hammond's *Realizations* contains seven reports on recent Brunswikian research projects as well as many further references to Brunswikian research. See also L. Petrinovich, "Probablistic Functionalism: A Conception of Research Method," *American Psychologist* 34 (1979):373–390.

35 D. T. Campbell, "Addendum: A Personal Appreciation of Egon Brunswik's Psychology," unpublished addendum to D. T. Campbell, "Pattern Matching as an Essential in Distal Knowing," in Hammond, *Psychology of Egon Brunswik,* 41, 47.

36 Norma Haan, Nanette Heiman, Julian Hochberg and Daniel Levinson are representative of those students whose later psychological views, though not Brunswikian in any narrow sense, nevertheless reflect Brunswikian points of view. Personal communications to the author from N. Haan, 26 March 1980; N. Heiman, 15 April 1980; J. Hochberg, undated (May 1980); and D. J. Levinson, 12 August 1980.

37 Personal communications to the author from R. G. Barker, 25 March 1980; J. Bruner, 26 March 1980; and H. A. Simon, 25 March 1980.

38 Brunswik, "Distal Focusing," 3, 38.

39 Ibid., 37.

40 Brunswik, *Perception and the Representative Design of Psychological Experiments,* viii.

41 From Brunswik, *Systematic and Representative Design of Psychological Experiments,* reprinted in *Perception and the Representative Design of Psychological Experiments,* 39.

42 From E. Brunswik, "The Conceptual Focus of Some Psychological Systems," *Journal of Unified Science* 8 (1939):36–49, reprinted in M. H. Marx (ed.), *Psychological Theory* (New York: Macmillan, 1951), 137.

43 J. J. Gibson, who knew Brunswik personally, noted that "Brunswik himself could not rest comfortably in the lap of uncertainty. Nevertheless he disciplined himself to make virtue of what he considered a necessity." See J. J. Gibson, "Survival in a World of Probable Objects," *Contemporary Psychology* 2 (1957):34.

44 Brunswik, *Perception and the Representative Design of Experiments,* viii, 143; "Organismic Achievement," 270.

45 Personal communication to K. R. Hammond from D. T. Campbell, undated (May 1954), confirmed by personal communications to the author by many former students at a special commemorative symposium on Brunswik at the 88th annual meeting of the American Psychological Association, Montreal, 3 September 1980.

46 The exception proves the rule: E. C. Tolman, the one American psychologist who resonated instantly and steadfastly to Brunswik's tune, was one of the few American psychologists who shared a similar intellectual background by means of the neo-realism he absorbed from R. B. Perry and E. B. Holt at Harvard. See L. D. Smith, "Purpose and Cognition: The Limits of Neorealist Influence on Tolman's Psychology," *Behaviorism* 10 (1982):151–163. Not only are there common roots from Brentano to Bühler to Brunswik, and from Brentano to Perry and Holt to Tolman, but the homologous conceptual framework of these two traditions is nicely shown in Brunswik's easy shift from referring to Bühler in Europe to referring to Holt in the United States. See, e.g., Brunswik, "Representative Design," 194–201. On the "two disciplines" distinction, see G. Gigerenzer, "Survival of the Fittest Probabilist: Brunswik, Thurstone, and the Two Disciplines in Psychology," in G. Gigerenzer, L. Krüger and M. Morgan (eds.), *The Probabilistic Revolution,* vol. 2 (Cambridge, MA: MIT Press, 1987), and L. J. Cronbach, "The Two Disciplines of Scientific Psychology," *American Psychologist* 12 (1957):671–684.

47 Brunswik's doctoral students were Max Levin (1946), Murray Jarvik (1952), Thomas Nichols (1955), and William Sickles (1955). I should also note that Vienna after 1937, when Brunswik left, would not have been very supportive either: the Nazis were soon to arrive and change the complexion of Viennese life and scholarship. See Ash, "Psychology and Politics in Interwar Vienna." Brunswik was not Jewish, but he was engaged to Else Frenkel, a Jew, who emigrated to the United States in 1938 and soon thereafter became Else Frenkel-Brunswik. She too had a notable career as a psychologist, and her life and work were interwoven with Brunswik's in ways that, unfortunately, I have been unable to discuss here. Relatedly, I have had to omit Brunswik's relationship to psychoanalysis from the present discussion. For an introduction to her life and work, see N. Heiman and J. Grant (eds.), *Else Frenkel-Brunswik: Selected Papers* (New York: International Universities Press, 1974).

48 E.g., E. Brunswik, "Psychology as a Science of Objective Relations," *Philosophy of Science* 4 (1937):227–260; "Die Eingliederung der Psychologie in die exakten Wissenschaften," *Einheitswissenschaften* 6 (1938):17–34; and "The Conceptual Focus of Some Psychological Systems."

49 To be sure, very few faculty members would have been prepared for Brunswik's course, in which he presented material that he was pulling together for *The Conceptual Framework of Psychology.* I have reviewed the syllabus, handouts, and lecture notes from this course (courtesy of K. R. Hammond), and I am amazed at how intensive and demanding it was. Brunswik worked on *Conceptual Framework* for more than a decade, presenting early versions of his thematic analyses in "The Conceptual Focus of Some Psychological Systems" and "Points of View," in P. L. Harriman (ed.), *Encyclopedia of Psychology* (New York: Philosophical Library, 1946), 523–537. After *Conceptual Framework* appeared, Brunswik published a remarkable condensation of its thematic core in "Historical and Thematic Relations of Psychology to Other Sciences." An offshoot of Brunswik's

research, presented as a speech in 1939, was published in somewhat revised form as "Ontogenetic and Other Developmental Parallels to the History of Science," in H. Evans (ed.), *Men and Moments in the History of Science* (Seattle: University of Washington Press, 1959), 3–21.

50 The final sections of *The Conceptual Framework of Psychology* exemplify Brunswik's wide-ranging interests and integrative skills. So too does Brunswik's "Historical and Thematic Relations of Psychology to Other Sciences."

51 E. C. Tolman, "Egon Brunswik, Psychologist and Philosopher of Science," *Science* 122 (1955):910. The relationships of Brunswik, Tolman, and Hull to the Unity of Science Movement, and of Brunswik to Tolman, are treated critically in L. D. Smith, *Behaviorism and Logical Positivism: A Reassessment of the Alliance* (Stanford: Stanford University Press, 1986).

52 J. Hochberg's review of Brunswik's *The Conceptual Framework of Psychology* appeared in *American Journal of Psychology* 67 (1954):386; G. Bergmann's in *Psychological Bulletin* 49 (1952):654.

53 Ironically, Brunswik's excessively terse style violated his own theoretical understanding of the need for "redundancy" in communication. See the very last section of his *Conceptual Framework of Psychology,* entitled "Redundancy as an Antidote to Equivocation." Brunswik's contentions in this regard exemplify a basic principle of probabilistic functionalism: the more redundant the cues or means (stimuli, words, behavioral options) the greater the probability of accurate or appropriate achievement (perception, communication, goal attainment).

54 Personal communication to K. R. Hammond from R. W. Leeper, 2 July 1962, Robert Leeper Papers, Archives of the History of American Psychology, Akron, Ohio.

55 Brunswik, *Perception and the Representative Design of Psychological Experiments,* 144.

56 Gibson, "Survival in a World of Probable Objects," 35.