

ARTICLE

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Re-Charting Tolman's Cognitive Maps

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Abstract

Philosophers and psychologists acclaim Edward C. Tolman's "Cognitive Maps in Rats and Men" as an early, transformative instance of representationalist explanation. The article is said to mark a move by Tolman to renounce his behaviorism and to herald a new, cognitivist psychology. I argue, opposingly, that framing the text with reference to later psychology badly distorts its meaning. The text is better understood with respect to the contexts of its age and deeper currents in the history of psychology. Tolman is not upturning behaviorism; he is re-litigating an intramural debate between behaviorists pertaining to the place of physiology in psychology.

Résumé

Les philosophes et les psychologues considèrent « Cognitive Maps in Rats and Men » d'Edward C. Tolman comme un exemple novateur de l'explication représentationaliste. Cet article est considéré comme marquant la volonté de Tolman de renoncer à son béhaviorisme et d'annoncer une psychologie cognitiviste. Je soutiens, à l'inverse, que le fait de d'interpréter le texte en se référant à la psychologie ultérieure en déforme considérablement le sens. Le texte est mieux compris dans le contexte de l'histoire de la psychologie. Tolman ne renverse pas le béhaviorisme ; il relance un débat intra-muros entre béhavioristes sur la place de la physiologie en psychologie.

Keywords: cognitive science; philosophy of psychology; cognitive maps; behaviorism

1. Introduction: Charting the Standard View

Edward C. Tolman is commonly understood as a crucial figure in the historical transition within American psychology from behaviorism to cognitivism. In particular,

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his “Cognitive Maps in Rats and Men” (CMRM; Tolman, 1948a) is acclaimed as an early demonstration of behaviorism’s empirical inadequacy. Surveying a set of experiments on maze-running rats, the article is said to motivate that there are certain behaviours only explicable in terms of mental representations. In this case, these representations are the article’s “cognitive maps” — stored informational states about locations and spatial features of the animal’s environment.

This is the standard story. Tolman, in the late 1940s, was 25 years into his career as an empirical psychologist. His writing and research, pursued at Berkeley since 1918, had made him a dominant figure in American psychology. With Clark C. Hull, B. F. Skinner, and other “*neobehaviorists*,” he had helped transform the crude behaviorism of John B. Watson (1913, 1914) into a respectable research program. Of special importance were the concepts of *intervening variable* and *operationalist definition*. These notions licensed talk about unobservable causes in entirely instrumentalist terms, allowing behaviorists to develop mathematical and functional accounts of the factors intermediating stimulus and response without thereby committing to realism about mental states.

The usual narration has it, however, that Tolman’s efforts could only accommodate so much. In 1948, he announced his break from behaviorism (“neo” or otherwise). In particular, he is said to have been pushed to this conclusion by the results of experiments that were inexplicable by behaviorism’s theories. CMRM defended the view that the rats must be navigating with reference to real intentional states — “cognitive maps” that represent the layouts and distal properties of familiar environments.

This view of Tolman, as the herald of the post-behaviorist age, is rehearsed across academic disciplines. In cognitive science, psychologists working on animals’ spatial navigation regularly cite CMRM as their founding text. Although their work stems from a distinct revival of the “cognitive map” in the 1970s (where it came to mean, explicitly, “map-like representation”), Tolman is believed to have already arrived at the basic evidence of this theory more than 20 years earlier (O’Keefe & Nadel, 1978, p. 78). The map he defended was “a rich internal model of the world” (Behrens et al., 2018, p. 490), a “higher-level representation of the environment — a map” (Jeffery, 2018, p. 1). Philosophers of mind and philosophers of science concur. Tolman had discovered behaviours that “only a representational approach could explain” (Rescorla, 2009, p. 381), the rats forming “an internal spatial representation” of their environments (Craver & Darden, 2013, p. 52).

Historians recount the same fundamental story, adding a wider scope. Textbooks describe CMRM as a “rebirth” that “set the stage for the reemergence of mind in psychology” (Goldstein, 2011, p. 11). Tolman’s maps were a breakthrough for cognitivism, “one of the first proposals for explaining behavior in terms of representations (stored information about the environment)” (Bermúdez, 2022, p. 16). Academic historiography says the same. In a recent biography of Tolman, David W. Carroll recounts that Tolman, by the mid-1940s, had realized “that *a new type* of theory would be needed” (Carroll, 2017, p. 173, emphasis added). Tolman’s efforts to salvage behavioristic theories with complicated formulae had proved futile; rats’ task performances could only be explained if it was allowed that they were representing the properties of the mazes. Carroll tells us that, in the face of this empirical pressure,

Tolman chose CMRM as the occasion to express a “clear and lucid form of cognitive realism,” one wherein his cognitive maps “referred to *real*, if unobserved, processes” (Carroll, 2017, pp. 181, 188, emphasis added). He had landed on evidence that, in “modern terms,” made him an “imagist and a propositionalist” about representations (Amundson, 1983, p. 269).

This view has near unanimity, with its proponents often claiming the conclusions to be obvious and effectively self-evident. Nevertheless, in what follows, I will argue that this understanding of CMRM is significantly misguided. Tolman’s maps were not “map-like representations,” and the aim of CMRM was not to promote a move against behaviorism or towards new psychological modes. Examining the text will reveal that there is little evidence that he was talking about mental representations or overturning the anti-realist, instrumentalist doctrines of neobehaviorism.

There is, I propose, a more fruitful framework for understanding the text. The standard view takes Tolman to be the progenitor of later work (work that would be first consolidated in the 1970s). However, a different story emerges if we reconstruct Tolman within the intellectual concerns of his own age and in light of certain entrenched divisions between himself and other behaviorists. What I will demonstrate is that, properly construed, the maps were part of an intramural debate between Tolman and various rival behaviorists of the 1940s. Moreover, this was not a new debate but one that tracked fundamental issues that had cast behaviorism into distinct lineages from its outset. Most prominent was a concern among moderate behaviorists that their fellows had deferred too strongly to physiological conceptions, and that this threatened to leave psychology without explanatory value of its own.

I will argue that Tolman’s CMRM speaks to this historical dialectic. Indeed, Tolman’s “cognitive map” was an attempt to provide an operational model of the mind that would allow psychologists to depict the *extra-physiological* variables unique to psychology’s purview. On this re-interpretation, the map was not intended as a “map-like representation,” held in the mind of an individual subject. It was a metaphor (and sometimes an actual diagram) for the causal relationships that psychology, and only psychology, could depict. What’s important to emphasize is that, understood thusly, Tolman’s promotion of maps did not require a turn to cognitivism. There were, I will show, already numerous instances of psychologists (including behaviorists) insisting on metaphorical “topologies,” “spaces,” “departments,” and “economies” of behaviour. Tolman’s maps, far from anticipating psychology’s future, are best understood with respect to its past.

The course of this article will be relatively straightforward. First, I will marshal some initial scepticism regarding the standard view of CMRM, with its understanding of Tolman’s maps as “map-like representations.” Second, I will begin to motivate my own alternative interpretation by introducing some of the relevant disputes within the history of psychology that I take to be informing Tolman’s polemic. This will include a sketch of William James’ response to the upstart physiological psychology of his own day. Third, I will connect this 19th century discourse to Tolman, demonstrating the formative influence it had on his intellectual development. Tolman will be shown to have framed his own behaviorism as a distinct alternative to the physiology-minded behaviorism of his contemporaries (with Watson and Hull the main foils). Fourth, I will conclude by returning to CMRM to demonstrate that the text is best explained

in terms of the described historical dialectic rather than as a portent of future psychology. The fifth and final move will be to explain CMRM's most proximate purpose. Namely, I will argue that Tolman's goal was to illustrate the advantage that the maps view had for picking out variables that factored into various social and political problems, variables that an excessively physiological behaviorism would have missed.

2. Unsettling the Standard View

I begin by introducing reasons to doubt the received account of CMRM. The evidence of Tolman being an early representationalist will be shown to be far more tenuous than commonly allowed.

2.1 *The Text*

In my introductory section, I provided a sample of the present-day consensus concerning CMRM's concepts and intentions. Commentators with considerable authority say things such as "Tolman's conclusion is clear: The rats are forming a cognitive representation of their environment," with this account of maze-running itself providing a long-due reveal of a "new type of theory" (Carroll, 2017, pp. 177, 173).

Notably, this interpretation (and the proposed clarity of Tolman's expression) would have surprised earlier commentators, many of whom found Tolman's conceptions imprecise and lacking in scientific rigour. Kenneth MacCorquodale and Paul E. Meehl, contemporaries of Tolman, argued that the cognitive maps were more "metaphors" than psychological descriptions (MacCorquodale & Meehl, 1954, p. 250). They granted that Tolman provided experiments that served as "embarrassments" for his rival "stimulus-response" theorists, but they did not see Tolman himself offering a clear counterview (MacCorquodale & Meehl, 1954, p. 196). CMRM's "affirmative side" — its "arguments for the cognitive map formulation" — are obscure and inadequate (MacCorquodale & Meehl, 1954, pp. 198, 196). The authors even suggested that Tolman used "metaphors" like "maps" to conceal the shallowness of his theories — that is, "to bridge over some very serious axiomatic gaps" (MacCorquodale & Meehl, 1954, p. 249).¹

Commentators were similarly perplexed in the 1970s, as a revived use of cognitive map (as an honest "map-like representation") became consolidated. David S. Olton argued that the maps' "characteristics [...] were never well-developed by Tolman" (Olton, 1979, p. 589). John O'Keefe and Lynn Nadel, in a foundational treatise on the cognitive-scientific sense of "map" now dominant, argued that Tolman had failed to "specify in detail the properties of maps" (O'Keefe & Nadel, 1978, p. 46). Rather than being properly psychological, the maps appeared more like "*good metaphors*, able to account for certain interesting forms of behaviour" (O'Keefe & Nadel,

¹ With prescience, they even worried that interpreters of CMRM would project "common-sense" "map-properties" onto Tolman's attempt at operational formulations, thereby assuming that his maps — like everyday maps — must be "environment-referential" states of the mind (MacCorquodale & Meehl, 1954, p. 250).

1978, p. 31, emphasis added). The authors directly distinguished Tolman's maps from their own, arguing that Tolman's map metaphors did not seem intended as "existing within the brain, as we propose here" (O'Keefe & Nadel, 1978, p. 31).

The contrast is remarkable. Presently, the maps are understood as an unambiguous proposal about real mental states and as an antecedent of present-day current programs in cognitive science. Yet, earlier commenters found Tolman's maps to be underdeveloped, metaphorical, and of a different nature than the cognitive maps that would become dominant in our own age.

Indeed, an examination of the text reveals that the former group's assuredness is largely undue. Tolman's descriptions are steeped in broad imagery and there is little to merit interpreting them as an account of mental representations. He begins his discussion of the maps speaking from the perspective of his own "field theorist" school and against a "stimulus-response" school:

We believe that in the course of learning *something like a field map of the environment gets established in the rat's brain*. We agree with the other school that the rat in running a maze is exposed to stimuli and is finally led as a result of these stimuli to the responses which actually occur. We feel, however, that *the intervening brain processes are more complicated, more patterned and often, pragmatically speaking, more autonomous* than do the stimulus-response psychologists. Although we admit that the rat is bombarded by stimuli, we hold that his nervous system is *surprisingly selective* as to which of these stimuli it will let in at any given time. (Tolman, 1948a, p. 192, emphasis added)

On offer is an assortment of loose images. However, they are not coherent as a description of internal processes. The "field map" phrase is suggestive, but, on reflection, this is a concept drawn from Tolman's instrumentalist science (alongside "topological maps," "behavior-spaces," and "sign-Gestalt fields"), dating to the early 1930s (Tolman, 1932, pp. 179–185, 1949). Such maps were visual diagrams of considerable complexity, and will be discussed in some detail later. At this juncture, the point simply needs to be made that a "field map" is not an internal state of the mind. It is a figurative model, emerging from the Gestalt tradition, where a psychological subject is depicted within a *field of forces* — a "psychological environment" — so as to illustrate the proposed causal factors involved in a given decision (Lewin, 1935, p. 240).

No other aspects of the indented quote suggest that Tolman is proposing a theory involving real internal states or processes. The phrasing is coarse and metaphorical. Animals *intervene* and the initial "bombardment of stimuli" is picked over. Matters are "more complicated," "more patterned," and "surprisingly selective" (even, in a volitional gloss, "more autonomous") than stimulus-response theorists would allow.

CMRM continued largely in this vein, with Tolman developing a set of metaphors but expressing nothing that provides a direct or forceful psychological description. When characterizing the opposing view — that of the stimulus-response theorists — he describes animals' psyches being "likened to a complicated *telephone switchboard*. There are the *incoming calls* from sense-organs and there are the *outgoing messages* to muscles" (Tolman, 1948a, p. 190, emphasis added). Here, the animal's mind is nothing but a waystation. Innervations arrive from the periphery (e.g., hunger

pangs from the animal's stomach or environmental input from sensory receptors), and are then connected by "simple one-to-one switches" to motor fibres (Tolman, 1948a, p. 192). Emphasized by Tolman is that, in such an account, the animal itself effects no pattern or complication but merely communicates the aggregate of incoming impulses to its action systems, moved "helplessly" by the stimuli (Tolman, 1948a, p. 189).

CMRM's subsequent descriptions further developed this division between Tolman's own "field," or "map," view and his opponents' "switchboard" view. In the former, the mind has a "central office," whose operations are "more *like* a map control room than *like* an old-fashioned telephone exchange" (Tolman, 1948a, p. 192, emphasis added):

The incoming impulses are usually *worked over and elaborated* in the *central control room* into a tentative, cognitive-like map of the environment. And it is this tentative map, indicating routes and paths and environmental relationships, which finally determines what responses, if any, the animal will finally release. (Tolman, 1948a, p. 192)

Although he has here added more discussion of the maps and their properties, there is still a considerable lack of clarity. Many claims are qualified with "like," and the few evocative phrasings (such as that pertaining to the "cognitive-like map") are left undeveloped. In turn, we need to moderate the implications of his various references to "maps," "fields," "paths," and so on with consideration of Tolman's standing theories. In fact, Tolman, who had explicitly identified himself in CMRM as a "field theorist," had a long history of using spatial diagrams — replete with metaphorical "force fields" and "paths" — to model animal behaviour (Lewin, 1943, p. 306; Tolman, 1949).

One theme that we see Tolman continue to push involves his insistence that there is a psychological centre to animal action: a "central office" or "central control room" where input is "worked over and elaborated." Further on in the text, a related emphasis is placed on animals being "self-initiated" (or, as quoted earlier, "autonomous") (Tolman, 1948a, p. 203). He also repeatedly references the concept of *selection*, mentioning "active selecting and comparing" (Tolman, 1948a, p. 200), "active selective character" (Tolman, 1948a, p. 201), and "surprisingly selective" (Tolman, 1948a, p. 192).²

As a last point about the constitution of the text, we should note that Tolman chose to conclude CMRM by expounding at considerable length on various social and political topics. He offered that the maps doctrine can explain motivations for war ("world conflagrations"), racism, the "displacement of aggressions onto out groups," and various clinical disorders (Tolman, 1948a, p. 207). Specifically, the maps doctrine diagnosed that such problems result from "narrow," or "strip," maps, where individuals have only single paths to their goals (Tolman, 1948a,

² "Selection" might harken to the Jamesian psychology that I will introduce into the picture shortly, with James using the concept dozens of times in single texts — notably, as part of a counterproposal to the neuropsychological work that he viewed as threatening psychology (e.g., James, 1879).

p. 207). Tolman even addressed “the child-trainers and the world-planners of the future” (Tolman, 1948a, p. 208). The schemes of Skinner and Hull would have children reared towards safe and prosocial behaviour by reinforcing and punishing their responses to given stimuli. However, Tolman cautioned against such methods. He favoured teaching children to develop “wide” and “comprehensive” maps that empower their “rationality” (Tolman, 1948a, p. 208). In such cases, rather than learning to have stimuli emit the response that will achieve some goal, children can “look before and after,” actively assessing the stimulus situation (Tolman, 1948a, p. 208). On such grounds, they even have the freedom to act against the entrained response in favour of a more “round-about” path (Tolman, 1948a, p. 208).

In the final section, I will offer an account of why Tolman had concluded CMRM with discussions of such far-ranging topics. For now, I simply note that the standard view can have little to say about what Tolman intended here. The maps, as deployed, are not involved in literal navigation (the behaviours don’t involve moving through space), and so the “paths” and “environments” could only be metaphorical. Further, why turn to politics at all? The usual account imagines the text to have been an intervention into empirical psychology (pertaining to rats’ maze-running, specifically), yet here Tolman has turned to entirely different matters. The standard view would seem to have to assume that the text’s conclusion, then, is tangential or beside the point. As I will argue later on, however, to dismiss the text’s concern for social and political matters as an addendum is to lose a grip on CMRM’s essential narrative.

2.2 Larger Circumstances

The prior subsection targeted the text of CMRM. Tolman was seen to develop a pair of dominant metaphors (the “switchboard” as contrasted to the “map”/“map room”/“central control room”), allude to processes of “selection,” “control,” “autonomy,” and so on, and then to conclude by connecting such notions to broader topics in American society. What was absent from the text, however, was evidence that Tolman was developing a substantive, representational theory of the mind.

Several larger contexts and circumstances further tax the standard view. The most basic issue is that Tolman *virtually never referred to the maps again* over the remaining 12 years of his career. He published a dozen scientific articles, wrote an autobiographical sketch (Tolman, 1952),³ and offered a final treatise (Tolman, 1959). However, he only rarely, and always insubstantially, mentioned maps.

The disappearance of the maps concept from Tolman’s post-CMRM work seriously confounds the received understanding. Tolman is supposed to have provided a clinching explanation of maze-running performances and to have proposed a turn to cognitivist, realist explanation. Yet, the remainder of his career showed no sign of transformation. He continued to deploy his neobehaviorist spatial diagrams (Tolman, 1948b, 1949, 1955) and to promote his master theory (of “expectancies”) (Tolman,

³ Here, Tolman discussed the content of CMRM — citing it and speaking on its “summarizing of experiments” — but he did not refer to the maps.

1959). Moreover, he remained unwavering in the insistence that his formulations were purely instrumental in nature. The models and concepts he promoted were:

merely an aid to thinking (“my thinking,” if you will). All anyone really sees are the empirically stipulated independent and dependent variables. In *developing notions of what happens in between* — such as beliefs, expectancies, representations, and valences and finally what I call performance vectors and their interactions — *all I really am doing is setting up a tentative logic (or psychologic) of my own*, for predicting what the dependent behavior should be and how it should be affected by variations in such and such sets of independent variables. (Tolman, 1959, p. 148, emphasis added)

Here, in 1959, more than a decade after CMRM, he is still expressing dedication to “developing notions of what happens in between.” That is, he continues his neobehaviorist aim of studying *intervening variables*. However, he also explicitly disavows any sense that he might have moved to construct this “in between” in terms of real internal states. He is merely “setting up a tentative logic (psychologic)” to better designate which variables might be manipulated. As he says elsewhere, all of this was “pragmatically justified,” and nothing should be assumed about the real “existential” referent of his formulae (Tolman, 1948b, p. 14).

Issues arise, too, when we examine the circumstances of CMRM itself. One important matter is that, although CMRM would be published in *Psychological Review* in 1948, the work had been penned in 1947 for the purposes of a popular talk — a lecture Tolman delivered at Berkeley for an occasion honouring his career. Today’s text still indicates that it was written for such an audience (with its teasing reference to rival schools, deference to his assistants and graduate students, among other things). This raises some immediate questions. Why would he have chosen a generalist audience to deliver the details of a new empirical account of rats’ maze-running? Likewise, why would he have chosen such an occasion to proclaim a bold new trajectory for scientific psychology?

2.3 CMRM’s Experiments

The final matter to discuss concerns the substantial review of experimental research detailed by Tolman in the body of CMRM. These experiments are commonly treated as decisive evidence for the standard view. This is because, as usually understood, the experiments are supposed to themselves support a representational account of the mind. That is, Tolman’s rats are said to perform feats that “require the existence of an internal representation of space” (Jeffery, 2018, p. 1), displaying behaviours that “only a representational approach” could explain (Rescorla, 2009, p. 381). If this were true, the various pieces of counterevidence I introduced earlier might fairly be treated as inconsequential. If his experiments provide evidence for the existence of map-like representations, surely this must speak strongly in favour of the standard view.

The problem is simply that, upon examination, the experiments do not truly warrant the attribution of such representations. As I argue in other work (in progress),

the belief that the observed performances “require” representations depends on distortions of the original experiments’ basic details. Moreover, it is because of those distortions (and *only* because of those distortions) that the experimental tasks become such that representations might be inferred.

A full discussion of CMRM’s experiments and the explanations they support is beyond the scope of the present article. To offer an illustration of the problem’s severity, however, I here offer a brief discussion of Tolman’s “sun-burst” experiment (Tolman et al., 1946; Tolman, 1948a). The following are images from the original text, with the training maze on the left and the testing maze on the right.

Rats in the training phase are gradually reinforced so that they learn to walk out from the circular arena into the maze, make the required turns, and find their way to the food box (under the arrow). What is impressive is that some of the rats, when put into the “sun-burst” arena of the test phase, managed to orient themselves and choose the correct branch (#6) that took them to the location where the food box had been.

How did they carry out this feat of navigation, transferring what they learned in the training phase to the testing phase? With the set-up as described, a representational explanation is often proposed. Namely, it’s argued that the animals must have been storing information about the metric and spatial properties of their movements in the training phase, and were then able to exploit that information in a reconstruction of the space so that the goal location could be designated (Carroll, 2017, pp. 174–175; Craver & Darden, 2013, p. 52).

The issue is that, in the actual experiment, there is a much more obvious explanation. This explanation involves the — usually ignored — fact that the set-up in *both training and testing* included a visible beam of light (the encircled “H” in the image) “primarily directed” on the goal location (Tolman et al., 1946, p. 14) (Fig. 1). The difference this makes is massive. The animals have a visible cue to the goal location, and solving the task simply requires their routing themselves directly towards it along branch 6 in the testing phase. There is thus no need to suppose that the rats are

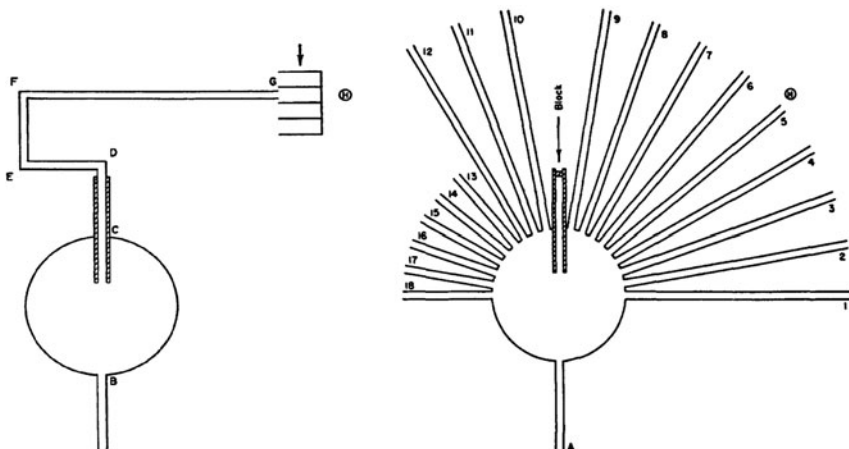


Figure 1. The sun-burst maze (Tolman et al., 1946, pp. 14–15).

storing information or reconstructing space. Training included a perceptible landmark, and this landmark remained visible in the testing phase.⁴

There is much more to say about this experiment (there are, for example, other crucial but commonly omitted details) and the other research that Tolman discussed in CMRM. For present purposes, it simply needs to be recognized that the received accounts of Tolman's experiments have become distorted by a set of falsities and omissions. Ultimately, none of them necessitate representational explanations and, accordingly, CMRM's review of experiments cannot be cited as evidence for the standard view or shield against the doubts that I am otherwise offering.

I have now presented a number of reasons to think that the standard view lacks serious support for its claims. CMRM's text does not clearly describe psychological states or processes. Tolman's career appeared unperturbed by CMRM, with him continuing to develop his instrumentalist models (including concepts adjacent to "maps"). And the interpretations of CMRM's experiments, usually deemed to favour the standard view, can be shown as resting on mistaken presentations of the experiments. Moreover, instead of evidence favouring the standard view, we have seen suggestions of an alternative. There are the duelling metaphors of switchboards and maps/control rooms/central control, CMRM's references to volitional matters and its discussion of sociopolitical topics, and the fact that the text was written not for scientists but for a generalist audience.

3. Behaviorism's Philosophical Divisions

The next step is to develop a view of the historical antecedents that, I propose, will better explain CMRM's intent.

Tolman's philosophical commitments can be traced deep into his personal biography. One place to pick up the story is in 1911, with Tolman beginning graduate school in the Harvard Philosophy Department. This was a department renowned for its relationship to empirical psychology, an association spurred in significant part by James (who had died only a year before Tolman's arrival). James, in 1892, for example, had encouraged the provisioning of a lab for Tolman's eventual advisor, Hugo Münsterberg (Carroll, 2017). The department's approach towards empirical research, however, was far from deferential (O'Donnell, 1987). The general attitude was that traditional categories of mind should be preserved against those emerging from the sciences themselves, and that empirical work ought to serve and be subjected to philosophical analyses.

The impact of Harvard's moderate, circumspect approach to empirical psychology will prove crucial to understanding Tolman's commitments and the schism manifested within behaviorism that I will highlight. James, in his influence on the Harvard department broadly and upon Tolman's immediate Harvard mentors is among the principal factors in the discourse that would find expression in CMRM. James's early career had been, in significant part, defined by his response to perceived

⁴ Notably, many commentators who claim Tolman as a representationalist also recount the sun-burst maze without mentioning the light. This includes José Luis Bermúdez (2022), Carroll (2017), and Carl F. Craver and Lindley Darden (2013).

oversteps from physiology and other sciences into psychology proper. Writing unabashedly to the Harvard administration in 1875, he proclaimed a threat to psychology posed by “men of the laboratory” and “magazines” peddling “the theory of evolution and the facts of archaeology, the nervous system and the sense” (James, as cited in Perry, 1935, p. 11). The administration eventually settled on a strategy of containment (including the granting of James a course in physiology) because “ignoring by philosophers the physical side of mental phenomena has had the natural effect of *exaggerating the importance of the materialistic view*” (as cited in O’Donnell, 1987, p. 61, emphasis added).

James’s early disputes with neuropsychology and its promoters (be they reflex physiologists or physiology-inspired structuralists like Wilhelm Wundt) are many. Alexander Bain is the most apt antagonist for the present discussion. Bain, working from anatomical and vivisectional research, promoted the reform of psychological categories. Most prominently, he radically deemphasized the place of the brain in psychological action. Instead, nervous system activity should be seen as relatively uniform from the periphery through the centre and back, with no reason to “separate the centres from their communicating branches” (Bain, 1874, p. 60). This entailed, Bain thought, that traditional views of perception and action, where impressions from the senses are conveyed to a centre — or “inner chamber” — which then causes actions (feeling or motor innervation), could not be supported (Bain, 1874, p. 53). All that occurs in any psychological process — whether in the limbs, spine, or brain — is that “a power generated at one part of the structure is conveyed along an intervening substance, and discharged at some other part” (Bain, 1874, p. 57).

Bain provided an early precedent for the views later offered by Watson, Hull, and the other stimulus-response theorists Tolman would oppose. He likewise came to consolidate some of the language and images that would feature in their debates. Psychology needs to “substitute” inherited categories of “inner chamber” and “an isolated cerebral life” (Bain, 1874, p. 62) with a “multiplex [...] of connexion” (Bain, 1874, p. 57). Bain even offered an analogy to the telegraph (anticipating the “telephone switchboard” referenced by Tolman). He argued that, as an analogy, a “system of telegraph wires might be formed to represent exactly what takes place in the brain,” “carrying an impulse, given to it at one extremity, onwards to the other extremity” (Bain, 1874, pp. 30, 38).

James’s account of psychological action, expressed from the 1870s through the 1890s, directly contrasted Bain’s. The psyche, per James, absolutely does have a centre. James even took up the “chamber”/“office”/“room” metaphor, speaking of the “mind’s middle department” (James, 1881/1979, p. 94). Importantly, the purpose of this middle department is not merely to act as a waystation for transmission but as “a transformer of the world of our impressions into a totally different world” (James, 1881/1979, p. 95, emphasis added). Here, James defended the “inner chamber” against Bain’s attempts at elimination. He also emphasized that the impressions, once acted upon by the middle department, take on a novel character — becoming a “totally different world.”

James wanted to accommodate physiology, not ignore it. As such, he tried to identify facets of the mind with specific nervous structures. For example, the “mental stage” by which the animal compares and selects, is in the cerebral cortex and

provides the “subjective aspects of as many nerve-processes” (James, 1879, p. 14). Positioned thus, the subject can interrupt the processes of nervous transmission and select from among the inputs. With an emphasis on this fact of intervention, James described the stage as an “additional stratum which *complicates the chain* of cause and effect [and] *gives it determinations* not identical with those which would result if it were left out” (letter to J. J. Putnam, 1879, as cited in Klein, 2021, p. 92, emphasis added).

In all cases, James continued to make efforts to remain a moderate force between naturalism and traditional psychology. The interactionism of the mental stage metaphor was deemphasized, and he wanted to ensure that the “complication” effected did not breach any principles of causation or physics. For example, in the same letter to Putnam, he allowed that the selection performed by the organism might itself be the determined effect of some further cause (say, the creature’s evolved interests) and thus that his account was no less “fatal” than any other (Klein, 2021, p. 92). Nevertheless, he wanted to retain a sense in which *something* belonging properly to the organism enters as a source of action between stimulus and response. Illustrating his promise to Harvard, James was attempting to prove that there are dimensions of the psyche independent of neurological action.

The contrastive images (“chambers” and “middle departments” versus “multiplexes” and “systems” of wires) and the particular vocabulary (“transformer,” “complicates,” “gives it determinations,” and so on) that I have referenced would resurface in 1948. However, this entails no great leap across time. The debate with neuropsychology, including the rhetorical choices of the partisans, continued through the 1870s into the middle of the 20th century. Most crucially, the discourse was reignited in the 1910s during the early years of American behaviorism. Adopting Bain’s position was Watson (see Rieber, 2012, for details on the influence), behaviorism’s figurehead in its first decade. Watson, most relevantly, was a *peripheralist*. He believed that “there are no centrally initiated processes,” but instead simply a series of dependent stimulus-response events transmitted through the nervous system (Watson, 1913, p. 423). Even “thoughts,” rather than taking the form of central images or representations, are just responses to internally perceived “movements in the speech musculature” (Watson, 1913, p. 424). Watson, like Bain, believed that grounding psychology in distributed sensorimotor activity was a way to rid the discipline of pre-scientific conceptions. Efforts to locate “neural drama” in the brain centre were unfounded, a compromise by psychologists attempting to appease their “consciences by setting up a ‘mind’” in replacement of the soul (Watson, 1914, p. 20).

Notably, Watson’s critics were not strictly from antithetical schools of thought (structuralism, for example) but included philosophers and psychologists generally sympathetic to behaviorism. These people recognized the failures of introspectionism (e.g., to replicate results) and wanted a science without metaphysical commitments to interactionism or psychophysical parallelism. Behaviorism provided not only a solution to those problems, but also the virtues of objectivity. It promised to begin with observable stimuli and to end with observable facts of bodily response. Moreover, this allied with the momentum of the experimental age, affording both manipulable variables (the stimuli, among other things) and recordable data (the responses).

The basic problem for these sympathizers was that Watson's doctrine also included several less agreeable components. Among these was the extent of Watson's "premature neurologizing" (Tolman, 1932, p. 417). Ralph B. Perry (a James student and one of Tolman's mentors at Harvard) stands out among the critics of overzealous behaviorism like Watson's. Perry even brings to mind Bain and James when insisting that, contra Watson, the organism "*intervenes [...] as a physical complex which receives, transmits, converts, and gives out physical influences*" (Perry, 1921, p. 87, emphasis added). Perry, as Tolman would do, described the complicating and patterning effects by which organisms intermediate. According to him, there are "systematic arrangements in the physical organism [...] stored energies and channels arranged in groups and patterns," and these conditions, proper to the organism and its psychology, alter the course of stimuli (Perry, 1921, p. 94).

Many others continued in similar veins. Edwin Holt (also a Jamesian at Harvard and someone who mentored Tolman) found the reflex psychologists "*too materialistically-minded*" (Holt, 1915, p. 78, emphasis added). As with James (and the Harvard approach of the 1870s), he took a moderate position that acknowledged the material substrates of the brain without merely yielding psychology to physiology. On Holt's construal, "reflexes are combined or integrated into more complicated processes" (Holt, 1915, p. 51). When animals act, he claimed, it is not merely in response to sensory stimuli or aggregates of such stimuli but with respect to emergent "objects," or "synthetic novelties," that are described as resulting from the integrating processes of animals' psychologies (Holt, 1915, p. 52). Grace de Laguna developed the same line of thought. She cited "a larger vital economy, in closest union with, yet distinguishable from" physiology (de Laguna, 1919, p. 300). She stressed, like James, that it is by using this organization that the animal "maintains his relations with the environment and *forms a factor in its transformation*" (de Laguna, 1919, p. 300, emphasis added).

Tolman entered the scene at a decade's delay from these earlier figures. Nevertheless, he took Watson on directly in his earliest publications, arguing that Watson's focus on physically describable stimuli, "muscle contractions," and "gland secretions" was overly reductionistic (Tolman, 1922, p. 45). Certainly, behaviour depends on the initiating causes of stimuli and ends with muscle or gland reactions. However, there is psychological intermediation. Principally, there is "selection" whereby stimuli are subjected to various "hierarchies" proper to the animals' organization (Tolman, 1920, p. 227). In this early articulation, Tolman advocated for "two levels," with an organism's ultimate goal or purpose serving to determine which "subordinate" response will be released (Tolman, 1920, p. 226). Psychology's place is to study factors like these, pitched at a level above muscles, glands, and the organism's history of relations to stimuli.

In Tolman's early work, he aimed to brand his own "formula for behaviorism" explicitly as "a behaviorism which shall be not a mere physiology" (Tolman, 1922, p. 45). This dialectic would continue to be a guiding challenge over the coming decades, with Hull emerging as Tolman's chief foil. Like earlier figures, Hull took the "quasi-neurological principles" of stimulus and response (and the adaption in the strength of their connection) to be the principles of psychological action (Hull, 1952, p. 354). Moreover, like Bain and Watson, he conceived of such action as

proceeding without any further structures or centres. He even invoked the switchboard metaphor that Tolman would use some years later:

The brain which acts as a kind of *automatic switchboard* together with the remainder of the central nervous system, routes and distributes the impulses to individual muscles and glands in rather precisely graded amounts and sequences. (Hull, 1943, p. 18, emphasis added)

All action, he wrote, is initiated by stimuli from internal sources (e.g., contractions of the stomach in a hungry animal) and external sensation. These are then aggregated and routed through the mind's waystation to motor operations:

The condition of organismic need and the status of the environment evoke from specialized receptors neural impulses which are *brought to bear jointly* on the motor organs by the central ganglia of the nervous system acting as an automatic switchboard. (Hull, 1943, p. 29, emphasis added)

Notice that Hull is directly opposing the claims by James and others that animals “transform,” “intervene,” “complicate,” or generate “novel” syntheses. Stimulus inputs are communicated without modification and impressed “jointly” upon motor output, as a mere summation.

Like Bain and Watson (but directly conflicting with James), Hull imagined that such “quasi-neurological” accounts were the fulfilment of behaviorism’s promise to eliminate the traditional categories that he viewed as pre-scientific. The “organism is here conceived as a completely automatic entity” (Hull, 1952, p. 347). In his view, there was “no entelechy, no disembodied mind, soul, or spirit which in some way tells the various parts of the body how to cooperate” (Hull, 1952, p. 347). As Holt had foretold, the vision was of psychology adopting an austere materialism, with actions described entirely as the combination of nervous events.

Tolman, meanwhile, had allied scientists standing with him against Hull. C. J. Herrick, a neurobiologist, had conjured the switchboard metaphor earlier than Tolman and Hull, expressing that neurology was limited in what it could describe of psychology proper:

No complication of separate and insulated reflex arcs, each of which is conceived as giving a one-to-one relation between stimulus and response, and no interconnection of such arcs by elaborate *switchboard devices*, can conceivably yield the type of behavior which we actually find in higher vertebrates. (Herrick, 1930, p. 646)

In a potent framing, Herrick claimed that psychological action is not determined by the mere “assemblage of separate sensorimotor components,” but is “primarily a *unitary event*” (Herrick, 1930, p. 646, emphasis added). The “unitary event” provides a nice distinction to Watson, who had denied the existence of mental images, thoughts, and other phenomena. Within this dialectic, Herrick responded by arguing for the necessity of just such centres of action. Herrick, like James and others,

answered the attempts by neuropsychologists to eliminate centres of action precisely by efforts to re-instate them.

There are further figures and wider dimensions to the debate described, and much remains to be explored.⁵ I have only sketched the barebones of two distinct lineages with a distinguishable, overlapping rapport. The moderate or *centralist* lineage is from James to Perry (and others) to Tolman. The neuropsychological or *peripheralist* lineage is from Bain to Watson to Hull. In the 1940s, the lineages manifested into two discernible groups within behaviorism. Tolman had his followers (derisively referred to as “Tolmanites” by MacCorquodale and Meehl) and colleagues, as well as allied figures like Karl Lashley (MacCorquodale & Meehl, 1954, p. 250). On the other pole, Hull had a well-funded research program at Yale, with a like-minded program at the University of Iowa run by Kenneth Spence (Mills, 1998). These two groups cast a significant division within the behaviorism of the 1940s, though — as discussed — each had debts to precedents in the 1910s and earlier.

4. Re-Charting CMRM

My goal in the preceding section was to provide the groundwork for a reinterpretation of CMRM. In what follows, I will begin by spelling out the connections between the historical peripheralists and centralists (just discussed) and CMRM itself. Last, I will demonstrate how the terms of that debate aptly account for the sociopolitical discussion Tolman presented in CMRM’s climax.

4.1 Connecting the Dots

It will be useful to begin by re-quoting the more potent sections of text from CMRM. Recall, of his “field theory,” Tolman says:

The intervening brain processes are more complicated, more patterned and often, pragmatically speaking, more autonomous [...] Although we admit that the rat is bombarded by stimuli, we hold that his nervous system is surprisingly selective as to which of these stimuli it will let in at any given time.

The incoming impulses are usually *worked over and elaborated* in the *central control room* into a tentative, cognitive-like map of the environment. And it is this tentative map, indicating routes and paths and environmental relationships, which finally determines what responses, if any, the animal will finally release. (Tolman, 1948a, p. 192, emphasis added)

The stimulus-response theorist, contrastingly, has no true “central office” (Tolman, 1948a, p. 192). Instead, they liken the mind “to a complicated *telephone switchboard*. There are the *incoming calls* from sense-organs and there are the *outgoing messages* to muscles” (Tolman, 1948a, p. 190, emphasis added). Further, the connections between calls and messages are constituted by “simple *one-to-one* switches” to motor fibres (Tolman, 1948a, p. 192, emphasis added).

⁵ The place of functionalism, for example, complicates what might appear to be a simple division between reductionists and their critics/moderates.

Much of this can now be seen as a repetition of metaphors and themes from historical antecedents. Bain had begun by denying the mind had anything like “inner chambers” and “isolated” functions. He defended that, instead, what’s established in the brain is simply a “multiplex” of “connexions” and a “telegraph.” Hull and Herrick, likewise, mention “switchboards,” with Herrick describing their “one-to-one relations.” James answers Bain’s denial by directly arguing for a “middle department” and “additional stratum,” with Perry describing that neural transmissions are intervened upon by a “physical complex.”

The terminology chosen by James, Perry, de Laguna, and Holt to denote the mind’s unique, extra-physiological action all overlap and foreshadow Tolman: “selecting,” “giving determinations,” “intervening,” “complicating,” “transforming,” and so on. The emphasis, further, was on these processes not only altering the course of nervous patterns but producing a new, proper psychological pattern to which the animal then responds. James had the “mental stage” and the “totally different world,” and Holt the “synthetic novelty.” Herrick adds the “unitary event.” These allusions are crucial because they indicate the role that the cognitive map, specifically, will fill. Namely, they are what the psychologist can describe as the “worked over” product of the mind’s selection. In later work, Tolman will — in plainer terms — contrast the “mere sensory-perceptual pattern” with “such a pattern suffused with instrumental meaning” (Tolman, 1952, p. 327). That latter pattern is the cognitive map, descendent of the transformed “world” James had indicated, and the pattern that only psychology proper can describe.

The similarity between these descriptions — in theme, metaphor, and language — offers, what I take to be, the interpretive key to CMRM. Tolman had adopted the terms of discourse from this historical debate to distinguish himself (and his brand of behaviorism) from the peripheralists of his age. The point to hone is that this doesn’t entail his supplanting behaviorism with cognitivism. It simply involves his taking up a historical position *within* behaviorism, the “behaviorism which shall be not a mere physiology” that he had mentioned 25 years earlier (Tolman, 1922, p. 45).

4.2 Mapping the Social Commentary

There is a final topic that I think refines the instrumentalism of the cognitive maps while also accounting for CMRM’s concluding social and political commentary. Recall the claims that Tolman had made with respect to various social maladies, which included the “displacement of aggressions onto out groups” (Tolman, 1948a, p. 208). He had said, more exactly, that this displacement results from “too narrow” a map, one limited to representing only a “strip” of the environment (Tolman, 1948a, p. 208).

What could this mean? As it happens, a rather precise answer is found deep in Tolman’s body of work, in the text of a talk (Tolman, 1949) he gave memorializing the psychologist, Kurt Lewin. In the article, Tolman offered a visual depiction that looks very much like the above-described displacement (Fig. 2). Moreover, he even labelled the lower component in the depiction, a “cognitive map”:

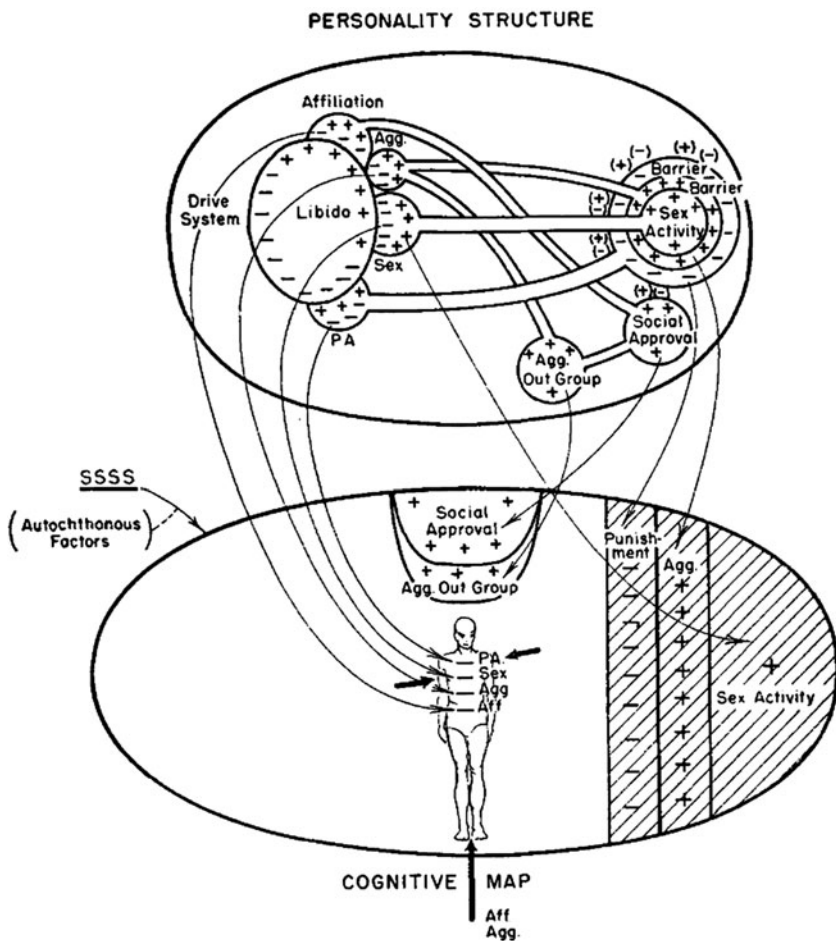


Figure 2. Cognitive map diagram (Tolman, 1949, p. 16).

The diagram is an instance of the “behavior-space,” or “sign-Gestalt-field,” technique referenced in earlier discussion of CMRM’s “field map.” For the immediate goals of this section, only a brief analysis is necessary. The individual in the lower circle (labelled a “Cognitive Map”) has to their right a region labelled, “Sex Activity.” As the depiction shows, however, they are rebuffed from reaching this goal (evidently, by “Punishment”) and, given their Personality Structure and libidinal system, this results in “Agg.”

Interpreting this, Tolman is depicting what in CMRM he had called a “strip” map. The individual has a goal (sex) but has only one route to achieving it, and frustration results. What they lack is a map “wide” enough to allow additional instrumental means, a map that he had advised would allow “round-about and safer paths to their quite proper goals” (Tolman, 1948a, p. 208).

The cognitive problem becomes a social problem because this frustration is then turned towards an orthogonal (pictorially and figuratively) matter, the goal of “Social Approval.” And, as depicted, for this individual, the path to social approval requires that they enact aggression towards an outgroup. What Tolman is describing, using the representational properties of these diagrams, is a case where libidinal aggression from one domain is *displaced* (a concept itself already containing a spatial analogy) to an entirely different domain. The pictured subject has limited means to their ends, lacking cognitive “width,” and this leads to the attributed displacement.

I grant that, to the contemporary reader, psychosexual analyses of social problems might appear hackneyed. That aside, however, this is clearly an actual “cognitive map” matching Tolman’s diagnosis of displacement in CMRM. As he had said in the latter text, “Over and over again men are blinded by too violent motivations and too intense frustrations into blind and unintelligent and in the end desperately dangerous hates of outsiders [...] discrimination against minorities [...]” (Tolman, 1948a, p. 208).

Whatever the scientific merits, an examination of the diagram clarifies Tolman’s intentions. First, it demonstrates that, per Tolman, peripheralism (or, physiological behaviorism) — which ignores the inner “rooms” and “control” of the organism — misses the relevant dimensions at work. Theorists of this sort focus on mere stimulus and response, with intermediating states reduced to the mere transmission and aggregation of neural impulse. Contrastingly, however, “field theory” (and field theory alone) is able to describe the larger, extra-neurological “force fields” and properly psychological complexity of the situation (Lewin, 1943, p. 306).

Second, the depiction offers further amplification that cognitive maps are neither (a) *in the head*, nor (b) “representations of the environment,” where the environment is supposed to be of an objective sort (e.g., the geographical environment). Instead, cognitive maps are simply instruments of psychological explanation. Tolman, in the end, remains dedicated to behaviorism and anti-realist theorizing.

5. Conclusion

My most basic contention has been that the standard view of CMRM, which interprets the text as a treatise in empirical psychology, has serious flaws. It is unsupported by the work’s own words, by Tolman’s experiments, and by larger facts about his further career and intellectual development. My own account changes the historiographic framing. Where most interpretations imagine Tolman as a forebearer of contemporary cognitive science, I have argued that this is misleading. His cognitive maps need to be understood with respect to the history that precedes CMRM. Indeed, in such a framing, it becomes apparent that Tolman is speaking within the terms of a well-honed discourse on the matter of psychology’s autonomy from physiology. In fact, he had foretold at the very outset of his career that this would be the dividing line between his brand of behaviorism and other varieties. His “New Formula for Behaviorism” (the work’s title) described his central concern as the distinguishing of “a behaviorism which shall be not a mere physiology” (Tolman, 1922, p. 45).

With these various pieces in place, a fuller picture of Tolman's intent in the text can be offered. The narrative, as I have it, begins with Tolman developing broad metaphors and carving a divide between his sort of behaviorism and rival stimulus-response sorts. He then motivates this divide further with a discussion of various experiments that expose the limited resources of "switchboard" behaviorism (i.e., they require intervening variables); and he continues by extending these initial two conceptions into a discussion of the various ways in which his work is relevant to problems of American society. In light of this narrative, a fundamental change in the characterization of CMRM is required. It is a work where Tolman uses his experimental work, as well as his deeper relations to the history of philosophy and psychology, to expound on what he can offer with respect to broader social and political topics.

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